

Astroparticle and High Energy Physics

Research Project / Research Group Description:

Boosted by major discoveries such as that of the Higgs boson (Nobel Prize in Physics 2012) and neutrino mass (Nobel 2015), particle physics is now ready for the next step. The success of the Large Hadron Collider (LHC) and of the recent neutrino experiments has brought astroparticle physics to the eve of a new era. Our interdisciplinary research program covers:

1) Neutrino properties and the nature of neutrinos. Unveiling whether they are their own anti-particles and performing precise determinations of their absolute mass scale and oscillation parameters. We analyse current and upcoming neutrino experiments probing their mass hierarchy, CP violation and the atmospheric octant, comparing with theoretical predictions, and study sub-leading effects that may give insight on the scale of neutrino mass generation.

2) Underpinning the origin of neutrino mass, its characteristic scale and impact on particle physics. We study theories of neutrino mass generation, both within the high and low-scale seesaw approaches, radiative scenarios and predictions from non-Abelian family symmetries, and their implications for neutrino oscillations, lepton flavour violation, colliders and dark matter searches.

3) New physics at the LHC after the Higgs boson. We stress the valuable guidance provided by neutrino data, investigating models with extended gauge groups and/or extra dimensions, with and without supersymmetry. We study signals for lepton number and lepton flavor violation within various theory setups and compare with the experiments.

4) Particle cosmology, including the analysis of the cosmological bounds on neutrino properties and the study of neutrino physics solutions to puzzles such as baryogenesis, dark matter and inflation. In addition to WIMPs, we investigate other particle dark matter candidates, such as axions and majorons, as well as decaying dark matter.

Job position description:

The proposed PhD training includes the active participation in summer schools, such as those organized by the ISAPP (International School on AstroParticle Physics) network. The PhD fellow will benefit from the wide research and training experience not only of the local AHEP staff, but also of its postdocs, with enough experience to contribute to the technical training of the PhD students. Moreover the fellow is expected to join the groups' rich network of external collaborators which adds to its lively research atmosphere, contributing positively to the high productivity and maturity of the PhD fellows. Exchanges with high level invited researchers has also been a key feature of our past experience, with a large number of PhD theses prepared at our group over the years. The successful candidate is expected to master the analytical and numerical tools required for the work and to take up all relevant duties needed to develop a high quality PhD. Previous interview is recommended.

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Research project/Research Group website

<https://www.astroparticles.es>

