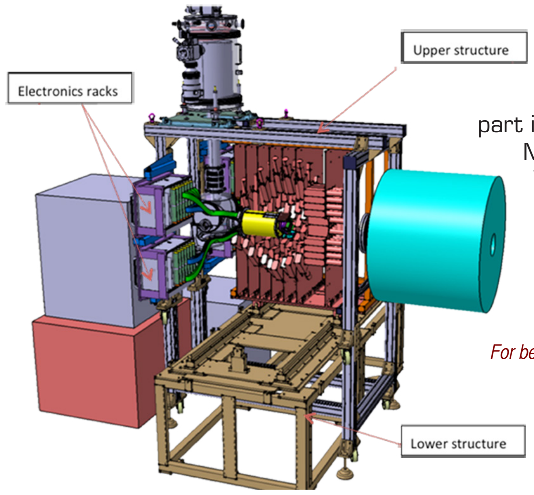
# MINOS News Letter n°3, April 2013




**Mechanics** A few months before transporting the MINOS experiment at RIKEN, the mechanical support components are now being manufactured. The support structure, made of modular tubes assembly has two parts: the upper part is common to the F8 and SAMURAI lines, the lower one allows the positioning of MINOS in the beam axis. On each side, it wears the electronic racks used by the TPC, mounted on a rotating frame for a better accessibility. The beam tube, containing the LH2 target, is closed at its ends by windows Mylar around which are mounted the Silicon detectors. For better viewing, on the figures below, the right side of the DALI2 detector is removed.

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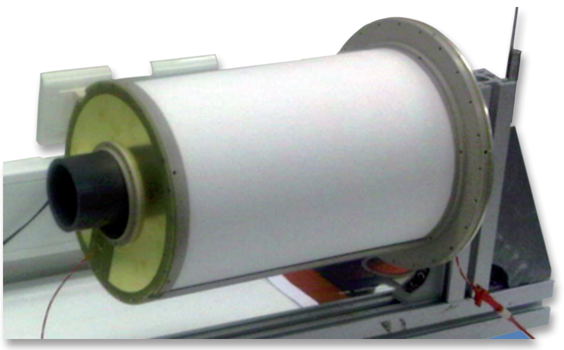
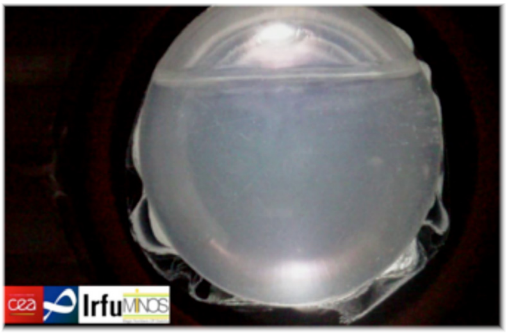
**Time Projection Chamber** Key features of the TPC are as follow: A cylinder long of 30 cm with at one end the cathode and the other the Micromegas detector. The read out is a projective distribution of 4608 pads (outer ones 2 x 2 mm – inner ones 2 x 1mm) where a bulked Micromegas was placed on top at CEA-Irfu-SEDI. The inner and outer field cages structure are made of a self-supporting sandwich Rohacell core and Kapton insulation layers arranged in two concentric cylinders. A total of 400 copper strips connected by CMS resistors on each side of a 25 mm thick Kapton foil with a strip pitch of 1.75mm insure a highly homogenized electric field. The first mechanical assembly of the TPC with all its final components was performed on the 3rd April. Now we are entering a testing phase to validate its operational mode with cosmic rays prior the full in-beam validation at HIMAC, end of 2013.



*Full TPC composed of a pad-plane detector, internal and external field cages and the cathode.*

**$LH_2$ Target Minos** We have received all elements of the cryostat in our laboratory since the beginning of 2013. The cryostat was assembled with all instruments (cold head with the condenser connected, thermalized screen, hermetic pumps, temperature sensors, vacuum gauges and hydrogen pressure sensors). We connected the cryostat with the instrumentation rack for the control command of the installation. We connected the $GH_2$ storage to the cryostat via the cryogenic rack.



*Front view of the target during the filling phase (the top part of the target cell is not filled yet).*

We have obtained the first liquid drogen in the target since the 7th of February. We checked the overall operations of the cryogenic system under the control of the automaton. We need 11 hours to obtain a full liquid hydrogen target:

- 2 hours to have a sufficient vacuum value ($1.10^{-4}$ mbar),
- 8 hours are required to reach the temperature of hy
- drogen liquefaction
- (20 K at 1 bar)
- 1 hour more to complete the liquid target (350 $cm^3$).

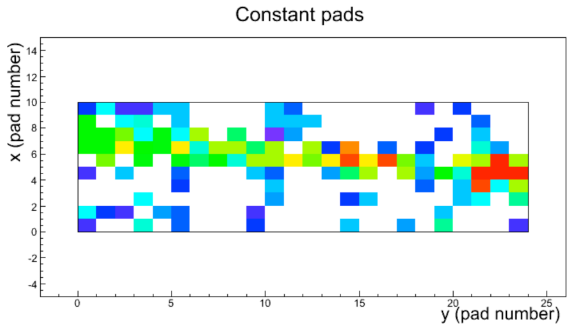
After using the system, we need 12 hours to have a safe system.

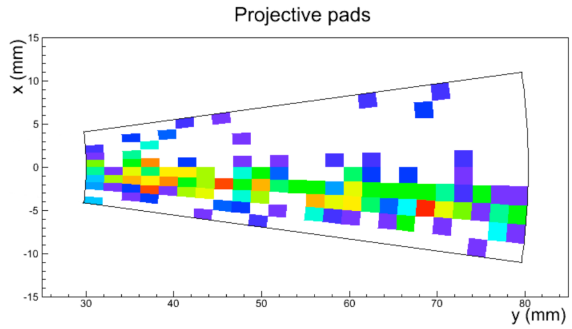
- 11 hours are necessary to reach the room temperature (20 ° C), we used 3 heaters installed in the cryostat (condenser, screen and support target)
- 1 additional hour to put $N_2$ gas instead of the $H_2$ gas in the circuit and in the cryostat.

In particular we tested the cold valve operation for empty target measurements. The target is emptied of its hydrogen liquid in 30 seconds. We stayed 10 hours in this mode. The temperature of the empty target is raised to 60 K. In 2 min we returned in full liquid target by opening the cold valve.

We left the system in operating condition for one week without incident. In April we will set a new target to check it with hydrogen liquid. We want to have a second target in case of problems with the first.

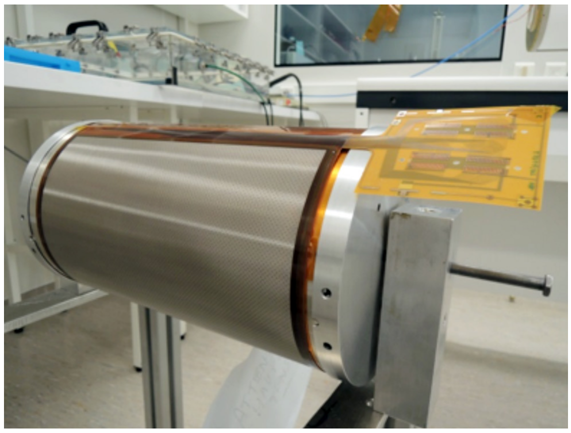
**Software** We are currently developing an acquisition software for MINOS. This software will drive the Feminos boards and collect their output data. The DAQ software will be composed of several processes interfacing with Feminos boards, performing event reconstruction and storage. The "run control" GUI process will control them and will allow users to prepare detector configuration, start and stop runs, monitor the detector status, and see some event display. The software is based on past achievements in reusable software in our institute: we already have robust libraries for configuration and distributed command/control. It is developed using C++ with Qt user-interface and ZeroC ICE network middleware. The global software architecture has been defined, and development has been started since the beginning of the year. Communication with Feminos board is implemented, and other core features are being developed in order to have a basic acquisition and run control from the end of April 2013.




Electronics Tests on the detector prototype have been performed with two front-end electronic cards Feminos equipped with AFTER chips and read via a trigger clock module in order to validate the full electronics system. To this end, two plastic scintillators were positioned above and below the prototype to trig on cosmic muons passing through the TPC. The Micromegas readout plane prototype, composed of 4 zones with different pad plane geometries, was used with the two cards reading two diametrically opposed zones, one with constant size pads disposed in a radial symmetry and the other one with concentric geometry. Despite the reduced effective detection area on the readout plane, we have obtained cosmic muon traces in coincidence in the two electronic cards. Such an event is shown in the figure below with a cosmic muon passing from the left to the right. These measurements validate the electronics operation for the future detector. Cosmic muons leave about three times less energy in MINOS than 200 MeV protons, demonstrating that the gain of the detector is sufficient.

Ancillary cylindrical Micromegas This ancillary detector is to be place around the MINOS Time Projection Chamber and used for real-time drift velocity calibrations and, possibly, for its trigger capabilities. The first part of the MINOS cylindrical tracker detector has been built at the CERN/TE-MPE-EM. This anode is 200 µm thick to make easier the curvature of the detector (radius of 92 mm), to reduce the radiation length and its capacitance. It is composed of 2 tiles of 128 strips of 260 mm along. The 2 detectors' goals are realized by zones different pitch : the z-position is measured thanks to 2*21 strips of 1 mm pitch and the external trigger by 2*43 strips of 2.5 mm pitch. This anode has been integrated on a 90 mm radius cylinder and tested electrically. Before summer 2013, we will receive the cathode in polyimide and finish the integration and characterization of the detector.



*Ancillary Cylindrical Micromegas Detector (one tile is shown).*

General information The target and its control should be sent to RIKEN in June. We proposed to perform a target production in RIKEN in July 2013. An in-beam validation and performance measurement of the TPC has been accepted at HIMAC by its PAC committee. This important phase of the project should take place at HIMAC, Chiba, at the end of 2013 but is not scheduled yet. A Memorandum of Understanding for operation of MINOS at RIBF has been written and is currently under study for signature. First Physics experiments and Letters of Intent should be proposed at the 12th PAC committee of RIBF. A. Obertelli will be supported by JSPS for a 8 months stay at RIKEN in the spin-isospin laboratory of T. Uesaka. C. Santamaria and A. Corsi from IRFU are also planning for a long-period stay during the measurement phases at RIBF (2014).

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