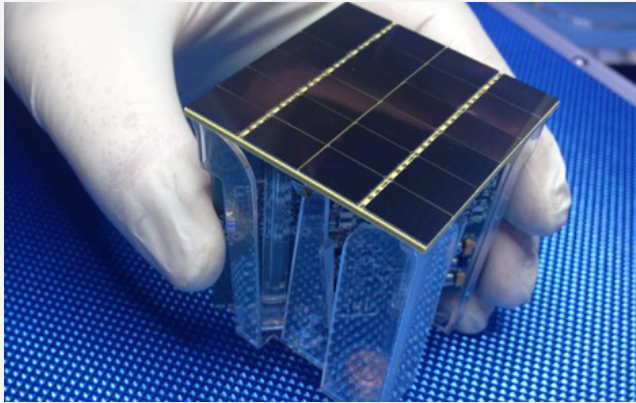


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DARK MATTER: FIRST PHOTO-DETECTOR MODULE FOR DARKSIDE READY

The Photo-Detector Modules (PDM), which will be used by the DarkSide-20k project for the direct search for dark matter at the Gran Sasso National Laboratories (LNGS), will be assembled in the Nuova Officina Assergi (NOA), the new technological centre of the LNGS of INFN. The first PDM built was presented during the Darkside International Collaboration meeting, which took place at the INFN Gran Sasso Science Institute (GSSI) from 5 to 9 March.

The main characteristic of this new device is the fact of combining state-of-the-art Silicon Photo Multipliers (SiPM) with very low noise cryogenic electronics.

Each PDM is a structural shell with peculiar characteristics: it must be strong enough to withstand temperature changes of more than 200 degrees (from ambient to liquid argon temperature) and as light and radiopure as possible, not to introduce signals in the detector that could be similar to the rare events produced by dark matter, the subject of the research.

The PDMs are made with highly radiopure components (i.e. with a very low level of radioactivity), consisting of 24 SiPMs with a total area of approx. 24 cm² each. The various parts comprising the PDM are assembled with an acrylic mechanical structure, with high radiopurity. Preliminary results show that the signal-to-noise ratio and the time resolution obtained by the first PDM are better by a factor of 3 compared to the Darkside-20k specifications.

The DarkSide-20k detector requires the use of more than 5,000 of these modules: its 20-tonne liquid argon Time Projection Chamber (TPC) provides a photosensitive surface of 14 m², implemented with over 125,000 SiPMs. To limit the number of electronic channels, each PDM must be read with a single channel. The main difficulty is due to the high capacity of the SiPM, which makes it difficult to read areas of several tens of square centimetres.

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This first module is the result of extensive R&D work carried out by the DarkSide photoelectronic group, consisting of over 30 researchers from Italian, Canadian and US research institutes. For INFN, in addition to LNGS, the divisions of Bologna, Cagliari, Milan, Naples, Pisa, Tifpa and Turin are involved. The SiPMs were produced by the Bruno Kessler Foundation (FBK) and the assembly was performed by researchers from the University of Princeton and LNGS. The mechanics of the PDM were implemented by the INFN Pisa section, the structure for PDM assembly and anchoring to the copper structure (motherboard) is the responsibility of the INFN Bologna section, while the optical fibre transmission of the PDM signals is the result of a joint effort by researchers from the INFN Cagliari division and LNGS.

The next objective will be the construction of a motherboard with 25 PDMs, to be used in the prototype with one tonne of liquid argon. ■