Chemistry in the Molecular Disks of Active Galactic Nuclei

Nanase Harada

Department of Physics, The Ohio State University, Columbus, Ohio 43210 USA

nanaseh@mps.ohio-state.edu

Eric Herbst

Departments of Physics, Astronomy, and Chemistry, The Ohio State University, Columbus, Ohio 43210 USA

Active galactic nuclei (AGNs) are the centers of galaxies with supermassive blackholes whose accretion of mass causes very high luminosities of L$\sim 10^{44-46}$erg s^{-1}. The accretion disks that exist in these regions consist of a dusty torus a few pc in size and a molecular disk extended to a scale of hundreds of pc. Rotational lines from these disks at a sub-kpc scale have been observed for molecules such as CO, HCO^+, HCN, HNC. When ALMA becomes fully operational, it will be able to resolve these disks at much higher resolution than currently. We modeled the chemical composition of a molecular disk in an AGN on a scale of tens of pc. To do this, we extended our standard gas-phase OSU network to include important processes at much higher temperatures, approaching 1000 K. We used the density model of Thompson et al.[1], and determined the temperature by the blackbody approximation from the luminosity of the AGN core. The central illumination from the AGN core also includes X-rays. If there are regions of star formation, they can lead to cosmic-rays from supernovae and OB stars, and also produce UV-photons. X-rays, cosmic-rays, and UV-photons all can affect the chemistry by ionizing and either directly or indirectly dissociating the molecules. There are some other factors that may affect the chemistry, which are left for the future work. For example, the accretion disk is highly turbulent, and associated shock waves can dissociate the molecules. In addition, the disk may also be clumpy, which changes the penetration of radiation and cosmic rays, as well as the cloud density.

[1] *Astrophysical J. 630, 167 (2005)*