JOINT TUFTS/MIT COSMOLOGY SEMINAR

Local primordial non-Gaussianity from 'zero-bias' 21cm radiation during reionization

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Mapping the large-scale structure of the Universe during the epoch of reionization and beyond through the 21cm transition of neutral hydrogen is one of the "holy grails" of cosmology, giving access to matter fluctuations at large volumes during a unique epoch. In particular, it has been noted that 21cm surveys can map sufficiently large volumes at low-enough noise that they become competitive probes of local primordial non-Gaussianity, a signature of models of multi-field inflation, by exploiting the "scale-dependent bias" effect of Dalal et al (2007). In this talk I will introduce a large-scale structure-based perspective on the 21cm signal and revisit its potential, during the epoch of reionization, in constraining the amplitude of local primordial non-Gaussianity (PNG). I will argue there generically exists an epoch at which the linear bias of the 21cm field crosses zero, independent of the precise astrophysics of reionization. This epoch implies the 21cm radiation is a natural "zero-bias tracer" in the sense of Castorina et al (2018). The rest of this talk will focus on the prospect for realizing zero-bias measurements, focusing on the "renormalized noise" terms sourced by higher-order bias in the effective field theory of large-scale structure, and how they may be mitigated. I will show that analyses which can control for this noise and harness the full power of the signal can potentially unlock a 10-fold reduction in error bars, even in the presence of large-scale cuts from foregrounds. The potential of this epoch motivates searching for it in future 21cm surveys, along with developing analysis techniques that can reach the noise floor required for the zero-bias epoch to saturate Fisher information. Based on arXiv:2504.20025.

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Cosman Seminar Room
Center for Theoretical Physics
Building 6C, Room 6C-442
Massachusetts Institute of Technology