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# Advancing Globular Cluster Constraints on the Axion-Photon Coupling

*Tuesday 18 July 2023 14:00 (15 minutes)*

For decades stellar evolution has been a rich source of constraints on physics beyond the Standard Model. In this talk I will discuss our recent improvement of the upper bound on the axion-photon coupling from stellar evolution, which has been derived using the $R_2$ parameter, the ratio of stellar populations on the Asymptotic Giant Branch to Horizontal Branch in Globular Clusters. I will compare observed limits on $R_2$ with data from simulations using the stellar evolution code MESA which include the effects of axion production. The benefits of considering $R_2$ over the traditionally employed $R$-parameter will be discussed, with particular attention given to quantifying in detail the effects of uncertainties on these parameters due to the modelling of convective core boundaries. Using a semiconvective mixing scheme we constrain the axion-photon coupling to be $g_{a\gamma\gamma} < 0.47 \times 10^{-10}$ GeV$^{-1}$. This rules out new regions of QCD axion and axion-like particle parameter space. Complementary evidence from asteroseismology suggests that this could improve to as much as $g_{a\gamma\gamma} < 0.34 \times 10^{-10}$ GeV$^{-1}$ as the uncertainties surrounding mixing across convective boundaries are better understood.

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