Title : Probing the Universe’s beginning and testing fundamental physics with Simons Array and Simons Observatory cosmic microwave background polarization data sets

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The Cosmic Microwave Background (CMB) is the oldest light observable in the Universe. It was emitted when free electrons combined with nuclei in the primordial plasma. Due to the absence of free electrons the Universe has suddenly become transparent. The photons freed in that process compose the CMB radiation that we see today.
However this signal is not uniform over the sky. The CMB anisotropies are the key to understanding of the primordial Universe and are uniquely characterized by their power spectra.
The current standard model of cosmology is best understood if an era called cosmological inflation is assumed. Inflation naturally leads to the CMB polarisation of the B (curly)-type and detecting it would provide its strong validation.
However, B modes anisotropies are very faint - at least 6 order of magnitudes lower in amplitude than temperature anisotropies. New hardware technologies and analysis techniques are required to detect it.
My PhD takes place in this context and is performed within the Simons Observatory (SO) project - a leading, ground-based telescope in the Atacama Desert in Chile. Its first light is expected in 2021 and it is one of the most promising instruments for the detection of primordial B modes.
Photons originating from astrophysical sources contaminate CMB measurements with amplitudes up to 4 orders of magnitude bigger than the expected CMB B mode polarisation. I work on methods to clean such signals to recover the most pristine CMB signal possible. This is one of the biggest challenges in the field. Addressing it will not only allow us to set tight limits on the B-mode signal but also help us constraining effects such as primordial magnetic fields or interactions with axion like particles which could rotate the polarization angle. These effects are one of the goals of my work.