Contribution ID: **38** Type: **not specified**

CMB as a powerful probe of dark matter annihilation at the epoch of recombination

Friday, 19 October 2012 09:00 (35 minutes)

The injection of secondary particles produced by dark annihilation around redshift 1000 would inevitably affect the process of recombination, leaving an imprint on cosmic microwave background (CMB) temperature and polarization anisotropies. We show that the most recent CMB measurements provided by the WMAP satellite mission and the ACT telescope place interesting constraints on DM self-annihilation rates. Our analysis includes an accurate treatment of the time-dependent coupling of the DM annihilation energy with the thermal gas.
We present constraints for specific models of dark matter annihilation channels, as well as a model-independent approach to calculate constraints with future experiments, based on a principal components analysis. We show that current data place already stringent constraints on light DM particles, ruling out thermal WIMPs with mass m < 10GeV annihilating into
electrons and WIMPs with mass m < 4GeV annihilating into muons. Finally, we argue that upcoming CMB experiments such as Planck, will improve the constraints by at least 1 order of magnitude, thus providing a sensitive probe of the properties of DM particles.

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Session Classification: Dark matter from the cosmos