CAN THE FIRST STARS FORMED BE PRE-GALACTIC ?

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ABSTRACT. We show that in a scenario of isothermal density perturbations, stars $\gtrsim 50 M_\odot$ (Population III) at a redshift $z \gg z_{gal}$ (redshift of galaxy formation) can be formed. We take into account in the calculation the expansion of the Universe and a series of physical processes relevant to the primordial plasma: photon-drag, photon-cooling, recombination, collisional ionization, photoionization, Lyman-α cooling and molecular hydrogen cooling.

The formation of the structures of the Universe is yet an open question. The formation of structures requires the existence of a spectrum of perturbations.

The isothermal density perturbations can be nonlinear for sub-galactic scales (e.g. Hogan 1978, Lahav 1986, de Araujo & Opher 1988, 1989) and lead to the formation of Population III objects. It is also possible to produce nonlinear perturbations for scales $M < 10^8 M_\odot$ by isocurvature or adiabatic cold dark matter density perturbations (see de Araujo and Opher 1991).

The Population III objects can collapse directly or fragment, forming in this way the first stars (Population III).The galaxies, cluster of galaxies and voids, for example, can be generated in a scenario of successive explosions of Population III objects (or stars).

We study the formation of Population III stars that can be produced by the fragmentation of clouds of mass $M \sim M_j$ (Jeans mass at the beginning of the recombination era, $\sim 10^{5-6} M_\odot$). We use the fact that a perturbation for $M \ll M_j$, that can survive with some residual amplitude, can produce the fragmentation of clouds of mass $M \sim M_j$ in the first free fall time scale of M (see de Araujo & Opher 1989).

We obtained that the minimum mass that can fragment from the M_c cloud is $\sim 50 M_\odot$ at $z \sim 181$.

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