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Bartosz Etmański - Ammonia in circumstellar envelopes of carbon rich stars

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The HIFI instrument on board of the Herschel Space Observatory (HSO) has been very successful in detecting molecular lines from circumstellar envelopes around evolved stars, like massive red supergiants, Asymptotic Giant Branch (AGB) and post-AGB stars, as well as planetary nebulae. Among others, ammonia has been found in circumstellar envelopes of C-rich AGB stars in amounts that significantly exceeded theoretical predictions for C-rich stars. Few models have been proposed to resolve this problem: formation of ammonia behind the shock front, photochemical processes in the inner part of the envelope partly transparent to UV background radiation due to the clumpy structure of the gas, and formation of ammonia on dust grains. Careful analysis of observations may help to put constraints on one or another mechanism of formation of ammonia. Here, we present details of the non-LTE radiative transfer modeling of ammonia transitions including a crucial process of radiative pumping via $v_2 = 1$ vibrational band (10 μm) for selected stars from the sample of C rich stars observed with the HIFI instrument. These sample of C-rich stars include mostly ground transition of ammonia J = 1_0–0_0 at 572.5 GHz. The photodissociation radius (and distribution molecule) of ammonia has been obtained from calculation of the simplified chemical model of the circumstellar envelope including only proces of photodissociation (Glassgold et al. 1987). The dust properties were obtained from modelling of the spectral energy distribution (SED) (MRT, R. Szczerba, 1993). In some cases observed SED was reproduced by assuming inverse power law dependence of dust opacity with wavelength, fixed optical depth at selected wavelength, and power law distribution of dust temperature in the envelope (e.g. Schönberg et al. 1987).

Primary author: Mr ETMAŃSKI, Bartosz (NCAC Toruń)

Co-authors: Prof. RYSZARD, Szczerba (NCAC Toruń); Dr SCHMIDT, Mirosław (NCAC Toruń)