PADME: HOW IT WORKS

The experiment works thanks to a small but extremely precise measuring apparatus, able to observe the production of the dark photon in electron-anti electron (called positrons) collisions. PADME is installed in the experimental hall of the test facility (BTF) of the linear accelerator of the INFN Frascati National Laboratories. Accelerated positrons are “shooted” on to a thin diamond target. By interacting with the atomic electrons, positrons could produce “dark photons” together with a visible photon. Data coming from the detector are received through optical fibers by a computer farm and analyzed in the control room where researchers monitor the experiment.

The positrons that do not interact with the target are then deflected away from the detectors with/through the magnetic field produced by a dipole magnet on loan from the CERN in Geneva. Photons produced in the collisions are detected by the PADME calorimeter which is composed of more than 600 inorganic scintillating crystals. Thanks to the precision in measuring the energy and position of the visible photon it is possible to get information on the existence and mass of the dark photon. The experiment is carried out by about 40 physicists, mostly Italian, with a significant presence of colleagues from Bulgaria, Hungary and United States.

ULTRAHIGH PRECISION TECHNOLOGIES

The target, the calorimeter and the beam monitor of PADME represent the outcome of innovative technologies developed with a synergetic cooperation of partners from both the industry and the research world (researchers from INFN and the matter structure field). The vacuum system was constructed by the Italian company FANTINI SPA, that had already collaborated with the INFN for the realization of experiments at CERN.

The PADME **target** is a synthetic polycrystalline diamond membrane, with a thickness of a tenth of a millimeter, an innovative device with detector capability. It was realized by industrial partners in collaboration with the INFN laboratories of the Lecce where the samples produced were characterized. Furthermore, in Lecce, a close cooperation between the INFN researchers and solid state physicists of the L3 Laboratory of the Math and Physics Department of the Salento University, allowed to develop a new technique for the realization of electrodes based on conductive graphite stripes/tapes obtained using the laser light irradiation of the diamond. The **calorimeter** is an example of how technologies developed in basic research have then relevant applications in several practical fields with a huge social impact. It is constructed with a material (BGO), born for particle physics, which was later spread, due to its granularity, high efficiency and density, in the field of medical diagnostics, such as for example in PET.

The beam monitor was constructed thanks to a technology called TimePix, developed at CERN, and which is capable of providing, with high precision, time and coordinates of the particles in a unique detector, built in collaboration with a company from Czech Republic (ADVACAM) that is working on industrial applications of this technology.

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