The chemistry, and radiative and collisional interactions of $\text{H}_3^+$ in the early Universe are examined. The object of study is to investigate whether $\text{H}_3^+$ is essential in cooling of the primordial gas and thus in the formation of the first stars. The consensus so far is overwhelmingly negative. Most previous papers ignore the possibility at the onset because of the very low concentration of $\text{H}_3^+$, about $10^{-9}$ of $\text{H}_2$ or less.

Since the dipole infrared emission of $\text{H}_3^+$ is $\left(\lambda/a\right)^2 \sim 10^9$ times faster than the quadrupole emission of $\text{H}_2$, however, there is a possibility that $\text{H}_3^+$ is comparably efficient coolant as $\text{H}_2$. Glover and Savin\textsuperscript{a} was the only paper which took this possibility into account. They negate the contribution of $\text{H}_3^+$ because at a gas density higher than $10^{8}$ cm$^{-3}$ $\text{H}_3^+$ number density is further reduced by endothermic reaction $\text{H}_3^+ + \text{H} \rightarrow \text{H}_2 + \text{H}_2^+$. We will examine this.

We will consider the following two effects which have been neglected by the previous workers: (1) the effect of collision which convert translational energy of the gas into the energy of vibration and rotation of the molecules and (2) the effect of spontaneous emission between rotational levels. We find $\text{H}_3^+$ can be a more efficient coolant than $\text{H}_2$ in the early Universe depending on temperature, density, and cosmological conditions of the primordial gas at the time of star formation.