The Chemical Composition in the Exosphere of Ceres

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The Dawn spacecraft has orbited around Ceres for more than two years, which is the largest object among the main-belt asteroids. Many unexpected discoveries have been made. In addition to the surface water ice seen in the permanently shadowed region (Platz et al., 2016), Prettyman et al. (2016) used the Gamma Ray and Neutron Detector (GRaND) instrument finding that Ceres' uppermost surface is rich in hydrogen (in the form of water ice), with higher concentrations in the mid/high latitude regions. Organic material is also discovered near Ernutet crater on Ceres, which makes its composition (i.e., rich in water and organics) similar to carbonaceous chondrites (Di Sanctis et al., 2017). Nathues et al. (2015) showed that a haze layer above the Occator crater has a diurnal change of brightness, indicating a comet-like sublimation activity. In addition, subsurface outgassing (e.g., impact-triggered upwelling and/or the plume activity similar to that found in Enceladus) is another possible source mechanism, which is not fully understood yet. *Kuppers et al. (2014) reported a direct detection of water vapor by Herschel that > 10^{26} molecules s^{-1} was produced from localized sources on Ceres' surface. Following the Ceres' exospheric model of Tu et al. (2014), we will re-investigate the source mechansims producing vapors and compute their source rates. In addition to the primary products of radiolytic and photolytic decomposition of water ice (i.e., O_2, O_3 and CO_2 produced from the impurities), the vapors from salts and organic material will be considered as well. Their interaction with the solar photons and solar wind plasma will be taken into account in the modeling the chemical composition of Ceres' exosphere. Then we will compare with the available data and seek for any evidence in the ground-based millimeter/submillimeter observations.*