Before the big bang:
New insights into the birth of the universe and the dawn of spacetime

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This talk will summarize three recent efforts to constrain the first few moments of cosmic creation before and during the epoch of inflation. We will consider two means to explain a slight dip in the power spectrum of the cosmic microwave background for multipoles in the range of \( l = 10-30 \) from both the Planck and WMAP data. We show that such a dip could be the result of resonant creation of a massive particle that couples to the inflation field. For best-fit models, the epoch of resonant particle creation reenters the horizon at wave numbers of \( k_* = 0.00011 \pm 0.0004 \text{ h/Mpc} \). The amplitude and location of these features constrains of a number of degenerate fermion species, their mass, and the coupling constant between the inflation field and the created fermion species. Alternatively, one can explain the existence of such a dip as due to a jump in the inflation generating potential. We show that such a jump can also resolve the excessively large dark flow predicted from the M-theory landscape. Finally, we summarize our efforts to quantify constraints on the cosmic dark flow from a new analysis of the Type Ia supernova distance-redshift relation.