# <Advanced Energy Generation Division> Complex Plasma Systems Research Section


Minami, T.; Kado, S.; Ohshima, S.

# Complex Plasma Systems Research Section

T. Minami, Associate Professor
S. Kado, Associate Professor
S. Ohshima, Assistant Professor

**1. Introduction**

Magnetic nuclear fusion energy has some attractive features as a future option for the base-load electrical power source: (1) inherent safety features, (2) no long-life nuclear waste emission, (3) no greenhouse gas emission during the energy production, (4) huge energy density stored in the fuel source(~90 MWh/g for D-T fuel), (5) abundant source availability spreading all over the Earth, and (6) high nuclear proliferation resistance, in terms of both resources and weapons technologies.

Among various issues to be overcome in physics and engineering fields, we have focused on the problems related to the plasma transport and magneto-hydrodynamics. Specifically, determination of a magnetic configuration that can efficiently confine high-density plasma at high temperature with a sufficiently long confinement time and developing diagnostics and control schemes for the high-temperature plasmas in such magnetic fields are regarded as crucial. In these respects, our research section investigates about heating and fueling, confinement and diffusion mechanisms and their diagnostics in a magnetic plasma confinement device, named Heliotron J.

Results in FY2020 featured in this report are about the comparison between the experiments and theory/simulation in turbulent and MHD phenomena.

**2. Study of Turbulence Properties against Isotope Ratio and Zonal Flow Activity in Heliotron J**

Confinement improvement in deuterium (D) plasmas, compared to the hydrogen (H) plasmas, called “isotope effect”, has been a long-standing issue in the study of magnetic confinement fusion. The isotope effect contradicts a fundamental model of transport, in which an increase of characteristic scale (ion Larmor radius or turbulence scale size here) simply gives the increase of transport, in other words, D plasmas should exhibit poorer performance than the H plasmas do, although experimental observations show the opposite result. A possible mechanism to explain the isotope effect is a favourable impact of a zonal flow, a type of coherent structure induced by turbulence itself, on the plasma transport. Several theoretical and experimental works also support the hypothesis. However, turbulence responses behind the isotope dependence of zonal flows, have not yet been studied in detail so far.

The frequency spectra of floating potential and ion saturation current indicate that the turbulence level gradually increases against the H/D ratio, as hydrogen is more dominated, as shown in Fig. 1(a) and (b). Interestingly, the small different characteristics can be seen by comparing two spectra; higher frequency components of > 100 kHz emerge in the case of floating potential, and fluctuation level in all the frequency range increases in ion saturation current, as hydrogen

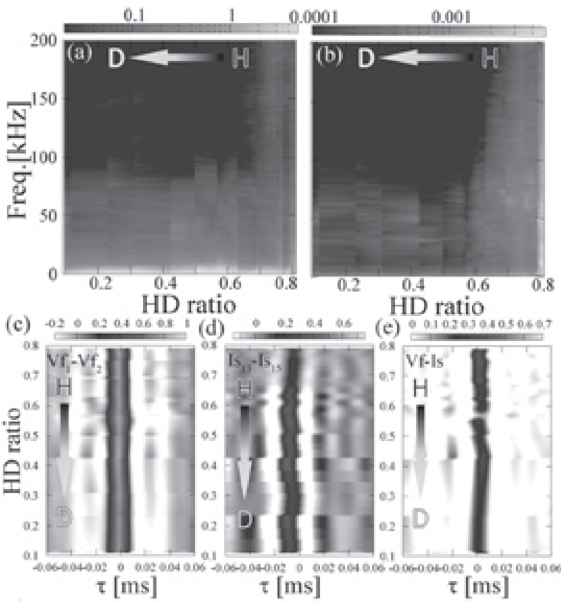


Fig. 1 (a)Dependence of frequency spectra on hydrogen/deuterium(H/D) ratio (~$n_H/(n_D+n_H)$) for potential fluctuation and (b) density fluctuation. (c)Isotope dependence of two-point correlation between adjacent probe signals with the distance of 5mm for floating potential (d)density fluctuations, and (e)between potential and density fluctuations. and double-path measurement using two forward backward scattered lights (chain line).

becomes dominant. This observation suggests that turbulence-induced transport increases in H plasmas.

Furthermore, the decorrelation of density and potential is also demonstrated from a statistical viewpoint using a joint probability density function(joint-PDF) technique. The observed decoupling of fluctuation has been revealed to be attributed to the enhancement of the zonal flow observed in this experiment.


1) M. Nakata, et al., Phys. Rev. Lett. 118 (2017) 165002.
2) S. Ohshima et al., , Proceedings of 26th IAEA Fusion Energy Conference EX/P8-20(2016).


### 3. Simulation Study of Energetic Particle-driven MHD Modes and Energetic Particle Redistribution in Heliotron J

Sufficiently long energetic particle (EP) confinement time is important for realizing self-sustainable plasma; however, these EPs can resonate with the shear Alfvén waves (SAW) through fundamental and sideband resonances in the magnetic confinement fusion devices (e.g. tokamak and stellarator/heliotron).

The interaction between energetic particles (EPs) and EP-driven magnetohydrodynamic (MHD) instabilities in Heliotron J has been investigated by MEGA[1-2)], a hybrid MHD-EP simulation code.

The three-dimensional magnetic field of Heliotron J is mainly composed of the helicity, toroidicity, and bumpy Fourier components.  This creates additional interactions between EP and SAW[3)].

It has been shown in Ref.4) that the free MHD boundary condition can have a significant impact on the stability of the low-n mode in the strongly shaped plasma. Then, we have recently made a success in improving the application of the MEGA simulation to free-boundary condition on the last closed flux surface (LCFS).

In this study, we analyzed the stability of the EP-driven MHD instabilities and their effects on the EPs confinement in Heliotron J. Both the fixed and free MHD boundary conditions are utilized.  The simulation is conducted on the low ($\epsilon_{01}$=0.01) bumpiness configurations.

The fixed boundary simulation results show that the n/m=2/4 mode is dominant while the n/m=1/2 mode is observed as a recessive component (Fig.2a). The time evolution of the n/m=1/2 mode is obscured due to the large difference in the amplitude between n/m=1/2 and n/m=2/4 modes.  This contradicts with the experiments where the n/m=1/2 mode is dominant.

In the free boundary simulation, much higher linear growth rates are predicted for both the n/m=1/2 and 2/4 modes (Fig.2a).  The change is much higher for the n/m=1/2 mode such that the n/m=1/2 mode emerges as the dominant mode, although both the

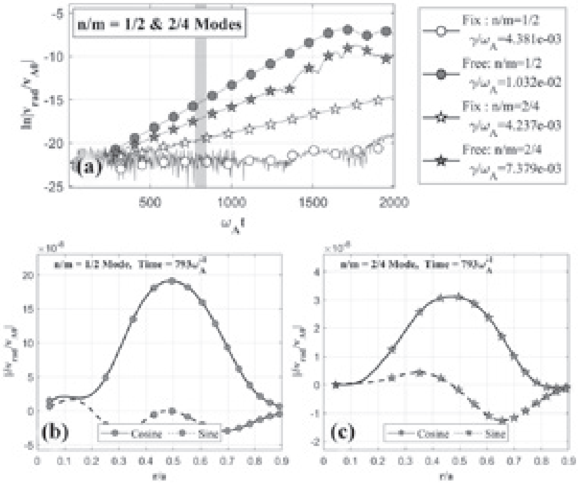


Fig.2 (a) The comparison of the logarithmic time evolution of the radial MHD velocity for n/m=1/2 and 2/4 modes between the fixed and free boundary simulations.  The spatial profile of the n/m=1/2 and 2/4 modes at $793\omega_A^{-1}$ are shown in panels (b-c), respectively.  $793\omega_A^{-1}$ is indicated by the vertical transparent gray bar in panel (a).

n/m=1/2 and 2/4 modes are located at the same radial location.  The spatial profiles of the n/m=1/2 and 2/4 modes are shown in Figs.2b-c, respectively.  In contrast to the fixed boundary case[2], the mode profiles are broadened and radially shift toward the edge.  By analyzing the changes in the EP driving rate ($\gamma_h$) and MHD dissipation rate ($\gamma_d$), it shows $\gamma_h$ is higher in the free boundary simulation while $\gamma_d$ remains the same.  The stronger EP-SAW interactions are brought about by the broadening of the mode profile. From the analysis of the EP redistribution in velocity space, the majority of the interactions are brought about by the high velocity co-passing EPs interact with the SAWs through high velocity toroidicity-induced resonance.  These EPs have large orbit widths such that they can interact with the mode in the edge region.

This study shows that the boundary condition has a significant role in Heliotron J, a low shear helical-axis stellarator/heliotron.  The boundary condition at the LCFS can significantly affect the linear properties of the low-n EP-driven mode, even if the mode's radial location is at r/a≈0.5.  The prospective cause is the low magnetic shear of Heliotron J.  This shall be verified in other low shear stellarators.


1) Y. Todo and T. Sato, Phys. Plasmas **5** 1321 (1998)
2) Adulsiriswad *et al*, Nucl. Fusion **60** 096005 (2020)
3) S. Yamamoto, et al. Phys. Rev. Lett. **91** 245001 (2003)
4) E.Y.Chen, *et al*, Phys. Plasmas **18** 052503 (2011),
5) M. Kaneko*, et al.*, Fus. Sci. Technol. **50** 428-433 (2006)

## Collaboration Works

大島慎介，西南物理研究所（中国），非線形結合同定のための新しい揺動解析手法に関する共同研究

大島慎介, 長﨑百伸, 岡田浩之, 南貴司, 小林進二, Wisconsin University（アメリカ），CIEMAT（スペイン），Max-Plank Institute（ドイツ），ヘリカル磁場配位における周辺揺動研究

長﨑百伸, 岡田浩之, 小林進二, 南貴司, 大島慎介, Univ. Wisconsin（アメリカ），Oak Ridge National Laboratory（アメリカ）, Max Plank Institute（ドイツ）, Stuttgart Univ（ドイツ），CIEMAT（スペイン），Australian National Univ.，（オーストラリア），Kharkov Institute（ウクライナ）, Southwest Institute of Physics（中華人民共和国），ヘリカル型装置における SOL/ダイバータプラズマに関する研究

長﨑百伸, 大島慎介, 岡田浩之, 南貴司, 小林進二, Stuttgart Univ.，CIEMAT，先進閉じ込め配位

小林進二，長﨑百伸，大島慎介，CIEMAT（スペイン），Kurchatov Institute（ロシア），ORNL（アメリカ），低磁気シアヘリカル装置における高速イオン励起 MHD 不安定性に関する研究

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南貴司，基盤研究(C)，電磁場制御による核融合プラズマの内部輸送障壁形成手法の新展開

大島慎介，基盤研究(C)，乱流の非線形性を介在した同位体効果発現機構の実験的検証

大島慎介，基盤研究(B)，先進ヘリカル配位のベータ効果が対称性と熱・乱流輸送に与える影響の実験的検証（分担金）

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## Publications

T. Minami, D. Qiu, T. Nishide, M. Miyoshi, Y. Yamanaka, N. Kenmochi, R. Yasuhara, C. Takahashi, S. Kobayashi, H. Okada, S. Kado, S. Ohshima, T. Mizuuchi, K. Nagasaki, Current status and plan of development of Nd:YAG laser Thomson scattering system in Heliotron J, Journal of Instrumentation, 15, 2, C02011, 2020

N.T. Tran, B. Oanthavinsak, S. Kado, H. Matsuura, Effect of insulating oil covering electrodes on the characteristics of a dielectric barrier discharge, Plasma Science & Technology, 22, 11, 115401, 2020

S. Yamamoto, K. Nagasaki, K. Nagaoka, J. Varela, 'A. Cappa, E. Ascasíbar, F. Castej'on , J.M. Fontdecaba, J.M. García-Regaña, 'A. Gonz'alez-Jerez, K. Ida, A. Ishizawa , M. Isobe, S. Kado, S. Kobayashi, M. Liniers, D. L'opez-Bruna, N. Marushchenko, F. Medina, A. Melnikov, T. Minami, T. Mizuuchi, Y. Nakamura, M. Ochando, K. Ogawa, S. Ohshima, H. Okada, M. Osakabe, M. Sanders, J.L. Velasco , G.M. Weirm, M. Yoshinuma, Effect of ECH/ECCD on energetic-particle-driven MHD modes in helical plasmas, Nuclear Fusion, 60, 6, 066018, 2020

M. Luo, K. Nagasaki, G. Weir, H. Okada, T. Minami, S. Kado, S. Kobayashi, S. Yamamoto, S. Ohshima, T. Mizuuchi, S. Konoshima, Y. Nakamura, A. Ishizawa, Measurement of Electron Temperature Profile and Fluctuation with ECE Radiometer System in Heliotron J, Plasma and Fusion Research, 15, SI, 2402038, 2020

D. Qiu, T. Minami, T. Nishide, M. Miyoshi, Y. Yamanaka, S. Kado, S. Ohshima, K. Nagasaki, H. Okada, S. Kobayashi, T. Mizuuchi, S. Konoshima, R. Yasuhara, Design of Compact Multi-Path Thomson Scattering Diagnosticwith Signal Delay System in Heliotron J, Plasma and Fusion Research, 15, SI, 2401044, 2020

S. Mori, T. Shikama, K. Hanada, N. Yoneda, A. Kuzmin, M. Hasuo, H. Idei, T. Onchi, A. Ejiri, Y. Osawa, Y. Peng, K. Matsuzaki, S. Kado, K. Sawada, T. Ido, K. Nakamura, R. Ikezoe, Y. Nagashima, M. Hasegawa, K. Kuroda, A. Higashijima, T. Nagata, S. Shimabukuro, Spectroscopic Measurement of Hydrogen Atom Density in a Plasma Produced with 28 GHz ECH in QUEST, Atoms, 8, 3, 44, 2020

N. Smith, K. Nagasaki, J.H.E. Proll, H. Okada, T. Minami, S. Kado, S. Kobayashi, S. Ohshima, S. Konoshima, T. Mizuuchi, Y. Nakamura, A. Ishizawa, T. Tomita, T. Fukuda, Y. Kondo, Measurement of Radial Correlation Lengths of Electron Density Fluctuations in Heliotron J Using O-Mode Reflectometry, Plasma and Fusion Research, 15, 2054, 2020

P. Adulsiriswad, Y. Todo, S. Yamamoto, S. Kado, S. Kobayashi, S. Ohshima, H. Okada, T. Minami, Y. Nakamura, A. Ishizawa, S. Konoshima, T. Mizuuchi, K. Nagasaki, Magnetohydrodynamic hybrid simulation of Alfvén eigenmodes in Heliotron J, a low shear helical axis stellarator/heliotron, Nuclear Fusion, 60, 9, 096005, 2020

Y. Kondo, T. Fukuda, K. Nagasaki, H. Okada, T. Mina-

mi, S. Kado, S. Kobayashi, S. Yamamoto, S. Ohshima, T. Mizuuchi, T. Tomita, Measurement of radial electric field using doppler reflectometer in high-density plasma of heliotron J, Plasma and Fusion Research, 15, 2064, 2020

L.G. Zang, S. Ohshima, Y.F. Qu, P.W. Shi, W.L. Zhong, X.Q. Ji, L.W. Yan, D.L. Yu, Z.B. Shi, Yi Liu, Q.W. Yang, Phase tracking with Hilbert transform and nonlinear wave-wave coupling analysis on the HL-2A tokamak, Nuclear Fusion, 61, 2, 026024, 2020

M. Yoshikawa, T. Mouri, F. Nakanishi, J. Kohagura, Y. Shima, M. Sakamoto, Y. Nakashima, N. Ezumi, R. Minami, I. Yamada, R. Yasuhara, H. Funaba, T. Minami, N. Kenmochi, First electron temperature and density measurements using the multi-pass Thomson scattering system with the laser amplification system in GAMMA 10/PDX, Journal of Instrumentation, 15, 8, T08011, 2020

S. Mori, T. Shikama,K. Hanada, N. Yoneda, A. Kuzmin, M. Hasuo, H. Idei, T. Onchi, A. Ejiri, Y. Osawa, Y. Peng, K. Matsuzaki, S. Kado, K. Sawada, T. Ido, K. Nakamura, R. Ikezoe, Y. Nagashima, M. Hasegawa, K. Kuroda, A. Higashijima, T. Nagata, S. Shimabukuro, Spectroscopic Measurement of Hydrogen Atom Density in a Plasma Produced with 28 GHz ECH in QUEST, Atoms, 8, 3, 44, 2020

T.I. Tsujimura, R. Yanai, Y. Mizuno, K. Tanaka, Y. Yoshimura, T. Tokuzawa, M. Nishiura, R. Sakamoto, G. Motojima, S. Kubo, T. Shimozuma, H. Igami, H. Takahashi, M. Yoshinuma, S. Ohshima, Improved performance of electron cyclotron resonance heating by perpendicular injection in the Large Helical Device, Nuclear Fusion, 61, 2, 026012, 2021

U. Losada, T. Kobayashi, S. Ohshima, A. Cappa, B.P.V. Milligen, M. Liniers, B. López-Miranda, B. Liu, I. Pastor, C. Silva, C. Hidalgo, Spatial characterization of edge Zonal Flows in the TJ-II stellarator: Role of plasma heating and isotope mass, Plasma Physics and Controlled Fusion, 63, 4, 044002, 2021

L.G. Zang, S. Ohshima, Y.F. Qu, PW. Shi, W.L. Zhong, Y.M. Hou, L.W. Yan, XQ. Ji, J.Q. Li, D.L. Yu, Z.B. Shi, Y. Liu, Q.W. Yang, M. Xu, Phase tracking with Hilbert transform and nonlinear wave-wave coupling analysis on the HL-2A tokamak, Nuclear Fusion, 61, 2, 026024, 2021

M. Yoshikawa, T. Mouri, H. Nakanishi, J. Kohagura, Y. Shima, M. Sakamoto, Y. Nakashima, N. Ezumi, R. Minami, I. Yamada, R. Yasuhara, H. Funaba, T. Minami, N. Kenmochi, Improvement in multipass Thomson scattering system comprising laser amplification system developed in GAMMA 10/PDX, Review of Scientific Instruments, 92, 033515, 2021

門信一郎, この感染は拡大か収束か:再生産数 R の物理的意味と決定，RAD-IT21 WEB マガジン，2020

門信一郎，神田峻彦，電子回路シミュレータで解く感染症モデル（その 1）〜 SIR モデルを解こう〜，RAD-IT21 WEB マガジン，2020

門信一郎，神田峻彦，電子回路シミュレータで解く感染症モデル（その２）〜 実効再生産数 Rt を求めよう〜，RAD-IT21 WEB マガジン，2020

小川雄一，岡野邦彦，笠田竜太（執筆協力者 門信一郎他），核融合エネルギーのきほん，誠文堂新光社，2021

長﨑百伸，水内亨，岡田浩之，南貴司，門信一郎，小林進二，大島慎介，岸本泰明，中村祐司，石澤明宏，四竈泰一，木島滋，的池遼太，横山雅之，本島厳，小林達哉，西野信博，山本聡，Gavin M. Weir，Ling Zang，Heliotron J 実験，Plasma and Fusion Research，96，9，475-518，2020

## Presentations

門信一郎，プラズマ核融合研究者からみた新型コロナ禍と感染症モデル，核融合科学研究会特別講演会，オンライン開催，2020.6.30

的池遼太，河村学思，大島慎介，鈴木康浩，小林政弘，増崎貴，小林進二，門信一郎，南貴司，岡田浩之，水内亨，木島滋，Y. Feng，H. Frerichs，長﨑百伸，Heliotron J における三次元磁場構造を背景とした周辺プラズマ輸送特性，日本物理学会 2020 年秋季大会，オンライン開催，2020.9.8-11

松浦寛人，ブイスアンニャットソン，村岡英樹，的池遼太，大島慎介，ヘリオトロン J 複合ダイバイータプローブアレイの熱電対信号解析，日本物理学会 2020 年秋季大会，オンライン開催，2020.9.8-11

小林進二，永岡賢一，長﨑百伸，徳原圭一，大垣英明，紀井俊輝，全炳俊，岡田浩之，村田駿介，大島慎介，門信一郎，南貴司，木島滋，水内亨，ヘリオトロン型磁場配位における非共鳴マイクロ波を利用した確率的静電加速，日本物理学会 2020 年秋季大会，オンライン開催，2020.9.8-11

A. Sanpei, H. Himura, Y. Ishida, T. Inoue, T. Inoue, S. Masamune, K. Nagasaki, H. Okada, S. Kado, Analysis of transition from axisymmetric torus to helical axis toroidal plasma, 第 11 回エネルギー理工学研究所国際

シンポジウム, Online, 2020.9.15-16

T. Shikama, Y. Ueno, T. Chatani, S. Kado, H. Kawazome, H. Okada, L. Matsuoka, T. Minami, S. Kobayashi, S. Oshima, A. Ishizawa, Y. Nakamura, S. Konoshima, T. Mizuuchi, K. Nagasaki, M. Hasuo, Spatially resolved measurement of atomic emission line spectra using NIR Zeeman spectroscopy, 第 11 回エネルギー理工学研究所国際シンポジウム, Online, 2020.9.15-16

H. Kawazome, S. Kado, R. Matoike, S. Ohshima, Development of HeI image reconstruction technique using neural network in Heliotoron J, 第 11 回エネルギー理工学研究所国際シンポジウム, Online, 2020.9.15-16

S. Inagaki, K. Nagasaki, G.M. Weir, T. Minami, S. Kado, S. Kobayashi, S. Yamamoto, S. Ohshima, H. Okada, T. Mizuuchi, M. Sasaki, Time-series data analysis of Heliotron-J plasma by statistical modeling, 第 11 回エネルギー理工学研究所国際シンポジウム, Online, 2020.9.15-16

M. Yoshikawa, S. Kobayashi, Y. Nakashima, J. Kohagura, T. Iijima, Y. Ariizumi, Y. Takeda, H. Okada, S. Ohshima, S. Murata, K. Tokuhara, M. Luo, R. Fukushima, Transport analysis for neutral beam heated plasmas in advanced heliotron configuration, 第 11 回エネルギー理工学研究所国際シンポジウム, Online, 2020.9.15-16

S. Ohshima, H. Okada, L. Zang, S. Kobayashi, S. Yamamoto, T. Minami, S. Kado, Y. Nakamura, S. Konoshima, T. Mizuuchi, N. Kenmochi, Y. Ohtani, M. Motoshima, P. Adlsriiswad, R. Matoike, D. Qiu, M. Luo, K. Nagasaki, Isotope Effects on Nonlinear Turbulence System in a Torus Plasma, 4th Asia-Pacific Conference on Plasma Physics, Online, 2020.10.26-31

D. Qiu, T. Minami, Y. Yamanaka, M. Miyoshi, R. Shinotsuka, M. Luo, S. Kado, N. Kenmochi, S. Ohshima, S. Kobayashi, H. Okada, S. Konoshima, T. Mizuuchi, K. Nagasaki, Development of Double Pockels Cells Multi-path Thomson Scattering System in Heliotron J based on Gauss Beam Analysis, 4th Asia-Pacific Conference on Plasma Physics, Online, 2020.10.26-31

P. Adulsiriswad, Y. Todo, S. Kado, S. Yamamoto, S. Kobayashi, S. Ohshima, H. Okada, T. Minami, Y. Nakamura, A. Ishizawa, S. Konoshima, T. Mizuuchi, K. Nagasaki, Simulation Study of Energetic Particle-driven MHD Modes and Energetic, 4th Asia-Pacific Conference on Plasma Physics, Online, 2020.10.26-31

門信一郎，拡大か収束か: 実効再生産数 Rt の物理的意味と時系列解析，第 37 回プラズマ・核融合学会年会 インフォーマルミーティング，オンライン開催，2020.12.1

森敦樹，門信一郎，本島厳，岩田晃拓，岡野竜成，馮超，岡田浩之，南貴司，大島慎介，小林進二，中村祐司，石澤明宏，木島滋，水内亨，長﨑百伸，ヘリオトロン J におけるペレット溶発雲の 2 次元計測のための変倍分光器の開発，第 37 回プラズマ・核融合学会年会，オンライン開催，2020.12.1-4

村田駿介，小林進二，門信一郎，大島慎介，小林達哉，南貴司，岡田浩之，吉川正志，中村祐司，石澤明宏，水内亨，木島滋，長﨑百伸，ヘリオトロン J におけるビーム放射分光法を用いた密度揺動計測，第 37 回プラズマ・核融合学会年会，オンライン開催，2020.12.1-4

山中雄太，南貴司，大島慎介，Dechuan Qiu，三好正博，篠塚凌我，南雲竜也，釼持尚輝，門信一郎，岡田浩之，小林進二，木島滋，水内亨，長﨑百伸，ヘリオトロン J における異なる磁場配位での ECH プラズマの実効電子熱拡散係数の比較II, 第 37 回プラズマ・核融合学会年会，オンライン開催，2020.12.1-4

岡佑旗, 長﨑百伸, 小林進二, 大島慎介, 笠原寛史, 岡田浩之, 門信一郎, 南貴司, 中村祐司, 石澤明宏, 木島滋，水内亨，加藤悠，ヘリオトロン J における電子バーンシュタイン波加熱・計測のための有限要素法を用いた O-X モード変換解析, 第 37 回プラズマ・核融合学会年会，オンライン開催，2020.12.1-4

徳原圭一, 小林進二, 大垣英明, 紀井俊輝, 全炳俊, 永岡賢一, 岡田浩之, 南貴司, 門信一郎, 大島慎介, 水内亨，木島滋，長﨑百伸，ヘリオトロン J における非共鳴マイクロ波加熱プラズマ中の高エネルギーX 線スペクトル計測，第 37 回プラズマ・核融合学会年会，オンライン開催，2020.12.1-4

上野陽平，四竈泰一，茶谷智樹，門信一郎，川染勇人，岡田浩之，松岡雷士，南貴司，小林進二，大島慎介，石澤明宏，中村祐司，木島滋，水内亨，長嵜百伸，蓮尾昌裕，核融合プラズマ中原子輝線スペクトルのゼーマン効果高感度計測に向けた近赤外分光システム開発，第 37 回プラズマ・核融合学会年会，オンライン開催，2020.12.1-4

X.N.S. Bui, H. Matsuura, R. Matoike, S. Ohshima, T. Mizuuchi, Heat Flux Estimation with Divertor Probes Array in Heliotron J, 第 37 回プラズマ・核融合学会年会, Online, 2020.12.1-4

P. Zhang, S. Ohshima, H. Kume, S. Kobayashi, H. Okada, T. Minami, S. Kado, S. Konoshima, T. Mizuuchi, K. Nagasaki, Development of a320 GHz interferometer system in Heliotron J, 第 37 回プラズマ・核融合学会年会, Online, 2020.12.1-4

宮下顕, 向井清史, 大島慎介, 的池遼太, 小林進二, 岡田浩之, 門信一郎, 南貴司, 水内亨, 木島滋, 長崎百伸　ヘリオトロン J におけるイメージングボロメータの開発　第 37 回プラズマ・核融合学会年会　　オンライン開催　2020.12.1-4

岡野竜成, 門信一郎, 岩田晃拓, 森敦樹, 馮超, 岡田浩之, 南貴司, 大島慎介, 小林進二, 本島厳, 中村祐司, 石澤明宏, 木島滋, 水内亨, 長崎百伸, ヘリオトロン J の固体水素ペレット入射実験における真空紫外スペクトルの時間発展計測, 第 37 回プラズマ・核融合学会年会, オンライン開催, 2020.12.1-4

三好正博, 南貴司, 釼持尚輝, Dechuan Qiu, 山中雄太, 篠塚凌我, 南雲竜也, 高橋千尋, 岡田浩之, 門信一郎, 大島慎介, 小林進二, 木島滋, 水内亨, 長崎百伸, ヘリオトロン J における Nd : YAG レーザトムソン散乱計測のためのイベントトリガシステムの開発, 第 37 回プラズマ・核融合学会年会, オンライン開催, 2020.12.1-4

岡佑旗, 長崎百伸, 小林進二, 大島慎介, 笠原寛史, 伊神弘恵, 門信一郎, 南貴司, 中村祐司, 石澤明宏, 木島滋, 水内亨, 岡田浩之, 加藤悠, 磁場閉じ込め核融合プラズマにおけるミリ波帯域電磁波モード変換シミュレーション, COMSOL Conference 2020 Tokyo, オンライン開催, 2020.12.4-11

R. Matoike, G. Kawamura, S. Ohshima, Y. Suzuki, M. Kobayashi, S. Masuzaki, S. Kobayashi, S. Kado, T. Minami, H. Okada, T. Mizuuchi, S. Konoshima, Y. Feng, H. Frerichs, K. Nagasaki, Peripheral Plasma Transport Characteristics arising from 3D Magnetic Field Structure in Heliotron J, The 24th International Conference on Plasma Surface Interactions in Controlled Fusion Devices, Online, 2021.1.25-29

岡野竜成, 門信一郎, 大島慎介, 山中雄太, 鈴木琢土, 岩田晃拓, 森敦樹, 馮超, 南貴司, 小林進二, 中村祐司, 石澤明宏, 岡田浩之, 木島滋, 水内亨, 長崎百伸, ヘリオトロン J における真空紫外分光法を用いた低価数輝線の空間分布計測, 日本物理学会第 76 回年次大会, オンライン開催, 2021.3.12-15

茶谷智樹, 四竈泰一, 上野陽平, 門信一郎, 川染勇人, 南貴司, 岡田浩之, 松岡雷士, 小林進二, 大島慎介, 石澤明宏, 中村祐司, 木島滋, 水内亨, 長崎百伸, 蓮尾昌裕, ヘリオトロン J における近赤外原子輝線のゼーマン効果計測, 日本物理学会第 76 回年次大会, オンライン開催, 2021.3.12-15