ICARUS

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We are working on the optimisation of noble liquid cryogenic detectors using photo-dopants, namely argon detector with double phase (liquid and gas) doped with TMG (Tetramethyl-Germanium). The TMG has a very large cross section for photo-absorption (62 Mb) and a high quantum efficiency to convert ultraviolet photons of argon scintillation (128 nm) in photo-electrons. Double phase detectors are able to combine a large mass with a low energy threshold; they are suitable for measuring rare events in the keV energy region (e.g.: neutrino coherent interactions and Dark Matter search). Photo-electrons are separated by several mm, depending on the concentration of TMG, and can therefore be considered isolated electrons. An electric field drives electrons toward the surface of the liquid and pulls them into the gaseous phase, where they meet one or more GEM (Gas Electron Multiplier) in cascade that, working in streamer mode, have the sensitivity to detect single electrons.
We continue the participation in the development of a new detector (LEM: Large Electron Multiplier), which exploits the avalanche multiplication in ultra pure noble gases in the absence of quencher with large gains and good spatial and energy resolution. This line of research began as an activity of Gruppo-V (LEM Project) and was most recently inserted in the RD51 international collaboration. This technique can be applied in many areas of fundamental physics: ionization signal detection at very low energy (e.g. for dark matter searches), the single photon UV detection on large areas (e.g. fast trigger for large TPC), ionization signals detection on large areas (pixels) for medical images. The LEM is a coarse-grained Gas Electron Multiplier obtained with approximately millimeter diameter holes in a G10 (copper cladded PCB) with thickness of about 2 mm. Gains of 10^3 - 10^4 in pure noble gases such as Ar and Xe has been obtained. The system was tested successfully also in conjunction with CsI photo-cathodes. These exceptional gains obtained without quencher are possible because the walls of the G-10 holes act as mechanical quencher absorbing UV photons produced by the electron avalanche in a confined space.
From October 2010 the ICARUS T600 detector is working in the Gran Sasso Laboratories, recording CNGS neutrino interactions events with efficiency greater than 95%. The characteristics of LAr-TPC as tracking and calorimetric detector as well as an excellent discrimination of electrons from π^0, allow good rejection of neutral current, without significant loss of efficiency for electron neutrino identification. In the current phase of data taking, we are participating to the support activities of the experiment such as the visual scanning of the collected events and their classification. This work will continue also during 2013. As a next step the detector ICARUS T600 will be moved from LNGS to CERN during the LHC and LSND long shut down in 2013-1214. The T600 should be located in a position where it can be used as a "FAR detector" in a short baseline “dual detector” experiment for the search of sterile neutrinos (LSND anomaly).

1) Experimental search for the LSND anomaly with the ICARUS LAr TPC detector in the CNGS beam
By M Antonello, B Baibussinov, P Benetti, E Calligarich, N Canci, S Centro, A Cesana, K Cieslik et al..
arXiv:1209.0122 [hep-ex].

2) Precision measurement of the neutrino velocity with the ICARUS detector in the CNGS beam
By M. Antonello, B. Baibussinov, P. Benetti, E. Calligarich, N. Canci, S. Centro, A. Cesana, K. Cieslik et al..
arXiv:1208.2629 [hep-ex].

3) Search for anomalies in the neutrino sector with muon spectrometers and large LArTPC imaging detectors at CERN
By A. Antonello, D. Bagliani, B. Baibussinov, H. Bilokon, F. Boffelli, M. Bonesini, E. Calligarich, N. Canci et al..
arXiv:1208.0862 [physics.ins-det].

4) Development and preliminary tests of resistive microdot and microstrip detectors
By V. Peskov, P. Fonte, E. Nappi, P. Martinengo, R. Oliveira, F. Pietropaolo, P. Picchi.
arXiv:1203.3658 [physics.ins-det].

5) Measurement of the neutrino velocity with the ICARUS detector at the CNGS beam
By ICARUS Collaboration (M. Antonello et al.).
arXiv:1203.3433 [hep-ex].
Phys.Lett. B713 (2012) 17-22.

6) Search for 'anomalies' from neutrino and anti-neutrino oscillations at Delta_m^2 $\sim$ 1eV^2 with muon spectrometers and large LAr-TPC imaging detectors
By M. Antonello, D. Bagliani, B. Baibussinov, H. Bilokon, F. Boffelli, M. Bonesini, E. Calligarich, N. Canci et al..
arXiv:1203.3432 [physics.ins-det].

7) Development of novel designs of spark-protected micropattern gaseous detectors with resistive electrodes
By V. Peskov, P. Martinengo, E. Nappi, R. Oliveira, P. Pietropaolo, P. Picchi.
JINST 7 (2012) C01005.

8) A Search for the analogue to Cherenkov radiation by high energy neutrinos at superluminal speeds in ICARUS
By ICARUS Collaboration (M. Antonello et al.).
arXiv:1110.3763 [hep-ex].
Phys.Lett. B711 (2012) 270-275.

9) Advances in the Development of Micropattern Gaseous Detectors with Resistive Electrodes
By P. Fonte, P. Martinengo, E. Nappi, R. Oliveira, V. Peskov, F. Pietropaolo, P. Picchi.
arXiv:1005.1477 [physics.ins-det].
Nucl.Instrum.Meth. A661 (2012) S153-S155.