The ROSINA Perspective on the CN/HCN Ratio at Comet 67P/Churyumov-Gerasimenko

Nora Hänni, Kathrin Altwegg, and Martin Rubin
University of Bern, Physikalisches Institut, WP, Bern, Switzerland (nora.haenni@space.unibe.ch)

The origin of cyano (CN) radicals in comets presents a long-standing riddle to the science community. Remote observations, e.g. reviewed by Fray et al. [1], show that for some comets the scale lengths, production rates, and spatial distributions of hydrogen cyanide (HCN) and CN using a Haser-based model are not consistent. Consequently, a process additional to photolysis of HCN seems to be required to explain the observed CN densities. Possible scenarios include (1) degradation of CN-producing refractories (e.g. HCN-polymers, tholins, or ammonium salts [2-3]) and (2) photolysis of other gaseous CN-bearing parent species (e.g. HC$_3$N or C$_2$N$_2$).

The CN/HCN ratio observed in the inner coma of comet 67P/Churyumov-Gerasimenko with the Double Focusing Mass Spectrometer DFMS, part of the ROSINA (Rosetta Orbiter Spectrometer for Ion and Neutral Analysis) sensor package [4] onboard ESA's Rosetta spacecraft, is not compatible with fragmentation of HCN under electron impact ionization. Even though from fragmentation a constant CN/HCN ratio of about 0.15 [5-7] is expected, the observed values range from almost 0.4 at the beginning of the mission (August 2014) to about 0.15 shortly after perihelion passage (August 2015). Towards the end of the mission (September 2016), CN/HCN ratios increase again. This presentation will discuss the data from ROSINA/DFMS in detail and present laboratory-based indications that direct production of CN from sublimating ammonium cyanide (NH$_4$CN) occurs, leading to increased CN/HCN ratios. Could this be the process generating a surplus of CN radicals with respect to photolysis of HCN in certain comets?


