Contribution ID: **41** Type: **Oral**

COSINUS, Dark Matter direct detection with NaI

Nowadays astronomical observations have provided solid proof for the existence of dark matter (DM), yet a direct measurement is lacking.
COSINUS (Cryogenic Observatory for SIgnatures seen in Next-generation Underground Searches) has the aim of detecting DM via elastic scattering off the nuclei of a target NaI crystal which is the core of the detector. The NaI crystal is kept at ~10 mK and it is operated as a low-temperature calorimeter. The deposited energy is precisely reconstructed from the phonon signal. By facing to the NaI crystal another cryogenic light detector particle discrimination is achieved using the scintillation signal. With this unique combined readout not only it is possible to eliminate the beta/gamma and alpha background, but also to study the material dependency of the DM interaction. Moreover, using the identical material as DAMA/LIBRA, COSINUS will finally shade a light on the long-standing controversy in the DM direct search community.
In this contribution I will outline the steps undertaken by the COSINUS collaboration towards establishing a final detector design and I will present the results of the first NaI prototypes.
The basic detector module is composed by a NaI crystal (up to 200 g mass) coupled to a Transition Edge Sensor (TES) via a carrier crystal (typically CdWO4) for practical purposes:being hygroscopic, NaI requires very special care in handling and does not cope well with the high temperature required to grow the thin superconducting W film of the TES. Except for the side where the NaI crystal is coupled to the carrier, all the other sides face a silicon beaker which encapsulates the NaI crystal and it is used as a light absorber. The emitted light is converted into a phonon signal which is read out using a second TES evaporated directly onto the silicon beaker external surface.
A prototype detector has been tested in a dilution refrigerator hosted in Hall C of the Laboratori Nazionali del Gran Sasso (LNGS), instrumented both with SQUIDs for the TES readout and conventional electronics for high impedance sensors, such as Neutron Transmutation Doped (NTD) Germanium thermistors.
I will present the first measurements perfomed with prototype detectors, the current status and further development of COSINUS concerning the experimental setup at LNGS and physics programme.

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Session Classification: Contributed Talks