Particle physics with neutrino telescopes: dark matter and neutrino mass hierarchy

Research Project / Research Group Description:
Neutrino telescopes are unique tools in high-energy physics. In addition to their capabilities for neutrino astronomy, two important topics can be addressed: the search for dark matter and the determination of the neutrino mass hierarchy. The nature of dark matter, the most abundant component of matter in the Universe, in still unknown. Detectors like ANTARES or KM3NeT, with advantages complementary to other searches, have the potential for the discovery of these particles. On the other hand, the ORCA configuration of KM3NeT offer the possibility of making the first measurement of the neutrino mass ordering, one of the fundamental missing pieces in particle physics today.

The ANTARES/KM3NeT research team at IFIC has a long experience in undersea neutrino telescopes, where it is involved in a variety of tasks. The group has built and operated the time calibration system based on optical beacons. It has led the search for neutrino point sources in ANTARES and is presently deeply involved in the indirect search for dark matter using cosmic neutrinos. The team participates also in the KM3NeT telescope which is being deployed in the Mediterranean Sea. Members of the IFIC group have relevant coordination responsibilities in both collaborations.

Job position description:
We propose two main possibilities as analysis topic, both related to the capabilities of neutrino telescopes to study two of the most relevant issues in physics today: dark matter and neutrino mass hierarchy.

Dark matter:
- Search for dark matter annihilation in the Sun with the ANTARES data.
- Search for dark matter annihilation in the Galactic Centre and halo.
- Preparation of the search of dark matter with the KM3NeT neutrino telescope, both in its ORCA and ARCA versions.

Neutrino mass hierarchy:
- Study of the sensitivity of KM3NeT-ORCA for the determination of the neutrino mass hierarchy.
- Study of the capability of KM3NeT-ORCA for the measurement of other oscillation parameters as theta23

In addition, the student will also contribute to the time calibration of the KM3NeT telescope.

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Research project/Research Group website
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