Standard Big Bang Nucleosynthesis (SBBN)

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Big Bang (primordial) nucleosynthesis is one of the robust components of the standard model of cosmology – the others being the discovery of Hubble expansion and the CMB. Observations of primordial elements abundances of D, ^{3}He, ^{4}He and ^{7}Li set robust constraints on the standard (or base) ΛCDM model, particularly by constraining the baryon fraction which is strongly correlated to the D abundance. The recent Planck data (as well as WMAP data) measured the standard ΛCDM and BBN parameters to such a high precision, making SBBN a parameter free model.

The aim of this summer project is to map the parameter space of SBBN within the base ΛCDM model as constrained by Planck and WMAP data and to analyse the sensitivity of SBBN output to their variations (and to the variation of the fundamental constants) as well as their implications on further production of heavier elements such as C, N and O. One of the possible questions to discuss is whether there is a case for fine-tuning of the parameters of SBBN and ΛCDM and whether the currently observed abundances are heavily constrained by these fine-tuned parameters.

Skills required from the student: programming in C++/Python and Java script, familiarity with web programming. The student is expected to review and compile the major ingredients of both SBBN and ΛCDM models and to develop a comprehensive picture of the formalism involved.