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Rock 'n' Roll, Jazzy, and Classical Solutions to the Hubble Tension

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Local measurements of the Hubble parameter are increasingly in tension with the value inferred from a Λ CDM fit to the cosmic microwave background (CMB) and baryon acoustic oscillation (BAO) data. A general class of solutions to this tension involves temporarily increasing the energy density of the Universe close to the epoch of matter-radiation equality to reduce the size of the baryon-photon sound horizon at recombination. In the literature, various models for this energy injection have been proposed, ranging from rolling and oscillating scalar fields, new relativistic species with nonstandard properties, or extra matter components that subsequently decay. We describe the appealing and problematic features of these proposed solutions, showing that it is in general challenging to resolve the tension between CMB, BAO, and distance ladder measurements without either introducing new tensions with other cosmological datasets or requiring particle physics models that are significantly fine-tuned. We argue that none of the currently proposed solutions are entirely satisfactory, but identify important properties that a complete solution should have.

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