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Development of a Pressurized Helium Scintillating Calorimeter for AntiMatter Identification.

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The search for low energy anti-nuclei in cosmic rays allows a test of fundamental physics problems such as the possible presence of primordial antimatter or the nature of Dark Matter.
The "PHeSCAMI"(Pressurized Helium Scintillating Calorimeter for AntiMatter Identification) project is aiming to study a new signature for the identification of anti-nuclei in cosmic rays.
In particular, anti-protons or anti-deuterons stopping in a medium can produce exotic atoms and for the particular case of an helium target, the captured antiparticle can orbit the nucleus for microseconds before the annihilation.
This characteristic delayed annihilation is a very distinctive signature able to identify the antimatter nature of the stopping particle and rejecting the ordinary matter cosmic rays.
A possible configuration for the "PHeSCAMI"detector consists of a pressurized helium scintillating calorimeter surrounded by plastic scintillator layers for velocity measurement.
Anti-deuterons are identified by combining the spectrometric measurement of the stopping particle (velocity vs energy) with the delayed emission of outgoing charged pions caused by the anti-nucleus annihilation.
A first prototype of the pressurized calorimeter, made by 1L stainless steel vessel filled by 200 Bar Helium acting as a scintillator, has been characterized with cosmic muons and with 70-240 MeV proton beam in the INFN-TIFPA laboratory. This allows us to prove an energy resolution better than 10% and a time resolution within 300ps for the scintillating helium calorimeters.
The development and test of an advanced calorimeter prototype, with a volume of 40L, pressure of 200 Bar and wall grammage within 1.5g/cmˆ2, based on an automotive COPV (composite overwrapped pressure vessel) is ongoing in the INFN-TIFPA laboratory.
The status of the PHeSCAMI project will be summarized and the results of the measured performance of the Helium calorimeter prototypes will be shown.

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