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Axions and the white dwarf luminosity functions of the galactic disks and halo

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The evolution of white dwarfs is a simple gravothermal process of cooling. Since the shape of their luminosity function is sensitive to the characteristic cooling time, it is possible to use its slope to test the existence of additional unexpected sources or sinks of energy. The aim of this paper is to study if the changes in the slope of the white dwarf luminosity function around bolometric magnitudes ranging from 8 to 10 previously attributed to axion emission are, effectively, caused by an intrinsic property or they are just an artifact introduced by the star formation rate. In this talk we compute theoretical luminosity functions of the thin and thick disks, and of the stellar halo and we compare them with the presently observed luminosity functions. Since these stellar populations have different star formation histories, the change of slope should be present at the same place in all of them if it is due to an intrinsic cooling mechanism like axions. Our results suggest that effectively, this signature is present in all the luminosity functions and, therefore, has an intrinsic character. This additional cooling is compatible with axion emission and gives support to the possible existence of DFSZ axions with masses in the range of 4 to 10~meV. If this were the case, these axions could be detected by the future solar axioscope IAXO.

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