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Blocking metal accretion onto population III stars by stellar wind

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Low-mass population III (PopIII) stars of $< 0.8M_{\odot}$ could survive up until the present, if they were formed. Non-detection of low-mass PopIII stars in our Galaxy has already put a stringent constraint on the initial mass function (IMF) of PopIII stars, suggesting that PopIII stars have a top-heavy IMF. On the other hand, some claims that the lack of such stars stems from metal enrichment of their surface by the accretion of heavy elements from interstellar media (ISM). We investigate effect of the stellar wind on the metal accretion onto low-mass PopIII stars because, in the heliosphere, it is known that the accretion of the local ISM is prevented by the solar wind even for neutrals. The stellar wind and radiation of low-mass PopIII stars are modeled based on studies of nearby low-mass stellar systems including our Sun. We find that low-mass PopIII stars traveling across the Galaxy forms the stellar magnetosphere during most of their life. Once the magnetosphere is formed, most of neutral interstellar particles are photoionized before reaching to the stellar surface and are blown away by the wind. Especially, the accretion abundance of iron will be reduced by a factor of $< 10^{-12}$ compared with Bondi-Hoyle-Lyttleton accretion and the observed metallicities down to $[\mathrm{Fe/H}] \sim -5$ are not realized. This demonstrates that low-mass PopIII stars remain pristine and will be found as metal free stars and that further searches for them are important to constrain the IMF of PopIII stars.

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