Poster session 4 – Friday 8 July

P4.016 keV sterile neutrino dark matter from singlet scalar decay -- Formal concepts and analyses on structure formation

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Besides their potential role in the quest to explain non-zero neutrino masses, right-handed neutrinos are an appealing Dark Matter candidate. In the case of keV scale sterile neutrino Dark Matter, the production mechanism is essential: thermal production via an extended gauge group will overclose the Universe if there is no additional entropy dilution, which – in turn - is hard to reconcile with BBN. Production by non-resonant conversion of active neutrinos is under strong tension due to Lyman-alpha observations and X-ray bounds. Resonant conversion may partially circumvent these restrictions but is also challenged by current studies.

Production from the decay of an additional scalar coupled to the Higgs sector (or from other moderately heavy particles) is therefore a very interesting and viable model to explain the origin of potential keV sterile neutrino Dark Matter that is in accordance with all cosmological observations.

We present a formalism to solve the Boltzmann equations related to the two-step production process of scalar decay on the fundamental level of distribution functions, i.e. taking into account the full spectral information of the Dark Matter population. The precise knowledge of the momentum distribution of this non-thermal candidate allows us to make very accurate analyses concerning the formation of cosmological structures. In contrast to earlier studies working on the level of particle densities and using several approximations, our formalism allows to treat the problem in an exact and physical way. In some limiting cases we can provide formal-analytical solutions to the Boltzmann equations describing the sterile neutrino population.