3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Extragalactic Millimeter Transients in the Era of Next Generation CMB Surveys

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The next generation of CMB surveys are poised to open a new window for transient discovery in the millimeter band. These surveys will cover a large fraction of the sky to unprecedented sensitivity and with high cadence, complementing existing wide-field radio and optical surveys. Using theoretical and empirical light curves for a wide range of extragalactic transients (including gamma-ray bursts, tidal disruption events, fast blue optical transients, neutron star mergers) in conjunction with known and estimated volumetric event rates, we explore the discovery phase space for millimeter transients in existing and near-term CMB surveys (ACT, SPT-3G, Simons Observatory, CMB-S4, CMB-HD). In each case, we use the CMB survey designs (area, depth, cadence, duration) to estimate detection rates and the resulting light curve characteristics. We find that CMB surveys will discover tens to hundreds of long-duration gamma-ray bursts (LGRBs), including the first large sample of reverse shock detections, facilitating detailed studies of the jet launching mechanism in LGRBs. Wide-field CMB surveys will also discover tens of fast blue optical transients, enabling the first unbiased sample of millimeter emission from these sources, and may detect up to several hundred tidal disruption events. Finally, we show that that the next decade of CMB experiments may detect a small number of short-duration gamma-ray bursts, which will be well within the detection volume of next generation gravitational wave experiments like Cosmic Explorer.