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Young, (metal-)rich ad not alone: formation of thin-disc RR Lyrae stars through binary evolution

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Despite the classical interpretation of RR Lyrae as old and metal-poor population II stars, it is well known that metal-rich (up to solar values) RR Lyrae stars exist in the solar vicinity. Thanks to the unprecedented Gaia capabilities (Gaia DR2 and Gaia DR3), we found that the metal-rich RR Lyrae stars are present all over the Galactic disc, well beyond the Solar neighbourhood. The kinematics of these stars is consistent with a young (less than 5 Gyr) thin-disc population. An age of only a few Gyrs would be very difficult to reconcile with the conventional scenarios of the RR Lyrae formation. At the same time, assuming that they are instead truly old implies that they are tracing one of the oldest components of the Milky Way. Alternative formation channels for RR Lyrae can be called into play to solve this conundrum. In particular, I will present the results of a set of MESA binary simulations showing that is theoretically possible to produce a population of metal-rich RR Lyrae with ages consistent with the thin-disc populations. Such stars are formed after an episode of Roche-Lobe overflow mass transfer that ends with a partial envelope stripping of the donor star.

Primary author: IORIO, Giuliano (University of Padova)

Presenter: IORIO, Giuliano (University of Padova)

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