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Absolute calibration of next generation of CMB experiments through current and future observations of the Crab nebula

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One of the most powerful probes to understand the Universe's evolution is the Cosmic Microwave Background (CMB). Lately the search for the CMB polarization B-modes has become one of the main objectives of observational cosmology, leading to active instrumental developments and to a large number of CMB experiments. Nowadays, it is widely recognised that any unambiguous detection of the B-modes polarization pattern requires a detailed, multi-frequency study of foreground contamination levels; a very high control of the systematic effects deriving from the instrument itself and a very high accuracy in the reconstruction of the polarization direction (i.e. polarization angle).
In terms of instrumental systematic effects, one of the main challenges for future ground-based, balloon-borne, and satellite CMB polarisation experiments is the accurate calibration of the absolute polarisation angle. Apart from the ground calibration an ideal sky calibrator is the Crab nebula (Tau A), which is the most intense polarized astrophysical object in the microwave sky at angular scales of a few arcminutes. Recent studies demonstrated that the polarization angle remains constant in the spectral range of 23-353 GHz, which is of interest for the calibration of CMB experiments. However the uncertainty associated with existing data does not allow yet to reach the sensitivity requirement for a clear detection of the tensor-to-scalar ratio r, that is directly related to the energy scale of inflation. In order to improve the global uncertainty on the polarization angle we need to add new measurements through independent ground-based observations, using facilities like NIKA2 (Perotto et al. 2020), SCUBA2 (Graves et al. 2019) or SRT (Bolli et al. 2015). In this contribution I will give an overview on the recent measurements of the Crab nebula and discuss the current limitations to accomplish the sensitivity requirements of CMB experiments like LiteBIRD. In addition I will give a perspective on how to overcome these limitations by using state-of-art ground-based observations.

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