Centro de Fusão Nuclear

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Centro de Física dos Plasmas

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OF THE ASSOCIATE LABORATORY ON

PLASMA PHYSICS AND ENGINEERING

Centro de Fusão Nuclear

Centro de Física dos Plasmas

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1. INTRODUCTION

This document summarizes the activities carried out in 2002 by the Associate Laboratory in Plasma Physics and Engineering.

This Laboratory has two Action Lines:

- Controlled Thermonuclear Fusion;
- Plasma Technologies and High Power Lasers,

where the activities referred to in sections 2 and 3 were performed by staff of respectively "Centro de Fusao Nuclear" (CFN) and "Centro de Fisica de Plasmas" (CFP)[1]. Fusion related activities of both Research Units have been carried out in the frame of the Contract of Association between "Instituto Superior Técnico" and the European Atomic Energy Community (EURATOM). Sections 4 and 5 contain information about the publications, post-graduation degrees, organization of scientific meetings and participation in the management of the Fusion Programme.

2. ACTIVITIES CARRIED OUT BY "CENTRO DE FUSÃO NUCLEAR" IN 2002

2.1. Introduction

This Research Unit had in 2002 the following nine Projects:

- Tokamak ISTTOK;
- Participation in the collective use of the JET facilities by the EFDA Associates;
- Participation in the ASDEX-UPGRADE Programme;
- Participation in the TJ-II Programme;
- Participation in the MAST Programme;
- Participation in the TCV Programme;
- Participation in the ITER Project;
- Other activities on theory and modelling;
- Other activities on control, data acquisition and signal processing.

2.2. Tokamak ISTTOK

This Project had in 2002 six main working areas: tokamak operation, testing of the liquid metal limiter concept[2], diagnostic developments, slow control system, real-time plasma control system and plasma physics studies.

Concerning the *tokamak operation*, the IST/CFN staff has guaranteed the maintenance of the discharge systems and the implementation of some diagnostic improvements, allowing the operation of the tokamak during 32 weeks.

Regarding the *testing of the liquid metal limiter concept*, the following main tasks were performed in 2002:

[1] The report of "Centro de Física dos Plasmas" also includes the 2001 activities.
[2] Work in collaboration with the Association EURATOM/University of Riga

- Collaboration with the University of Riga (UoR) on the elaboration of the proposal submitted to CCE-FU for the award of preferential support and on the definition of the technical characteristics of the vacuum system;
- Design of a new spectrometer to measure the liquid metal (Gallium) erosion rate by the determination of Ga absolute radial profiles. This diagnostic is based on a 0.5 m imaging flat field spectrograph, a CCD multichannel analyzer and photomultiplier tubes;
- Conceptual study of a combined mass-energy analyser for study of the SOL plasmas, based on a Bennet-type mass spectrometer, which generally utilizes the principles of both a radio-frequency time-of-flight mass spectrometer and a retarding field energy analyzer.

In the area of the *diagnostic developments*, the following main activities were carried out in 2002:

- Maintenance and improvement of the visible spectrometer for the monitoring of the plasma impurities spectroscopic lines, allowing to obtain the temporal variation of both the ion temperature and the plasma poloidal velocity;
- Development of a new H_a-diagnostic for the analysis of the light emitted at that spectral line by the limiter-plasma interaction;
- Installation on ISTTOK, test and operation of a new ion injector of the heavy ion beam diagnostic, development of a 4 channel time-of-flight energy analyzer and optimization of the plasma potential measurements by this diagnostics;
- Implementation on ISTTOK of a new set of emissive probes[3], including the development of the dedicated electronics, and of a bolometer, based on AXUV[4] and UVG[5] photodiodes;
- Remote collaboration on the development of new Thomson scattering diagnostics for the tokamaks GLOBUS-M (S. Petersburg) and ETE (S. José dos Campos, Brazil). These diagnostics provide multipoint measurements using time-delay techniques and multi-input polychromators.

A *slow control system*, designed in a hierarchical structure based on CANbus, is being developed aiming at to overcome some constrains of the present system, which is based on a commercial vacuum controller unit. The following main tasks were made in 2002:

- Finalization of the assembly and testing of the hardware modules and of the software developed in a distributed, decentralized, object-oriented, modular and user-friendly philosophy;
- Testing of the slow control system.

A *real-time plasma control system* is being developed based on 12 MHD coils. The following main activities were performed in 2002:

- Development of: (i) the feedback control systems of the primary current and vertical magnetic field; (ii) a SQL database for the experimental results; (iii) numerical codes for signal analysis;

[3] Work performed in collaboration with the University of Innsbruck, on behalf of the Association EURATOM/OÄW.
[4] AXUV means sensitive from soft X-rays to ultra-violet radiation.
[5] UVG means sensitive from ultra-violet to visible radiation.

(iv) algorithms for the control of the plasma position; (v) and tools for the remote access to the experimental results;

- External calibration of the magnetic probes and of the acquisition system;
- Test of the performance and accuracy of the system.

The following *plasma physics studies* were carried out in 2002:

- Investigation of the runaway electron characteristics in discharges with minor and major disruption events;
- DC electrode biasing experiments;
- Simultaneous limiter and electrode biasing experiments;
- Measurement of the plasma potential by emissive probes.

2.3. Participation in the collective use of the JET facilities by the EFDA Associates

CFN has proceeded with its participation in the collective use of the JET Facilities by the EFDA[6] Associates, with activities in the areas of operation, scientific exploitation, performance enhancements and management.

Three members of the CFN staff belonged in 2002 to the JET *Operation* Team working in the Reflectometry and LIDAR Diagnostic Group and in the Motional Stark Effect Diagnostic Group. The following main activities were carried out:

- Participation in the upgrade of the X-mode correlation reflectometer and operation and maintenance of the O-mode fluctuation reflectometer;
- Operation and data analysis of the MSE diagnostic as well as the development of a new technique to measure the plasma radial electric field using the MSE diagnostic.

The CFN participation in the JET *scientific exploitation* included the participation of 12 scientists in the experimental campaigns C5-C7 (with Dr. Filomena Nave acting as Session Leader in several experiments) and the development of numerical codes, leading to the following physics studies:

- Comparison of the effects of enhanced radiation on ELM behaviour in JET plasmas;
- Study of the onset of neo-classical tearing modes in JET discharges;
- Study of non-linear coupling using bi-coherence analysis;
- Time-frequency analysis of non-stationary signals in fusion plasmas using the CHOI-williams distribution;
- Use of TRANSP for transport analysis of the radiative improved confinement H-mode;
- Study of the effect of plasma shape on the TAE stability;
- Analysis of the Alfven cascades instabilities;
- Numerical analysis of the loss of sawtooth stabilisation by ICRH driven fast particles in low density discharges;

[6] EFDA means “European Fusion Development Agreement”

- Study of the physical mechanism of the fast destruction of energy confinement that triggers major density limit disruptions;
- Study of runaway electrons in JET disruptions;
- Direct measurements of the radial electric field using the upgraded MSE diagnostic;
- Turbulence studies with the upgraded correlation reflectometer;
- Analysis of the interplay between parallel transport and poloidal flows using a new reciprocating probe;
- Edge Localized Modes propagation and fluctuations in the JET SOL region using probes.

CFN was in charge with five tasks of the JET *Enhanced Performance* Project: (i) study of turbulence by microwave reflectometry (Project Leader and implementation); (ii) microwave access (Project Leader and implementation); (iii) real-time diagnostic; (iv) reflectometer for the ICRH Project; and (v) Fast Data Acquisition (FDA) Project (design and procurement activities). The following main activities were performed in 2002:

- Shipping to JET of the microwave and data acquisition components of the microwave reflectometer; commissioning of the diagnostic at JET; development of software for the integration of the dedicate data acquisition system in CODAS, including the adaptation of a new communication protocol; and intensive tests of the microwave components and data acquisition system;
- Elaboration of: (i) Task 1.0 report on the reflectometry frequency access range and waveguide specifications; and (ii) Task 2.0 report on the antenna design specifications and performance;
- Development of software for real-time analysis of the experimental data provided by the Motional Stark Effect diagnostic;
- Preliminary study for the ICRH Project of the waveguides taking into account the space constrains inside the tokamak; and development of ray tracing calculations using adequate antenna patterns and typical JET plasma geometries, in order to estimate the reflectometers performance for the foreseen antenna positioning;
- Design, production and test of eight Fast ADC modules in CFN; assembling and test of these boards in a CODAS VME crate and installation in a CODAS cubicle near the KK3 diagnostic; integration of the system software in the CODAS offline network and test of CODAS compliance; implementation and test of a system Remote Boot feature to ease the maintenance task in the case of hardware failure by allowing readily changing the system hard disk and backup/restore the system software; and test of the system in the online CODAS network by acquiring real data from the JET tokamak. Collected data was analyzed and compared with the data obtained from the old system using data reduction techniques on the new data in order to allow a correct comparison. Both data sets were found to match almost perfectly showing the correct operation of the system.

2.4. Participation in the ASDEX-UPGRADE Programme

The Portuguese participation in the ASDEX-Upgrade[7] (AUG) Programme has been mainly focussed on the areas of microwave reflectometry (microwave systems and electronics, control and data acquisition, data processing, modelling and plasma physics studies) as well as MHD and turbulence studies.

The following main activities were carried out in the *microwave systems and electronics* in order to improve the operation and reliability of the reflectometry system:

- Installation of solid state switches for toggling between fixed frequency and broadband operation;
- Design, construction and installation of a 1.3 MHz high-pass 5th order Butterworth filter to remove the parasitic low frequency of the W band microwave signal;
- Replacement of the intermediate frequency amplifiers of the heterodyne detection systems by more robust ones;
- Reduction of the bandwidth in the W band channel from 75-110 GHz to 75-100 GHz in order to avoid problems in ultra fast swept operation (25 μs);
- Removal of the reference pin from the Q band fluctuation monitor channel to accommodate the new heterodyne detection to be implemented in 2003;
- Development of an heterodyne Q-band fixed frequency channel using synthesizer sources, to study radial correlation parameters of plasma turbulence;
- Assessment of a new localization for the W band antenna in view of the necessity to displace it due to the forthcoming installation of the new ECRH antennas.

Concerning *control and data acquisition*, the following main modifications were made:

- Re-written from scratch of the control software due to the complexity of the changes in the diagnostic resulting from the upgrades in the hardware made in 2001;
- Implementation of the new control server together with a new client that can be used/compiled in several platforms (UNIX, Windows). The communication and logging protocols were implemented and fully tested;
- Development of the graphical user interface (GUI) of the client. It was programmed in C++ and a portable X based graphical library was used for the GUI of the client;
- Development of a Web based acquisition database to store the information of reflectometry experiments on AUG as well as relevant physics issues related to those experiments;
- Development of a Web based logbook database for the daily maintenance and logistics related information. A forum was implemented allowing discussions and conferences on the Web.

The following main activities were performed aiming at upgrading the *data processing* tools in order to smooth or avoid statistical distortions of the density profiles due to plasma turbulence:

- Testing of algorithms to reject density profiles corrupted by plasma turbulence;

[7] ASDEX-Upgrade is a tokamak of the Association EURATOM/IPP, in operation in Garching.

- Development and implementation of data processing algorithms to automatically compute edge pedestal data (position, density, and width) from broadband reflectometry data;
- Implementation of 2D smoothing data analysis techniques to extract density profiles in the presence of strong plasma turbulence as well as of level 2 public shot files with the smoothed density profiles.

The following main *modelling* activities were also carried out:

- Simulation of the plasma response in broadband reflectometry due to the presence of rotating and locked MHD modes using 1D and 2D codes;
- Investigation of the link between the k-spectrum of non-coherent density fluctuations and the phase variations of the reflectometry signals.

Finally, and regarding microwave reflectometry, the following main *plasma physics studies* were made:

- Study of edge density pedestral characteristics in standard and advanced plasma scenarios;
- Contribution to the study of the impact on confinement of inboard launched pellets;
- Study of the effects of type I and type III ELMs on density profiles and estimation of ELM-induced particle losses;
- Studies on locating rational surfaces from reflectometer fluctuations.

Concerning *MHD and turbulence* the following tasks were performed:

- Study of the role of magnetic islands in the energy quench preceding disruptions;
- Study of runaway generation in tokamak disruptive events;
- Code developments for the analysis of turbulence and transport in the SOL of ASDEX-Upgrade.

2.5. Participation in the TJ-II Programme

The CFN participation in the TJ-II[8] Programme has been mainly focussed on the areas of microwave reflectometry, heavy ion beam diagnostic and edge plasma physics.

Concerning *microwave reflectometry*, CFN began the development of an heterodyne Q-band fixed frequency channel using synthesizer sources, to study radial correlation parameters of plasma turbulence.

Regarding the *heavy ion beam diagnostic*, the following main tasks were carried out:

- Test of the transimpedance amplifiers and development of new pre-amplifiers for the detected signals;
- Installation of the multiple cell array detector (MCAD), the manipulator system and the transimpedance amplifiers on TJ-II;

[8] TJ-II is a stellarator of the Association EURATOM/CIEMAT, in operation in Madrid.

- Development of new deep Faraday cup type cells aiming at decreasing the plasma loading effect on the measurements and of an upgrade version of the dedicate control and data acquisition software and its installation in the TJ-II system.

Concerning *edge plasma physics*, the statistical properties of the radial correlation of turbulence in the TJ-II boundary region were studied.

2.6. Participation in the MAST Programme

This Project aims the development and scientific exploitation of a microwave reflectometer for MAST[9]. The following main activities were carried out in 2002:

- Finalization of the assembly, implementation and testing of the diagnostic;
- Improvements in the detection amplifiers in order to reduce the noise;
- Assessment of the reflectometry diagnostic performance. All channels have been tested with a metallic mirror placed inside the machine;
- Realization of the first plasma measurements. The experimental results showed clear fringes due to the MAST plasma in the Ka band channel but reveal the loss of reflected signal in the K band and part of the U band channels. This situation was identified as being most likely due to problems in the installation of the diagnostic in the machine, which can only be corrected in the next vacuum break.

2.7. Participation in the TCV Programme

The main objectives of this Project are the development and scientific exploitation of three X-ray diagnostics (a horizontal Pulse Height Amplitude (PHA) spectrometer, a vertical PHA spectrometer and a rotating crystal spectrometer) and the development of an advanced plasma control system for TCV[10].

The *horizontal PHA spectrometer*, in operation since 2001, was designed in a hybrid analogue-digital configuration, based on a Germanium-cooled detector, a spectroscopy amplifier, an on-site developed IATG (Interface Amplifier Timing Generator) and a CAMAC transient recorder module. The following main tasks were performed in 2002:

- Routine operation of the diagnostic for the measurement of the electron temperature and analysis of the line radiation in the soft X-ray range from 1 to 10 keV;
- Elaboration of Users Reference Guides.

The *vertical PHA* is being developed aiming at to operate in almost all the TCV plasma configurations and to provide real-time control capabilities, overcoming the constrains of the horizontal PHA. The new spectrometer is based on a Roentec Xflash Silicon Drifted Detector and a

[9] MAST is a Mega Ampere Spherical Tokamak of the Association EURATOM/UKAEA, in operation in Culham.
[10] TCV is a "Tokamak de Configuration Variable" of the Association EURATOM/Confederation Suisse, in operation in Lausanne.

DSP system, based on either a commercial CAMAC unit or a CFN VME module. The following main activities were made in 2002:

- Finalization of the diagnostic design, including the issues related with its implementation on TCV;
- Improvement of a CAMAC DSP based algorithm aiming at meeting the experimental aims and performance;
- Beginning of the tests of the basic components of the diagnostic;
- Development of software for the utilization of a CFN DSP-based VME system on these diagnostics, aiming at achieving real-time operation for the feedback control of some TCV and diagnostic parameters;
- Development of a Linux based server and control program as well as a remote graphical user interface for the implementation of the CFN DSP-based VME system in the TCV control and data acquisition system.

The *rotating crystal spectrometer* is based on equipment lent by the Princeton Plasma Physics Laboratory. The following main tasks were performed in 2002:

- Cleaning up of the vacuum chamber, replacement of the gold O-rings by viton ones and test of its performance at high vacuum;
- Tests of the step motor support structure, CRPP manufactured amplifiers, crystals reflectivity and multichannel plates (MCPs) performance;
- Call for tender for a new set of crystals and MCPs.

The development by IST/CFN of a new *digital plasma control system* for TCV was discussed after summer 2002. This system will be based on a CFN DSP-based VME module, which was specially designed for real-time feedback control. The following main activities were made in 2002:

- Meetings between CRPP and IST staff to understand how the CFN DSP-based VME module could be used on TCV;
- Elaboration of a proposal for the upgrading of the central analogue controller of the TCV plasma control system.

2.8. Participation in the ITER Project

The Portuguese participation in the ITER Project included in 2002 activities related with diagnostics design and integration, microwave reflectometry and ITER Negotiations.

Concerning *diagnostics design and integration*, Prof. Artur Malaquias belonged during this year to the ITER International Team, working at Garching on the Motional Stark Effect (MSE) Diagnostic, Charge Exchange Recombination Spectroscopy and X-ray System.

Regarding *microwave reflectometry*, the following main tasks were performed:

- Development of a software tool to simulate O/X mode reflectometry experiments aiming at demonstrating the possibility of measuring Bt (r) with combined O and X mode probing. First dedicated O/X mode measurements have been performed at the LFS;

- Assessment of the reliability and accuracy of plasma position measurements from reflectometry.

Concerning the *ITER Negotiations*, Prof. Carlos Varandas participated in five meetings and chaired one meeting of the "Negotiator's Standing Sub-Group".

2.9. Other activities on theory and modelling

Besides the work on theory and modelling previously presented, this section reports on two topics: (i) role of magnetic reconnection (ideal and resistive) processes in the dynamics and confinement of thermonuclear plasmas; and (ii) non-inductive current drive.

Concerning the *role of magnetic reconnection (ideal and resistive) processes in the dynamics and confinement of thermonuclear plasmas*, the following main studies were performed in 2002:

- Feedback stabilization of vertical displacement instabilities;
- Forced magnetic reconnection in fusion burning plasma experiments;
- Shear flow effects on tearing mode stability.

Regarding *non-inductive current drive,* the following studies were made in 2002:

- Studies on the effects of magnetic ripple for lower-hybrid wave propagation;
- Beam-tracing and diffraction effect studies on lower-hybrid wave propagation;
- Development of kinetic codes for RF heating and current drive.

2.10. Other activities on control, data acquisition and signal processing

This Project aims the development of a fast, galvanic isolated, PCI data acquisition module as well as of PCI time digitisers and transient recorders.

Concerning the *fast galvanic isolated PCI data acquisition module*, the following main activities were carried out:

- Conceptual design of the module;
- Elaboration of a proposal regarding the use of this module on the JET fast magnetics KC1F diagnostic and discussion of this proposal with the EFDA Culham Close Support Unit (CSU);
- Beginning of the development of the circuit schematic.

The following main tasks related with the PCI time digitizers and transient recorders were performed in 2002:

- Conceptual design of a PCI time digitizer module and a PCI transient recorder module taking into account the requirement of the neutron diagnostic of the JET Enhancement Programme;
- Elaboration of a proposal aiming at the use of these modules on JET and discussion of the proposal with the Project Leader and the EFDA Culham CSU.

3. ACTIVITIES CARRIED OUT BY CENTRO DE FÍSICA DOS PLASMAS IN 2001 AND 2002

3.1. Foreword

In December 2000 the activities of the Centre for Plasma Physics (Centro de Física dos Plasmas, CFP) were recognized as strategically important in the context of the Portuguese scientific research, when they were integrated in the Associated Laboratory for Nuclear Fusion and Plasmas. This Laboratory is sheared with the Centre for Nuclear Fusion. The research of these two research centres remains scientifically independent, but a number of connections and collaborations are being incremented. Here we give the first account of the research activities of Centre for Plasma Physics after its integration in the Associated Laboratory, which corresponds to a period of two years, 2001 and 2002.

Our Centre is composed of three Groups: 1) the Group of Lasers and Plasmas, or GoLP, 2) the Space Plasmas Group, and 3) the Group of Gaseous Discharges. These Groups have independent research programmes, but they have recently established collaborative work in the area of Space Plasmas. The activity report of these three Groups will be given separately.

3.2. GoLP – Group of Lasers and Plasmas

This Group works on theory, simulation, and experiments. Its main research activities are related with the field of laser-plasma interactions. The main achievements of GoLP during 2001 and 2002 were:

- The commissioning and the set-up of the fastest Macintosh production cluster in the World (2001) at IST. This cluster now runs full time, with an occupation rate of over 90 %. This work led to the first reference to Portugal on the technology news site slashdot.org. This work was also mentioned in several news sites, press releases, and non-scientific publications. Access to these computational resources, along with the expertise in parallel computing, scientific visualization, and particle-in-cell simulations, have put our team in the leading front in this field in Europe, and have opened new collaborations in the field of scientific computing.
- The demonstration of laser produced plasma channels using a laser triggered high-voltage discharge, with a length of 15 mm. Using pic code simulations it was possible to show that Tera-Watt laser pulses, produced by our system and guided by such channels will be abble to attain energies in the GeV range.

3.2.1. Theory and simulation

During this period we have performed theoretical work in several topics. Most of this work has been either published in refereed journals, presented as invited talks in conferences, or presented as contributed papers in conferences. A non-exaustive list of theoretical problems studied by GoLP is given here:

Collective neutrino-plasma interactions: Work on this new area of Plasma Physics, pioneered by GoLP, was pursued. In particular, we have studied the neutrino conversion in magnetic fields, the influence of proton correlations on the neutrino effective charge, and the symmetry breaking in electron-positron plasmas by neutrino generated plasma wakefields.

Plasma accelerators: Work includes, proton shock acceleration in laser-solid interactions, one-to-one modelling of laser plasma accelerators in channels, tilted filamentation of relativistic electron beams. Another area, with pioneering contributions by GoLP researchers, is photon acceleration. Work in this topic included photon acceleration in relativistic ionization fronts, photon kinetics, pulse shaping, pulse compression and attosecond pulse generation.

Astrophysical plasma physics: We have recently began to extrapolate from our knowledge of laboratory plasma physics into similar problems related to astrophysical plasmas and to matter in extreme conditions. In particular, we have studied the interaction of a photon gas with gravitational waves, plasma dispersion of gravitational waves and nonlinear gravitational optics. We have also studied the quantum fluctuations in plasmas and nuclear reaction rates in supernovae scenarios, relativistic shocks in gamma-ray bursters, Weibel instability in astrophysical scenarios, and in fast ignitor scenarios.

Inertial Confinement: Many of the above topics are related to inertial confinement fusion and to the fast ignitor concept. Additional topics in this area were studied, by theory and simulation, including heat flow in cone-shaped targets for fast ignition, fast proton production in laser-solid interactions, laser propagation in plasma waveguides, fast electron transport in laser-solid interactions and X-ray laser-matter interaction.

Complex Plasmas: Research has proceeded in the context of two large European Research Networks of the 5th Framework Programme which were approved during the year 2000. A theoretical model of dust dynamics has been developed, including the observed self excited oscillations, nonlinear resonance and parametric oscillations. A new mechanism, namely the modulational forcing, for exciting nonlinear resonances has been proposed. A Langevin theory of heating has been developed. The Casimir effect and the Ising model were applied to dusty plasma media.

Space Plasmas: Research activities of GoLP in the area of Space Plasmas was financed by the European Space Agency. These projects were launched during the period of 2001-2002. Three main areas can be mentioned: 1) Plasma propulsion, 2) Artificial magnetospheric propulsion, and 3) Laser propulsion. The first project deals with the problem of plasma propulsion and it aims to improve the performances of the Hall thruster, by decreasing the divergence of its plume, and by introducing a system of static plume deflection. The second project discusses the possible use of an artificial magnetosphere, created around a satellite, to sail in the solar wind and to make long travels across the Solar System. The third project deals with the possibility of using strong laser beams to push a satellite

from far away and to make small adjustments on its orbit. In addition, numerical Pic codes for the Hall thruster and for the artificial magnetosphere have been developed.

Nonlinear and Quantum Optics: Work in this area included a new theoretical proposal for high harmonic generation and for attosecond pulse generation in dielectric media and in weakly ionized plasmas. It was also shown that self-phase modulation effects in Optics are nothing but particular cases of photon acceleeration and can be described by photon kinetic equations where the field phase is absent. In Quantum Optics we have studied the dynamics of two interacting electrons confined in a Penning trap. We have also proposed a demonstration of the EPR Paradox by measuring the position and momenta of electrons in two coupled Penning traps.

3.2.2. Laser experiments

a) Tera-Watt Laser Development

Two major upgrades were initiated during this period, the replacement of the seed oscillator, and the design and installation of a new grating pulse stretcher. Experimental developments included the characterisation of the amplified laser pulses in terms of duration, contrast and energy; the optimisation of the overall shot-to-shot energy stability of the entire system; the design of a vacuum spatial filter; and the assembly of two new pulse diagnostics.

New ultra-short pulse main oscillator : The use of an optical fibre to enlarge the pulse spectrum out of our previous oscillator was found to be responsible for a non-uniform pulse profile.

For this reason, we acquired a Coherent laser oscillator Mira 900-F, pumped by a Nd:YVO4 laser Verdi 10, capable of producing of 100 femtosecond pulses at 1053 nm.

Laser diagnostics: Two new important diagnostics were added this year for the purpose of characterising the temporal behaviour of the laser output: a single-shot, second-order autocorrelator, and a scanning third-order autocorrelator.

Stretcher: The new grating stretcher was assembled towards the end of 2002. The vacuum spatial filter was also assembled, installed and tested successfully. Finally, work on Optical Parametric Chirped Pulse Amplification (OPCPA) was initiated.

Target Area: A laser control unit, a video control unit, a ns precision six channel delay generator, a gas jet control unit and a unit responsible for the communication with the control computers were installed during this period. A secondary vacuum target chamber, for small-scale experiments, or to be coupled with the main target chamber, was also installed. A setup for plasma channels using this vacuum chamber was developped, including an home made 20 KV power supply, a 12 nF capacitor bank, a laser triggered ultra-fast high voltage switch, and special shaped electrodes. The design and development of an ultra-short laser pulse interferometer for measuring plasma electron densities was concluded as well as a complex software package for fully automatic interferogram.

b) Experiments at L2I

We have performed two series of experiments at L2I in 2001-2002. The first one was a test experiment with plasma production, its qualitative observation by shadowgraphy and test of the main laboratory systems. The second one took place from June 2001 to Jully 2002. A new technique plasma channel production in the cm range was developed, for use in high intensity laser guiding. Reproducible guiding plasma channels with electron densities from 2 x 10^{18} cm^{-3} to 6 x 10^{18} cm^{-3} on axis we achieved. In this series of experiments the laser system was significantly improved at front end level to attain a contrast up to 10^6 by changing the regenerative amplifier pockels cells and by adding the new oscillator.

c) Experiments within International Collaborations

Electron acceleration: In 2001 – 2003 we were involved in two experiments in the laser Astra – Rutherford Appleton Laboratory – UK. The objective of these experiments were the observation of photon acceleration by interaction with wake-fields and the measurement of the energy spectra of the electron beam produced in the forward direction. Electrons with energies up to 20 MeV have been measured.

X-ray laser: The first longitudinal coherence measurement of the transient inversion collisional x-ray laser was performed at LLNL (Livermore). The scheme under study was the picosecond output of the Ni-like Pd x-ray laser at 14.68 nm generated by the COMET laser facility. Interference fringes were generated using a Michelson interferometer setup in which thin multilayered membranes were used as beam splitters. Systematic variation in the relative lengths of the two-interferometer arms results in a temporal coherence dependent variation in the fringe visibility. The nature of this dependence allows for an estimation of the line-shape of the laser transition to be made. Comparisons are drawn on previous measurements made with quasi steady-state pumped x-ray laser schemes.The imaging system that was used showed evidence for speckles in the x-ray laser footprint and also in the fringes, suggesting different path lengths for amplified spontaneous emission.

High Harmonic Generation: Focusing High Harmonics with unprecedented energy density was performed in experiments at the "salle rouge" facility in LOA, in collaboration with Philippe Zeitoun's group at LIXAM (Orsay). High harmonics of an ultra-short pulse were created. A filtered set of harmonics (from 25 to 35 nm) were focused using an off-axis parabola, which was ultra-polished to better than $\lambda/50$. An innovative technique was used to measure the focal spot, using a Ce-doped YAG crystal to fluoresce followed by collecting visible optics. The resulting focal spot was better than 3 μm diameter, without any trace of aberrations, contrary to previous experiments. High enough intensities on target may be created in order to create a plasma with multi-layer coating.

d) Femtolab

A new type of ultra-fast laser oscillator was developed and studied at GoLP, delivering 2 nJ laser pulses, with a duration of 7.5 femto-seconds and 85 MHz of repetition rate. Mode competition in cw operation of the laser cavity was observed. The amplification stage of this laser system up to the mili-Joule level, working at 10 Hz, was installed and partially tested. Pulse compression will be installed in 2003.

d) LIDAR

Full scientific exploitation of our mobile aerosol LIDAR laboratory began in 2002. Our activities are integrated in the European network, EARLINET: *A European Aerosol Research LIDAR Network to Establish an Aerosol Climatology.* The GoLP/IST system successfully completed the hardware and software inter-comparisons in 2002 and now operates on a harmonized European basis. The existing LIDAR is dedicated to climatological studies. In the near future, efforts to implement a new upgrade for inelastic Raman detection will be pursued.

3.3. Space Plasmas

The activity of the Space Plasmas Group is centered on the theoretical study of space plasma physics and nonlinear dynamics, with present emphasis on wave generation via perpendicular currents and parametric decays.

During this period, the theoretical research work of the second Group of the Centro de Física de Plasmas (CFP) looked into three topics within space plasmas: (i) stability of perpendicular currents, (ii) parametric decays, and (iii) preliminary assessment of the feasibility of the "magnetic bubble concept" as a means of space propulsion.

The studies on parametric decays and the stability of perpendicular currents were jointly carried out with L. Gomberoff of the Physics Department of the University of Chile (Santiago), within a space plasma research project partially funded by ICCTI and (Chilean Institute) FONDECYT. The investigations on the feasibility of the "magnetic bubble" propulsion arise from a CFP project supported by ESA.

Perpendicular currents integrate space structures that drastically influence the behavior of the plasma environment (boundary regions, shocks, magnetotails, drifts, reconnection, etc.) and the study of their stability has attracted many research efforts. We studied the properties of this free energy source in cold and hot plasmas and characterized the wave activity that can thus be stimulated.

Ion beam--plasma interactions are the source of wave activity in several space environments. We studied parametric decays of right-hand polarized proton beam--plasma waves including the effect of the beam and its deceleration as the interaction evolves.

The study of the "magnetic bubble" concept is in a preliminary stage and attention has been focussed on the injected plasma properties in the vicinity of the spacecraft.

3.4. Gas Discharges and Gaseous Electronics

3.4.1. Theoretical and experimental study of wave driven molecular discharges

An experimental and theoretical study of wave driven molecular discharges (long cylindrical plasma columns extending out of the launcher) has been carried out in the Laboratory of Gas Discharges during the last 2 years in H_2, N_2, and Ar gases, as well as in their mixtures (H_2–N_2, N_2–Ar). The discharges are generated by azimuthally symmetric (TM mode) surface waves operating at microwave frequencies $\omega/2\pi$ = 500 MHz and $\omega/2\pi$ = 2.45 GHz.

By means of optical emission spectroscopy, laser photodetachment, and radiophysics methods, the relevant active species concentrations, such as $N(^4S)$, H(1s), H^-, and $N_2(C^3\Pi_u, v), N_2^+(B^2\Sigma_u^+, v), H_2(d^3\Pi_u^-, v)$, and some discharge parameters as the gas temperature and electric field, have been measured. Emission spectroscopy methods have been developed and applied to determine the degree of molecular dissociation in H_2, N_2, N_2-Ar and N_2-H_2 discharges. Microwave H_2 discharges have also been investigated as sources of negative H^- ions. A significant amount of negative ions has been experimentally detected contrary to the negligible presence of H^- ions usually found in microwave hydrogen discharges.

The theoretical models developed couple self-consistently the discharge kinetics (electron and heavy particles kinetics), the gas thermal balance, the wave electrodynamics and important aspects of plasma-wall interactions. The models describe the spatial discharge structure and are instrumental in the sense that they provide a tool for discharge optimization in respect to the active species concentration. The important problems of molecular dissociation, i.e. creation and loss of ground state $N(^4S)$ and H(1s) atoms and the inhomogeneous gas heating are analyzed in the terms of obtained theoretical and experimental results. A strong coupling between degree of dissociation, negative ions density and wall temperature has been experimentally and theoretically demonstrated. The contribution of fast charge transfer processes (between Ar^+ and N_2) with consequent dissociative recombination of N_2^+ in the kinetic of molecular dissociation in N_2-Ar microwave discharges has been elucidated.

3.4.2. Electron and heavy-species kinetics in a nitrogen afterglow

The study of the kinetics of electrons in post-discharges of nitrogen have been realised both experimentally and theoretically. The electron energy distribution functions (EEDF) have been measured in the framework of a cooperation including *Université des Sciences et Technologies de Lille* (France) and the Bulgarian Academy of Sciences, which has allowed to obtain EEDF measurements in a nitrogen flowing afterglow under collisional conditions. On

the other hand, the theoretically study of the time-relaxation of the EEDF in a nitrogen afterglow has been also pursued. It has been shown that an equilibrium between the vibrational distribution of ground-state N_2 molecules is established and that collisions of highly vibrationally excited molecules with N atoms are at the origin of a maximum in the EEDF occurring downstream the discharge.

In what concerns the kinetics of heavy-species in the post-discharge, some new aspects of nitrogen afterglows were also described. In particular, for the first time the raise in the concentrations of several species occurring downstream the discharge, after a dark zone, has been explained. This work has been developed in close collaboration with colleagues from other Institutions, such as the Faculty of Engineering of the Oporto University (Portugal), Université des Sciences et Technologies de Lille (France) and Université Joseph Fourier de Grenoble (France).

3.4.3. Modelling of PECVD Reactor, GEC Cell and Magnetron Discharge

The modelling of a PECVD reactor based on low-pressure (p<1 Torr) rf discharges, operating at 13.56 MHz frequency in SiH_4-H_2 mixtures (at various dilution conditions) and in pure H_2, was successfully concluded. The modelling of a GEC Cell, based on low-pressure (p<1 Torr) rf/vhf discharges, operating at frequencies up to 700 MHz in highly diluted SiH_4-H_2 mixtures has been initiated. This research is carried out in collaboration with the LPTP, *École Polytechnique*, Palaiseau (France) and the LPGP, *Université Paris Sud*, Orsay (France).

The work developed so far includes the optimization of an existing 2D fluid code for the transport of charged particles in the reactor, and a systematic characterization of capacitively coupled radio-frequency (ccrf) hydrogen discharges. The latter enabled some first comparisons between model results and measurements. We have also tried to improve the space-time calculation of electron transport parameters used in discharge models, aiming at a coherent modelling of ccrf discharges in argon.

The modelling of a low-pressure (p ~ 10 mTorr) dc magnetron discharge in argon, with an additional hf power source for ionization of the metal vapor emitted by the cathode has been initiated. This work was carried out in the framework of a collaboration with LPGP, *Université Paris Sud*, Orsay. Part of this work involved several industrial partners and the French *Ministère de la Recherche et de la Technologie*. A 2D fluid code describing the transport of electrons and positive ions in the magnetron discharge has been created. A previously developed 1D fluid code for the transport of charged particles in the microwave discharge was self-consistently solved, coupled to the appropriate set of Maxwell's equations and to a collisional - radiative model for argon. Expected problems involving the electron plasma resonance have been pointed out, which has contributed to a deeper understanding of the wave-plasma energy coupling.

3.4.4. Large-Scale HF Molecular Plasma Sources

A new experimental project on Large-Scale HF Molecular Plasma Sources has been initiated. In the framework of the new project, building the new apparatus has been a time-consuming task due to budget restrictions. Nevertheless, the new apparatus is now in conditions to start providing experimental results. It includes a PC-controlled, 3-axes movement of the diagnostic tools, which will include wave field (electric and magnetic), probe (electrons and negative ions), and spectroscopic measurements (emission and absorption).

Within the scope of this scientific task, an electrodynamical analysis of a large-area, slot antenna excited plasma sources have been performed. The theoretical results have been confirmed by experimental measurements of the electric field components distribution.

3.4.5. Dissociation and surface atomic recombination in nitrogen discharges

The dissociation in nitrogen discharges at pressures above 1 Torr has been investigated by modelling. This study leads to the identification of new dissociation mechanisms involving excited vibrational levels of ground-state N_2 molecules and $N_2(A\ ^3\Sigma_u^+)$ metastable states.

A Dynamical Monte Carlo method to study surface recombination of atoms on silica and Pyrex has also been initiated. The method developed for heterogeneous atomic recombination allows to establish a direct relationship between Monte Carlo time and real time, which constitutes an exact way of treating time-dependent surface phenomena.

3.4.6. Modelling of a nitrogen discharge with graphite electrodes

The modelling of a nitrogen discharge with graphite electrodes has been investigated in the framework of a collaboration with the Lebedev Physical Institute of the Russian Academy of Sciences, the Research Institute for Solid State Physics and Optics, Budapest, and with the ITN, Sacavém. Also in cooperation with these institutes, a joint work is underway to compare different methods of calculation of transport parameters and excitation coefficients for electron impact as well as electron distribution functions, *viz.* the Monte Carlo method, and the density expansion and the classical two-term expansion method to solve the electron Boltzmann equation.

3.4.7. Studies on electronegative gases

A study on the electrical properties of discharges in mixtures of SF_6 with a non-electronegative gas, for applications in electrical power engineering has been carried out. The effective ionization coefficients, drift velocities and electron attachment coefficients have been determined for different mixture compositions of SF_6 with a companion gas (He, Ar, CO_2, N_2) from Boltzmann analysis.

4. OTHER ACTIVITIES OF CENTRO DE FUSÃO NUCLEAR

4.1. Participation in the management of the Fusion Programme

- Some members of the Research Unit are delegates to Committees of the European Fusion Programme and of the European Fusion Development Agreement (Table 1).

Name	Member of
Carlos Varandas	CCE-FU[11]
	EFDA Steering Committee
	FTC[12]
	CFI[13]
Maria Emília Manso	CCE-FU
	EFDA Steering Committee
Fernando Serra	EFDA JET Sub-Committee / STAC[14]
	FPC[15] / STAC
J.P. Bizarro	FPC / STAC
Carlos Silva	AFAC[16]

Table 1 – Participation of members of Centro de Fusão Nuclear in the management of the European Fusion Programme and of the European Fusion Development Agreement

- *Prof. Carlos Varandas* is:
  - Chairman of the EFDA Steering Committee
  - Vice-Chairman of the "CCE-FU Special Working Group on Possible Joint Implementation of ITER";
  - Member of the Steering Committees of the Bilateral Agreements of EURATOM with Russia, Japan and the US Department of Energy, in his position of Chairman of the EFDA Steering Committee.
- *Prof. Maria Emilia Manso* is the Chairman of the International Advisory Board on Reflectometry
- Prof. Fernando Serra is a EU member of the ITPA (International Tokamak Physics Activities) Topical Group on Diagnostics.

4.2. Organization of scientific meetings

- CFN is in charge with the organization of the "IAEA Fusion Energy Conference", to be held in Vilamoura, in October 2004.
- *Prof. Carlos Varandas:*
  - Was the Chairman of the Programme Committee of the "29th EPS Conference on Plasma Physics and Controlled Fusion", 18-22 June 2002, Montreux.

[11] CCE-FU means "Consultative Committee for the EURATOM Specific Research and Training Programme in the Field of Nuclear Energy (Fusion).
[12] FTC means "Fusion Technology Committee", a sub-committee of CCE-FU.
[13] CFI means "Committee Fusion-Industry", a sub-committee of CCE-FU.
[14] STAC means "Scientific and Technical Advisory Committee", a sub-committee of CCE-FU and EFDA Steering Committee.
[15] FPC means "Fusion Physics Committee", a sub-committee of CCE-FU.
[16] AFAC means "Administrative and Financial Advisory Committee", a sub-committee of CCE-FU and EFDA.

- Is member of the Programme Committee of the "30th EPS Conference on Controlled Fusion and Plasma Physics", to be held in July 2003, in S. Petersburg.

4.3. Collaboration in post-graduation programmes

- CFN has proceed with the collaboration in post-graduation programmes of "Instituto Superior Técnico", "Universidade de Coimbra" and "Universidade da Beira Interior". Twenty Research Assistants (A. Silva, P. Varela, J. Santos, I. Nunes, F. Silva, T. Ribeiro, R. Gomes, B.B. Carvalho, H. Figueiredo, A. Batista, A.P. Rodrigues, J. Sousa, A. Combo, J. Belo, M.P. Alonso, J. Ferreira, F. Nabais, P. Belo, S.R. Cortes, B. Gonçalves) are carrying out Ph.D programmes, while four Research Assistants (T. Madeira, R.C. Pereira, D. Alves, P. Rodrigues) are performing Master programmes.
- The following Ph.D Programmes were finalized in 2002:

  D1 - "Sistema de temporização e gestão de eventos para dispositivos experimentais de fusão nuclear"

  Jorge de Sousa, June 2002

  D2 - "Automatic time-frequency analysis for plasma density profile evaluation from microwave reflectometry"

  Paulo Varela, July 2002

  D3 - "O diagnóstico de espalhamentoThomson do tokamak ISTTOK"

  Manuel Peres Alonso, October 2002

  D4 - "Transition-probability formulation of the electron kinetics during rf current drive of fusion plasmas"

  Jorge Belo, November 2002
- The following Master Programmes were finalized in 2002:

  M1 - "Discretização de operadores de Fokker-Planck unidimensionais em grelhas não - uniformes"

  Paulo Rodrigues, June 2002

  M2 - "Sistemas de visão laser para inspecção de grandes máquinas de fusão"

  Rita Pereira, July 2002

  M3 - "Dois diagnósticos de raios-X de análise de amplitude de impulsos para o tokamak TCV"

  Teresa Madeira, July 2002

4.4. Publications

4.4.1. Articles in scientific journals

A1 - "A high-data-transfer-rate VME system for TCP-IP remote real-time control of the ITER in-vessel vision system"

R. Pereira, N. Cruz, C. Neri, C. Correia and C. Varandas

Fusion Engineering and Design, 60, (3) , 253, 2002

A2 - "A large memory, high transfer rate VME data acquisition system for the JET correlation reflectometer"

N. Cruz, R. Pereira, M. Correia, L. Cupido, C. Correia and C. Varandas

Fusion Engineering and Design, 60, (3) , 273, 2002

A3 - "A CORBA sharing and messaging server-client information system"

H. Fernandes, J.P.A. Pereira and C. Varandas

Fusion Engineering and Design, 60, (3) , 279, 2002

A4 - "A high performance real-time plasma control and event detection DSP based VME system"

A.P. Rodrigues, C. Correia and C. Varandas

Fusion Engineering and Design, 60, (3) , 435, 2002

A5 - "A distributed, hardware reconfigurable and packet switched real-time control and data acquisition system"

A.J.N. Batista, A. Combo, J. Sousa and C. Varandas

Fusion Engineering and Design, 60, (3) , 443, 2002

A6 - "Remote participation at JET Task Force work: users' experience"

W. Suttrop, D. Kinna, J. Farthing, O. Hemming, J. How, V. Schmidt, The EFDA-JET Remote Participation Users Group and EFDA-JET Work Programme contributers

Fusion Engineering and Design, 60, (3) , 459, 2002

A7 - "Integrating discharge control and data acquisition at ASDEX Upgrade"

G. Raupp, K. Behler, G. Neu, R. Merkel, W. Treutterer, D. Zasche, T. Zehetbauer and ASDEX Upgrade Team

Fusion Engineering and Design, 60, (3) , 353, 2002

A8 - "On a variational approach to the extraction of quadratures from broadband reflectometry signals"

A.C.A. Figueiredo and J.P.S. Bizarro

Review Scientific Instruments, 73, (2) 289, 2002

A9 - "ELM mitigation by nitrogen seeding in the JET gas box divertor"

J. Rapp, T. Eich, M. von Hellermann, L.C. Ingesson, S. Jachmich, G.F. Matthews, V. Philipps, G. Saibene and contributors to the EFDA-JET WorkProgramme

Plasma Physics Controlled Fusion, 44, (6) , 639, 2002

A10 - "The effect of CD_4 puffing on the peripherical scrape-off layer in JET"

G.F. Matthews, S.K. Erents, G. Corrigan, W. Fundamenski, I. Garcia-Cortes, J. Mailloux, C. Hidalgo, M.A. Pedrosa, V. Pericoli, J. Spence, C. Silva, J. Strachan and contributors to the EFDA-JET WorkProgramme

Plasma Physics Controlled Fusion, 44, (6) , 689, 2002

A11 - "Particle recirculation studies in JET"

E. Tsitrone, J. Bucalossi, T. Loarer, Ph. Ghendrih, A. Loarte, P. Andrew, P. Coad, W. Fundamenski, M. Stamp, D. Coster and contributors to the EFDA-JET WorkProgramme

Plasma Physics Controlled Fusion, 44, (6) , 701, 2002

A12 - "Interpretation of recent power width measurements in JET MkIIGB ELMy H-modes"

W. Fundamenski, S. Sipilä, G.F. Matthews, V. Riccardo, P. Andrew, T. Eich, L.C. Ingesson, T. Kiviniemi, T. Kurki-Suonio, V. Philipps and contributors to the EFDA-JET WorkProgramme

Plasma Physics Controlled Fusion, 44, (6) , 761, 2002

A13 - "Impurity behaviour in the ASDEX Upgrade divertor tokamak with large area tungsten walls"

R. Neu, R. Dux, A. Geier, A. Kallenbach, R. Pugno, V. Rohde, D. Bolshukhin, J.C. Fuchs, O. Gehre, O. Gruber, J. Hobirk, M. Kaufmann, K. Krieger, M. Laux, C. Maggi, H. Murmann, J. Neuhauser, F. Ryter, A.C.C. Sips, A. Stäbler, J. Stober, W. Suttrop, H. Zohm and the ASDEX Upgrade Team

Plasma Physics Controlled Fusion, 44, (6) , 811, 2002

A14 - "Transport into and across the scrape-off layer in the ASDEX Upgrade divertor tokamak"

J. Neuhauser, D. Coster, H.U. Fahrbach, J.C. Fuchs, G. Haas, A. Herrmann, L. Horton, M. Jakobi, A. Kallenbach, M. Laux, J.W. Kim, B. Kurzan, H.W. Müller, H. Murmann, R. Neu, V. Rohde, W. Sandmann, W. Suttrop, E. Wolfrum and the ASDEX Upgrade Team

Plasma Physics Controlled Fusion, 44, (6) , 855, 2002

A15 - "Properties of the new divertor Iib in ASDEX Upgrade"

R. Neu, J.C. Fuchs, G. Haas, A. Herrmann, M. Laux, J. Neuhauser, F. Ryter, J. Gafert, O. Gruber, M. Kaufmann, B. Kurzan, V. Mertens, H.W. Müller, V. Rohde, A. Sips, J. Stober, B. Streibl, W. Treuterer and the ASDEX Upgrade Team

Plasma Physics Controlled Fusion, 44, (6) , 1021, 2002

A16 - "Influence of the q-profile shape on plasma performance in JET"

C.D. Challis, X. Litaudon, G. Tresset, Yu F. Baranov, A. Bécoulet, C. Giroud, N.C. Hawkes, D.F. Howell, E. Joffrin, P.L. Lomas, J. Mailloux, M.J. Mantsinen, B.C. Stratton, D.J. Ward, K-D Zastrow and contributers to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, (7) , 1031, 2002

A17 -"Towards fully non-inductive current drive operation in JET"

X. Litaudon, F. Crisanti, B. Alper, J.F. Artaud, Yu F. Baranov, E. Barbato, V. basiuk, A. Bécoulet, M. Bécoulet, C. Castaldo, C.D. Challis, G.D. Conway, R. Dux, L.G. Eriksson, B. Esposito, C. Fourment, D. Frigione, X. Garbet, C. Giroud, N.C. Hawkes, P. Hennequin, G.T.A. Huysmans, F. Imbeaux, E. Joffrin, P.J. Lomas, Ph. Lotte, P. Maget, M. Mantsinen, J. Mailloux, D. Mazon, F. Milani, D. Moreau, V. Parail, E. Pohn, F.G. Rimini, Y. Sarazin, G. Tresset, K.D. Zastrow, M. Zerbini and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1057, 2002

A18 - "Real-time control of internal transport barriers in JET"

D. Mazon, X. Litaudon, D. Moreau, M. Riva, G. Tresset, Y. Baranov, A. Bécoulet, J.M. Chareau, F. Crisanti, R. Dux, R. Felton, E. Joffrin and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1087, 2002

A19 - "The formation and evolution of extreme shear reversalin JET and its influence on local thermal transport"

N.C. Hawkes, Y. Andrew, C.D. Challis, R. De Angelis, V. Drozdov, J. Hobirk, E. Joffrin P. Lotte, D. Mazon, E. Rachlew, S. Reyes-Cortes, F. Sattin, E. Solano, B.C. Stratton, T. Tala, M. Valisa and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1105, 2002

A20 - "The role of axisymmetric reconnection events in JET discharges with extreme shear reversal"

B.C. Stratton, J.A. Breslau, R.V. Budny, S.C. Jardin, W. Park, H.R. Strauss, L.E. Zakharov, B. Alper, V. Drozdov, N.C. Hawkes, S. Reyes-Cortes and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1127, 2002

A21 - "MHD stability with strongly reversed magnetic shear in JET"

T.C. Hender, P. Hennequin, B. Alper, T. Hellsten, D.F. Howell, G.T.A. Huysmans, E. Joffrin, P. Maget, J. Manickam, M.F.F. Nave, A. Pochelon, S.E. Sharapov and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1143, 2002

A22 - "Electron heated internal transport barriers in JET"

G.M.D. Hogeweij, Y. Baranov, G.D. Conway, S.R. Cortes, M.R. De Baar, N. Hawkes, F. Imbeaux, X. Litaudon, J. Mailloux, F.G. Rimini, S.E. Sharapov, B.C. Stratton, K-D Zastrow and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1155, 2002

A23 - "Turbulence behaviour during electron heated reversed shear discharge in JET"

G.D. Conway, G.M.D. Hogeweij, M.R. de Baar, Yu Baranov, R. barnsley, N.C. Hawkes, X. Litaudon, J. Mailloux, E. Righi, F.G. Rimini, K-D Zastrow and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1167, 2002

A24 - "Impact of different heating and current drive methods on the early q-profile evolution in JET"

T.J.J. Tala, V.V. Parail, A. Becoulet, C.D. Challis, G. Corrigan, N.C. Hawkes, D.J. Heading, M.J. Mantsinen, S. Nowak and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1181, 2002

A25 - "q=1 advanced tokamak experiments in JET and comparison with ASDEX Upgrade"

E. Joffrin, R. Wolf, B. Alper, Yu Baranov, C.D. Challis, M. de Baar, C. Giroud, C.W. Gowers, N.C. Hawkes, T.C. Hender, M. Marachek, D. Mazon, V. Parail, A. Peeters, K-D Zastrow and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1203, 2002

A26 - "Microturbulence and flow shear in high-performance JET ITB plasma"

R.V. Budny, R. Andre, A. Bécoulet, C.D. Challis, G.D. Conway, W. Dorland, D.R. Ernst, T.S. Hahm, T.C. Hender, D. McCune, G. Rewoldt, S.E. Sharapov and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1215, 2002

A27 - "Neutron emission from JET DT plasmas with RF heating on minority hydrogen"

H. Henriksson, S. Conroy, G. Ericsson, G. Gorini, A Hjalmarsson, J. Källne, M. Tardocchi and contributers to the EFDA-JET Workprogramme

Plasma Physics Controlled Fusion, 44, (7) , 1253, 2002

A28 - "Transport in high normalized beta discharges on ASDEX Upgrade"

Yong-Su Na, A.C.C. Sips, O. Gruber, J. Hobirk, G. Pereverzev and ASDEX Upgrade team

Plasma Physics Controlled Fusion, 44, (7) , 1285, 2002

A29 - "Analysis of ion cyclotron heating and current drive at ? ~ 2? $_{cH}$ for sawtooth control in JET plasmas"

M.J. Mantsinen, C. Angioni, L-G Eriksson, A. Gondhalekar, T. Hellsten , T. Johnson, M-L Mayoral, K.G. McClements, M.F.F. Nave, F. Nguyen, S. Podda, J. Rapp, O. Sauter, S.E. Sharapov, E. Westerhof and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, (8) , 1521, 2002

A30 - "Empirical similarity in the probability density function of turbulent transport in the edge plasma region in fusion plasmas"

C. Hidalgo, B. Gonçalves, M.A. Pedrosa, J. Castellano, K. Erents, A.L. Fraguas, M. Hron, J.A. Jiménez, G.F. Matthews, B van Milligen and C. Silva

Plasma Physics Controlled Fusion, 44, (8) , 1557, 2002

A31 - "Small-angle scattering and spatial resolution of fluctuation reflectometry: comparison of 2D analytical theory with numerical calculations"

E.Z. Gusakov, g. Leclert, I. Boucher, S. Heraux, S. Hacquin, M. Colin, V.V. Bulanin, A.V. Petrov, B.O. Yakovlev, F. Clairet and X.L. Zou.

Plasma Physics Controlled Fusion, 44, (8) , 1565, 2002

A32 - "Triggering of internal transport barrier in JET"

E. Joffrin, G. Gorin, C.D. Challis, N.C. Hawkes, T.C. Hender, D.F. Howell, P. Maget, P. Mantica, D. Mazon, S.E. Sharapov, G. Tresset and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, (8) , 1739, 2002

A33 - "Edge operational space for high density/high confinement ELMY H-modes in JET"

R. Sartori, G. Saibene, M. Becoulet, P.J. Lomas, A. Loarte, D.J. Campbell, Y. Andrew, R. Budny, M.N.A. Beurskens, A. Kallenbach, V. Parail, W. Suttrop, J. Stober, K.D. Zastrow, M. Zerbini, R.D. Monk, and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, 1801, 2002

A34 - "Characteristics and scaling of energy and particle losses during Type I ELMs in JET H-modes"

A. Loarte, M. Becoulet, G. Saibene, R. Sartori, D.J. Campbell, T. Eich, A. Herrmann, M. Laux, W. Suttrop, B. Alper, P.J. Lomas, G. Matthews, S. Jachmich, J. Ongena, P. Innocente and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, 1815, 2002

A35 - "Confinement properties of high density impurity seeded ELMy H-mode discharges at low and high triangularity on JET"

P. Dumortier, P. Andrew, G. Bonheure, R.V. Budny, R. Buttery, M. Charlet, I. Coffey, M. de Baar, P.C. de Vries, T. Eich, D. Hillis, C. Ingesson, S. Jachmich, G. Jackson, A. Kallenbach, H.R. Koslowski, K.D. Lawson, C. Liu, G. Maddison, A.M. Messiaen, P. Monier-Garbet, M. Murakami, M.F.F. Nave, J. Ongena, V. Parail, M.E. Puiatti, J. Rapp, F. Sartori, M. Stamp, J.D. Strachan, W. Suttrop, G. Telesca, M. Tokar, B. Unterberg, M. Valisa, M. von Hellermann, B. Weyssow and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, 1845, 2002

A36 - "Radiation pattern and impurity transport in argon seeded ELMy H-mode discharges in JET"

M.E. Puiatti, M. Mattioli, G. Telesca, M. Valisa, I. Coffey, P. Dumortier, C. Giroud, L.C. Ingesson, K.D. Lawson, G. Maddison, A.M. Messiaen, P. Monier-Garbet, A. Murari, M.F.F. Nave, J. Ongena, J. Rapp, J. Strachan, B. Unterberg, M. von Hellermann and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, 1863, 2002

A37 - "Seeding of impurities in JET H-mode discharges to mitigate the impact of ELMs"

S. Jachmich, G. Maddison, M.N.A. Beurskens, P. Dumortier, T. Eich, A. Messiaen, M.F.F. Nave, J. Ongena, J. Rapp, J. Strachan, M. Stamp, G. Telesca, B. Unterberg and contributors to the EFDA-JET Workprogramme.

Plasma Physics Controlled Fusion, 44, 1879, 2002

A38 - "Comparison of L-mode regimes with enhanced confinement by impurity seeding in JET and DIII-D"

G.L. Jackson, M. Murakami, D.R. Baker, R. Budny, M. Charlet, M.R. de Baar, P. Dumortier, T.E. Evans, R.J. Groebner, N.C. Hawkes, D.L. Hillis, L.C. Ingesson, E. Joffrin, H.R. Koslowski, K.D. Lawson, G. Maddison, G.R. Mckee, A.M. Messiaen, P. Monier-Garbet, M.F.F. Nave, J. Ongena, J. Rapp, S. Sartori, G.M. Staebler, M. Stamp, J.D. Strachan, M.

Tokar, B. Unterberg, M. von Hellerman, M.R. Wade and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1893, 2002

A39 - "Predictive modelling of impurity seeded plasmas in JET"
M.Z. Tokar, H. Nordman, J. Weiland, J. Ongena, V. Parail, B. Unterberg and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1903, 2002

A40 - "Long timescale density peaking in JET"
M. Valovic, J. Rapp, J.G. Cordey, R. Budny, D.C. McDonald, L. Garzotti, A Kallenbach, M.A. Mahdavi, J. Ongena, V. Parail, G. Saibene, R. Sartori, M. Stamp, O. Sauter, J. Strachan, W. Suttrop and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1911, 2002

A41 - "High density operation at JET by pellet refuelling"
P.T. Lang, B. Alper, L.R. Baylor, M. Beurskens, J.G. Cordey, R. Dux, R. Felton, L. Garzotti, G. Haas, L.D. Horton, S. Jachmich, T.T.C. Jones, A. Lorenz, P.J. Lomas, M. Maraschek, H.W. Müller, J. Ongena, J. Rapp, K.F. Renk, M. Reich, R. Sartori, G. Schmidt, M. Stamp, W. Suttrop, E. Villedieu, D. Wilson and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1919, 2002

A42 - "Energy confinement in steady-state ELMy H-modes in JET"
J.G. Cordey, D.C. McDonald, K. Borrass, M. Charlet, I. Coffey, A. Kallenbach, K. Lawson, P. Lomas, J. Ongena, J. Rapp, F. Ryter, G. Saibene, R. Sartori, M. Stamp, J. Strachan, W. Suttrop, M. Valovic and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1929, 2002

A43 - "ELM moderation with ICRF heating on JET"
G.P. Maddison, J.A. Snipes, J-M Chareau, G.D. Conway, I.H. Hutchinson, L.C. Ingesson, H.R. Koslowski, A. Loarte,P.J. Lomas, M.J. Mantsinen, G.F. Matthews, L. Meneses, M.F.F. Nave, E. Righi, G. Saibene, R. Sartori, O. Sauter, K-D Zastrow and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1937, 2002

A44 - "Marginal β-limit for neoclassical tearing modes in JET H-mode discharges"
O. Sauter, R.J. Buttery, R. Felton, T.C. Hender, D.F. Howell and contributors to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, 1999, 2002

A45 - "Self-consistent analysis of the power-energy balance and determination of the runaway electron characteristics in the ISTTOK discharges"
V.V. Plyusnin, J.A.C. Cabral, H. Figueiredo, I.S. Nedzelskii and C.A.F. Varandas
Plasma Physics Controlled Fusion, 44, 2021, 2002

A46 - "Perturbative transport experiments in JET low or reverse magnetic shear plasmas"
P. Mantica, G. Gorini, F. Imbeaux, J. Kinsey, Y. Sarazin, R. Budny, I. Coffey, R. Dux, X. Garbet, L. Garzotti, C. Ingesson, M. Kissick, V. Parail, C. Sozzi, A. Walden and contributers to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, (10) 2185, 2002

A47 - "Real-time determination of internal inductance and magnetic axis radial position in JET"
O. Barana, A. Murari, E. Joffrin, F. Sartori and contributers to the EFDA-JET Workprogramme.
Plasma Physics Controlled Fusion, 44, (10) 2271, 2002

A48 - "Neutral beam stabilization of sawtooth oscillations in JET"
C Angioni et al.,
Plasma Physics Controlled Fusion, 44, 205, 2002

A49 - "Steady state advanced scenarios at ASDEX Upgrade"
A.C.C. Sips, R. Arslanbeko, C. Atanasiu, W. Becker, G. Becker, K. Behler, K. Behringer, A. Bergmann, R. Bilato, D. Bolshukhin, K. Borras, B. Braams, M. Brambilla, F. Braun, A. Buhler, G. Conway, D. Coster, R. Drube, R. Dux, S. Egorov, T. Eich, K. Engelhardt, H-U fahrbach, U. Fantz, H. Faugel, M. Foley, K.B. Fournier, P. Franzen, J.C. Fuchs, G. Gantenbein, O. Gehre, A. Geier, J. Gernhardt, O. Gruber, A. Gude, S. Günter, G. Haas, D. Hartmann, B. Heger, B. Heinemann, A. Herrmann, J. Hobirk, F. Hofmeister, H. Hohenöcker, L. Horton, V. Igochine, D. Jacobi, M. Jakobi, F. Jenko, A. Kallenbach, O. Kardaun, M. Kaufmann, A. Keller, A. Kendl, J-W Kim, K. Kirov, R. Kochergov, H. Kollotzek, W. Kraus, K. Krieger, B. Kurzan, P.T. Lang, P. Lauber, M. Laux, F. Leuterer, A. Lohs, A. Lorenz, C. Maggi, H. Maier, K. Mank, M.E. Manso, M. Maraschek, K.F. Mast, P. McCarthy, D. Meisel, H. Meister, F. Meo, R. Merkel, D. Merkl, V. Mertens, F. Monaco, A. Mück, H.W. Müller, M. Münich, H. Murmann, Y-S Na, G. Neu, J. Neuhauser, J-M Noterdaeme, I. Nunes, G. Pautasso, A.G. Peeters, G. Pereverzev, S. Pinches, E. Poli, M. Proschek, R. Pugno, E. Quigley, G. Raupp, T. Ribeiro, R. Riedl, S. Riondato, V. Rohde, J. Roth, F. Ryter, S. Saarelma, W. Sandmann, S. Schade, H-B Schilling, W. Schneider, G. Schramm, S. Schweizer, B. Scott, U. Seidel, F. Serra, S. Sesnic, C. Sihler, A. Silva, E. Speth, A. Stäbler, K-H Steur, J.

Stober, B. Streibl, E. Strumberger, W. Suttrop, A. Tabasso, A. Tanga, G. Tardini, C. Tichmann, W. Treutterer, M. Troppmann, P. Varela, O. Vollmer, D. Wagner, U. Wenzel, F. Wesner, R. Wolf, E. Wolfrum, E. Würsching, Q. Yu, D. Zasche, T. Zehetbauer, H-P Zehrfeld and H. Zohm.
Plasma Physics Controlled Fusion, 44, (12B) B69, 2002

A50 - "ECH physics and new operational regimes on TCV"

J-M Moret, S.M. Ahmed, S. Alberti, Y. Andrebe, K. Appert, G. Arnoux, R. Behn, P. Blanchard, P. Bosshard, Y. Camenen, R. Chavan, S. Coda, I. Condrea, A. Degeling, B.P. Duval, D. Fasel, A. Fasoli, J-Y Favez, T. Goodman, M. Henderson, F. Hofmann, J-P Hogge, J. Horacek, P. Isoz, B.Joye, A. Karpushov, I. Klimanov, J.B. Lister, X. Llobet, T. Madeira, J-C Magnin, A. Manini, B. Marlétaz, P. Marmillod, Y. Martin, A. Martynov, J-M Mayor, J. Mlynar, E. Nelson-Melby, P. Nikkola, J.P. Paris, A. Perez, Y. Peysson, R.A. Pitts, A. Pochelon, L. Porte, O. Sauter, A. Scarabosio, E. Scavino, S-H Seo, U. Siravo, A. Sushkov, G. Tonetti, M.Q. Tran, H. Weisen, M. Wischmeier, A. Zabolotsky and G. Zhuang.
Plasma Physics Controlled Fusion, 44, (12B) B85, 2002

A51 - "MHD spectroscopy"

A. Fasoli, D. Testa, S. Sharapov, H.L. Berk, B. Breizman, A. Gondhalekar, R.F. Heeter, M. Mantsinen and contributors to the EFDA-JET Workprogramme
Plasma Physics Controlled Fusion, 44, (12B) B159, 2002

A52 - "Confinement and stability on the TJ-II stellarator"

E. Ascasibar, C. Alejaldre, J. Alonso, L. Almoguera, A. Baciero, R. Balbin, E. Blanco, M. Blaumoser, J. Botija, B. Brañas, A. Cappa, R. Carrasco, F. Castejón, J.R. Cepero, A.A. Chmyga, J. Doncel, N.B. Dreval, S. Eguilior, L. Eliseev, T. Estrada, O. Fedyanin, A. Fernández, J.M. Fondecaba, C. Fuentes, A. Garcia, I. Garcia-Cortés, B. Gonçalves, J. Guasp, J. Herranz, A. Hidalgo, J.A. Jiménez, I. Kirpitchev, S.M. Khrebtov, A.D. Komarov, A.S. Kozachok, L. Krupnik, F. Lapayese, K. Likin, M. Liniers, D. López-Bruna, A. López-Fraguas, J. López-Rázola, E. de la Luna, A. Malaquias, R. Martin, M. Medrano, A.V. Melnikov, P. Méndez, K.J. McCarthy, F. Medina, B. van Milligen, I.S. Nedzelskiy, M. Ochando, L. Pacios, I. Pastor, M.A. Pedrosa, A. de la Peña, A. Petrov, S. Petrov, A. Portas, J. Romero, L. Rodriguez-Rodrigo, A. Salas, E. Sanchez, J. Sanchez, K. Sarksian, S. Schchepetov, N. Skvortsova, F. Tabarés, D. Tafalla, V. Tribaldos, C.A.F. Varandas, J. Vega and B. Zurro.
Plasma Physics Controlled Fusion, 44, (12B) B307, 2002

A53 - "Effect of low magnetic shear induced by lower hybrid current drive on high performance internal transport barriers in the Joint European Torus (JET)"
C. Castaldo, R. Cesario, A. Cardinali, X. Litaudon, J. Mailloux, V. Rarail, T. Tala, F. Crisanti, C. Gormenzano, L. Panaccione, F. Santini, P. Smeulders, A.A. Tucillo and Contributors to the EFDA-JET Workprogramme
Physics of Plasma, 9, (9), 3205, 2002.

A54 - "High resolution temperature and density profiles during the energy quench of density limit disruptions in Rijnhuizen tokamak project"
F. Salzedas, S. Hokin, F.C. Schuller, A.A.M. Oomens and the RTP Team
Physics of Plasma, 9, (8), 3402, 2002.

A55 - "Error field locked modes thresholds in rotating plasmas, anomalous braking and spin-up"
E. Lazzaro, R.J. Buttery, T.C. Hender, P. Zanca, R. Fitzpatrick,M. Bigi, T. Bolzonella, R. Coelho, M. DeBenedetti, S. Nowak, O. Sauter, M. Stamp and contributers to the EFDA-JET work programme
Physics of Plasma, 9, (8), 3906, 2002.

A56 - "Role of the shear flow profile on the stability of magnetic islands"
E. Lazzaro, R. Coelho, T. Ozeki
Physics of Plasma, 9, 371, 2002.

A57 - "Time–frequency images of magnetohydrodynamic phenomena in tokamak plasmas using a discrete-time Wigner distribution"
A.C.A. Figueiredo and J.P.S. Bizarro
IEEE Transactions on Plasma Science, 30, (1), 54, 2002

A58 - "Images of electrostatic lower-hybrid-wave beam propagation in tokamak plasmas using a paraxial WKB approach"
P. Rodrigues and J.P.S. Bizarro
IEEE Transactions on Plasma Science, 30, 68, 2002

A59 - "Images of electron kinetics during electron-cyclotron current drive in tokamak plasmas using Gaussian short-time propagators"
J.H. Belo and J.P.S. Bizarro
IEEE Transactions on Plasma Science, 30, 70, 2002

A60 - "Evolution of electron temperature during the energy quench of a major plasma disruption"

F. Salzedas, S. Hokin, F.C. Schüller and A.A.M. Oomens

IEEE Transactions on Plasma Science, 30, (1), 80, 2002

A61 - "Exponentially growing tearing modes in Rijnhuizen tokamak project plasmas"

F. Salzedas, F.C. Schüller, A.A.M. Oomens, and the RTP Team

Physical Review Letters, 88, (7), 075002-1, 2002

A62 - "Control of Neoclassical tearing modes by sawtooth control"

O. Sauter, E. Westerhof, M. L. Mayoral, B. Alper, P. A. Belo, R. J. Buttery, A. Gondhalekar, T. Hellsten, T. C. Hender, D. F. Howell, T. Johnson, P. Lamalle, M. J. Mantsinen, F. Milani, M. F. F. Nave, F. Nguyen, A. L. Pecquet, S. D. Pinches, S. Podda, and J. Rapp

Physical Review Letters, 88, 105001, 2002

A63 - "Generic structure of externally driven tearing modes instabilities"

E. Lazzaro and R. Coelho

European Physics Journal, D 19, 97, 2002

A64 - "A dimensionless criterion for characterizing internal transport barriers in JET"

G. Tresset, X. Litaudon, D. Moreau, X. Garbet and contributors to the EFDA-JET WorkProgramme

Nuclear Fusion, 42, (5) , 520, 2002

A65 - "Effect of ELMs on the measurement of vertical plasma position in TCV and JET"

F. Hofmann, I. Furno, S. Gerasimov, Y. Martin, F. Milani, M.F.F. Nave, H. Reimerdes, F. Sartori, O. Sauter

Nuclear Fusion, 42**,** 59, 2002

A66 - "Fast particle effects on the sawtooth stability of JET DT discharges"

M.F.F. Nave, N.N. Gorelenkov, K.G. McClements, S.J. Allfrey, B. Balet, D.N. Borba, P.J. Lomas, J. Manickam, T.T.C. Jones, P.R. Thomas

Nuclear Fusion, 42**,** 281, 2002

A67 - "Temporal evolution of neoclassical tearing modes and its effect on confinement reduction in ASDEX Upgrade"

A. Gude, S. Gunter, M. Maraschek, H. Zohm, and the ASDEX Upgrade Team

Nuclear Fusion, 42**,** (7), 833, 2002

A68 - "The effect of ECRH on the stability of the radiation induced m=2 mode and on the current quench of a major disruption"

F. Salzedas, A.A.M. Oomens, F.C. Schuller and the RTP Team

Nuclear Fusion, 42**,** (7), 881, 2002

A69 - "Overview of results and possibilities for fast particle research on JET"

J. Pamela, D. Stork, E. Solano, Yu.F. Baranov, D. Borba, C.D. Challis, H.P.L. de Esch, R.D. Gill, A. Gondhalekar, V. Kiptily, T. Johnson, M. Mantsinen, K.G. McClements, M. F.F. Nave, S.D. Pinches, O. Sauter, S.E. Sharapov, D. Testa and contributors to the EFDA.JET Workprogramme

Nuclear Fusion, 42**,** (8), 1014, 2002

A70 - "Modelling of Alfvén waves in JET plasmas with the CASTOR-K code"

D. Borba, H.L. Berk, B.N. Breizman, A. Fasoli, F. Nabais, S.D. Pinches, S.E. Sharapov, D. Testa and contributors to the EFDA.JET Workprogramme

Nuclear Fusion, 42, (8), 1029, 2002

A71 - "Behaviour of disruption generated runaways in JET"

R.D. Gill, B. Alper, M. de Baar, T.C. Hender, M.F. Johnson, V. Riccardo and contributors to the EFDA.JET Workprogramme

Nuclear Fusion, 42**,** (8), 1039, 2002

A72 - "Scaling of the pedestal density in type-I ELMy H-mode discharges and the impact of upper and lower triangularity in JET and ASDEX Upgrade"

A. Kallenbach, M.N.A Beurskens, A. Korotkov, P. Lomas, W. Suttrop, M. Charlet, D.C. McDonald, F. Milani, J. Rapp, M. Stamp, EFDA-JET Workprogramme contributors and ASDEX Upgrade Team

Nuclear Fusion, 42**,** (10), 1184, 2002

A73 - "Experimental investigation of dynamical coupling between density gradients, radial electric fields and turbulent transport in the JET plasma boundary region"

B. Gonçalves, C. Hidalgo, M.A. Pedrosa, K. Erents, G. Matthews, B. Van Milligen, E. Sánchez, C. Silva

Nuclear Fusion, 42**,** (10), 1205, 2002

A74 - "Natural density formation as an H.mode operational limit"

K. Borrass, ASDEX Upgrade Team and EFDA-JET Workprogramme collaborators

Nuclear Fusion, 42**,** (10), 1251, 2002

A75 - "Control of sawteeth and triggering of NTMs with ion cyclotron resonance frequency waves in JET"

E. Westerhof, O. Sauter, M.L. Mayoral, D.F. Howell, M.J. Mantsinen, M.F.F. Nave, B. Alper, C. Angioni, P. Belo, R.J. Buttery, A. Gondhaleker, T. Hellsten, T.C. Hender, T. Johnson, P. Lamalle, M.E. Maraschek, K.G. McClements, F. Nguyen, A.L. Péquet, S. Podda, J. Rapp, S.E. Sharapov, M. Zabiego and contributers to the EFDA JET Workprogramme

Nuclear Fusion, 42**,** (11), 1324, 2002

A76 - "Modelling of mixed-phasing antenna-plasma interactions on JET A2 antennas"

D.A. D'Ippolito, J.R. Myra, P.M. Ryan, E. Righi, J. Heikkinen, P.U. Lamalle, J.-M. Noterdaeme and Contributors to the EFDA-JET Workprogramme

Nuclear Fusion, 42**,** (12), 1357, 2002

A77 - "Confinement physics of the advanced scenario with ELMy H-mode edge in ASDEX Upgrade"

A.G. Peeters, O. Gruber, S. Günter, M. Kaufmann, H. Meister, G.V. Pereverzev, F. Ryter, A.C.C. Sips, J. Stober, W. Suttrop, G. Tardini, R.C. Wolf, H. Zohm and the ASDEX Upgrade team

Nuclear Fusion, 42**,** (12), 1376, 2002

A78 - "Fluctuations, sheared radial electric fields and transport interplay in fusion plasmas"

C. Hidalgo, M.A. Pedrosa and B. Gonçalves

New Journal of Physics, 4, 51.1, 2002

4.4.2. Papers in international conferences

- ***2nd Meeting of the ITPA Topical Group on ITER Diagnostics San Diego, USA, 4-8 March 2002***

C1 - "Progress in charge exchange recombination spectroscopy (CXRS) and beam emission spectroscopy (BES) for ITER"

M. von Hellermann, R. Jaspers, P. Lotte, A. Malaquias, S. Tugarinov

C2 - "Study of mirror and Be coating effect on light polarization state – the ITER MSE case"

A. Malaquias, P. Lotte, R. Giannella, P. Nielsen, C. Walker

- ***57th Annual Meeting of Physical Society of Japan, Kusatsu, Japan, 24-27 March 2002***

C3 - "Research needs for ITER diagnostics"

A.E. Costley, A. Malaquias, S. Tatsuo, G. Vayakis and C. Walker

C4 - "Spectroscopic diagnostics for the International Thermonuclear Experimental Reactor (ITER)"

T. Sugie, A. Costley, K. Ebisawa, A. Malaquias, C. Walker

- ***15th International Conference on Plasma Surface Interactions in Controlled Fusion Devices, Gifu, Japan 27 April - 3 May, 2002***

C5 - "Experimental Evidence of Fluctuations and Flows near Marginal Stability and Dynamical Interplay Between Gradients and Transport in the JET Plasma Boundary Region"

C. Hidalgo, B. Gonçalves, M. A. Pedrosa, C. Silva, R. Balbín, M. Hron, A. Loarte, K. Erents, G. F. Matthews e R. Pitts

C6 - "Runaway Effects at the Plasma Boundary in ISTTOK"

V. V. Plyusnin, J. A. C. Cabral, H. Figueiredo, C. A. F. Varandas

C7 - "Influence of Electrode and Limiter Biasing on the ISTTOK Boundary Plasma"

C. Silva, H. Figueiredo, J. A. C. Cabral, B. Gonçalves, I. Nedzelsky, C. A. F. Varandas

- ***29th EPS Conference on Controlled Fusion and Plasma Physics, Montreux, Suisse 17-21 June, 2002***

C8 - "Observations of the onset of the energy quench in ASDEX Upgrade Density Limit Disruptions"

F. Salzedas, G. Pautasso, I. Nunes, W. Suttrop, M. Maraschek, M.E. Manso and the ASDEX Upgrade Team

C9 - "Edge Localized Modes and fluctuations in the JET SOL region"

C. Hidalgo, M.A. Pedrosa, B. Gonçalves, C. Silva, R. Balbin, M. Hron, K. Erents, G. Matthews, A. Loarte

C10 - "Plasma potential measurements by heavy ion beam probing in the TJ-II stellarator"

A.A. Chmyga, N.B. Dreval, S.M. Khrebtov, A.D. Komarov, A.S. Kozachok, L.I. Krupnik, A.V. Melnikov, B. Gonçalves, A. Malaquias, I.S. Nedzelskiy, C.A.F. Varandas, T. Estrada, C. Hidalgo, J. López, E. de la Luna, M.A. Pedrosa

C11 - "Confinement and stability on the TJ-II stellarator"

E. Ascasíbar, C. Alejaldre, J. Alonso, L. Almoguera, A. Baciero, R. Balbín, M. Blaumoser, J. Botija, B. Brañas, A. Cappa, J. Castellano, R. Carrasco, F. Castejón, J.R. Cepero, A.A. Chmyga, J. Doncel, N.B. Dreval, S. Eguilior, T. Estrada, A. Fernández, C. Fuentes, A. Garcia, I. Garcia-Cortés, B. Gonçalves, J. Guasp, J. Herranz, C. Hidalgo, J.A. Jiménez, I. Kirpitchev, S.M. Khrebtov, A.D. Komarov, A.S. Kozachok, F. Lapayese, K. Likin, M. Liniers, D. López-Bruna, A. López-Fraguas, J. López-Rázola, A. López-Sanchez, E. de la Luna, A. Malaquias, R. Martín, M. Medrano, A.V. Melnikov, P. Méndez, K.J. McCarthy, F. Medina, B. Van Milligen, I.S. Nedzelskiy, M. Ochando, L. Pacios, I. Pastor, M.A. Pedrosa, A. de la Peña, A.

Portas, J. Romero, L. Rodríguez-Rodrigo, A. Salas, e. Sanchéz, J. Sanchéz, F. Tabarés, D. Tafalla, V. Tribaldos, C.A.F. Varandas, J. Vega and B. Zurro

C12 - "Experimental evidence of turbulent transport near marginal stability in the plasma boundary region in the TJ-II stellarator"
B. Gonçalves, C. Hidalgo, M.A. Pedrosa, E. Sánchez, B. Van Milligen

C13 - "Fluctuation-induced turbulent transport and sheared flows close to instability threshold in the TJ-II stellarator"
M.A. Pedrosa, C. Hidalgo, T. Estrada, B. Gonçalves, E. Ascasíbar, I. Pastor, J.A. Jiménez, A. López-Fraguas and the TJ-II team

C14 - "Pulse height analysis X-ray spectroscopy in the TCV tokamak"
T.I. Madeira, P. Amorim, B.P. Duval and C.A.F. Varandas

C15 - "Real time signal analysis with TCV PHA diagnostic"
T.I. Madeira, A.P. Rodrigues, P. Amorim, B.P. Duval and C.A.F. Varandas

C16 - "Numerical study of spatial and temporal localization of magnetic modes using O-mode reflectometry"
F. da Silva, S. Heuraux, M. Manso and S. Hacquin

C17 - "Effect of the k-spectrum and the poloidal rotation of turbulence in reflectometry measurements"
S. Hacquin, S. Heuraux, F. Silva, G. Leclert, M. Manso and F. Serra

C18 - "Radial wave-number spectrum deduced from phase fluctuation spectrum given by a reflectometer"
S. Heuraux, S. Hacquin, F. Silva, F. Clairet, R. Sabot, G. Leclert and M. Colin

C19 - "Study of ELMs on ASDEX Upgrade using reflectometry measurements with high temporal and spatial resolution"
I.Nunes, G.D.Conway, M.Manso, M.Maraschek, F.Serra, W.Suttrop, the CFN and ASDEX Upgrade teams

C20 - "Current profile redistribution due to internal relaxation events in extreme reversed shear JET plasmas"
S.R. Cortes, N.C. Hawkes, B.C. Stratton, M.F.F. Nave, D. Testa, P.A. Belo, E. Solano, V. Drozdov and C.A.F. Varandas

C21 - "Effect of micro-instabilities on runaway generation in tokamak disruptions"
V.V. Plyusnin

C22 - "On the motional stark effect diagnostic for ITER"
P. Lotte, A. Malaquias, R. Giannella, M. von Hellermann, P. Nielsen, C. Walker

C23 - "Progress in charge exchange recombination spectroscopy (CXRS) and beam emission spectroscopy (BES) for ITER"
M.von Hellermann, R. Jaspers, P. Lotte, A. Malaquias, S. Tugarinov

C24 - "Location rational surfaces from reflectometer fluctuations "
G.D. Conway, P.J. McCarthy, I. Nunes, A.C.C. Sips, F. Serra, S. Sesnic, M. Maraschek, A. Mück, W. Suttrop, M. Manso, ASDEX Upgrade and CFN Teams.

C25 - "Simulation of the time behaviour of impurities in JET Ar-seeded discharges and its relation with sawteething"
M.Mattioli, M.E.Puiatti, M.Valisa, I.Coffey, R.Dux, P.Monier-Garbet, M.F.F.Nave, J.Ongena, M.von Hellermann and contributors to the EFDA-JET workprogramme

C26 - "Neoclassical Tearing mode control through sawtooth destabilization in JET"
M.L. Mayoral, D.F. Howell1, O. Sauter, E. Westerhof, B. Alper, R.J. Buttery, T.C. Hender, M.J. Mantsinen, M.F.F. Nave and contributors to the EFDA JET workprogramme

C27 - "Measurements of plasma potential fluctuations in the edge region of the ISTTOK plasma, using electron emissive probes"
P. Balan, J.A.C. Cabral, H. Fernandes, H.F.C. Figueiredo, C. Ionita, R. Schrittwieser and C.A.F. Varandas

- ***IAE Workshop on ELMs, JET, 24-26 June 2002***

C28 - "ELM control by enhanced radiation"
M. F. F. Nave, C. Ingesson, S.Jachmich, Z. Klaus-Dieter, T.C. Jones, K. Lawson, P. Lomas, G. Mathews, J. Ongena and contributors to the EFDA-JET workprogramme

- ***14th APS Topical Conference on High Temperature Plasma Diagnostics, Madison, USA 08-11 July, 2002***

C29 - "Real time signal analysis with TCV PHA diagnostic"
T.I. Madeira, A.P. Rodrigues, P. Amorim, B.P. Duval and C.A.F. Varandas

C30 - "High dispersion spectrometer for time resolved Doppler measurements of impurity lines emitted during ISTTOK discharges"
R.B. Gomes, C.A.F. Varandas, J.A.C. Cabral, E. Sokolova and S.R. Cortes

C31 - "Measurment of the Plasma Radial Electric Field by the Motional Stark Effect Diagnostic on JET Plasma"
S. Reyes Cortes, N. C. Hawkes, P. Lotte, C. Fenzi, B. C. Stratton, J. Hobirk, R. De Angelis, F. Orsitto e C. A. F. Varandas

C32 - "Comparative study design of a heavy ion and neutral beam diagnostic for ITER"
A. Malaquias, I. Nedzelsky, B. Gonçalves, C. A. F. Varandas, A. Melnikov, L. Eliseev, S.Perfilov, O. Yudina and L. Krupnik

C33 - "An Event-driven Reconfigurable Real-Time Processing System for the Next Generation Fusion Experiments"
A. Combo, A. J. N. Batista, J. Sousa and C. A. F. Varandas

C34 - "A low cost, fully integrated, event-driven, real-time control and data acqusition system for fusion experiments"
A. J. N. Batista, A. Combo, J. Sousa and C. A. F. Varandas

C35 - "Improved 20 keV injection system for the heavy ion beam diagnostic of the tokamak ISTTOK"
J.A.C. Cabral, I.S. Nedzelskiy, A.J. Malaquias, B. Gonçalves, C.A.F. Varandas, I.S. Bondarenko, S.M. Khrebtov, A.D. Komarov, A.L. Kozachok, L.I. Krupnik.

C36 - "Evaluation of the incident angle of the beam into 30-degree electrostatic energy analyzer directly during HIBP operation in plasma experiments"
I.S. Nedzelskiy, A.J. Malaquias, B. Gonçalves, C.A.F. Varandas, J.A.C. Cabral, N.B. Dreval, S.M. Khrebtoc, A.D. Komarov, A.L. Kozachok, L.I. Krupnik.

C37 - "On the use of the analytic signal to retrieve the phase from broadband reflectometry signals"
A. C.A. Figueiredo and J.P.S. Bizarro

C38 - "Velocity fluctuations and time dependent ExB flows in the JET boundary region"
B. Gonçalves, C. Hidalgo, M.A. Pedrosa, C. Silva, K. Erents, G. Mathews

C39 - "Plasma position measurements from ordinary FM-CW reflectometry on ASDEX Upgrade"
J. Santos, J. Neuhauser, M. Manso, P. Varela and ASDEX Upgrade Team

C40 - "Electron temperature determination and subsequent analysis of short time-scale variation of plasma parameters in ISTTOK discharges"
V.V. Plyusnin, J.A.C. Cabral, H. Figueiredo, C.A.F. Varandas

C41 - "Conceptual design of the CXRS diagnostic for ITER"
S. Tugarinov, A. Krasilnikov,V. Dokouka, R. Khayrutdinov, I. Beigman, I. Tolstikhina, L. Vainshtein, M. von Hellermann, A. Malaquias.

C42 - "A low cost, real-time DSP-based diagnostic for the control of operation of a fusion experiment"
B.B. Carvalho, H. Fernandes, C.A.F. Varandas.

C43 - "Simulation of amplitude and phase variations induced by magnetic islands with turbulence on reflectometry signals"
F. da Silva, S. Heuraux, S. Hacquin and M. Manso.

C44 - "Radial kf-spectrum of fluctuations obtained from reflectometry phase data and validations with 1D and 2D simulations"
S. Heuraux, S. Hacquin, F. da Silva, F. Clairet, R. Sabot and G. Leclert.

C45 - "High resolution edge density measurements in ASDEX Upgrade H-mode discharges with broadband reflectometry"
P. Varela, M.E. Manso, G.D. Conway, W. Suttrop, H. Zohm and ASDEX Upgrade Team.

C46 - "Emissive probe measurements of the plasma potential fluctuations in the edge plasma region of the ISTTOK and CASTOR tokamaks"
P. Balan, J.A.C. Cabral, R. Schrittwieser, H.F.C. Figueiredo H. Fernandes, C. Ionita, C.A.F. Varandas, J. Adamek, M. Hron, J. Stockel, E. Martines, M. Tichy and G. van Oost.

- ***International Congress on Plasma Physics, Sidney, Australia, July 2002***

C47 - "Applicability of electron emissive probes for plasma potential and electric field measurements in magnetised fusion plasmas"
R. Schrittwieser, J. Adamek, P. Balan, J.A.C. Cabral, H. Fernandes, H.F.C. Figueiredo, C. Hidalgo, M. Hron, C. Ionita, E. Martines, M.A. Pedrosa, J. Stöckel, M. Tichy, G.van Oost and C.A.F. Varandas

- ***Theory of Fusion Plasmas Joint Varenna-Lausanne International Workshop, Varenna, Italy, August, 2002***

C48 - "Numerical analysis of the loss of sawtooth stabilisation by ICRH driven fast particles in low density discharges"

F. Nabais, D. Borba, M. Mantsinen, F. Nave and S. Sharapov

- ***9th EU-US Transport Task Force Workshop, Córdoba, Spain 09-12 September, 2002***

C49 - "On the radial propagation of edge localized modes and edge fluctuations in JET"

B. Gonçalves, C. Hidalgo, M.A. Pedrosa, C. Silva, M. Hron, R. Balbín, B. Van Milligen, A. Loarte, K. Erents, G. Matthews

C50 - "Parallel and poloidal sheared flows close to instability threshold in the TJ-II stellarator"

M.A. Pedrosa, C. Hidalgo, B. Gonçalves, E. Ascasíbar, T. Estrada, J.A. Jiménez, A. López-Fraguas, I. Pastor and TJ-II Team

C51 - "Plasma potential measurements by heavy ion beam probe in the TJ-II stellarator"

A.A. Chmyga, N.B. Dreval, S.M. Khrebtov, A.D. Komarov, A.S. Kozachok, L.I. Krupnik, V.I. Tereshin, L.G. Eliseev, A.V. Melnikov, B. Gonçalves, A. Malaquias, I.S. Nedzelskiy, C.A.F. Varandas

C52 - "Impact of ELMs on particle losses measured with microwave reflectometry on ASDEX Upgrade"

I. Nunes, G.D. Conway, W. Suttrop, M.E. Manso, F. Serra, A. Loarte, G. Saibene, the CFN and ASDEX Upgrade teams.

C53 - "Impurity transport in high density plasmas in JET and FTU"

M.Valisa, L. Carraro, M.Mattioli, M.E. Puiatti, P. Scarin, M.F.F.Nave, L. Gabellieri

- ***3rd Meeting of the ITPA Topical Group on ITER Diagnostics Tajimi, Japan 17-21 September, 2002***

C54 - "Status of the active spectroscopic systems for ITER"

A. Malaquias, C. Walker, G. Vayakis, A. Costley, T. Sugie, S. Tugarinov, A. Gorshkov, M. von Hellermann, P. Lotte

C55 - "Diagnostic integration issues"

C.I. Walker, A. Costley, A. Malaquias, T. Sugie, G. Vayakis

- ***International Conference and School on Plasma Physics and Controlled Fusion, Alushta, Krimea, Ukraine 16-22 September, 2002***

C56 - "TOF method in plasma potential measurements by HIBD"

I.S. Nedzelskiy, A.J. Malaquias, B. Gonçalves, C.A.F. Varandas, J.A.C. Cabral

C57 - "Accuracy of electrostatic energy analyser in HIBP diagnostic"

I.S. Bondarenko, A.A. Chmuga, N.B. Dreval, S.M. Khrebtov, A.D. Komarov, A.S. Kozachok, L.I. Krupnik, I.S. Nedzelskiy

C58 - "Ion beam injectors for plasma diagnostic"

I.S. Bondarenko, A.A. Chmuga, G.N. Deshko, N.B. Dreval, S.M. Khrebtov, A.D. Komarov, A.S. Kozachok, L.I. Krupnik, I.S. Nedzelskiy

- ***19th IAEA Fusion Energy Conference, Lyon, France 14-19 October, 2002***

C59 - "Experimental evidence of fluctuations and flows near marginal stability in the plasma boundary region in fusion plasmas"

C. Hidalgo, B. Gonçalves, M.A. Pedrosa, B. Van Milligen, E. Sánchez, C. Silva, K. Erents, G.F. Matthews

C60 - "Magnetic configuration nad transport interplay in the TJ-II flexible heliac experiment"

C. Alejaldre, J. Alonso, L. Almoguera, E. Ascasíbar, A. Baciero, R. Balbín, M. Blaumoser, J. Botija, B. Brañas, A. Cappa, R. Carrasco, F. Castejón, J.R. Cepero, J. Doncel, S. Eguilior, T. Estrada, A. Fernández, C. Fuentes, A.García, I. García-Cortés, J. Guasp, J. Herranz, C. Hidalgo, J. A. Jiménez, I. Kirpitchev, F. Lapayese, K. Likin, M. Liniers, D. López-Bruna, A.López-Fraguas, J. López-Rázola, A López-Sánchez, E. de la Luna, R. Martín, M. Medrano, P. Méndez, K.J. McCarthy, F. Medina, B. van Milligen, M. Ochando, L. Pacios, I. Pastor, M.A. Pedrosa, A. de la Peña, A. Portas, J. Romero, L. Rodríguez-Rodrigo, A. Salas, E. Sánchez, J. Sánchez, F. Tabarés, D. Tafalla, V. Tribaldos, J. Vega and B. Zurro, A.A.Chmyga, N.B Dreval, S.M.Khrebtov, A.D.Komarov,A.S.Kozachok, L.I. Krupnik, A.V.Melnikov, B.Gonçalves, A.Malaquias, I. S.Nedzelskiy, C.A.F.Varandas, A.Petrov, K. Sarksian, N. Skvortsova

C61 - "ITER diagnostics: design choices and solutions"

A.E. Costley, A. Malaquias, T. Sugie, G. Vayakis and C. Walker

C62 - "Physics R&D in support of ITER/BPX diagnostic development"

A.J.H. Doné, R. Boivin, A.E. Costley, R. Giannella, D. Johnson, E.R. Hodgson, A. Kislyakov, A. Krasilnikov, Y. Kusama, T. Leonard, A. Malaquias, G. Mckee, P. Nielsen, T. Nishitani, W.

Peebles, F. Orsitto, R.A. Pitts, G. Razdobarin, J. Sanchez, M. Sasao, F. Serra, T. Shikama, V. Strelkov, T. Sugie, G. Vayakis, V. Voitsenya, K. Vukolov, C. Walker, G. Wurden, K. Young and V. Zaveriaev

C63 - "Predicting the behaviour of magnetic reconnection processes in fusion burning plasma experiments"

A.E. Costley, A. Malaquias, T. Sugie, G. Vayakis and C. Walker

C64 - "Electrode and limiter biasing experiments on the tokamak ISTTOK"

C. Silva, H. Figueiredo, J.A.C. Cabral, I. Nedzelskiy and C.A.F. Varandas

C65 - "Experimental study of the stability of Alfvén eigenmodes on JET"

D. Testa, A Fasoli, G. Fu, A. Jaun, D. Borba, P. De Vries, and JET-EFDA contributers.

- ***44th APS Annual Meeting of the Division of Plasma Physics***

C66 - "ELM control by enhanced radiation in JET Plsmas"

M.F.F.Nave , S. Jachmich, L.C. Ingesson, J. Strachan, J. Ongena, G. Saibene, TTC Jones, K. Lawson, P. Thomas, G. Matthews, P. Andrew and EFDA-JET Contributors

C67 - "Upgrade of the JET multichannel fluctuation and correlation reflectometer diagnostic"

L Meneses, L. Cupido, N. Cruz, L. Kokonchev, E. Mazzucato, R. Prentice

- ***Workshop on Active Control of MHD Stability: Extension of Performance, Columbia University, N.Y., 18-20 Nov., 2002***

C68 - "Control of Edge MHD instabilities in JET"

M.F.F.Nave

4.4.3. Papers in national conferences

- ***13ª Conferência Nacional de Física, Évora, 6-10 Setembro, 2002***

C69 - "E-Lab, laboratórios robotizados interactivos"

H. Fernandes, J. Pereira

- ***II Congresso Ibérico de Espectroscopia, Coimbra, Portugal 16-21 September, 2002***

C70 - "X-ray spectroscopy diagnostics in the tokamak TCV, in the frame of a collaboration between CFN and CRPP"

T.I. Madeira, P. Amorim, B.P. Duval and C.A.F. Varandas

C71 - "Os diagnósticos de espectroscopia do tokamak ISTTOK"

M.P. Alonso, R. Gomes, E. Sokolova, S.R. Cortes, P. Amorim, C.A.F. Varandas and J.A.C. Cabral

5. OTHER ACTIVITIES OF CENTRO DE FÍSICA DOS PLASMAS

5.1. GoLP – Group of Lasers and Plasmas

5.1.1. PhD thesis

- Ricardo Fonseca, *"Experimental and numerical study of laser-plasma electron accelerators"* Doctorate Thesis, Tech. Univ. Lisbon, 2002
- N.C. Lopes, *"Laser-plasma interaction: application to particle acceleration"* Doctorate Thesis, Tech. Univ. Lisbon, 2002
- Gonçalo Figueira, *"Development and characterisation of a Ti:sapphire - Nd:glass laser system based on chirped pulse amplification"* Doctorate Thesis, Tech. Univ. Lisbon, 2001
- João M. Dias, *"Experimental evidence for adiabatic photon frequency upshift: photon acceleration"* Doctorate Thesis, Tech. Univ. Lisbon, 2001

5.1.2. Papers

1) - "Two-dimensional collision of probe photons with relativistic ionization fronts"

J. M. Dias, L. Oliveira e Silva, N. C. Lopes, G. Figueira, J. T. Mendonça
Physical Review E, 65, 3, 036404(6), (2002).

2) - "Nonlinear mode coupling in a CW operating Ti: Sapphire laser"

M.A. Cataluna, H. Crespo, A. Guerreiro and J.T. Mendonça
Physica Scripta, T98, 134 (2002).

3) -"Neutrino effective charge in a plasma"

J.T. Mendonça, A. Serbeto, P.K. Shukla and L.O. Silva
Phys. Lett B, 548, 63 (2002).

4) - "Neutrino driven wakefields in an electron-positron plasma"

A. Serbeto, J.T. Mendonça, P.K. Shukla and L.O. Silva
Phys. Lett. A, 305, 190 (2002).

5) - "Gravitational waves in plasmas"

J.T. Mendonça

Plasma Physics and Controlled Fusion, 44, B225, 2002

6) - "Proton acceleration by fast electrrons in laser-solid interactions

J.R. Davies

Laser and Part. Beams, **20**, 243 (2003).

7) - "Second harmonic generation of h^5-monocyclopentadienyl ruthenium p-benzonitrile derivates by Kurtz powder technique. Crystal and molecular structure determinations of [Ru(h^5-C_5H_5)((+)-DIOP)(p-$NCC_6H_4NO_2$)][X], X=PF_6^-, $CF_3SO_3^-$ and [Ru(h^5-C_5H_5)((+)(-DIOP)($NCCH_3$)][PF_6]"

M. Helena Garcia, João C. Rodrigues, A. Romão Dias, M. Fátima M. Piedade, M. Teresa Duarte, M. Paula Robalo, Nelson Lopes

J. Organomet. Chem. **632** (2001) 133-144.

8) - "Dust waves in a periodic medium with spatial dust density distributions"

Sorasio, L. O. Silva, P.K. Shukla, D.P. Resendes

Physics Letters A **305** , 75 (2002).

9) - "On the role of the purely transverse Weibel instability in fast ignitor scenarios"

Luís O. Silva, Ricardo A. Fonseca, John W. Tonge, Warren B. Mori, John M. Dawson

Physics of Plasmas **9**, 2458 (2002).

10) - "Three-dimensional particle-in-cell simulations of the Weibel instability in electron-positron plasmas"

R. A. Fonseca, L. O. Silva, J. Tonge, R. G. Hemker, J. M. Dawson, W. B. Mori

IEEE Transactions on Plasma Science **30**, 28 (2002);

11) - "Osiris: a three-dimensional fully relativistic particle in cell code for modelling plasma based accelerators"

R. A. Fonseca, L. O. Silva, R. G. Hemker, F. S. Tsung, V. K. Decyk, W. Lu, C. Ren, W. B. Mori, S. Deng, T. Katsouleas, and J.C. Adam

Lecture Notes in Computer Science, **2331**, 342 (Springer-Verlag, Heidelbeg, (2002);

12) - "Generation of ultra intense single-cycle laser pulses using photon deceleration"

F. S. Tsung, C. Ren, L. O. Silva, W. B. Mori, and T. Katsouleas

Proceedings of the National Academy of Sciences of the USA **99**, 29 (2002);

13) - *"Nuclear reaction rates and energy in stellar plasmas: the effect of highly damped mode"*
M. Opher, L. O. Silva, D. Dauger, V. Decyk, and J. M. Dawson
Physics of Plasmas, **8** 2454 (2001).

14) - *"Enhanced electromagnetic emission from a dusty plasma"*
P. K. Shukla, L. Stenflo & D. P. Resendes
Phys. Plasmas **9**, 1043, (2002).

15) - *"Nonlinear dynamics of a grain in a discharge plasma sheath"*
D. P. Resendes, G. Sorasio & P. K. Shukla
Physica Scripta **T98**, 87, (2002).

16) - *"Dynamics of dust particles in plasma sheaths"*
D. P. Resendes, G. Sorasio & P. K. Shukla
Phys. Plasmas **9**, 2988-2997, (2002).

17) - *"Dust acoustic waves in a periodic medium with spatial dust density distributions"*
G. Sorasio, L. O. Silva, P. K. Shukla & D. P. Resendes
Phys. Lett. A **305**, 75 (2002).

18) - *"Acceleration of dust grains by means of electromagnetic cyclotron waves"*
P. K. Shukla, L. Stenflo, A. A. Mamun, D. P. Resendes & G. Sorasio, J. Geophys
Res. **107**, 10.1029/2002JA009321(2002).

19) - *"Dynamics of Farley-Buneman fluctuations in the presence of radar beams"*
P. K. Shukla, L. Stenflo, M. Rosenberg and D. P. Resendes
J. Geophys Res. **107**, 10.1029/2002JA009408, (2002).

20) - *"Dust Grain Oscillations in Plasma Sheaths under Low Pressures"*
G. Sorasio, R.A. Fonseca, D.P. Resendes, and P.K. Shukla
"Dust Plasma Interaction in Space", Ed. P.K. Shukla, Nova Sci. Pub. N.Y., 2002.

21) - *"Dust Agglomeration and Gravitational-Like Instabilities in Laboratory and Astrophysical Plasmas"*
R. Bingham, D.P. Resendes and V.N. Tsytovich
"Dust Plasma Interaction in Space", Ed. P.K. Shukla, Nova Sci. Pub. N.Y., 2002.

22) - "Some Exotic Phenomena in Dusty Plasmas"
J.T. Mendonça, P.K. Shukla, R. Bingham, D.P. Resendes and A. Guerreiro
"Dust Plasma Interaction in Space", Ed. P.K. Shukla, Nova Sci. Pub. N.Y., 2002.

23) - "Chiral organometallic chromophores for nonlinear optics derived from [Fe2(h5-C5H5)2(CO)2(m-CO)(m-C-CH3)]+[BF4]"
R. D. A. Hudson, A. R. Manning, J.F. Gallagher, M. Helena Garcia, N. Lopes, I. Asselberghs, R. Van Boxel, A. Persoons and A. J. Lough
J. Organomet.Chem., 655, 70 (2002).

24) - "Comment on dynamic behaviors of dust particles in the plasma-sheath boundary"
D. Resendes, G. Sorasio, P. K. Shukla
Physics of Plasmas 9, 1057 (2002).

25) - "Electrostatic instabilities in current-carrying magnetoplasmas with equilibrium density and ion velocity gradient"
P.K.Shukla, G. Sorasio and L. Stenflo
Physical Review E **66**, 067401 (2002).

26) - "Gravitational optics: Self-phase modulation and harmonic cascades"
J. T. Mendonça, Vitor Cardoso
Physical Review D **66**, 104009 (2002).

27) - "How wrong is collisional Monte Carlo modelling of fast electron transport in high-intensity laser-solid interactions?"
J. R. Davies
Physical Review E **65**, 026407 (2002).

28) - "Induced oscillations of dust grains in a plasma sheath under low pressures"
G. Sorasio, D. Resendes, P. K. Shukla
Physics Letters A **293**, 67 (2002).

29) - "L-band x-ray absorption of radiatively heated nickel"
C. Chenais-Popovics et al.
Physical Review E **65**, 016413 (2002).

30) - "Laser propagation in cylindrical waveguides"
J. R. Davies, J. T. Mendonça
Physical Review E **66**, 046604 (2002).

31) - "On the mutual interaction between laser beams in plasmas"
C. Ren, B. J. Duda, R. G. Evans, R. A. Fonseca, R. G. Hemker, W. B. Mori
Physics of Plasmas **9**, 2354 (2002).

32) - "Photon acceleration of ultrashort laser pulses by relativistic ionization fronts"
J. M. Dias, N. C. Lopes, L. O. Silva, G. Figueira, J. T. Mendonça, C. Stenz, F. Blasco, A. Dos Santos, A. Mysyrowicz,
Physical Review E **66**, 056406 (2002).

33) - "Plasmon beam instability and plasmon Landau damping of ion acoustic waves"
J. T. Mendonça, R. Bingham
Physics of Plasmas **9**, 2604 (2002).

34) - "Proposed demonstration of the Einstein-Poldosky-Rosen paradox using trapped electrons"
Ana M. Martins
Physical Review A **65**, 052114 (2002).

35) - "Resonant interaction of photons with gravitational waves"
J. T. Mendonça, L. O. Drury
Physical Review D **65**, 024026 (2002).

36) - "Some Cross-Field Instabilities in magnetized dusty Plasmas"
P.K. Shukla, M. Salimullah, G. Sorasio
Physics of Plasmas **9**, 5121 (2002).

37) - "Thomas-Fermi model for a dust particle in a plasma"
J. T. Mendonça, N. L. Tsintsadze, A. Guerreiro
Europhysics Letters **57**, 362-367 (2002).

38) - "Time refraction and time reflection: Two basic concepts"
J. T. Mendonça, P. K. Shukla
Physica Scripta **65**, 160 (2002).

39) - "High-order self-dispersion compensation in a Ti:sapphire laser oscillator"
H. Crespo, M.A. Cataluna, A. Guerreiro and J.T. Mendonça,
Ultrafast Phenomena XIII, R.D. Miller et al. Eds., Springer-Verlag, Berlin, p. 161 (2002).

40) - "Photon kinetic theory of self-phase modulation"
L. O. Silva, J. T. Mendonça
Optics Communications **196** , 285 (2001).

41) - "Casimir effect in a turbulent plasma"
J. T. Mendonça, R. Bingham, P. K. Shukla, and D. Resendes
Physics Letters A **289**, 233 (2001).

42) - "Chargeons and phonons in a dusty plasma"
J. T. Mendonça, N. N. Rao, A. Guerreiro
Europhysics Letters **54**, 741 (2001).

43) - "Fast particle generation and energy transport in laser-solid interactions"
M. Zepf, E. L. Clark, K. Krushelnick, F. N. Beg, C. Escoda, A. E. Dangor, M. I. K. Santala, M. Tatarakis, I. F. Watts, P. A. Norreys, R. J. Clarke, J. R. Davies, M. A. Sinclair, R: D. Edwards, T. J. Goldsack, I. Spencer, K. W. D. Ledingham
Physics of Plasmas **8**, 2323 (2001).

44) - "Gravitational wave instabilities in the presence of photon beams"
J. T. Mendonça
Journal of Physics A - Mathematical and General **34**, 9677 (2001).

45) - "Interaction of ultrashort high-intensity laser pulses with atomic clusters"
M. Eloy, R. Azambuja, J. T. Mendonça and R. Bingham
Physics of Plasmas **8**, 1084 (2001).

46) - "Large amplitude oscillations sustained by stochastic plasma density fluctuations in plasma sheaths"
G Sorasio, D. P. Resendes, P. K. Shukla
JETP Letters **74**, 77 (2001).

47) - "Laser photodetachment technique for the measurement of H- in a high frequency traveling wave discharge"
F. M. Dias, E. Tatarova, H. Crespo, and C. M. Ferreira
Review of Scientific Instruments **72**, 1680 (2001).

48) - "Lenz-Ising model for elongated dust particles in a plasma"
J. T. Mendonça, P. K. Shukla, R. Bingham
Physics Letters A **282**, 288 (2001).

49) - "MeV ions generated via coulombic explosions of atomic clusters"
M. Eloy, R. Azambuja, J.T. Mendonca and R. Bingham
Physica Scripta **T89**, 60 (2001).

50) - "A new method for high harmonic generation by cascaded four-wave mixing"
J. T. Mendonça, H. Crespo, and A. Guerreiro
Optics Communications **188**, 383 (2001).

51) - "Proton and neutron sources using terawatt lasers"
J. T. Mendonça, J. R. Davies, M. Eloy
Measurement Science and Technology **12**, 1801 (2001).

52) - "Quantum models for classical dust particles"
J. T. Mendonça
Physica Scripta **T89**, 55 (2001).

53) - "Second harmonic generation of eta(5)-monocyclopentadienyl ruthenium p-benzonitrile derivatives by Kurtz powder technique. Crystal and molecular structure determinations of [Ru(eta(5)-C5H5)((+)-DIOP)(p-NCC6H4NO2)][X], X = PF6-, CF3SO3- and [RU(eta(5)-C5H5)((+)-DIOP)(NCCH3)][PF6]"
M. H. Garcia, J. C. Rodrigues, A. R. Dias, M. F. M. Piedade, M. T. Duarte, M. P. Robalo, N. Lopes
Journal of Organometallic Chemistry **632**, 133 (2001).

54) - "Self-excited oscillations of charged dust grains in the plasma sheath"
D. P. Resendes, P. K. Shukla
Physica Scripta **T89**, 101 (2001).

55) - "Short pulse interaction experiments for fast ignitor applications"

M. Borghesi, A. J. Mackinnon, R. Gaillard, G. Malka, C. Vickers, O. Willi, A. A. Offenberger, B. Canaud, J. L. MiquelL, N. Blanchot, J. R. Davies, A. Pukhov, J. Meyer-Ter-Vehn

Laser and Particle Beams **18**, 389 (2001).

56) - "Study of the ion-distribution dynamics of an aluminum laser-produced plasma with picosecond resolution"

M. Fajardo, P. Audebert, P. Renaudin, H.Yashiro, R. Shepherd, J. C. Gauthier, C. Chenais-Popovics

Physical Review Letters **86**, 1231 (2001).

57) - "X-ray emission from laser-irradiated gold targets with surface modulation"

T. Desai, H. Daido, M. Suzuki, N. Sakaya, A. P. Guerreiro, K. Mima

Laser and Particle Beams **19**, 241 (2001).

58) - "Heliumlike geonium atom"

A.M. Martins

Physical Review A, **64**, 023407 (2001).

5.2. Space Plasmas Group

1) - "Ion-acoustic damping effects on parametric decays of Alfvén waves: Right-hand polarization"

L. Gomberoff, K. Gomberoff, and A.L. Brinca

J. Geophys. Res.,106, 18713, 2001

2) - "On the stability of perpendicular particle drifts in cold magnetoplasmas"

A.L. Brinca, F.J. Romeiras, and L. Gomberoff

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3) - "Ion-acoustic damping effects on parametric decays of Alfvén waves: Right-hand polarization"

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