

PhD in Physics and Nanoscience - XXXVI cycle

First year report

Matteo Rossi

Tutors:

Alessio Caminata

Gemma Testera

Research activity:

My activity is focused on the direct detection of Dark Matter particles and I am working on the design of the neutron veto for the DarkSide-20k Dark Matter experiment. The whole detector consists of a 20 T liquid Argon Time Projection Chamber, surrounded by a neutron veto, with all the system immersed in liquid Argon and closed in a cryostat. The interaction between a candidate for a Dark Matter particle, namely a Weakly Interacting Massive Particle (WIMP) and an atomic nucleus of a scintillator, as liquid Argon, is expected to generate photons, that can be collected using photosensors as cryogenic Silicon PhotoMultipliers. Since the small WIMP-nucleon cross section, it is necessary to identify spurious events that can mimic a Dark Matter particle interaction with Argon atoms. Neutrons are responsible of these events and the role of the veto is to moderate and record the events generated by neutrons; indeed, when the material that constitute the veto itself, that is Gadolinium-loaded plastic, captures a neutron, that results in emitted photons that can be collected in the veto volume as these photons interact in veto liquid Argon.

My contribution is focused on simulating the DarkSide-20k detector exploiting the Geant-4 software, aligning the drawings in Geant-4 with the CAD ones, and analysing the results of several physics simulations in order to understand the best way to construct the detector and find its potentialities and properties. In addition, my work is to find out the best way to place photosensors in the veto, that are cryogenic Silicon PhotoMultipliers, reaching the highest and most uniform light collection.

I am also working on ARTIC (ARgon Test InfrastruCture), that is a cryostat in Genoa which will allow tests in liquid Argon and liquid Nitrogen, useful for DarkSide components. In particular, I am working on the LabVIEW program to control and maintain the cryostat (temperature, pressure, liquid level, ..)

Courses and exams:

- High energy astrophysics (F. Tavecchio), course and exam
- Criogenia applicata (R. Musenich), course and exam
- Particle physics and multi-messenger astroparticles (M. Pallavicini), course

Schools:

- INFN SOUP 2021 school on underground physics

Publications:

- I am author of the communication "The Darkside-20k veto detector" at Congresso Nazionale SIF 2020, awarded with honourable mention, published on Il Nuovo Cimento C
- I am author of a poster and an article on the Darkside-20k detector in occasion of INFN SOUP 2021 school on Underground Physics, in submission to Il Nuovo Cimento C

Conference presentations:

- Speaker at June 2021 DarkSide collaboration meeting on behalf of the veto group

Extra:

I attended an extra course on ANSYS and finite elements (S. Farinon).

