POLYCYCLIC AROMATIC HYDROCARBON GROWTH IN A PLASMA REVEALED BY IR-UV ACTION SPECTROSCOPY

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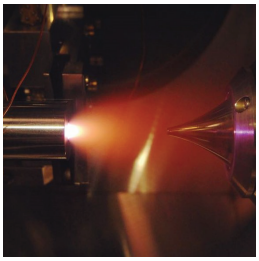

The bottom-up formation of polycyclic aromatic hydrocarbons (PAHs) in combustion and interstellar gas-phase environments is still subject of extensive debate. As a result, accounting for PAH abundance in soot and the interstellar medium is far from trivial. Over the past years, a number of new reaction mechanisms have been proposed, spectroscopically identified and added as possible growth routes for larger PAHs.[a] These include reactions with radical phenyl rings and several small hydrocarbon radicals. We show here that a combination of these barrierless reactions is necessary to fully describe the chemistry leading to PAH growth.

To this purpose we follow and characterize in our experiments the formation of PAHs in an electrical discharge. The fragments, products and reactive intermediates that are produced in this discharge are entrained in a molecular beam and structurally identified by mass selective IR-UV spectroscopy using an IR Free Electron Laser. Comparison of the mass-selected IR absorption spectra with IR spectra calculated for potential species associated with each of these spectra enables us to identify products including larger PAHs, radicals, and intermediates. The assigned structures serve as promising candidates for radio astronomical searches and highlight the necessity of describing PAH growth by an interconnected network of pathways.[b]

[a] Kaiser, R. I., Hansen, N. (2021), JPC A, 125(18), 3826-3840

[b] Lemmens, A. K., Rap, D. B., Thunnissen, J. M., Willemsen, B., Rijs, A. M. (2020), Nat. Comm., 11(1), 1-7