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Beyond Gaia DR3: tracing the [α/M] – [M/H] bimodality from the Inner to the outer Milky Way disc with Gaia RVS and Convolutional Neural-Networks

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Gaia DR3 provided the community with one million RVS spectra covering the CaII triplet region, similarly to the RAVE spectra. One third of the spectra have a signal-to-noise ratio from 15 to 25 per pixel. Gaia also provides XP spectra/coefficients in DR3. We aim to leverage versatility/capabilities of machine learning techniques for combining
the full set of Gaia products for supercharged stellar parametrization. We developed a hybrid Convolutional Neural-Network (CNN)to derive atmospheric parameters (Teff, log(g), and [M/H]) and chemical abundances ([Fe/H] and [α/M]). Our CNN is designed to effectively combine the Gaia DR3 RVS spectra, photometry (G, Bp, Rp), parallaxes, and XP coefficients and is able to extract formation from non-spectral inputs to supplement the limited spectral coverage of the RVS spectrum. We trained CNN with high-quality training sample based on APOGEE DR17 labels. The atmospheric parameters we provide thanks to CNN out-perform the spectroscopic ones provided by the Gaia Collaboration both in terms of uncertainties and comparison with external high-quality data-sets. CNN is extremely robust to noise in RVS data, and very precise labels are derived down to S/N = 15. We provide atmospheric parameters and abundances for 841 300 stars homogeneous being the first machine-learning catalog to combine such diverse datasets.
We managed to characterize the [α/M] – [M/H] bimodality from the inner regions to the outer part of the Milky Way, which has never been characterized using RVS spectra or similar datasets. This study set the path for the machine-learning analysis of Gaia-RVS spectra for the next data releases. Large high-quality datasets and archives can be ideally combined thanks to CNN,releasing the full power of spectroscopy, astrometry, and photometry.

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