Summary and Aims

Contributed by Administrator
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SloopS: a code for one-loop processes in the MSSM with applications to Collider Physics and Dark Matter

TO EDIT The long awaited LHC will be launched in a few months. The LHC research program has traditionally centred around the discovery of the Higgs. However, the standard model description of this particle calls for New Physics. Until a few years ago the epitome of this New Physics has been supersymmetry which when endowed with a discrete symmetry furnishes a good Dark Matter, DM, candidate. Recently a few alternatives have been put forward. Originally this was to solve the Higgs problem but it has been discovered that, generically, their most viable implementation (in accord with electroweak precision data, proton decay,..) fares far better if a discrete symmetry is embedded. This symmetry is also behind the existence of a possible DM candidate. From another viewpoint, the last few years have witnessed spectacular advances in cosmology and astrophysics confirming that ordinary matter is a minute part of what constitutes the Universe at large. At the same time as the LHC will be gathering data, a host of non collider experiments will be carried out in search of DM (PLANCK, GLAST, AMS, HESS, Edelweiss,..) with an accuracy making cosmology enter the era of precision. The emergence of this new paradigm means it is of utmost importance to analyse and combine data from these upcoming observations with those at the LHC. This will also pave the way to search strategies for the next Linear Collider, ILC. This crucial programme is only possible if a cross-border particle-astroparticle collaboration is set up having at its disposal common or complementary tools to conduct global searches and analyses. Moreover it is crucial to associate theorists and experimentalists from these two communities. Our proposal is to develop, improve, interface and exploit such tools for the prediction and analysis of Dark Matter signals from a combination of terrestrial and non terrestrial observations, paying due attention to astrophysical uncertainties.
. Our objectives include: Complete and accurate computation of the relic density of dark matter in different models of New Physics (Supersymmetry, extra-dimensions, little Higgs). The goal is to match the accuracy of PLANCK. This requires computation of one-loop corrections to dominant processes for DM annihilation. A task that has never been addressed so far. Development of tools for predictions of signals from indirect detection of DM annihilation into photons, antiprotons, positrons, neutrinos and anti-deuterons in different models. Quantifying the physics potential of astroparticle experiments (AMS, HESS, GLAST...). Development of tools for analysis of signal and background to new particles production at colliders (LHC,ILC).. Interpretation of signals and extraction of the fundamental parameters of the New Physics models. Correlation between Dark matter signals in astroparticle, cosmology and colliders. Constraints on models and exploiting the information from colliders to refine predictions on dark matter in astroparticle and cosmology. Confronting, for example, future collider data on the microscopic properties of DM against a combination of data from direct/indirect detection can give strong constraints on the astrophysical properties of DM such as its distribution that can reveal much about galaxy formation. The proposal will be carried by a collaboration between four teams of LAPP and LAPTH, with the additions of phenomenologists from IAP and LPSC, that have a proven track record in the different aspects of the project. The members from the LAPP experimental teams are heavily implicated in collider physics (LHC-ILC) and astroparticle physics (AMS-HESS) and have been a driving force in data analysis and simulations. Members of LAPTH/IAP draw from a recognised astrophysics team heavily involved in indirect signals of Dark Matter with, for example, sophisticated codes for the propagation of cosmic ray anti-protons, positrons. The particle physicists of LAPTH/LPSC have conducted some of the most complex calculations in the standard model and supersymmetry. They have furnished the popular code micrOMEGAs for the calculation of the relic density of DM. Both of these feats would not have been possible were it not for the exploitation of automated codes for the SM and the New Physics. Automation will be at the centre of this project and will help build up a modular structure of codes that easily incorporate New Physics models ``turning their Lagrangian'' into simulation codes. Combined with the expertise and the complementarity of the teams we believe that such an ambitious and original project will be brought to fruition if these teams are strengthened. The possibility for our teams to incorporate young post-docs and invite other world experts is a key element of the project and a source of momentum for the collaboration.