Theory Seminar

Monday, November 30, 2009 2:10 PM 831 Pupin Hall

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Cosmological hydrogen recombination: the effect of high-n states and forbidden transitions

Thanks to the ongoing Planck mission, a new window will be opened on the properties of the primordial density field, the cosmological parameters, and the physics of reionization. Much of Planck's new leverage on these quantities will come from temperature measurements at small angular scales and from polarization measurements. These both depend on the details of cosmological hydrogen recombination; use of the CMB as a probe of energies greater than 1016 GeV compels us to get the ~eV scale atomic physics right.

One question that remains is how high in hydrogen principle quantum number we have to go to make sufficiently accurate predictions for Planck. Using sparse matrix methods to beat computational difficulties, I have modeled the influence of very high (up to and including n=200) excitation states of atomic hydrogen on the recombination history of the primordial plasma, resolving all angular momentum sub-states separately and including, for the first time, the effect of hydrogen quadrupole transitions. I will review the basic physics, explain the resulting plasma properties, discuss recombination histories, and close by discussing the effects on CMB observables.