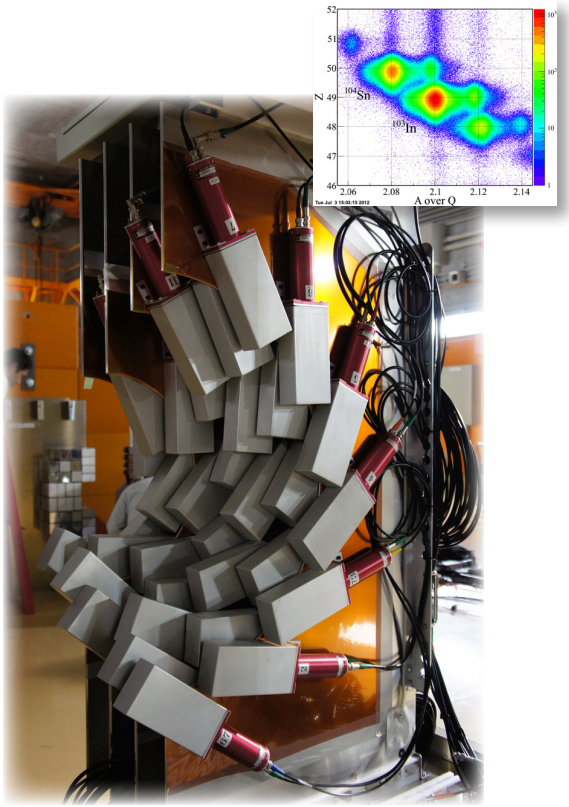
MINOS News Letter n°2, July 2012

Physics discussion

General discussions for the physics cases to be proposed to the next RIKEN PAC (december 2012) have been carried in June 2012 at the Nishina Center. New ideas are still under study. Physics cases requiring high-intensity ^{48}Ca and ^{70}Zn primary beams have been discussed. The interest for the development of a ^{76}Ge beam at intensities larger than 20 pnA has been raised. The use of MINOS to be extended to invariant-mass measurements simultaneously with gamma spectroscopy has been underlined. A quantitative study of the mentioned cases (full simulation for rate estimates, efficiencies and resolutions) will be performed. Detailed discussions will be undertaken within the SAMURAI and SUNFLOWER collaborations in September and October 2012 in view of the 12th PAC.

RIKEN experiment

The RIKEN gamma group and CEA team have performed joint experiments at RIKEN in July 2012. The objectives of the experiments were to measure the transition probability B(E2;0^+->2^+_1) in ^{104}Sn at 150 MeV/nucleon and the one and two neutron knockout from the same nucleus. The experiments were requiring the DALI spectrometer array at the object point of the Zero-Degree Spectrometer downstream the BigRIPS separator. Even though the beam intensity was lower than expected, the experiment is considered successful.



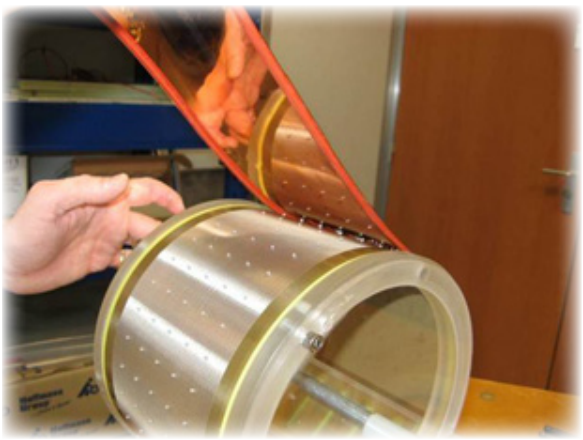
Picture of the left side of the DALI spectrometer. Insert: Online A/q-Z identification of the incoming beam used at RIKEN Nishina center during the experiments.

Electronics

Some of the recent progresses of the GET collaboration include the completion of the characterization of the AGET chip, the production of the first prototype CoBo and a revision of the AsAd board. Mass production of the AGET chip is planned for September. Developments on the Feminos card have been pursued and operation with 4 AGET chips has been tested. A Trigger and Clock distribution Module (TCM) was built. System scalability and synchronization is being tested with five Feminos cards. If robust operation and adequate performance are shown, the Feminos system could be the solution retained for MINOS should the GET system not be available in time. The connection between the readout-electronics and the TPC will be based on micro-coaxial flat cables. The solution being studied uses standard 1 mm pitch, 68-contact connectors on the detector side. Although less compact than the 900-pin grid array connector originally thought, dual-row connectors allow substantial simplifications in the design of cable assemblies that reduce technical risks.

An ancillary detector for MINOS

A cylindrical micromegas detector stripped along the Z direction will surround the MINOS TPC. It is closely inspired by the CLAS12 tracker detector that is currently under development at CEA/SEDI and CEA/SPhN for the upgrade of the CLAS detector at Jefferson Lab (USA). The purpose of this detector is to obtain the information on the z-coordinate of the track independently of the TPC. This will allow to correct the changes of electrons drift velocity that may occur during an experiment. Furthermore, it can be used as an external trigger for the MINOS device. The detailed features of this detector have still to be defined. The cylinder will have the smallest radius achievable (~100 mm) and a strip pitch of ~1 mm covering only a part of the cylinder in order to limit the number of electronic channels to 192. The technique used to build the Micromegas detector (i.e. standard or resistive) is under evaluation based on the expected rate of charge deposit and the results obtained by the CLAS12 collaboration.



A cylindrical Micromegas detector for the CLAS12 experiment.

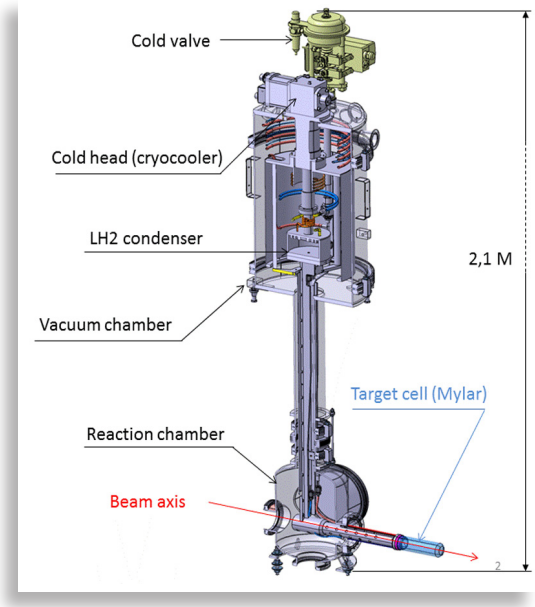
Target cryostat

To liquefy the hydrogen we use a cryostat equipped with a cryocooler. A power of 10 W at 20 K will be needed for the operation. The hydrogen liquefied in the condenser falls by gravity into the target through its circuitry. The cryostat is equipped with a cold valve. By closing this valve, liquid hydrogen can be pushed to the condenser, leaving the target empty. By opening the valve, the liquid hydrogen fills the target cell in few minutes.

All elements of the cryogenic system are defined and mostly already purchased. The 3D conception and drawings are finished. Firm order of the cryostat will be made at the beginning of August. We expect to have the cryostat for the middle of November in our laboratory.

The control and command of the hydrogen transfer is performed via a cryogenic rack. The 3D conception and dimensioning of the safety valves is complete. The order of the cryogenic rack and storages will be made in July 2012.

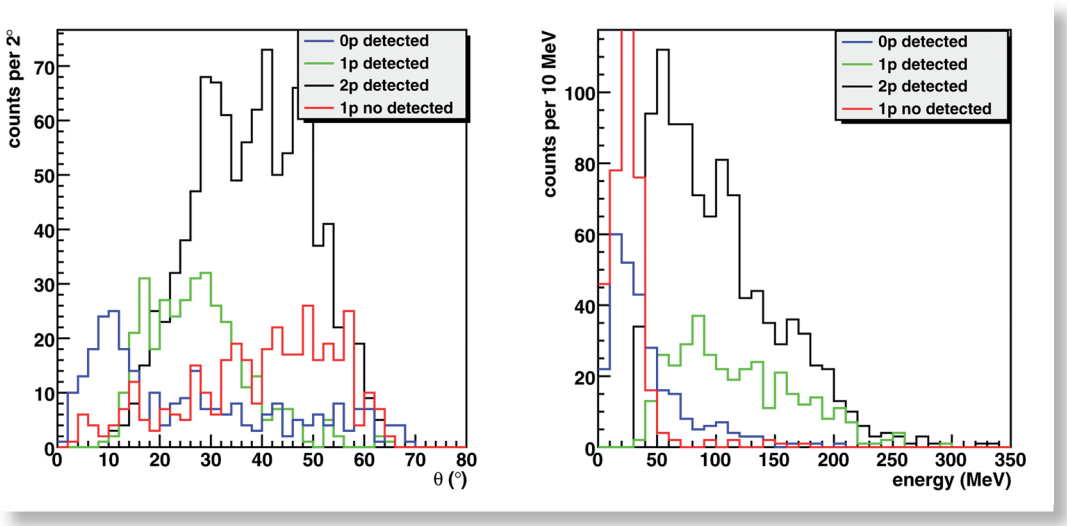
The test campaign of pressure resistance (at liquid nitrogen) is finished. We obtained a safety marge factor of 3.9 (initial goal was 3). We are now achieving 4 target cells to be used in the experiments.



Cryostat MINOS

Simulations

Up to now, simulations of the MINOS device were performed for realistic physics cases such as (p,2p), (p,pn) reactions with Geant4 coupled with the INCL/ABLA code. In order to take into account realistic cross sections and verify the kinematics of emission provided by INCL/ABLA, the THREDEE code is used to generate input files for the Geant4 simulations. THREDEE allows to consider the structure of the nucleus, especially the energy level of the knocked-out nucleon, in a DWIA approximation. The calculated cross sections for ^{61}Ge(p,pn)^{60}Ge and ^{29}F(p,2p)^{28}O for the first 2+ excited state, taking into account the shell-model spectroscopic factors, are respectively 4.64 and 0.66 mbarn. Angular and energetic distributions of the reaction products from THREEDEE were taken as an input for Geant4 simulations for tracking and energy reconstruction of the protons emitted. The kinematics is very similar to those from INCL and a position resolution around 3 mm is obtained.



Left: angular distribution of the protons entering the TPC of MINOS from a Geant4 simulation with THREEDEE inputs for ^{29}F(p,2p)^{28}O at 250 MeV/nucleon. Distinction is made between the cases when zero, one and two protons are detected. Right: energy distribution of the protons.

New comers

Alain Delbart has been promoted as deputy head of the Detector and Electronics Laboratory (SEDI). Alan Peyaud, engineers experienced in Micromegas detectors and freshly hired at SEDI, will take part to the TPC development in MINOS. Anna Corsi has been hired at CEA Saclay as a permanent staff to work on MINOS and RIKEN experiments, Clementine Santamaria got her PhD funded from CEA for 3 years starting from october 2012. Her thesis will be focused on the MINOS development, tracking algorithms, commissioning and RIKEN experiments.

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Design: C. Marteau
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News Letter n°3 is expected in december 2012