Chemical modeling of gas-phase molecules containing refractory elements in hot disks around massive protostars

○Furuya Kenji[1] Tanaka Kei[2] (1.RIKEN 2.Science Tokyo)

Refractory elements are thought to be predominantly locked in dust grains in star-forming regions. However, recent ALMA observations have detected emission lines from refractory-element-bearing molecules, such as NaCl, SiS, and SiO, in the inner regions (<100 au) of protostellar disks around massive protostars. One possible explanation is that refractory elements are released from dust grains and subsequently participate in gas-phase chemistry, leading to the formation of these molecules. If this is the case, what fraction of the released refractory elements is contained in the detected species? Can observations of these molecules be used to constrain the abundance of refractory elements in the gas phase?

To address these questions, we constructed a physical and chemical model of a massive protostellar disk. Because astrochemical networks are primarily developed for cold molecular clouds, we expanded an astrochemical network to include reactions relevant to high-temperature and high-density conditions of the inner disk. Given the disk density structure and stellar parameters, we calculate the two-dimensional distributions of temperature and UV radiation field, and then solve the chemical network at each location in the disk. We find that NaCl can be efficiently formed once Na is released into the gas phase, through either ion-neutral or neutral-neutral reactions depending on the temperature. In the presentation, we will further discuss the gas-phase elemental abundances of Na (and Cl) required to reproduce the observed molecular abundances.