Title: Modelling the Thermal dust with Dust Temperature Ladder Model

Abstract: Measuring thermal dust emission is a central challenge for the detection of CMB B-modes. Several studies have shown that the commonly used single-temperature modified blackbody approximation is insufficient for accurate component separation, particularly in the presence of line-of-sight temperature variations.

In this talk, I describe the Dust Temperature Ladder Model (DTLM) which goes beyond this approximation by modelling the distribution of dust temperatures along the line of sight around a mean value using a moment-based expansion on temperature. We use a ladder of discrete temperatures to describe the emissions from cold dust, hot dust, and the cosmic infrared background (CIB) within a single framework. Our approach is based on a linear optimization scheme, making it computationally efficient and well suited for pixel-by-pixel analysis of high sky resolutions. Using this method, we reconstruct maps of dust optical depth and temperature distribution that explicitly capture variations in temperature in the dust environments. To constrain the model, we combine data from Planck, WMAP, DIRBE, and IRIS, ensuring sensitivity in low and high-frequency emission range. The resulting maps provide a more realistic description of thermal dust emission and can improve foreground separation in future CMB polarization analysis.