P106a Multiplicity of the first stars confirmed by supervised classification of extremely metal-poor stars

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Background: feedback from the first stars is crucial to set the initial conditions for galaxy formation. However, little is known about the mass range and multiplicity of these first stars. While recent numerical simulations predict that the first stars form in clusters, an observational confirmation is still lacking.

Methods: Based on theoretical models of the chemical yields of the first supernovae, we train Support Vector Machines (SVMs) to classify EMP stars. This AI-based approach predicts if a specific abundance pattern is consistent with supernova enrichment by one or by several progenitor stars. We use Ensemble Learning to combine the predictions from several SVMs to avoid overfitting and to increase the reliability.

Results: By applying the trained classifier to actual observations, we find that 288 out of 410 classified EMP stars are multi-enriched and only 122 are mono-enriched. We also find that the probability of mono-enrichment decreases with metallicity, which is an expected trend that our model can recover independently.

Discussion: We find that most EMP stars are multi-enriched. This indicates that multiple Pop III SNe must have exploded in the same minihalo. Our study is therefore the first observational confirmation for the multiplicity of the first stars. In addition, we can identify the most informative abundance ratios and elements to discriminate mono- and multi-enriched EMP stars, which can be used to optimise future surveys.