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## ALP-Mediated Dark Matter at Low Reheating Temperature and the Belle II Excess

Belle II has reported a  $2.7\sigma$  excess in  $B^+ \rightarrow K^+ \nu \bar{\nu}$  over its Standard Model prediction, recently interpreted as arising from an axion-like particle mediating a thermal dark matter candidate. We reassess this interpretation using a new mass-differential measurement of the same data set and adding two visible-decay searches that earlier analyses omitted. The resulting bounds leave the predictions from a standard cosmological history only marginally compatible with the excess, viable in a narrow window of parameter space. Thus, we consider a situation where dark matter freezes out during a low-temperature reheating era, featuring entropy injection diluting the relic abundance, and lowering the couplings needed to match the observed dark matter density. This opens a region of parameter space that standard cosmology excludes, significantly improving the compatibility of the model with the Belle II excess.

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