The Galactic evolution of phosphorus

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As a galaxy evolves, its chemical composition changes and the abundance ratios of different elements are powerful probes of the underlying evolutionary processes. Phosphorous is an element whose evolution has remained quite elusive until now, because it is difficult to detect in cool stars. The infrared weak P I lines of the multiplet 1, at 1050-1082 nm, are the most reliable indicators of the presence of phosphorus. The availability of CRIRES at VLT has permitted access to this wavelength range in stellar spectra.We attempt to measure the phosphorus abundance of twenty cool stars in the Galactic disk. The spectra are analysed with one-dimensional model-atmospheres computed in Local Thermodynamic Equilibrium (LTE). The line formation computations are performed assuming LTE. The ratio of phosphorus to iron behaves similarly to sulphur, increasing towards lower metallicity stars. Its ratio with respect to sulphur is roughly constant and slightly larger than solar, [P/S]=0.10+- 0.10. We succeed in taking an important step towards the understanding of the chemical evolution of phosphorus in the Galaxy. However, the observed rise in the P/Fe abundance ratio is steeper than predicted by Galactic chemical evolution model model developed by Kobayashi and collaborators. Phosphorus appears to evolve differently from the light odd-Z elements sodium and aluminium. The constant value of [P/S] with metallicity implies that P production is insensitive to the neutron excess, thus processes other than neutron captures operate. We suggest that proton captures on 30Si and alpha captures on $27Al are possibilities to investigate. We see no clear distinction between our results for stars with planets and stars without any detected planet.

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