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Assessing tensions in CMB Polarization data by extending the Minkowski Functional framework

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Minkowski Functionals are high-order statistics that can be extracted from spherical maps such as the CMB, providing additional information to that in the angular power spectrum. The expected value of these functionals can be very accurately predicted for Gaussian isotropic maps, which turn them into an excellent tool to look for Non-Gaussianities and violations of the Cosmological Principle in a model-independent way. They have been widely applied to scalar maps such as CMB temperature and lensing, but they can not be directly applied to spin maps such as CMB polarization. In this talk, I will extend the formalism of Minkowski Functionals to CMB polarization (and generally, to spin fields) in two different ways that keep full information of the spin field. I will briefly introduce the theoretical predictions for the Minkowski Functionals in these extensions and present a Python package developed in our group that can be used to compute them in scalar and spin maps. This framework and software will soon be extended to include other high-order statistics such as peak statistics. Finally, I will present the results of applying this framework to Planck polarization data and explain how present and future CMB data can be used to assess the Cosmological Principle and to disentangle primordial and foreground-induced Non-Gaussianities. I will also explain how Minkowski Functionals can be used to assess anomalies such as the power asymmetry of the CMB temperature and how polarization can help in this task. This talk is based on several ongoing projects developed with Domenico Marinucci, Nicola Vittorio, Marina Migliaccio, Alessandro Carones, Giuseppe Puglisi, and Giacomo Galloni.

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