

## Formation Process of Interstellar Glycine

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The study of the chemical evolution of glycine in the interstellar medium is one of challenging topics in astrochemistry. We will present the chemical modeling of glycine in hot cores using the state-of-the-art three-phase chemical model NAUTILUS [1], which is focused on the latest glycine chemistry. For the formation process of glycine on the grain surface, we obtained consistent results with previous studies that glycine would be formed via the reactions of COOH with CH<sub>2</sub>NH<sub>2</sub>, which agrees with the previous modeling study [2]. However, we will report three important findings regarding the chemical evolution and the detectability of interstellar glycine.

First, with the experimentally obtained binding energy from the temperature programmed thermal desorption (TPD) experiment [3], a large proportion of glycine was destroyed through the grain surface reactions with NH or CH<sub>3</sub>O radicals before it fully evaporates. As a result, the formation process in the gas phase is more important than thermal evaporation from grains. If this is the case, NH<sub>2</sub>OH and CH<sub>3</sub>COOH rather than CH<sub>3</sub>NH<sub>2</sub> and CH<sub>2</sub>NH would be the essential precursors to the gas phase glycine. Secondly, since the gas phase glycine will be quickly destroyed by positive ions or radicals, early evolutionary phase of the hot cores would be the preferable target for the future glycine surveys. Thirdly, we suggest the possibility that the suprathreshold hydrogen atoms can strongly accelerate the formation of COOH radicals from CO<sub>2</sub>, resulting in the dramatic increase of formation rate of glycine on grains. The efficiency of this process should be investigated in detail by theoretical and experimental studies in the future.

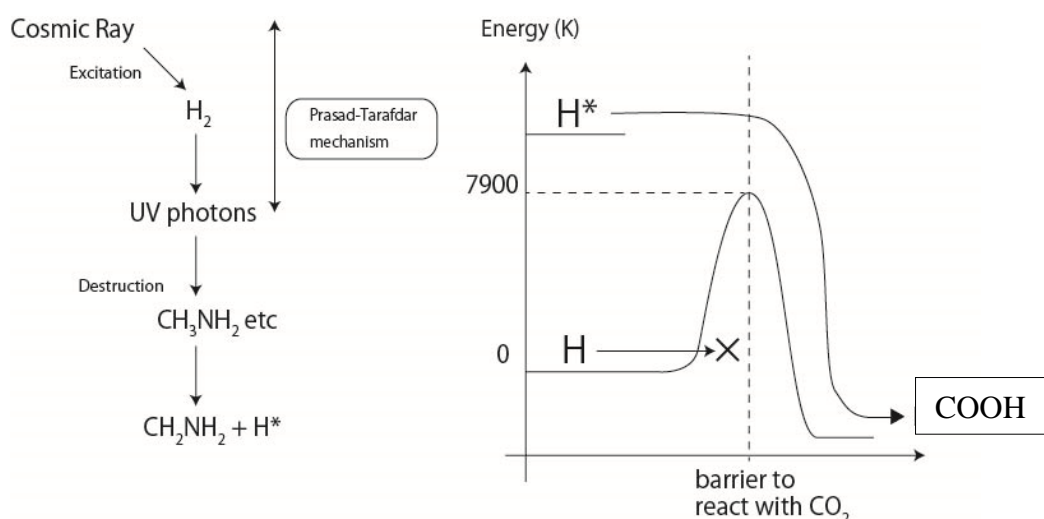


Figure 1: The chemistry of the suprathreshold hydrogen atoms.

### References

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- [2] R. T. Garrod, 2013, ApJ 765, 60.
- [3] G. Tzvetkov, M.G. Ramsey, F.P. Netzer, 2004, Chemical Physics Letters, 397, 392