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LABORATORI NAZIONALI DEL SUD

ACTIVITY REPORT 2009

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Cover figure:
the primordial nucleosynthesis and the element and energy production mechanisms accompanying the evolution of stars are the main subjects of nuclear astrophysics studies that are carried out worldwide in the nuclear laboratories with the aim of understanding the structure and the history of the Universe. At LNS a large number of experiments concerning central problems of nuclear astrophysics have been performed either by directly measuring reaction cross sections of astrophysical interest or by applying alternative methods, like the Trojan Horse one, able to give indirect information on such cross sections. Stable Tandem beams as well as the radioactive ^{8}Li beam produced by EXCYT have been used for this purpose.

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Foreword

The main mission of the INFN Laboratori Nazionali del Sud (LNS) consists in fundamental research in nuclear and astroparticle physics, as well as in applications of physics technologies and methodologies in different fields of human activities.

Following this traditional path, in 2009 several experimental studies on nuclear structure, reaction mechanisms and nuclear astrophysics processes have been performed taking advantage of the ion beam accelerators and particle detection systems like Chimera and Magnex, available at LNS.

The recently developed pulse shape analysis inplemented on Chimera enhanced its performances, allowing detection of charged particle with much lower identification thresholds than before and revealing new opportunities of experimental research with low energy beams as the ones produced by EXCYT. Also for Magnex a powerful method has been developed for identification of particles detected in the spectrometer, that improved the peculiar features of the magnetic spectrometer. Also thanks to those improvements the two big detection systems have been fruitfully exploited during 2009. Chimera was specially used for experiments on the multifragmentation process whilst experiments with Magnex mainly concerned the structure of neutron-rich nuclei produced by multineutron transfer. Many other experiments performed with Tandem and Cyclotron beams, concerning, for instance, the role of the symmetry term in the nuclear equation of state, the structure of weakly bound nuclei, the rate production of elements in stars and so on, complete the articulated panorama of nuclear research topics addressed at LNS. It is to be stressed that in many cases the close collaboration of the experimentalists with the theoritician group of LNS was very helpful in designing the experiments and interpreting their results.

As in the past, a significant fraction of the accelerators beam time has been devoted to interdisciplinary experiments, mostly related to radiation hardness of materials and to the response of biological tissues to irradiation with ionizing particles. In the same framework of applications a primary and most visible role is played by the treatment of the ocular melanoma by means of the cyclotron proton beam, that now has become a routine operation; new sessions have been performed in 2009 leading to a total number of about 190 patients treated from the beginning of this activity.

In the field of technological research special mention is deserved by the development of innovative ion sources and of the beam diagnostics systems, a issue specially crucial for low intensities, as well as the exploitation of simple systems of scintillating fibers as versatile, cheap detectors for nuclear waste repository monitoring. Moreover, as a support to the activity on in situ analysis of archaelogical samples, a new laboratory (LAB-ALFA) has been set up where the sources of 210Po used for the portable systems developed at LNS can be produced with the required intensities.

LNS is committed to participate in the big challenge represented by the italian radioactive ion beam facility SPES, that will be installed at the Laboratori Nazionali di Legnaro, the other low energy nuclear laboratory of INFN. The experience and the knowledge acquired at LNS during the design and realization of the EXCYT facility have been put at the disposal of this new project.

The medium/long term future of LNS relies on the project of the undersea telescope for cosmic neutrinos and many steps forwards have been done in 2009, connected to several aspects of the project.

At Capo Passero, the Italian candidate site for the installation of the telescope, the on-shore laboratory has been completed and is now operational. Moreover, the submarine infrastructure located at a depth of 3500 m has been enriched with the deployment of the DC-DC Medium Voltage Converter.

Noticeable advances towards the design of the final detection unit have been made with the realization and test of a full scale demonstrator of the NEMO tower. At the same time the development of a new mechanical structure that puts together the best aspects of the different solutions proposed by the KM3NeT partners is in progress. In the framework of the KM3NeT Consortium, LNS is active in many technological aspects including mechanical design, deep sea operations, power feeding, front-end electronics, opto-electronics for data transmission, calibration and acoustic positioning system.

In parallel with the development of the technologies required by the project, attention has been paid also to the physics that can be done with the presently available small scale detectors, by analyzing the data taken by ANTARES and NEMO-phase1, and to the physics that will be done with the KM3NeT telescope, by comparing the simulated response of different configurations of the whole detector.

Among the multidisciplinary activities exploiting the observatory infrastructures, an impulse was given in 2009 to the LIDO-ESONET project aimed at the realization of a system for acoustic and geophysical monitoring of deep sea environment. Sensors and electronics have been tested in view of the future deployment of the whole equipment in the so called test site, off the coast of Catania.

Finally a warm thank has to be given to the LNS staff and to the whole community of LNS users. The continuous interest of users in the growth of the Laboratory pushed us to give our best in improving day by day the reliability and the performances of our facilities.

Marcello Lattuada
INFN-LNS Director

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Italy. Delivered single doses were 12 and 16 Gy, at the dose rate of 15 Gy/min. Irradiation position in the middle of the spread-out Bragg peak (SOBP) was obtained by inserting 16.3 mm thick Perspex plate (Polymethyl methacrylate - PMMA) between the final collimator and the cell monolayer. The corresponding relative dose was 99.42 ± 0.58 %, with the mean energy of protons of 34.88 ± 2.15 MeV and the linear energy transfer (LET) of 4.71 ± 0.15 keV/μm. The mean energy and LET values were obtained by numerical simulations carried out with the GEANT4 code [6]. Reference dosimetry was performed by the plane-parallel PTW 34045 Markus ionization chamber (Advanced Markus Chamber, 0.02 cm^2, Type 34045, PTW Freiberg, Germany), calibrated according to the International Atomic Energy Agency (IAEA) code of practice (IAEA-TRS-398 2000) [7, 8]. All cell irradiations were carried out in air at room temperature.

Quantification of apoptosis

For quantification of apoptotic cells, the flow cytometric analysis with Annexin V-FLUOS Staining kit (Roche Diagnostics GmbH, Mannheim, Germany) was performed according to the manufacturer's instructions. Samples were analyzed on a FACSCalibur (Becton Dickenson, Heidelberg, Germany). The number of apoptotic cells was calculated using ModFit software (Verity Software, Becton Dickenson).

Western blot

For the Western blot analysis cells were collected, washed with PBS, lysed in lyses buffer and centrifuged at 13000 × *g*. The extracted protein samples were added in the sample buffer and subjected to denaturation, then electrophoretically separated and finally transferred onto the polyvinylidene fluoride (PVDF) membrane. The PVDF membrane was treated with phosphate buffered saline tween-20 (PBST), followed by incubation with the primary antibodies – anti-p53, anti-Bcl-2 or anti-Bax (Cell Signaling, Danvers, MA, USA). After washing with PBST, membrane was incubated with the corresponding Horseradish peroxidase (HRP, Cell Signaling) secondary antibody for 2 h and washed with PBST. Proteins were visualized with enhanced chemiluminescence (Sigma-Aldrich Chemie GmbH) and exposed to X-ray film. Densitometry of protein bands on X-ray film was performed using Image J Analysis PC software.

Statistical analysis

Measurements were made in triplicate during each experiment, while each experiment was repeated three times. The significance of differences among the experimental groups was assessed by the independent Student's t-test, with the level of significance set at $p < 0.05$. The results were presented as the Mean ± S.D. (standard deviation).

RESULTS

Flow cytometric analysis showed that the number of apoptotic nuclei increased 6 h after exposure to protons (15 % - 25 %) or FM (5.2 – 7.3 %) as compared to untreated control. When the HTB140 cells were treated with FM and then irradiated with protons the level of apoptosis ranged from 4 to 19 % (Figure 1A).

The percentage of apoptosis significantly increased when the incubation time was extended to 48 h, especially in samples exposed to 250 μM FM and protons, reaching from 38 to 41 % (Figure 1B).

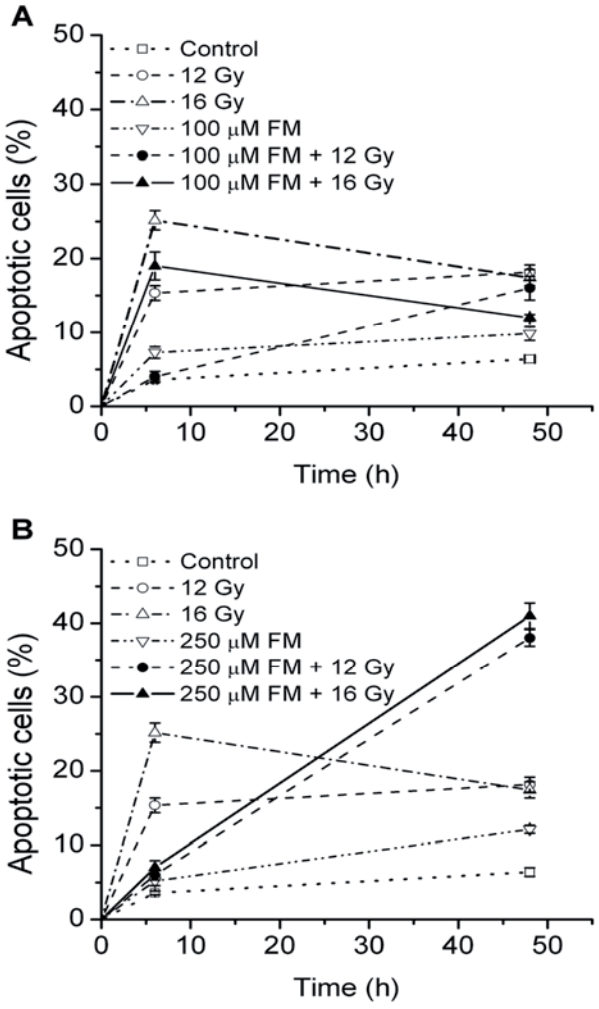

Figure 1. Percentage of apoptotic cells, evaluated by flow cytometric analysis of Annexin V/PI stained samples 6 and 48 h after treatments with protons (12, 16 Gy) and 100 μM FM (A), as well as protons (12, 16 Gy) and 250 μM FM (B).

To examine the molecular level of the observed induction of apoptosis, key molecules of the mitochondrial apoptotic pathway were analyzed under the described experimental conditions. This included the analysis of p53 gene and protein expression, as well as the expression of Bax and Bcl-2 regulatory proteins.

Significant increases of p53 were detected 6 h after the exposure to 16 Gy protons (12 %) and after the single treatment with 250 μM FM (13 %) as compared to control. More enhanced increase was observed after the combined treatments (24 – 48 %).

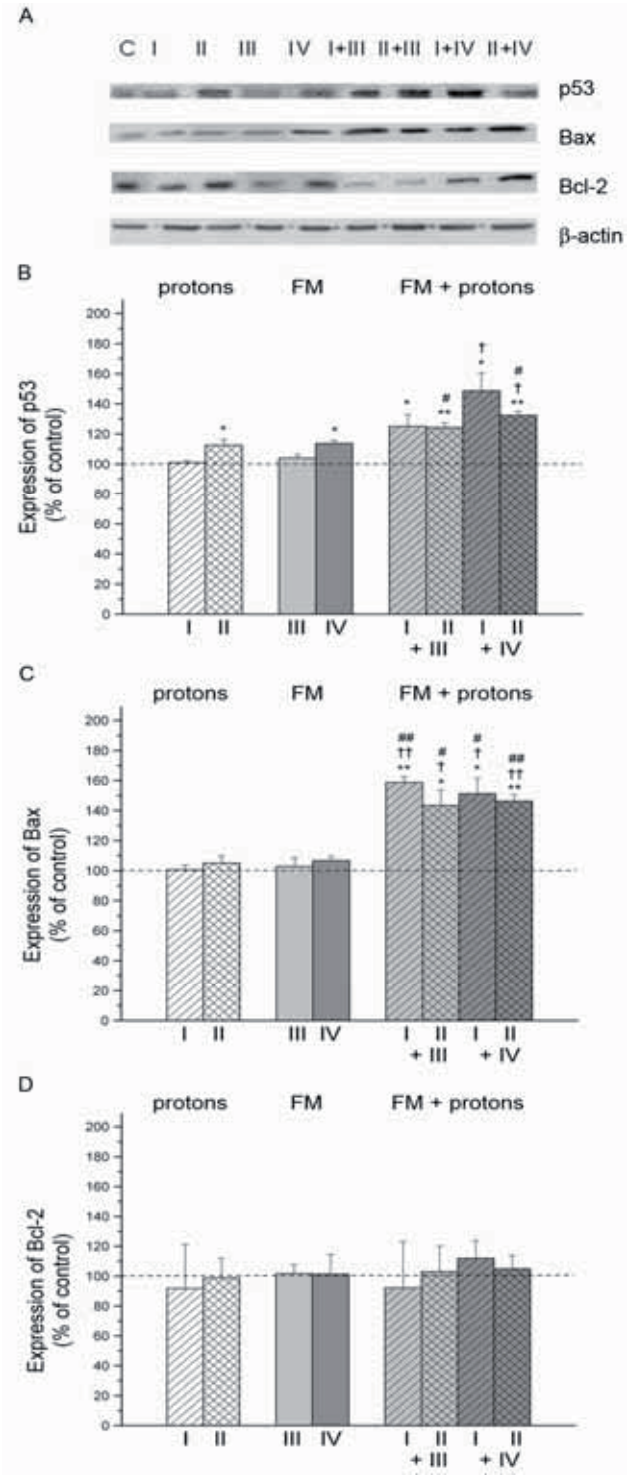

Figure 2. Western blot analysis of p53, Bax and Bcl-2 6 h after single and combined treatments with FM and protons (A). The level of p53 (B), Bax (C) and Bcl-2 (D) was normalized to β-actin and expressed as percent of control. Irradiation doses were 12 (I) and 16 Gy (II), while FM concentrations were 100 (III) and 250 μM (IV). C – control. * - Statistical significance compared to the control; † - statistical significance compared to the radiation; # - statistical significance compared to FM. *, †, # - $0.01 < p < 0.05$; **, ††, ## - $0.001 < p < 0.01$; ***, †††, ### - $p < 0.001$.

Treatment with 250 μM FM and 16 Gy protons additionally increased p53 expression as compared to appropriate single treatments (Figure 2A and B).

The expression of p53 was not changed 48 h after all single or combined treatments (Figure 3A and B).

The increased level of the pro-apoptotic protein Bax was detected 6 h after all combined treatments (41 – 58 %), as compared to control or to single treatments with protons or FM (Figure 2A and C). Forty eight hours after treatment, the expression of Bax increased in all analyzed samples, except in the sample exposed to 12 Gy protons. Combined treatments have shown the increase of Bax expression as compared to the appropriate single treatments (Figure 3A and C).

Furthermore, treatments with FM and protons did not induce changes in the expression of anti-apoptotic protein Bcl-2 after 6 h (Figure 2A and D), but resulted in a significant decrease of Bcl-2 expression after the incubation for 48 h, as compared to control (24 – 49 %). Better effects were achieved after combined treatments (Figure 3A and D).

DISCUSSION

Considering the significance that apoptosis has in the development of cellular chemo- and radio-resistance, in this study the effects of applied treatments were analyzed on this process. Highly radio-resistant human HTB140 melanoma cells, with SF2 values of ~ 0.93 were used [9]. Applied concentrations of FM were close to those defined as IC_{50} values for the HTB140 melanoma cells, while the doses of 12 and 16 Gy protons were in the range of those used in therapy. Time point of 48 h after combined treatment (i.e. 72 h after FM administration) was appropriate for the analysis of FM effects [10-13].

In radio-sensitive cancer cells apoptosis usually occurs within the first 24 h after irradiation. However, for the majority of cells, apoptosis may arise after one or more cell divisions. Usually the maximal number of apoptotic cells in vitro was observed 48 h after irradiation [14]. On the basis of these data, time points of 6 and 48 h after treatment were selected for the assessment of apoptosis.

Analyzed treatments have shown different influence on the induction of apoptosis. Proton irradiation revealed better pro-apoptotic effects than FM. Similar effects were reported for PC3 prostate adenocarcinoma cells, CA301D thyreoidea cancer cells and MCF7 breast adenocarcinoma cells after proton irradiation [15] and 1205Lu, 451Lu, WM35 and Sbcl2 human melanoma cells after FM treatment [16]. Combined treatments applied in this study showed time- and FM concentration- dependent pro-apoptotic effect, while the increase in radiation dose did not significantly influence the level of apoptosis. Particularly good effect was achieved when the cells were exposed to 250 μM FM and irradiation for 48 h.

Induction of apoptosis was confirmed by the analysis of the regulatory proteins involved in this process. Transcription factor p53 is known to provoke cell cycle arrest or apoptosis in response to cellular stress, such as DNA damage induced by drugs or radiation [17].

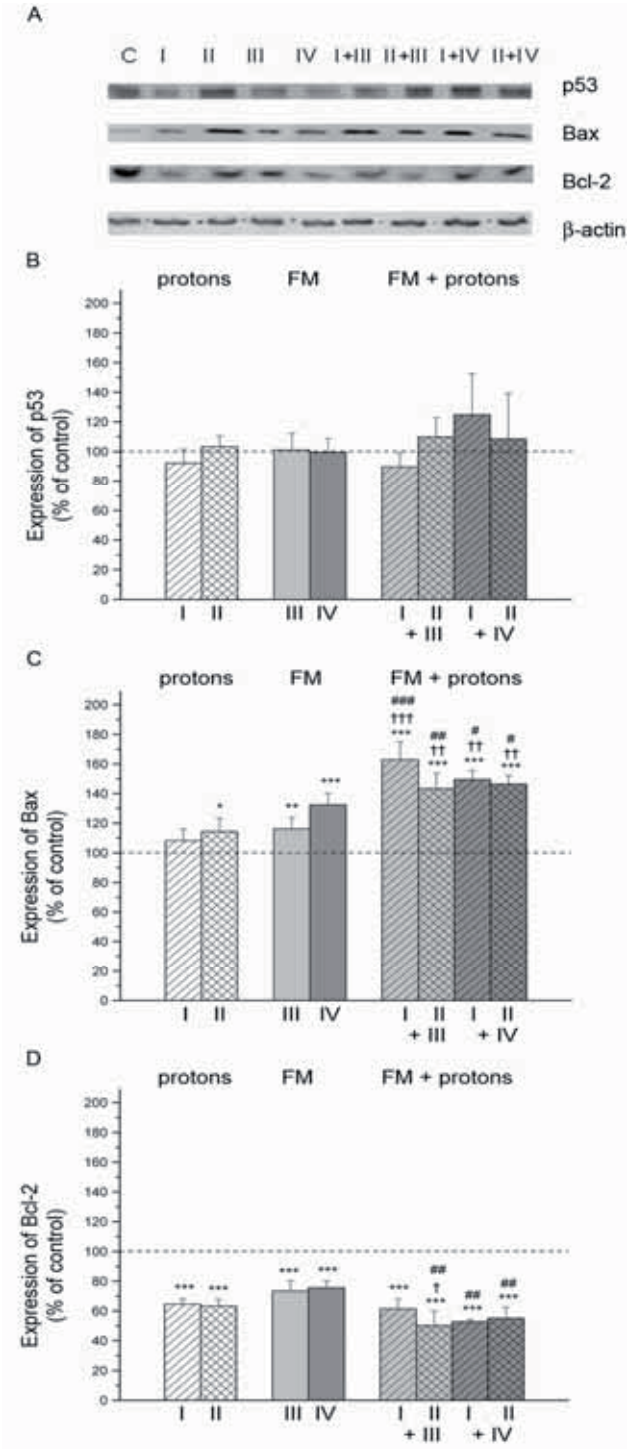

Figure 3. Western blot analysis of p53, Bax and Bcl-2 48 h after single and combined treatments with FM and protons (A). The level of p53 (B), Bax (C) and Bcl-2 (D) was normalized to β-actin and expressed as percent of control. Irradiation doses were 12 (I) and 16 Gy (II), while FM concentrations were 100 (III) and 250 μM (IV). C – control. * - Statistical significance compared to the control; † - statistical significance compared to the radiation; # - statistical significance compared to FM.
*, †, # - 0.01 <p < 0.05; **, ††, ## - 0.001 <p < 0.01; ***, †††, ### - p < 0.001.

The activation of p53 by FM and protons could affect the expression of its downstream effectors such as the Bcl-2 family of proteins, the key regulators of apoptosis [18]. In this study it was shown that the level of Bax increased at both analyzed time points, while the level of Bcl-2 decreased in the cells that were exposed to FM and protons for 48 h. This implies that the treatments that were used induced apoptosis by shifting the Bax/Bcl-2 ratio in favour of apoptosis, especially after 48 h. The obtained results suggested that FM and protons induced apoptosis through the activation of the intrinsic pathway. Significant decrease of Bcl-2 and increase of Bax in proton irradiated Lewis lung carcinoma cells (LLC), as well as hepatocellular carcinoma HepG2 cells were reported [19].

CONCLUSIONS

The obtained results indicate that combined treatments with higher concentration of FM and both doses of protons have better pro-apoptotic effect than single treatments with these agents after incubation of 48 h. Improved pro-apoptotic ability of combined vs. single treatments is also confirmed at the level of molecules involved in the mitochondrial apoptotic pathway. This was quantified by the changes of p53, as well as Bax and Bcl-2 protein expression.

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APOPTOSIS OF HTB140 MELANOMA CELLS INDUCED BY CARBON IONS OF DIFFERENT LET

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Abstract

Exposure to irradiation can trigger the p53 tumor suppressor to induce cell growth arrest or apoptosis. This study was conducted in order to evaluate the ability of carbon ions to induce apoptosis. The HTB140 melanoma cells were irradiated at three positions along the Bragg curve of the 62 MeV/u ^{12}C ion beams. In this way the cells were exposed to different high linear energy transfer (LET) values. The percentage of apoptotic cells was evaluated by flow-cytometry and the corresponding apoptotic indexes were calculated. The expression of apoptosis-associated proteins, p53 and Bax was estimated by Western blot analyses. A dose dependent increase of apoptosis was noticed in all irradiation positions. When moving along the Bragg curve, i.e., with the raise of LET, the level of apoptosis increased, but was somewhat attenuated for the highest LET value. The corresponding apoptotic indexes ranged from 2.45 to 7.71. Moreover, the induction of apoptosis was associated with p53 and Bax up regulation.

INTRODUCTION

Carbon ions have a unique advantage due to their physical properties and thus higher dose effect on malignant tumours compared to conventional radiotherapy. The cell mortality rate from a carbon ion beam is also greater than that from a proton beam when the same physical dose is used. The energy deposited per unit of length along the particle track, which is the linear energy transfer (LET), explains induced biological effects to radiation damage. Since LET depends on particle species, as well as on its energy, heavier particles have higher energy loss per unit length. The ratio of cell killing is expressed by the relative biological effectiveness (RBE). Commonly for most cell lines, the RBE of a carbon ion beam has been reported to be from 2 to 3, meaning that the cell killing of carbon ions is two to three times stronger than that of γ – rays [1].

Bax is the member of the Bcl-2 family that accelerates or activates apoptosis [2]. The tumour suppressor protein p53, which is the most frequently mutated gene in human cancers, plays a protective role to the genome in the response to a variety of stresses [3]. When the cells are subjected to radiation or some other stress events, p53 is activated and its level increases. Also it provokes either cell cycle arrest or programmed cell death - apoptosis [4]. The mechanism by which p53 protein might trigger apoptotic machinery involves the pro-apoptotic regulator, Bax. In certain cell types, after the DNA damage Bax appears to be transcriptionally induced by p53 [5].

Radiobiological data for the HTB140 cells exposed to the same beam of ^{12}C ions have been already reported [6].

In order to contribute to the understanding of mechanisms involved in the induction of apoptosis, the pro-apoptotic cell response to carbon ions of different, but high LET, was investigated.

MATERIAL AND METODS

Cell Culture

The human HTB140 melanoma cells were grown in the RPMI 1640 medium supplemented with 10 % foetal calf serum, penicillin/streptomycin and L - glutamine in a humidified atmosphere of 5 % CO_2, at 37 ^{0}C (Heraeus, Hanau, Germany).

Irradiation Conditions

Cells were irradiated with the 62 MeV/u ^{12}C ion beams produced by the superconducting cyclotron at INFN – LNS, in Catania. Three positions for irradiation within the Bragg curve (A, B and C) were obtained by interposing Perspex plates (Polymethyl methacrylate - PMMA) of different thickness between the final collimator and the cell monolayer. The corresponding relative doses at positions A, B and C were 73.37 ± 3.92, 98.12 ± 2.17 and 16.68 ± 5.21 %, respectively (Figure 1) [6]. Reference dosimetry was performed by the plane-parallel PTW 34045 Markus ionization chamber calibrated according to the IAEA code of practice [7, 8]. Cells were irradiated at the single dose levels of 2, 4, 8, 12 and 16 Gy, with the average dose rate of 11.45 ± 0.31 Gy/min. For each position the corresponding LET values were obtained by numerical simulations with the GEANT4 code [9] and were 285, 465 and 765 keV/μm, respectively. Cell monolayers were fixed vertically in a special device for irradiation, facing the horizontal beam.

Since the range of the 62 MeV/u carbon ions is short (~ 8 mm), with a very narrow Bragg peak, the precision of

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1. CAMPO Daniela
2. GAMBINO Nadia
3. GARUFI Donatella
4. GIACOPPO Francesca
5. GIORDANO Valentina
6. GIUFFRIDA Lorenzo
7. GRASSO Rosaria
8. JACCARINO Danilo
9. LATTUADA Dario
10. LOMBARDO Ivano
11. MASCALI David
12. MIRACOLI Rosalba
13. NERI Lorenzo
14. PUGLIA Sebastiana
15. RAPISARDA Giuseppe Gabriele
16. RIZZO Carmelo
17. ROMANO Francesco
18. SCARDINA Francesco
19. SCUDERI Valentina
20. STRANO Emanuele
21. TORRESI Domenico

INFN/CIAE/CAS Fellows

1. CHEN Ruofu
2. LI Lulu
3. TANG Bing
4. ZHANG Qiwei
5. XIA Le

Specialization School Students

1. BONANNO Elisa
2. BORZI' Giuseppina
3. LA ROSA Rosamaria
4. LEANZA Deborah Maria
5. MILLUZZO Maria Ausilis
6. PANSINI Floriana
7. POLITI Giacomo

Personnel of other Institutions

1. AMATO Ernesto
2. ANDO' Lucio
3. CAPPUZZELLO Francesco
4. CHERUBINI Silvio
5. GRECO Vincenzo
6. GUARINO Pietro
7. LANZALONE Gaetano
8. MANCIAGLI Sebastiano
9. PAPPALARDO Lighea
10. PATTI Jolanda Valeria
11. PAVAN Gianni
12. PRIVITERA Giuseppe
13. RAFFAELE Luigi
14. RE Maurizio
15. ROMANO Francesco Paolo
16. RUSSO Giorgio
17. SABINI Maria Gabriella
18. SALAMONE Vincenzo
19. SCORDINO Agata
20. TUMINO Aurora

Undergraduated Students Fellows

1. BARBAGALLO Massimo
2. CARBONE Diana
3. CASTRO Fabrizio
4. CHISARI Marco Carmelo
5. D'AMATO Gaetano
6. D'AMATO Giovanni
7. GRECO Giuseppe
8. LO VERDE Enrico
9. PLATANIA Fabio
10. SARTA Francesco
11. SCALIA Giuseppe
12. SCHILLACI Maria
13. SCIRÉ SCAPUZZO Carlotta
14. SPARTA' Roberta
15. TROVATO Agata
16. VIOLA Salvatore

Undergraduated Students

17. FEBBRRARO Vincenzo
18. PAPARO Nino
19. MYAGMARJV Odsuren
20. NICOLASI Dario
21. RICUPERO Simone
22. SCIRÉ SCAPUZZO Sergio
23. STARK Frank

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Attanasi Francesca	Italy	Attili Andrea	Italy
Baldacchini Leonardo	Italy	Baldaccini Francesca	Italy
Basile Salvatore	Italy	Belcari Nicola	Italy
Berardinelli Francesco	Italy	Bertolotti Alessia	Italy
Bizzarri Fabrizio	Italy	Brambilla Sergio	Italy
Bruzzaniti Vicente	Italy	Bufacchi Antonella	Italy
Busatto Giovanni	Italy	Caciolli Antonio	Italy
Camera Franco	Italy	Caraffini Diego	Italy
Cherubini Roberto	Italy	Cicione Michele	Italy
Civinini Carlo	Italy	Claps Gerardo	Italy
Colò G.L.	Italy	D' Andrea Marco	Italy
D' Angelo Giovanni	Italy	D'onofrio Antonio	Italy
De Natal Viviana	Italy	Degl'innocenti Scilla	Italy
Di Leva Antonio	Italy	Esposito Giuseppe	Italy
Falco Maria Daniela	Italy	Fattori Andrea	Italy
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Gerardi Silvia	Italy	Gerbaldo Roberto	Italy
Ghigo Gianluca	Italy	Gozzelino Laura	Italy
Grandi Sveva	Italy	Guerro Leonardo	Italy
Guidoni Antonella	Italy	Iannuzzo Francesco	Italy
Introini Maria Vittoria	Italy	Larosa Giuseppina	Italy
Laviano Francesco	Italy	Lopardo Giuseppina	Italy
Luciani Anna Maria	Italy	Malferrari Luciana	Italy
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Marrale Maurizio	Italy	Masullo Rocco	Italy
Mazzocchi Chiara	Italy	Menichelli David	Italy
Million Benedicte	Italy	Morelli Luca	Italy
Nardelli Sara	Italy	Nurra Viviana	Italy
Odorici Fabrizio	Italy	Palmerini Sara	Italy
Passeri Daniele	Italy	Patera Vincenzo	Italy
Pavan Gianni	Italy	Poggi Marco	Italy
Pola Andrea	Italy	Porcari Paola	Italy
Porzio Antonino	Italy	Renzi Francesca	Italy
Rosi Antonella	Italy	Rosso Valeria	Italy
Russo Stefano	Italy	Saltarelli Alessandro	Italy
Scaringella Monica	Italy	Sciubba Adalberto	Italy
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Vazzana Dario	Italy	Velardi Francesco	Italy
Verona Rinati Gianluca	Italy	Vigilante Mariano	Italy
Adroit Guillaume	France	Bruzzi Mara	Italy
Bisogni	Italy	Amutkan Ozge	Turkey

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Baran Virgil	Romania	Basrak Z.	Croatia
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Blokhintsev Leonid	Russia	Bonnet Eric	France
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Cao L.G.	China	Carlin Nelson	Brasil
Chatterjee M.	India	Cheal Bradley	UK
Coc Alain	France	Cruceru Ilie	Romania
Das Cupta Shinjinee	India	De Assis Souza F.	Brasil
De Sereville Nicolas	France	De Toledo Szanto	Brasil
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Fiore Enrico	France	Gabor Kiss	Hungary
Gimenez Marcelo	Brasil	Gorioly Stefane	Belgium
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Hermann Wolter	Germany	Irgaziev Bakhadir	Pakistan
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Kozik Tomasz	Poland	Kroha Vaclav	Czech rep.
La Rosa Giusy	Spain	Li Chengbo	China
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Miljanic Diuro	Croatia	Mukhamedzhnov A	Usa
Nelson Carlin	Brasil	Niggli Hugo	Svizzera
Odsuren M.	Mongolia	Ostahhko Volodymyr	Ukraine
Pain Steven	UK	Patrois Nikolas	Greece
Pawlowski P.	Poland	Pereira Dirceu	Brasil
Petrascu Horia	Romania	Petrovic Ivan	Serbia
Pfabe Malgorzata	Usa	Piasecki E.	Poland
Pietrzak T.	Poland	Planeta Roman	Romania
Pop Amalia	Romania	Prepolec Lovro	Croatia
Ristic - Fira Alexsandra	Serbia	Rosinski Marcin	Poland
Rothard Hermann	France	Ruofu Chen	China
Ryuto Hiromichi	Japan	Sandor Blasco	Hungary
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Schoeder Udo	Germany	Senee Frank	France
Seredov Vasily	France	Simpon Gary	France
Sobiczewski Adam	Poland	Soic Neven	Croatia
Somoriaj Endre	Hungary	Tabassan Uzma	Turkey
Typel Stefan	Germany	Uroic Milivoj	Croatia
Veselsky Martin	Slovakia	Wen Qungang	China
Wieleczko Jean Pierre	France	Wieloch A.	Poland
Wolter Hermann	Germany	Yakovlev D.	Russia
Yamaguchi Kanato	Japan	Yan	China
Zadro Mile	Croatia	Zakula Jelena	Serbia
Zhang	China	Zhang Hong Fei	China

Zhang Shi Sheng	China	Mauger Alain	Italy
Loktev Denis	France	Lipari Paolo	Italy
Roux Jean	France	Favalli Paolo	Italy
Beranzoli Laura	Italy	Marinaro Giuditta	Italy
Capone Antonio	Italy	Bonori Maurizio	Italy
Taiuti Mauro	Italy	Anghinolfi Marco	Italy
Piombo Davide	Italy	Morganti Mauro	Italy
De Bonis Giulia	Italy	Barbarino Giancarlo	Italy
Circella Marco	Italy	Barbarito Elio	Italy
Spurio Maurizio	Italy	Margiotta Annarita	Italy
Chiarusi Tommaso	Italy	Smerzi Augusto	Italy
Rivet Marie France	France	Brink David	England
Napolitani Paolo	France	Wei Zuo	China
Matera Francesco	Italy	Bou Cabo Manuel	Spain
Capel Pierre	Belgium	Menegon Oshima M	Brasil
Pleskac Radek	Germany	Rodrigues Marcia RD	Brasil
Shvedov Leonid	Ukraine	Sura Jozef	Poland
Verboncoeur John	Usa	Zhanov Akram	Russia
Zhao Enguang	China	Zhou Shangui	China
Hang Janlong	China	Acquaviva Grazia	Italy
Aliotta Marialuisa	UK	Balabanski Lukanov	Bulgaria
Bardelli Luigi	Italy	Barlini Sandro	Italy
Benitez Sanchez Miguel	Spain	Bini Maurizio	Italy
Casini Giovanni	Italy	Ciaranfi Roberto	Italy
Cirio Roberto	Italy	Ciulla Elena	Italy
Degerlier Meltem	Italy	Del Carmine Piero	Italy
Di Franco Ivana	Italy	Donetti Marco	Italy
Emanuele Umberto	Italy	Galichet Emmanuelle	France
Giordanengo Simona	Italy	Grassi Laura	Italy
Guazzoni Paolo	Italy	Gueli Anna Maria	Italy
La Monica Viviana	Italy	Lo Bianco Giovanni	Italy
Lo Faro Giuseppe	Italy	Malannino Daniela	Italy
Manzelli Luca	Italy	Marchetto Flavio	Italy
Mezzetti Enrica	Italy	Minetti Bruno	Italy
Nicolosi Dario	Italy	Olmi Alessandro	Italy
Ott Johannes	Italy	Owens Alan	NL
Pagano Angelo	Italy	Papa Massimo	Italy
Pasquali Gabriele	Italy	Petta Catia	Italy
Piantelli Silvia	Italy	Pirrone Sara	Italy
Poggi Giacomo	Italy	Politi Giacomo	Italy
Potenza Renato	Italy	Privitera Sonia	Italy
Pulvirenti Manuela	Italy	Quarati Francesco	Italy
Randazzo Nunzio	Italy	Ricupero Simone	Italy
Rosato Elio	Italy	Russo Valerio	Italy
Sambi Sara		Sanfilippo Marisa	Italy
Sipala Valeria	Italy	Spatola Corrado	Italy
Sperduto Maria Leda	Italy	Stefanini Andrea	Italy
Tobia Gianpaolo	Italy	Tricomi Alessia	Italy
Trifirò Antonio	Italy	Tuvè Cristina	Italy

Valastro Lucia	Italy	Verde Giuseppe	Italy
Zanini Alba	Italy	Zdenek Hons	Czech rep.
Colonna Nicola	Italy		

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Recent results and perspectives of the NEMO project
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Cocimano R for the KM3NeT collaboration.
A comparison of AC and DC power feeding systems based on the NEMO experiences
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Leonora E on behalf on NEMO collaboration
Characterization of two prototypes for a new large area four anode photomultiplier
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Amore I for the NEMO collaboration
First results from the NEMO Phase-1 experiment
VLVnT Workshop, 22-24 April 2008, Toulon, France – NIM A602, 68, 2009

Bersani A
Instrumentation of a new direction sensitive segmented optical module
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Ameli F for the KM3NeT collaboration.
KM3NeT: A proposal design for a detection unit data transmission system based on copper backbone
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Coniglione R, Distefano C, Migneco E, Sapienza P for the KM3NeT collaboration
KM3NeT: Optimization studies for a cubic kilometer neutrino detector
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Sapienza P, Coniglione R, Distefano C, Migneco E for the KM3NeT collaboration
KM3NeT: Study of the angular acceptance for a high energy neutrino telescope in the Mediterranean sea
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Lo Presti D, Caponetto L, Randazzo N
Low power multi-dynamics front-end architecture for the optical module of a neutrino underwater telescope
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Megna R
Monte Carlo simulation studies of the timing calibration accuracy required by the NEMO underwater neutrino telescope
VLVnT Workshop, 22-24 April 2008, Toulon, France – NIM A602, 80, 2009

Orlando A. for the NEMO collaboration
On line monitoring of the power control and engineering parameters systems of the NEMO phase-2 tower
VLVnT Workshop, 22-24 April 2008, Toulon, France – NIM A602, 180, 2009

Russo S
Qualification tests and readout electronics reliability analysis for the deep sea Underwater telescope NEMO
VLVnT Workshop, 22-24 April 2008, Toulon, France – NIM A602, 137, 2009

Piombo D, for the ANTARES and NEMO collaborations
The sector of the ANTARES line to be deployed in the NEMO site
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Toscano S, Ardid M, Bou-Cabo M, Circella M, Hernandez-Rey JJ, Perkin J, Schuller JP, Thompson LF
Time calibration and positioning for KM3NeT
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Circella M, for the ANTARES collaboration
The Construction of ANTARES, the first undersea neutrino telescope
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Giovannetti G, for the NEMO collaboration
New electronics architecture in NEMO phase-2.
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D'Amico A, for the NEMO collaboration
The electro-optical cabling system for the NEMO phase-2 tower
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Sapienza P, for the KM3NeT collaboration
KM3NeT: a cubic-kilometer scale deep sea neutrino telescope in the Mediterranean sea.
NNN09 - Workshop on next generation nucleon decay and neutrino detectors, 8-10 October 2009, Estes Park, Colorado, USA

Riccobene G
The ESONeT East Sicily Node
ESONeT 05 - 07 October 2009 - IPGP, Paris, France

DEGREES THESES

Student: Barbagallo Massimo
"Studio di fattibilità di un rivelatore compatto per neutroni termici"
Tutor: Bellia G, Finocchiaro P, Cosentino L

Student: Candiano Giuliana
"Ricostruzione tomografica di una immagine con protoni attraverso simulazione Montecarlo"
Tutors: Cirrone GAP, Cuttone G, Lo Nigro S

Student: Carbone Diana
"Studio della reazione $^{13}C(^{18}O,^{16}O)^{15}C$ a 84 MeV con MAGNEX "
Tutors: Cunsolo A, Cappuzzello F

Student: Febbraro Vincenzo
"Rivelazione di gamma per il monitoraggio di scorie radioattive"
Tutor: Bellini V, Finocchiaro P, Capogni M

Student: Greco Giuseppe
"Caratterizzazione di dispositivi fotomoltiplicatori al silicio per applicazioni di monitoraggio di radiazioni"
Tutor: Russo GV, Finocchiaro P, Pappalardo A

Student: Minniti Triestino
"Produzione di Ioni da Plasmi Laser per studi di reazioni nucleari D-D"
Tutor: Torrisi L

Student: Rizzo Carmelo
"Effetto di isospin su meccanismi dissipativi in collisioni fra ioni pesanti alle Energie di Fermi"
Tutors: Colonna M, Di Toro M

Student: Scardina Francesco
"Dinamica del QGP: soppressione di jet adronici e flussi collettivi"
Tutors: Di Toro M, Greco V

Student: Schillaci Maria
"Ricerca della strength di Gamow-Teller nella $^{28}Si(^{7}Li,^{7}Be)^{28}Al$ con MAGNEX e la tecnica di ricostruzione delle traiettorie"
Tutors: Cunsolo A, Cappuzzello F

Student: Spartà Roberta
" Studio dei canali di reazione $^{2}H(d,p)^{3}H$ e $^{2}H(d,n)^{3}He$ ad energie di interesse astrofisico attraverso il Metodo del Cavallo di Troia "
Tutors: Spitaleri C, Pizzone RG

Student: Trovato Agata
"Ottimizzazione delle prestazioni del telescopio per neutrini KM3NET"
Tutors: Migneco E, Coniglione R, Sapienza P

Student: Viola Salvatore
"Realizzazione e test di un sistema di posizionamento acustico innovativo per il telescopio Km3
Tutors: Migneco E, Riccobene G

PH.D. THESES

Student: Cavallaro Manuela
"First Application of the MAGNEX spectrometer: investigation of the $^{19}F(^{7}Li,^{7}Be)^{19}O$ reaction at 52.2 MeV"
Tutors: Cunsolo A, Cappuzzello F

Student: Plumari Salvatore
"Dinamica partonica in presenza di campi effettivi autoconsistenti"
Tutors: Di Toro M, Greco V

SEMINARS

The following seminars were presented at LNS this year

18-Feb-2009
F. Cappuzzello
MAGNEX: primi risultati e prospettive

23-Feb-2009
D. Mascali
A new approach to the study of the ECR heating and particle dynamics in the plasma of ECR Ion Sources

25-Feb-2009
B. Irgaziev
Use of Mathematica

6-Mar-2009
P. Finocchiaro
New LNS website

12-Mar-2009
R.Calabrese
Intrappolamento di atomi di Francio per test di simmetrie fondamentali

18-Mar-2009
I. Rabin
Archaeometry of Dead Sea Scrolls

18-Mar-2009
M. Bicchieri
Spectroscopic analysis of jewish parchments

23-Mar-2009
L. Calabretta
Informal meeting on FRIBs update

11-May-2009
D. Pereira
Nuclear rainbow scattering in heavy ion systems

19-May-2009
G. Cuttone
Misure di frammentazione per adroterapia...

22-Jun-2009
T. Borello Lewin
(6Li,d) experiments on odd light

16-Jul-2009
C. Mazzocchi
Astrofisica nucleare

23-Jul-2009
P. Capel
Theoretical description of breakup reactions o

31-Jul-2009
J. Verboncoer
Overview of the Particle-in-Cell Simulation

31-Jul-2009
J. Verboncoeur
A PIC-MCC Model of a Sputtering Magnetron

31-Jul-2009
J. Verboncoeur
XOOPIC tutorial

12-Oct-2009
J. Harasimowicz
Beam instrumentation development development at the QUASAR group, University of Liverpool

13-Nov-2009
I. Padròn Diaz
Experimental progress on reaction

14-Dec-2009
G. Riccobene, F. Del Tevere, F. Ferrera, G. Barbagallo, VR. Potenza
Nuove infrastrutture e servizi di rete ai LNS

18-Dec-2009
X. Michalet
New detectors for single-molecule fluorescence spectroscopy and imaging

EVENTS

February 11
Olimpiadi della Fisica

March 23
Informal Meeting on FRIBs update

April 3
Emilio Migneco's 70th birthday

April 6 – 16
XIX Settimana della Cultura Scientifica e Tecnologica

May 11
Fisica in Barca

June 8 – 12
Tecnical Meeting on Heavy Charged Particle Interaction data for radiotherapy

June 18 – 20
PPLA 4th Workshop Plasma Production by Laser Ablation

June 30
Meeting gruppo III LNS

July 1
Meeting gruppo V LNS

July 8 – 9
LNS Scientific Committee

July 10
LNS User Meeting

September 14 – 18
INFN CNS V Annual Meeting

September 18 – 19
Workshop in honor of the 70th birthday of Massimo Di Toro

September 20 – 27
5th European Summer School on Nuclear Astrophysics

October 10
Open Day ASPERA

October 12 – 14
Utilizzo del codice GEANT4 in campo medico LNS

October 15 – 22
14th Geant4 Users and Collaboration Workshop

November 4 – 7
IWM2009 International Workshop on Multifragmentation

November 27
Caffè Incontro con gli Studenti di Fisica ai LNS

November 30 – December 2
Spes – Excyt incontro tecnico

December 4
Caffè Incontro con gli Studenti di Fisica ai LNS

December 9 – 11
The First EURISOL UG topical meeting