

LNS News

INFN - Laboratori Nazionali del Sud



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This report represents the start of a periodic publication devoted to collect the most relevant information on the LNS user activity. The main purpose is to highlight the LNS excellences as the result of intensive experimental and theoretical activity of international importance. Today the LNS can boast a multidisciplinary activity, where nuclear physics is still alive in a leading position, together with nuclear and particle astrophysics. Over the last decades very

important skills have been acquired on the physics of accelerators and their applications in various fields, such as hadron therapy, cultural heritage, science of materials. Our efforts will be focused on the maintaining of the still well running accelerators and the facilities around them. LNS is even strongly engaged in the realization of the first part of the Km3Net telescope at our lab in Capo Passero then we expect to play a key role in high energy neutrino astronomy in Europe.

NEMO KM3NeT project funded

In August 2011 the LNS-INFN applied to the PON 2007-2013 with the project KM3NeT-ITALIA aiming at the construction of the first part of the KM3NeT italian node. The project has been approved in November 2012 and funded for 20.8 M€ by the Italian Ministry of Research. This infrastructure, made of 30 “towers” equipped with 37200 photomultipliers (3” diameter), will be the largest neutrino telescope in the Northern hemisphere and will provide an invaluable opportunity to validate the overall technology and the data analysis.



From the Accelerators

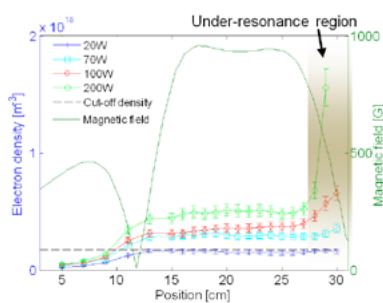
The 2012 Cyclotron beam calendar will start in February. In fact some upgrading activities will take place in January: the room temperature ECR source Caesar will be commissioned with the new injection section, which will enable the production of medium-low energy metallic beams in addition to the usual beam types. Also, the source performance is expected to improve. At the same time, some steps forward towards a new controller of the helium liquefier will be made. No Tandem beams will be allocated at least for the first two months of 2012. In this period, the belt question, which is presently limiting the Tandem performance, will be investigated. Since the residual pressure in the Low Energy section has recently increased, a vacuum leakage campaign will be accomplished.



CHIMERA is again at home

After about one year the four CHIMERA rings used for the ASY EOS experiment at GSI are again at LNS. The GSI experiment was successful and now data analysis is in progress. The rings are going to be remounted inside the CHIMERA scattering chamber after some maintenance. CHIMERA should be ready in its complete configuration at the end of February. Also a new target system with the possibility to introduce new targets without breaking the vacuum of the scattering chamber will be available.

info:<https://192.84.151.50/joomla/>



New ignition mode for ECR sources

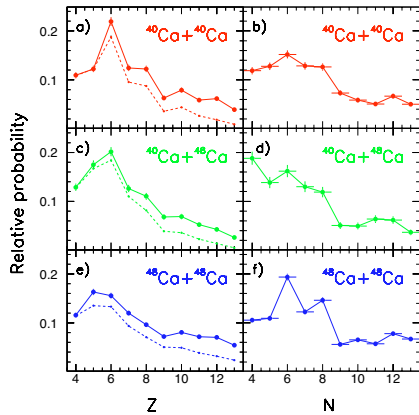
The measurements carried out with a Microwave Discharge Ion Source (MDIS) enabled us to compare the ECR heating with the innovative mechanisms of plasma ignition based on the Electrostatic Bernstein Waves (EBW). Figure features that X rays come out only when conditions for EBW generation were established, i.e. only when $\text{Bin}/\text{Becr} < 1$. In the regions where EBW can propagate and be absorbed (under-resonance B field) the electron density (10^{18} cm^{-3}) is much larger than in off-resonance zones, being 20 times larger than the cutoff. Hence MDIS and ECR multicharged ion sources working in EBW heating regime could reach beam currents much higher than actual ones. Future experiments will determine the achievable brightness.

MAGNEX – EDEN completed the commissioning

The EDEN array of 36 Ne213 liquid scintillators from IN2P3 IPN-Orsay [1] has been coupled to the MAGNEX spectrometer [2]. The EDEN read-out electronics has been completely renewed. The commissioning of the new facility was very positive. Thanks to the large acceptance and high resolution of MAGNEX and to the capability of EDEN to identify with good efficiency the neutrons and measure their energy new perspectives are opened in many field of nuclear spectroscopy and reaction mechanisms studies.



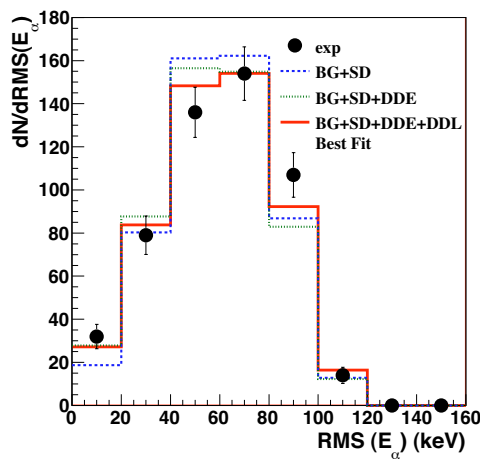
[1] H. Laurent et al., NIM A326 (1993) 517-525 [2] F.Cappuzzello, et al. “MAGNEX: an innovative large acceptance spectrometer for nuclear reaction studies” in: Magnets: Types, Uses and Safety, Nova Publisher Inc., New York, 2011, pp 1-63.



Even odd staggering in nuclear reactions

The CHIMERA collaboration has recently published a paper showing some results obtained at LNS. The paper shows for the first time the staggering on the even odd yield of the light fragments emitted as a function of both their proton (Z) and neutron (N) numbers. The fragments were produced in nuclear reactions between Calcium isotopes. It is very interesting to note that the amplitude of the staggering depend on the N/Z of the colliding system. The staggering in N is larger for large N/Z of the system (48Ca+48Ca), while it is reduced for small N/Z (40Ca+40Ca). The staggering in Z has exactly the contrary behavior, being larger for 40Ca+40Ca.

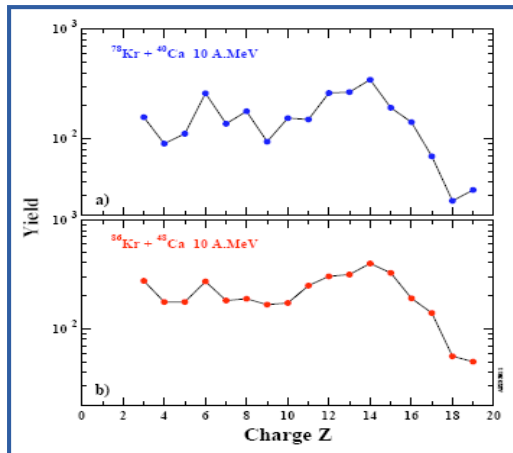
I.Lombardo et al Phys. Rev. C 84, 024613 (2011)



First direct evidence for alpha-particle condensation in nuclei

The ISOSPIN collaboration has very recently published a letter relative to alpha-particle condensate in nuclei, which is a novel state described by a product state of alpha's, all in the lowest S orbit. The fragmentation of quasi-projectiles from the reaction $^{40}\text{Ca} + ^{12}\text{C}$ at 25 MeV per nucleon, obtained at LNS, was used to produce excited states candidates to alpha-particle condensation. Complete kinematic characterization of individual decay events, made possible by the very high granularity of CHIMERA at forward angles, reveals that $7.5 \pm 4.0\%$ of the particle decays of the Hoyle state correspond to direct decays in three equal-energy alpha particle (DDE), which is a direct signature for alpha-condensation. This study also evidenced the presence of direct alpha decays from a linear alpha-chain (DDL) discussed in theoretical studies. The Hoyle state ($E_x = 7.65$ MeV, 0_2^+ state of ^{12}C) which plays a crucial role for the synthesis of ^{12}C in the universe was theoretically demonstrated as the typical alpha-particle condensate state.

R. Raduta et al., Phys. Lett. B 705, 65 (2011)



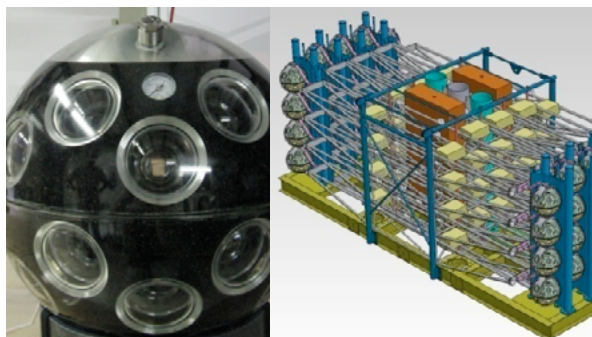
Isospin effects in medium compound nuclei decay at 10 MeV/A

The first results of the ISODEC experiment, performed at the INFN-LNS by using the CHIMERA detector, were presented at different international conferences. The principal aims of this experiment is to study the competition between the various disintegration modes of $^{118,134}\text{Ba}$ compound nuclei produced in the reactions $^{78}\text{Kr} + ^{40}\text{Ca}$ and $^{86}\text{Kr} + ^{48}\text{Ca}$ at 10 A.MeV, exploring the isospin dependence of the decay modes of compound nuclei and providing crucial information on fundamental nuclear quantities as level density, fission barrier or viscosity. First results show evident staggering effects in the Z distributions, as well as different isotopic composition and enrichment for the reaction products in the two systems. The results will be published in the FUSION11 and CNR11 Conference Proceedings.

Solar fusion cross sections. II. The pp chain and CNO cycles

The LNS nuclear astrophysics group, led by prof. Claudio Spitaleri, has recently contributed to a review of the most recent data on nuclear fusion cross sections. Such a compilation gives a very important contribution to the understanding of energy generation in the Sun and in other hydrogen-burning stars and of solar neutrino production.

Adelberger E.G. et al Reviews of Modern Physics Volume: 83 Issue: 1 Pages: 195-245



The Pre-Production Model (PPM) of KM3NeT

The first tower prototype of the future multi-kilometre neutrino telescope in the deep Mediterranean Sea, is now under construction. The PPM consists of 20 mechanical storeys made of 6m long bars 40 m spaced for a total tower height of about 900 m. Two storeys are equipped with multi-PMT (31 3" PMTs) Optical Modules (OMs) (see photo) at each bar edge, thus allowing a complete test of electronics and data transmission, while the other storeys host dummy OM. The PPM installation is expected to take place in 2012 in the Capo Passero site. The LNS group has a very active role in this project that will be the conclusion of the European KM3NeT Preparatory Phase that is lead by LNS INFN. www.km3net.org

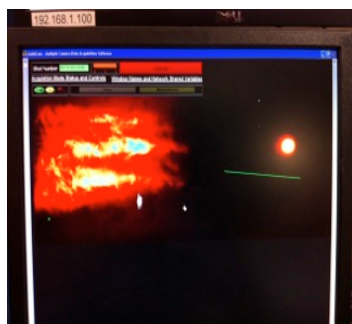


ICIS 2011

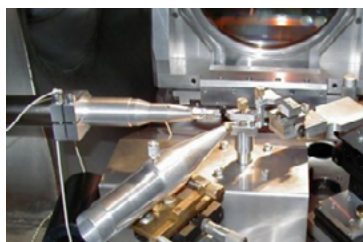
The 14th International Conference on Ion Sources - September 12th -16th, 2011 Giardini Naxos. More than 280 people attended the conference and almost 230 contributions have been presented, which figures exceed significantly the previous conferences. A relevant number of innovations have been discussed and the proceedings of the Conference are expected to appear on Review of Scientific Instruments of february 2012.

ICIS'11 website <http://icis11.lns.infn.it/> dr.Santo Gammino – ICIS'11 Chairman

Applications of high power laser



- On November 7 dr. Aldo Bonasera gave a seminar presenting his recent experimental data obtained at the Petawatt laser-University of Texas in Austin (see figure with a plasma of CD4+3He), in particular the possibility to measure fusion cross sections in plasma's at different density and temperature. Possible applications in medicine (PET), energy production as well as induced fission from high power laser with high repetition rates (>100TW, 1-10Hz) were discussed. These could be used to produce radioactive nuclei which to be separated and reaccelerated in the cyclotron or tandem. This method could be alternative to exotic nuclei studies in different energy regimes offering a novel perspective of development at LNS.



- A European proposal from Prof. L. Torrisi, (Responsible of the project LIANA-INFN) has been accepted by LASERLAB Europe Community to be developed in the ambit of measurements of non-equilibrium plasmas generated by high power lasers In particular the LIANA measurements demonstrated that plasma-laser interaction from thin films accelerates ions up to energies of about 5 MeV for charge state and that D-D reactions occur in deuterated targets, as demonstrated by the 3 MeV and 2.5 MeV energy detection of protons and neutrons, respectively. These results are permitting to open new horizons to the applications of the physical of plasmas generated by power laser pulses, as that to investigate on nuclear processes to create high electric fields driving ion acceleration to produce monoenergetic ion emission. This can represent a novel field of R&D at LNS.

Users News

Preparation of Sm targets

LNS target Lab is now able also to prepare metallic Sm target. Sm is provided as oxid. The Lab is able to reduce the Sm isotope obtaining a metallic form and with rolling to provide targets of (600-700 µg/cm²)

Electronic service

A new acq system has been implemented in the laboratory for test detector equipped with 32 ch ADC and QDC CAEN

Prof. Stefano Romano appointed as LNS PAC Secretary

The new responsible of the user support for 2012 -2014 is dr. Domenico Santonocito