

LNS News

INFN - Laboratori Nazionali del Sud



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LNS Director*



In these first months Superconducting Cyclotron beam has been steadily delivered for experimental activity, while major maintenance and improvement of the performance of the Tandem accelerator were successfully performed.

Important agreements were signed with MIT and the ELI. The wide experience in the field of accelerators at LNS was the basis of the agreement signed with MIT to participate in the experiment DEAdALUS.

A Memorandum of Understanding between LNS and the ELI (Extreme Light Infrastructure) of Prague, has been signed. This MoU officially establishes the European ELIMED project whose main aim is the realization of a facility dedicated to Medical Physics studies with the charged particle

beams produced in the interaction of high power lasers with the matter for therapeutic use.

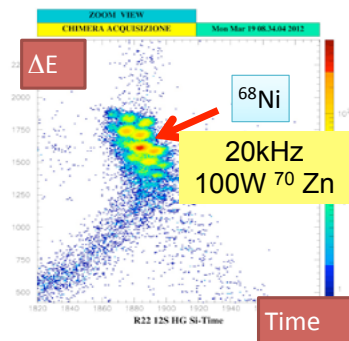
LNS is also strongly involved with the ion sources group in the design update of the Linac for the European Spallation Source in Lund.

Protontherapy cycles devoted to the melanoma treatment continue regularly.

LNS are also actively engaged in dissemination of scientific research. On January took place the third edition of the "Coffee-Meeting" aimed primarily at university students of the department of physics and astronomy for the presentation of research topics for their thesis. A huge success was the event called "Explorers of the Invisible" with the participation of over 1500 students from schools in Sicily.

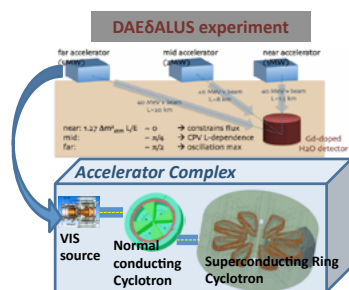
From the Accelerators

During the first five months of 2012, time and manpower were dedicated to look for possible solutions of the main problems of the Tandem, with the aim of restoring the high level of reliability that qualified the accelerator in the past years. Only part of this time was used, since at the same time the Cyclotron was delivering beams for the usual experimental activity, therefore access to the Tandem area was somewhat reduced due to restrictions imposed by radioprotection when accelerating and transporting proton beams or high intensity beams. However, the following tasks were accomplished: a) repairing of the first accelerating tube by means of a special vacuum leak sealant; b) assembling of a new belt type and first tests of its mechanical and electrical properties. Moreover, in parallel several maintenance operations were made on the SF6 circuit, since some oil deposit was found on the last damaged belt as well as on several parts of the Tandem. The task a) was successful: the residual pressure is now around the operating value. Concerning the task b), our conclusion is that the new belt needs to be improved: the tested prototype was not enough stiff, and, more important, the insulating material has to be more temperature resistant. After having reported the above data to the company, while waiting for their decision about putting further efforts on the construction of an improved belt, we are installing a repaired HV belt to run the Tandem and make experiments.



New beam produced

A 28 MeV/A ^{68}Ni fragmentation beam was produced at LNS in March. The beam was obtained using a primary ^{70}Zn 40 MeV/A beam impinging on 250 μm thick Be target. For this first production test only 300nA of ^{70}Zn were used, and a total intensity of fragmentation beams of about 35-40kHz were delivered in the CHIMERA scattering chamber. ^{68}Ni was the most intense beam transported around 20% of the total intensity. The experience acquired with the production of the primary beam ^{70}Zn will allow in the future runs to get larger beam intensity. 20kHz ^{68}Ni should be obtained with a nominal primary beam of 100 W.

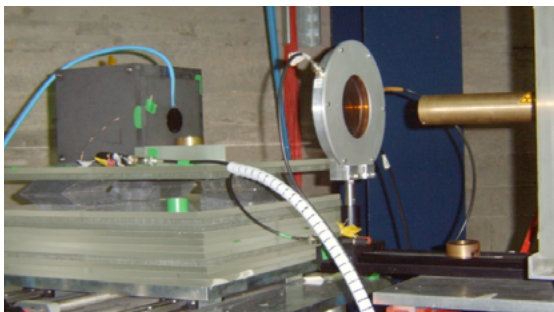


MIT collaboration established

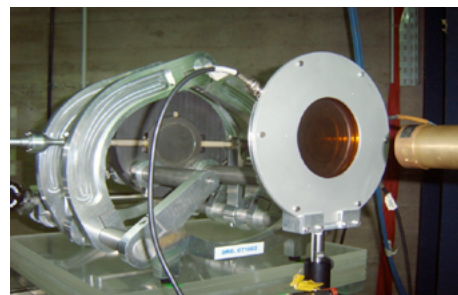
LNS have established a collaboration with MIT on DAEδALUS (Decay-At-rest Experiment for CP studies At the Laboratory for Underground Science), which is short-base-line neutrino experiment. MIT want to take advantage of the know-how developed during these years at LNS on sources and cyclotrons. The project, which involves researchers from all over the world, foresees the VIS source designed and built at INFN-LNS and two cyclotrons, whose combination will deliver 1.6MW. The final energy of the protons extracted will be 800MeV/amu. Dr. Calabretta leads the team in Catania that include 2 full-time collaborators directly funded by MIT.

Reference dosimetry for light-ion beams based on graphite calorimetry

The ReDoLib project aims to measure the mean energy required to produce an ion pair in dry air (w_{air}) by light-ions at LNS. To this end, a primary standard level graphite calorimeter for proton and light-ion beams developed at the National Physical Laboratory, UK is compared with the dose response of ionization chambers. In order to derive dose to water from graphite calorimetry, measurements require determination of a dose conversion. A first experimental campaign, in an 80 MeV/n carbon ion beam at the 0 degree beam line, was dedicated to determine a correction factor included in dose conversion procedure. In a second campaign, the w_{air} -values were successfully determined in the 80 MeV/n alpha particle beam. In a third campaign the w_{air} -value will be measured for carbon ion. Results have been and will be presented at different international conferences (PTCOG, ESTRO, BHPA) and will be the subject of forthcoming publications.



Ionometry measurement with a Roos chamber



Calorimetry measurement with the proton and light-ion graphite calorimeter

A brand new ^{208}Pb beam for alpha cluster studies in ^{212}Po

A new ^{208}Pb beam has been produced and delivered by the Superconducting Cyclotron (CS) at LNS at the end of November 2011. It has been used for the POLONIUM experiment, approved by the LNS PAC on July 2011. The ^{208}Pb beam (31+ charge state), extracted from the SERSE ECR source, was accelerated by the CS at the beam energy of 10.1 A·MeV. The timing, measured by using a MCP placed in the ex-neutroni beam line, had a resolution less than 1 ns FWHM. The average beam intensity, without interburst suppression, was about 300 epA. In the POLONIUM experiment, the resonant scattering method in inverse kinematic has been used for the first time to measure the elastic and inelastic scattering of ^{208}Pb on ^4He in order to investigate on alpha-cluster structures in ^{212}Po . The ^{208}Pb has been sent through a ~ 2 m long gas target filled by ^4He . The recoiling alpha particles have been measured at zero degree. The ^4He stopping power of ^{208}Pb on ^4He , a crucial ingredient in performing such kind of experiment, has been also measured. The POLONIUM spokesperson, Maria Grazia Pellegriti wishes to thank all the LNS staff for the efficient support



Li(alpha,n) ^{11}B data recommended

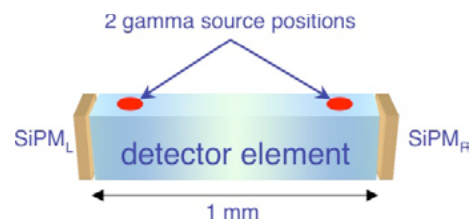
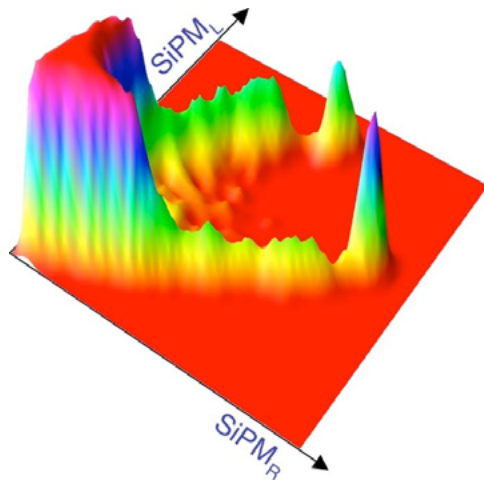
The LNS data, measured by means of the first EXCYT beam, and the LNS analyses of all existing reaction data have been selected by A. Coc et al. to identify the $^8\text{Li}(\alpha, n)^{11}\text{B}$ recommended cross section in a new extended nuclear network relevant for Big Bang nucleosynthesis calculations [The Astrophysical Journal 744(2012)158]. In fact, the LNS research works has allowed solving the strongly controverted issue of the cross section magnitude resulting from previous inclusive and exclusive experimental studies in the literature. The novelty of the LNS research works consists, first of all, of the innovative technique using a threshold-less neutron detector, sensitive to all energetically open $^{11}\text{B}^* + n$ reaction branches, well suited to be used with extremely low intensity beams. It also consists of the development of an original formalism that allows obtaining a reliable estimate of the reaction rate at astrophysical energies. An exhaustive list of the LNS publications on this subject can be found in the bibliography of the recent paper by M. La Cognata and A. Del Zoppo [The Astrophysical Journal 736(2011)148]. Results have been and will be presented at different international conferences (PTCOG, ESTRO, BHPA) and will be the subject of forthcoming publications.

High-resolution Time-of-Flight PET with Depth-of-Interaction becomes feasible: a proof of principle

Prove was obtained that the choice of a suitable treatment of the scintillator surfaces, along with suitable photodetectors electronics and specific algorithms for raw data analysis, allow to achieve an optimal tradeoff between energy, time and DOI resolution, thus strongly supporting the feasibility of a prostate TOF-PET probe, MRI compatible, with outstanding features and performance. In numbers this means a detector element of 1.5mm x 1.5mm x 10mm, achieving at the same time energy resolution around 11.5%, time-of-flight resolution around 150 ps and DOI resolution even below 1 mm. Such a time resolution allows to increase significantly the Noise Equivalent Counting Rate, and consequently improve the image quality and the lesion detection capability.

These individual values correspond to the best obtained so far by other groups, but now at LNS all of them were obtained simultaneously. This proof of principle could pave the way to the feasibility of a TOF-PET MRI compatible probe with unprecedented features and performance, not only innovative for prostate radiotracer imaging but possibly also for other organs.

L Cosentino, P Finocchiaro, A Pappalardo, F Garibaldi arXiv:1203.0043v1 [physics.med-ph]gs.



3D representation of a left-right energy scatter plot with a 662keV gamma source placed first in a position and then in another one. The full-energy peak and the Compton shoulders are clearly seen.

Users News

Memorandum of Understanding between the LNS and the ELI (Extreme Light Infrastructure) of Prague signed.

LNS and CSFNSM with MIT on DAEδALUS neutrino experiment established.

LNS Scientific Committee meeting scheduled June 11-13.

On July will begin the installation of a new beam line in the MAGNEX hall.