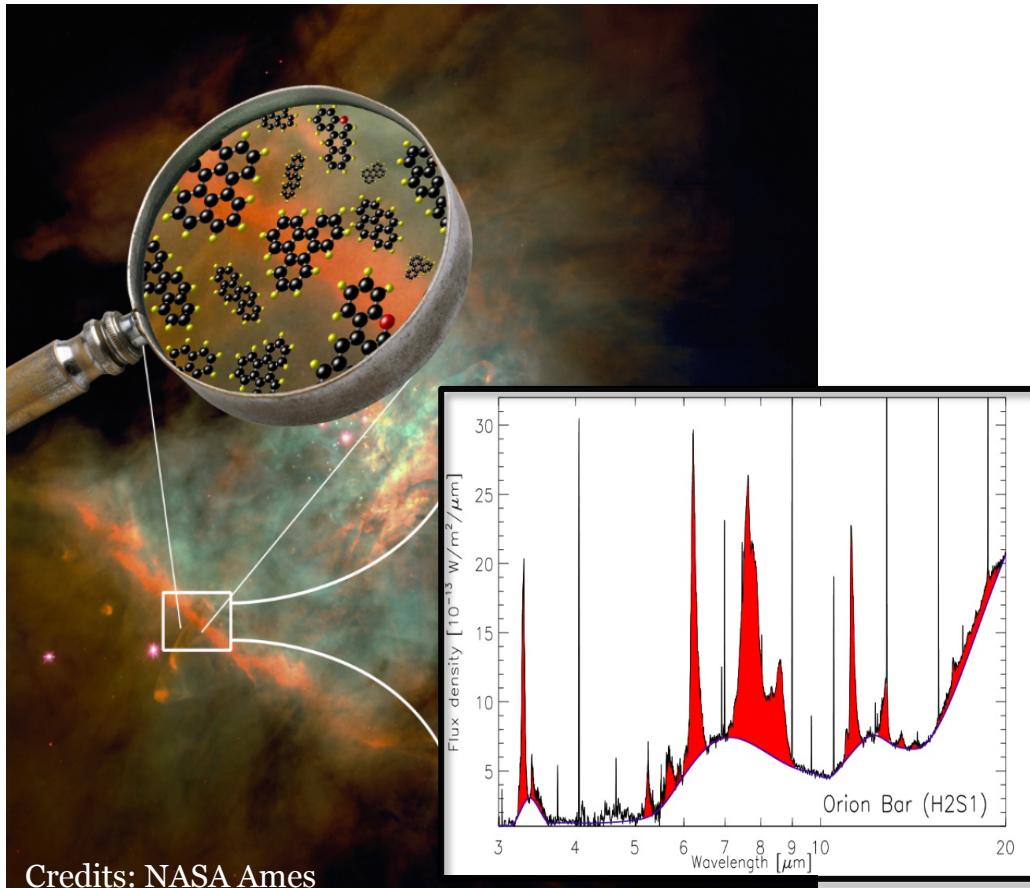


Shining Light on the Photodissociation of Polycyclic Aromatic Hydrocarbons

Jordy Bouwman

PAHs in the Interstellar Medium



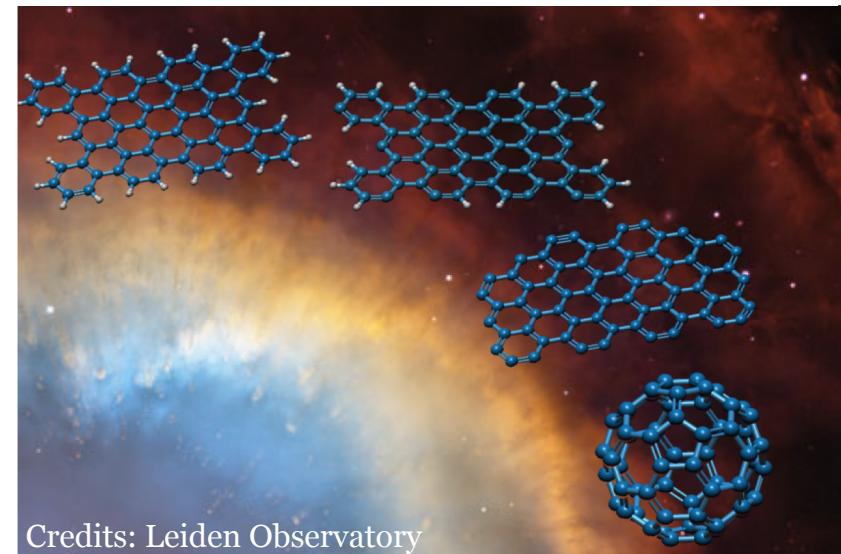
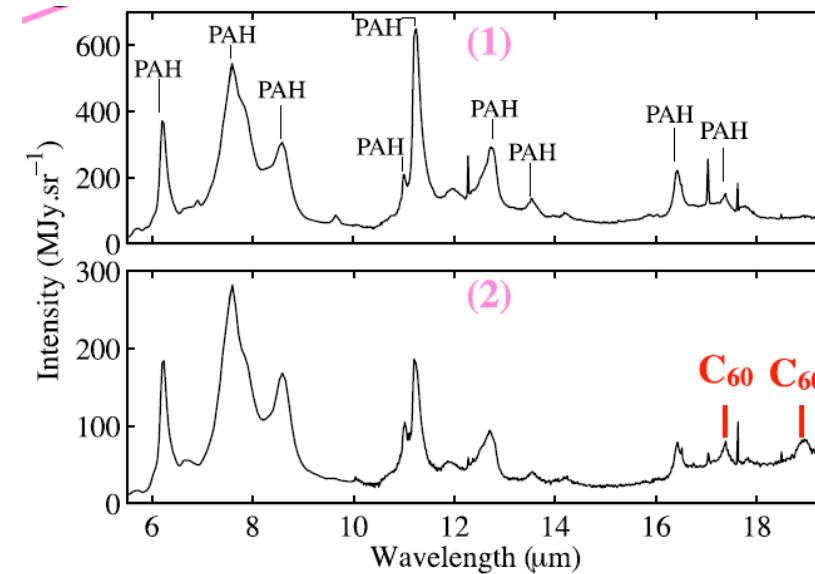
- Detected via mid-IR emission
- Up to 15% of elemental carbon locked in PAHs
- Changes in spectral characteristics reflect local conditions
- Information on charge, size, shape, & degree of photoprocessing

PAH photoprocessing

- Energetic processing of PAHs in PDRs
- Fullerene formation via top-down chemistry
- Underlying mechanisms not understood

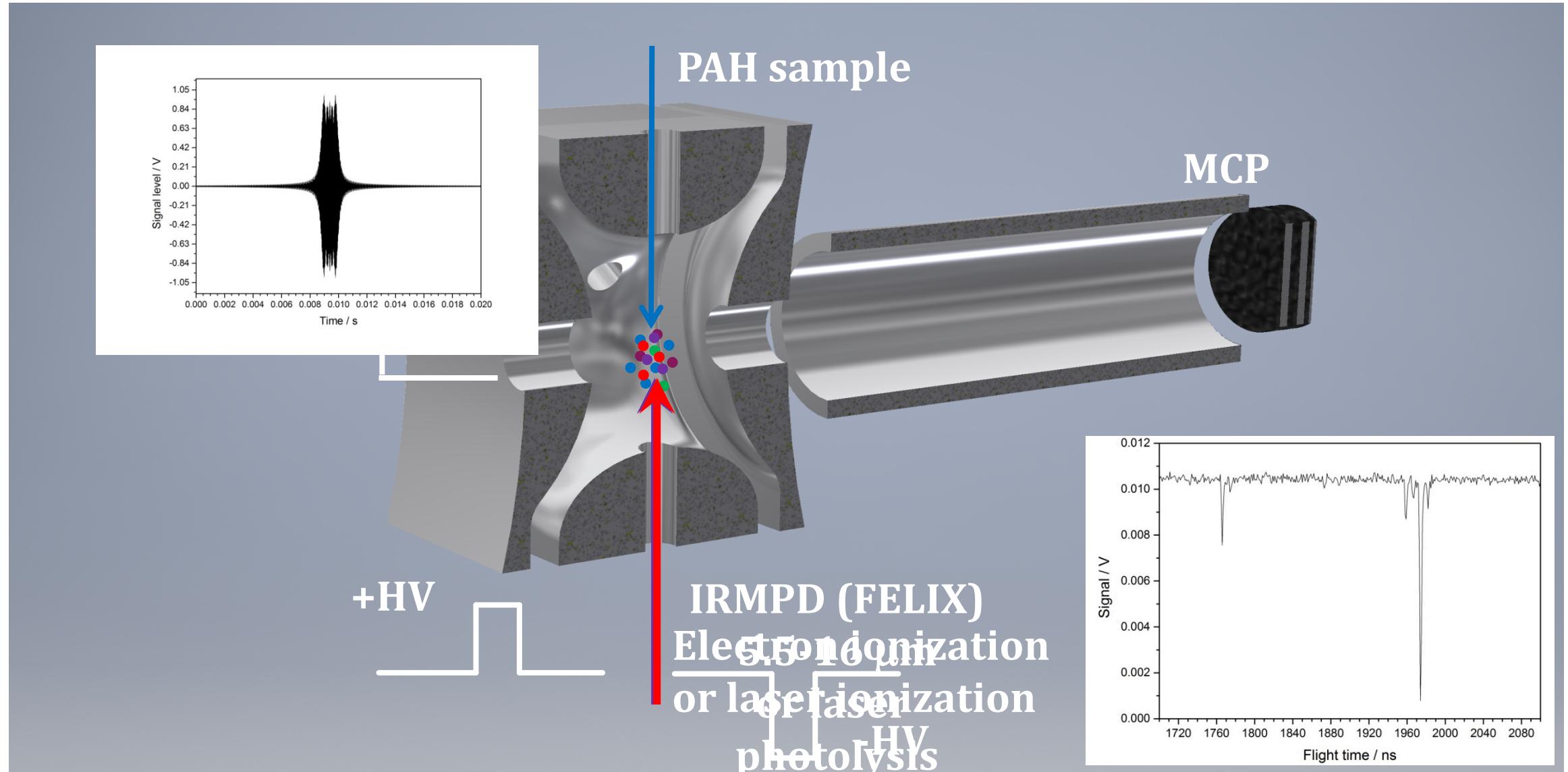
Berné & Tielens, PNAS 109, 401–406, 2012

Zhen et al. ApJ Lett. 797:L30, 2014

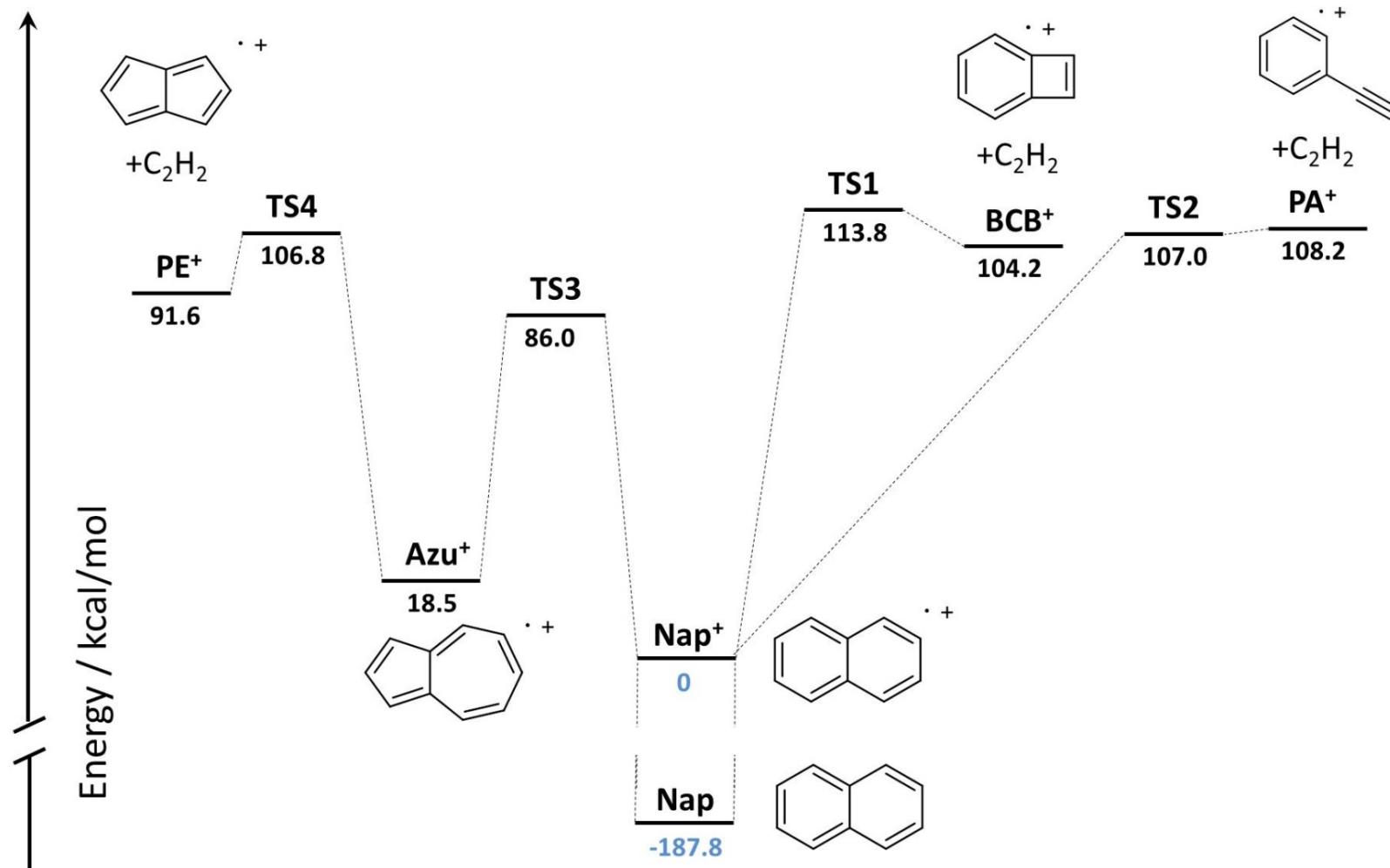


Credits: Leiden Observatory

Ion trap apparatus



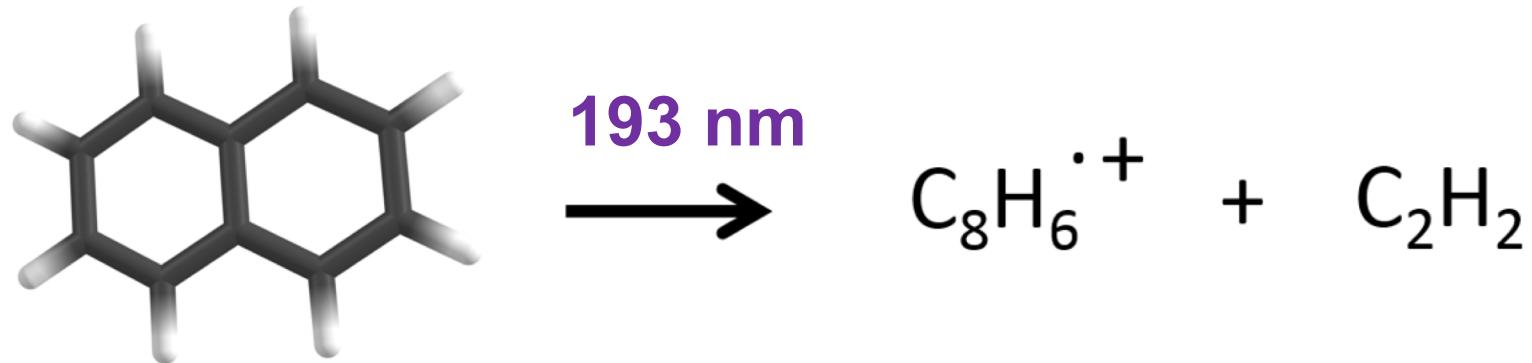
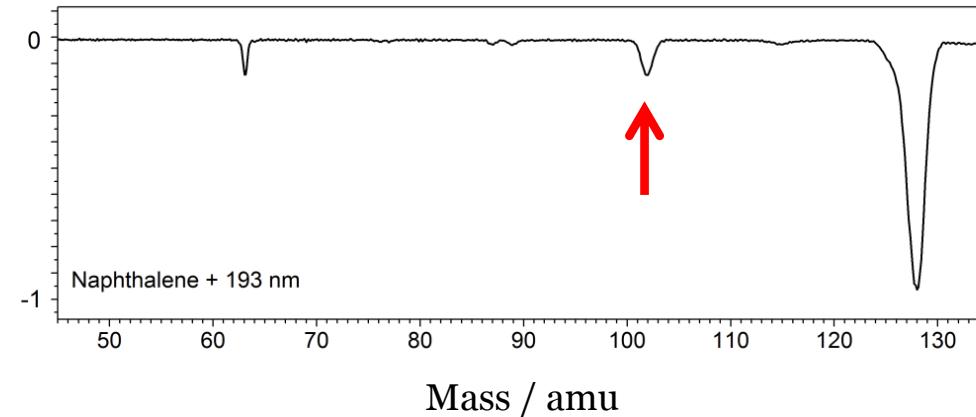
Naphthalene dissociative ionization



Dyakov, Ni, Lin, Lee and Mebel, PCCP, 2006, 8, 1404–1415

Naphthalene dissociative ionization

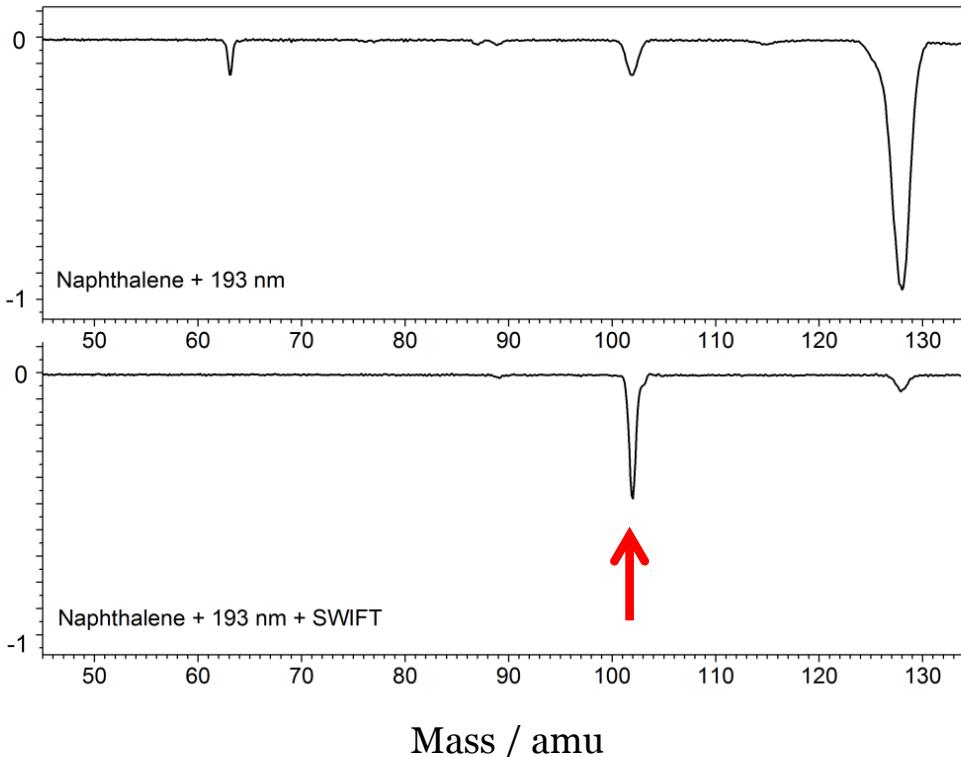
Dissociative ionization
Some dissociation visible



Naphthalene dissociative ionization

Dissociative ionization
Some dissociation visible

SWIFT isolation
Enhanced dissociation



Naphthalene dissociative ionization

Dissociative ionization

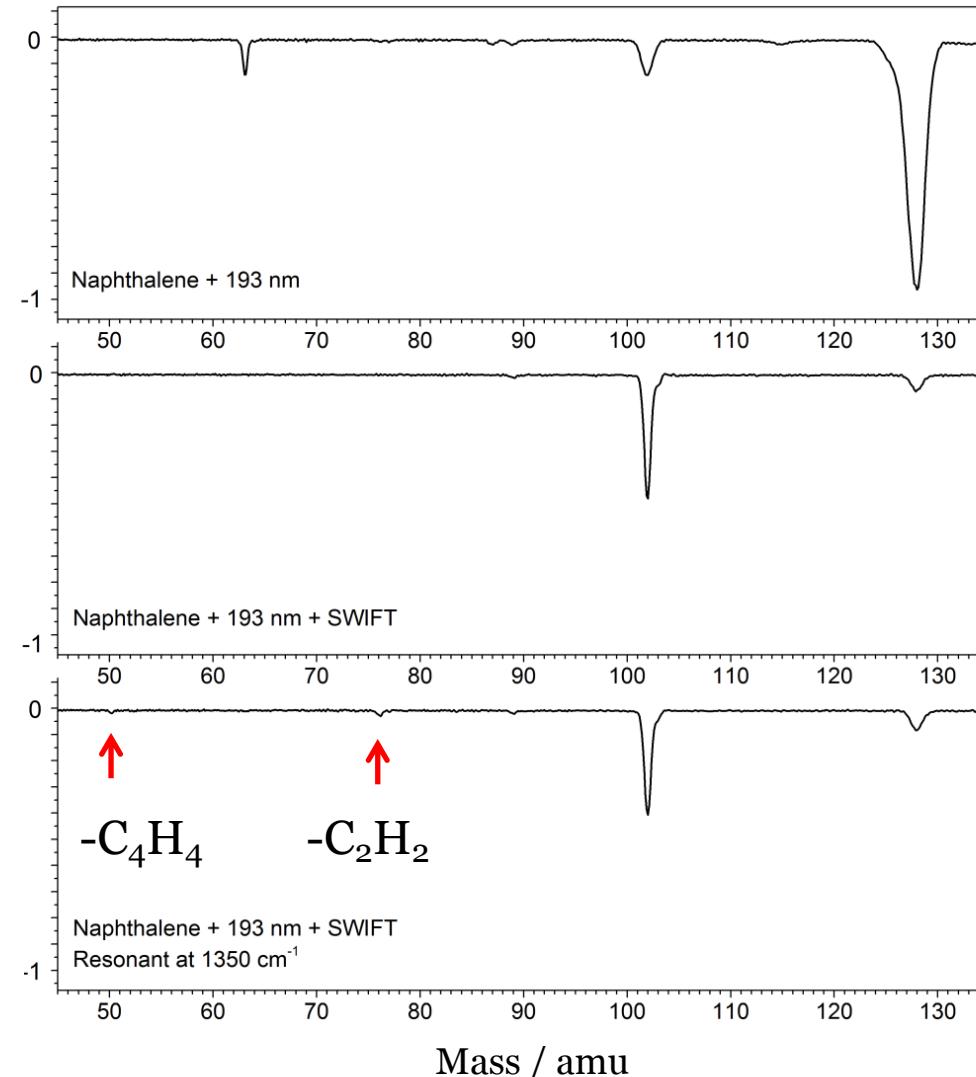
Some dissociation visible

SWIFT isolation

Enhanced dissociation

IRMPD yields products

C_4H_2^+ and C_6H_4^+



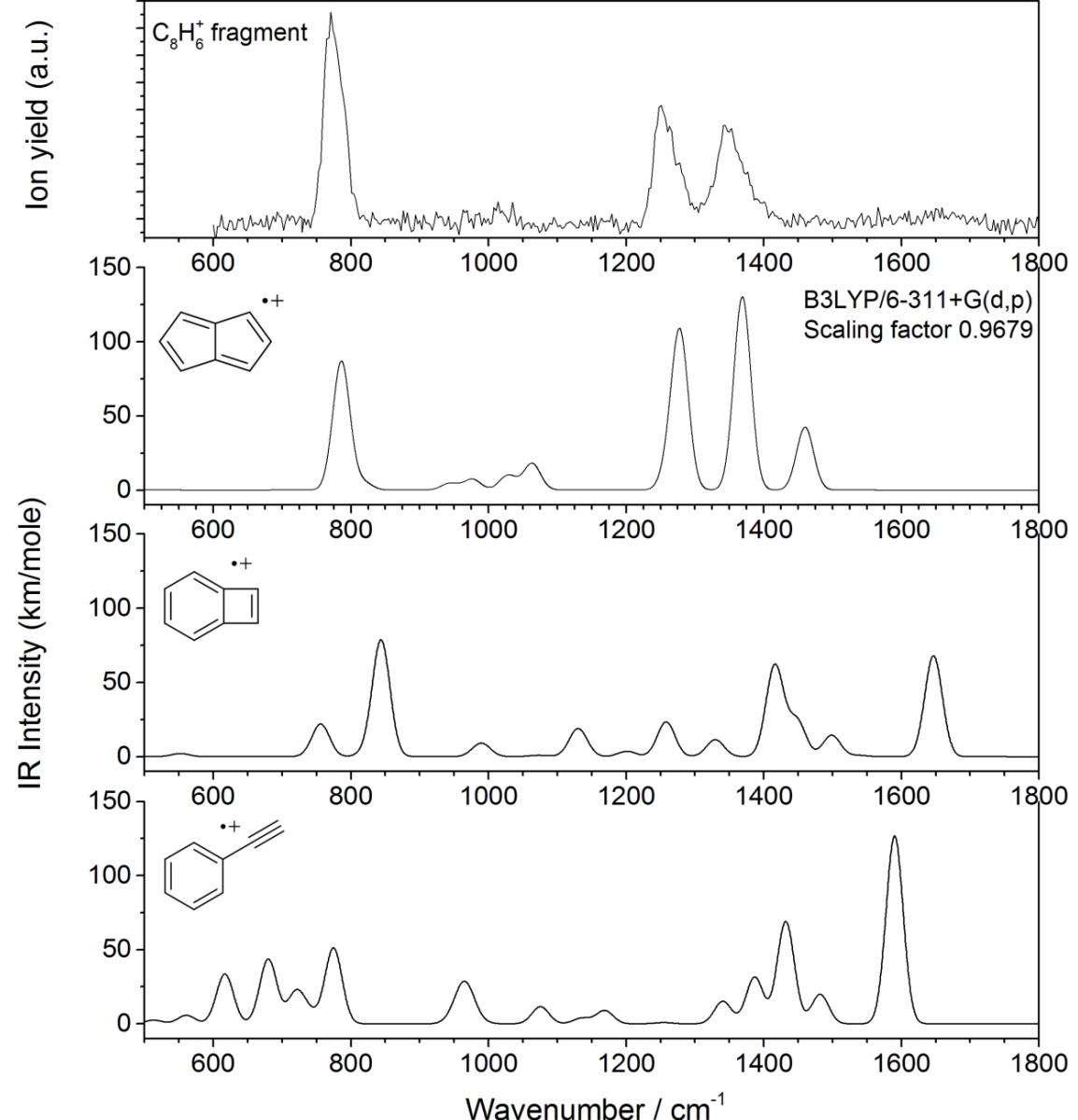
IRMPD spectrum

Compare with simulated spectra:

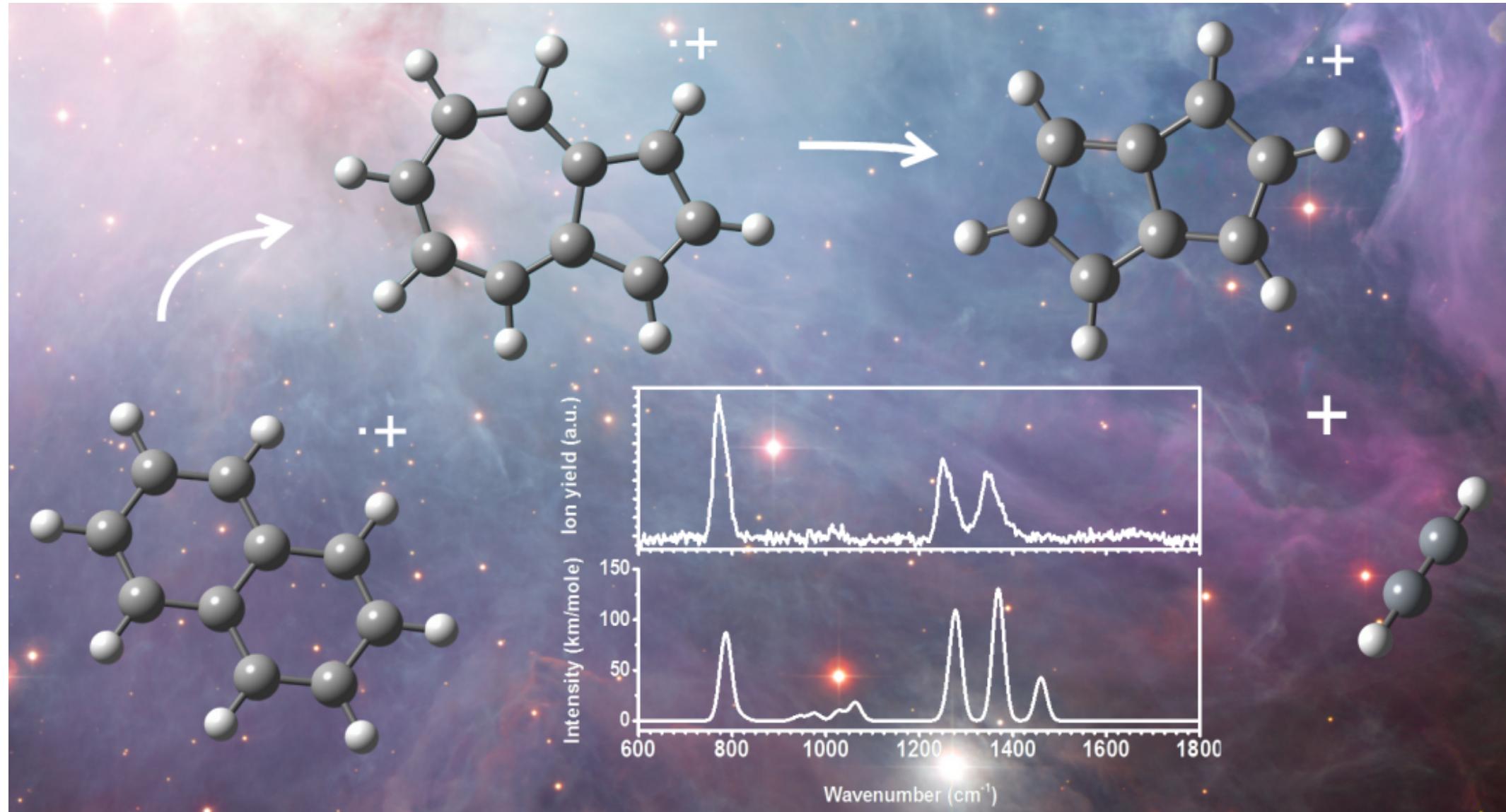
Pentalene

Benzocyclobutadiene

Phenylacetylene

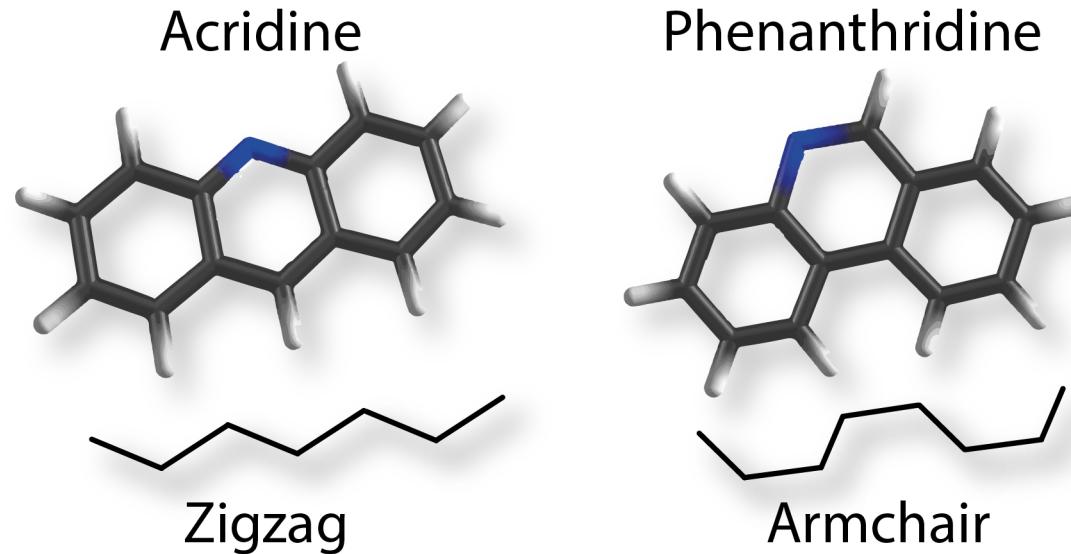


Interstellar pentagon formation



Dissociation of larger PAHs

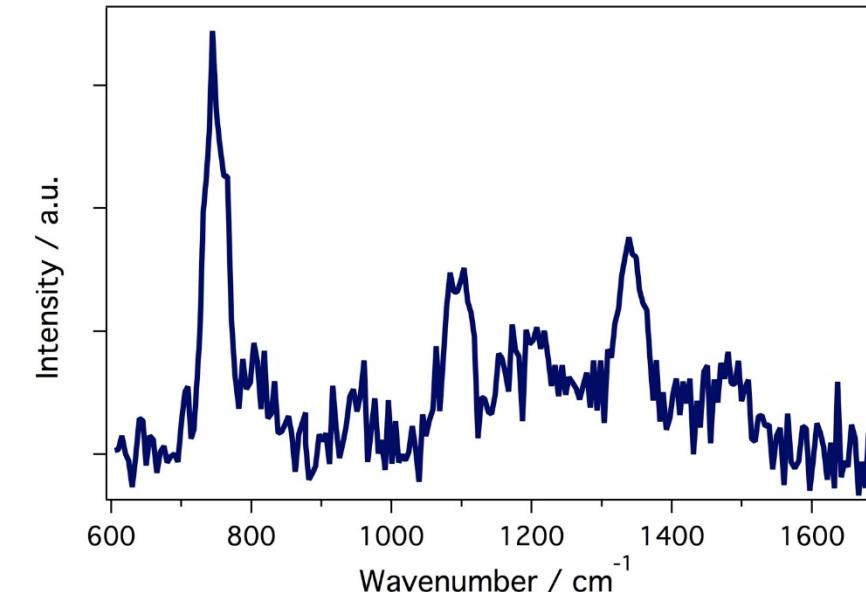
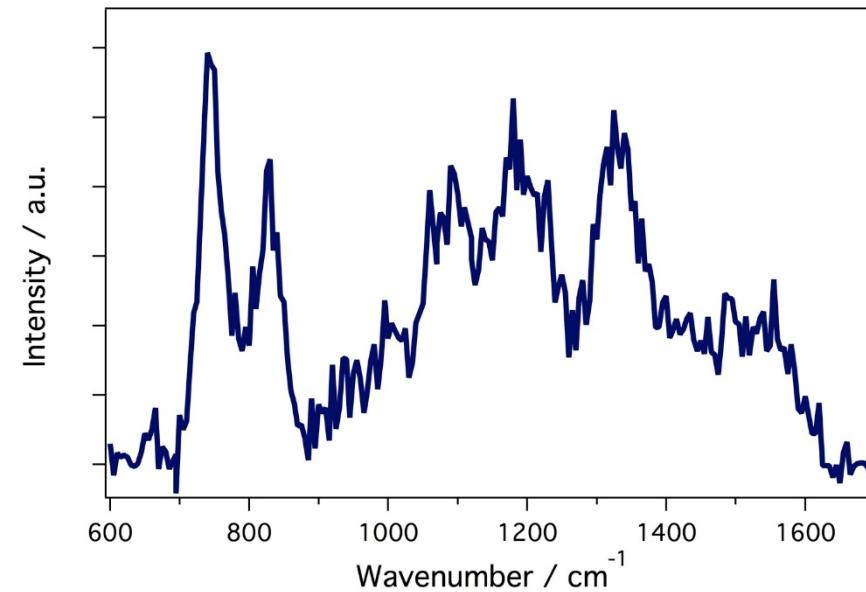
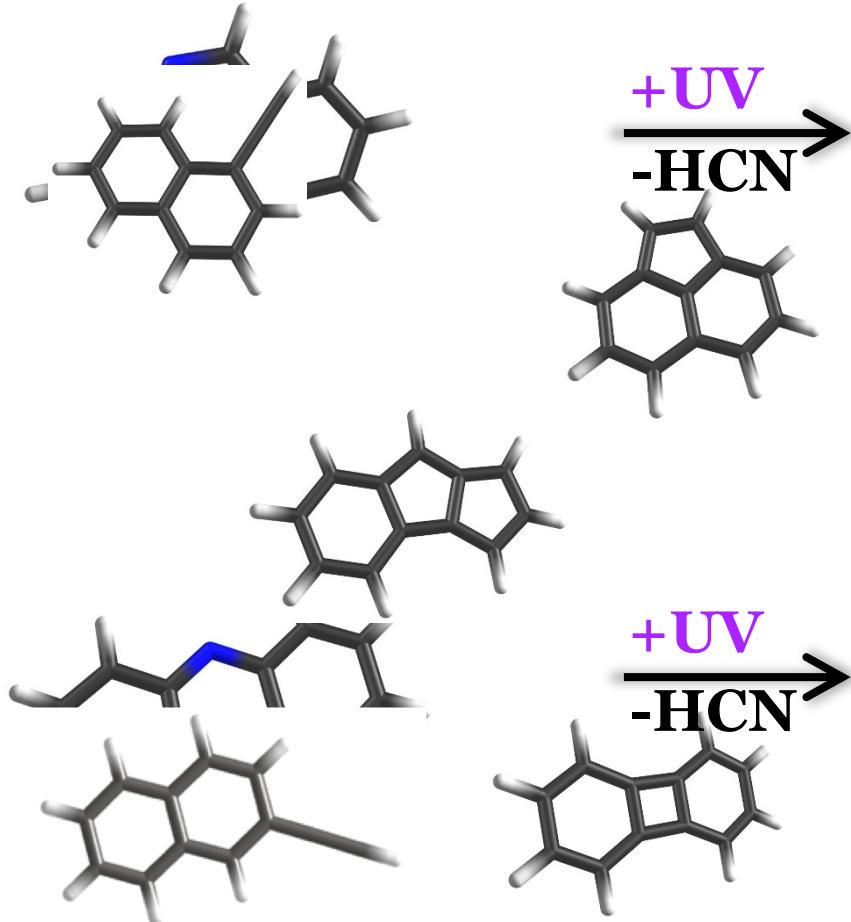
- Interstellar PAHs are typically much larger
- Nitrogen inclusion allows for site specific studies



- Effect of edge topology on dissociation

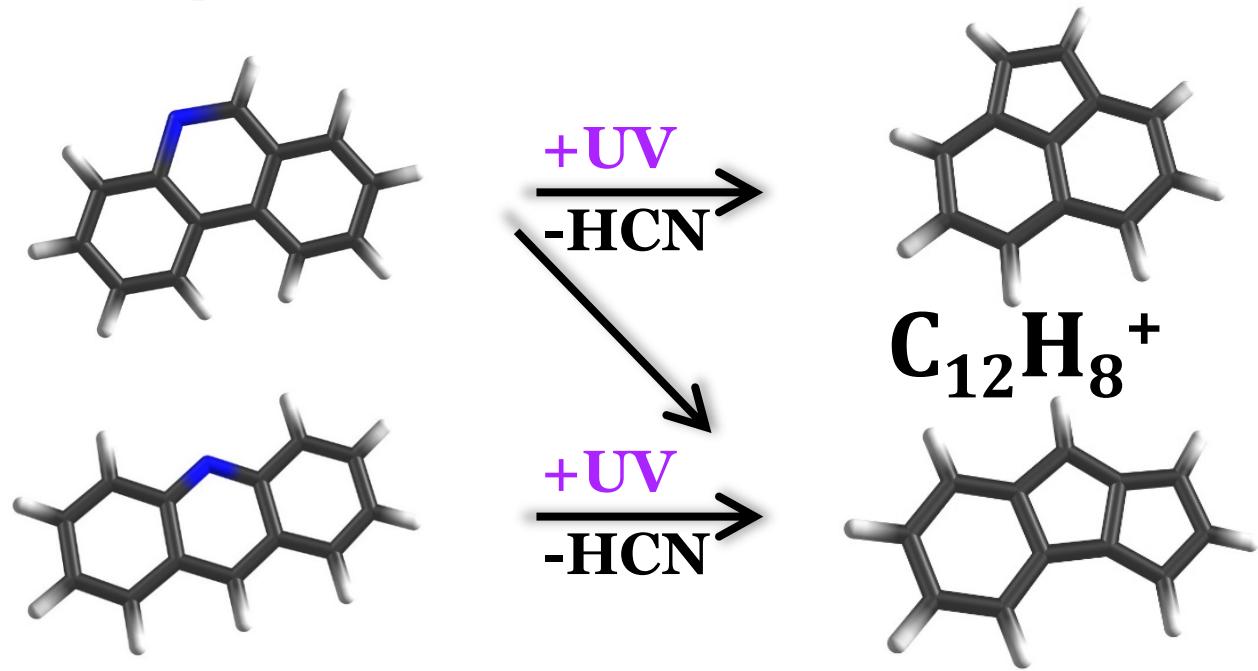
IR action spectroscopy

Possible $\text{C}_{12}\text{H}_8^+$ products



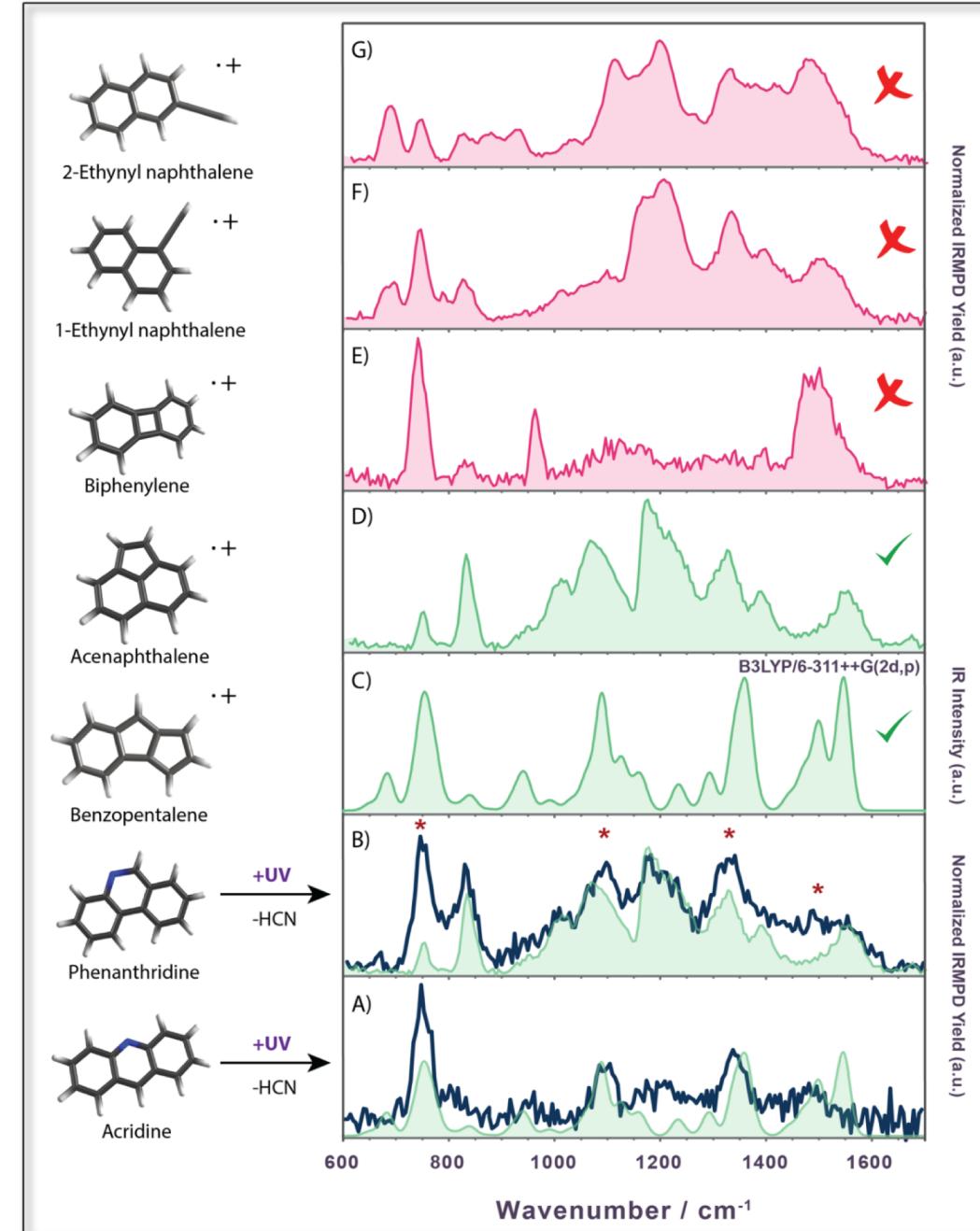
Mid-IR action spectra

- Mid-IR action spectroscopy reveals two main products:

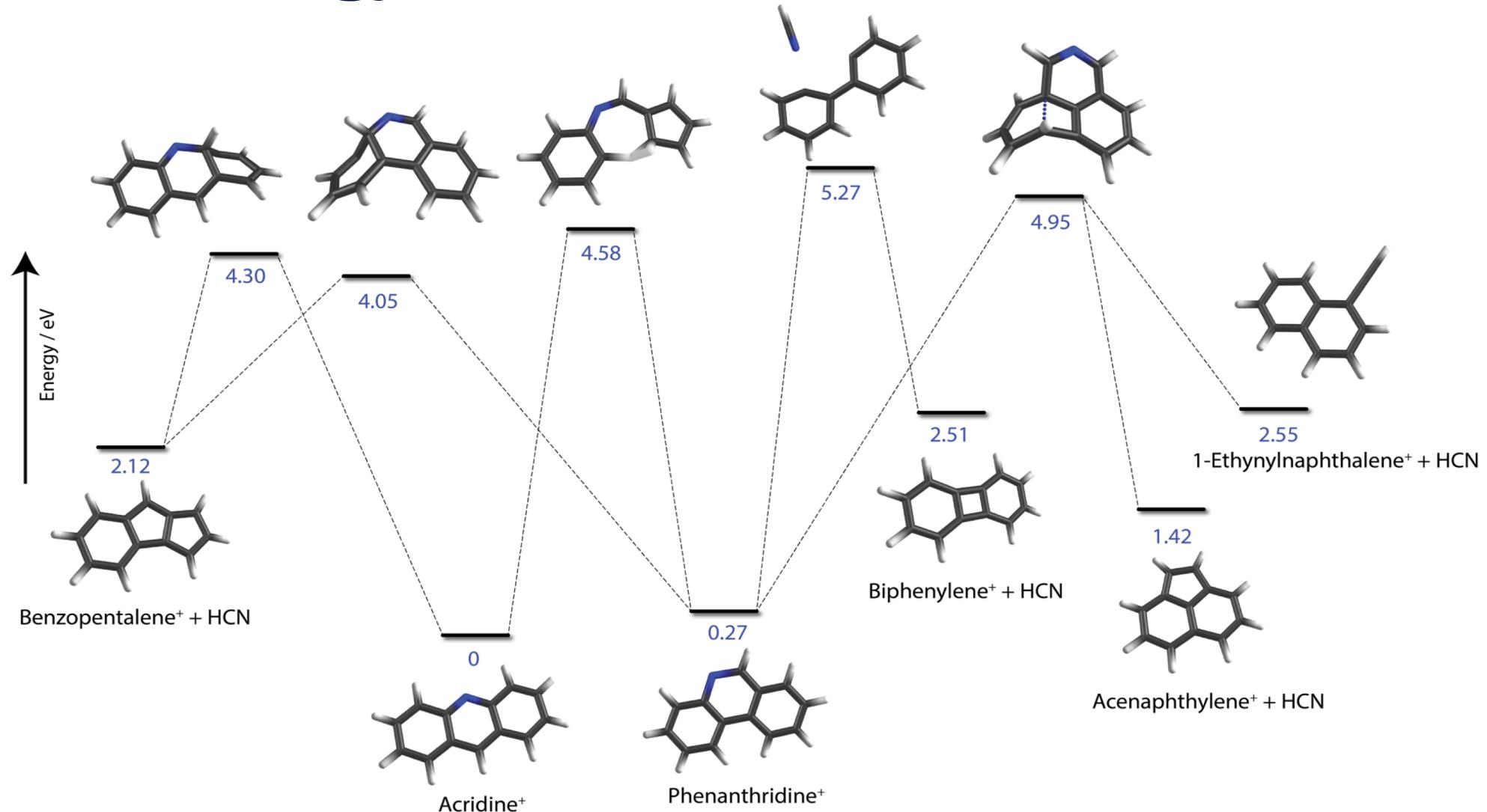


- Facile pentagon formation!

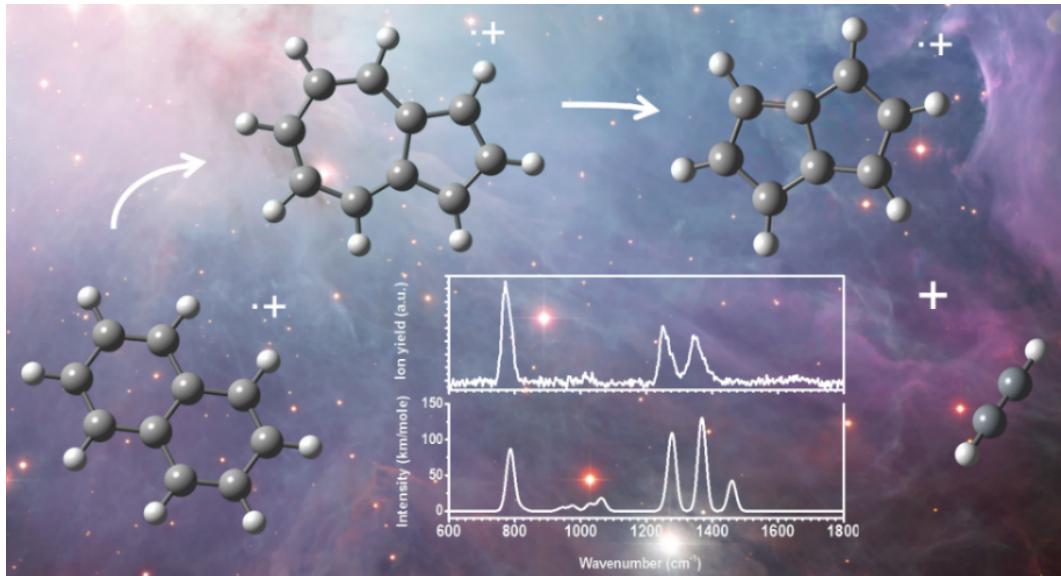
De Haas, Oomens & Bouwman PCCP **19**, 2974-2980, 2017



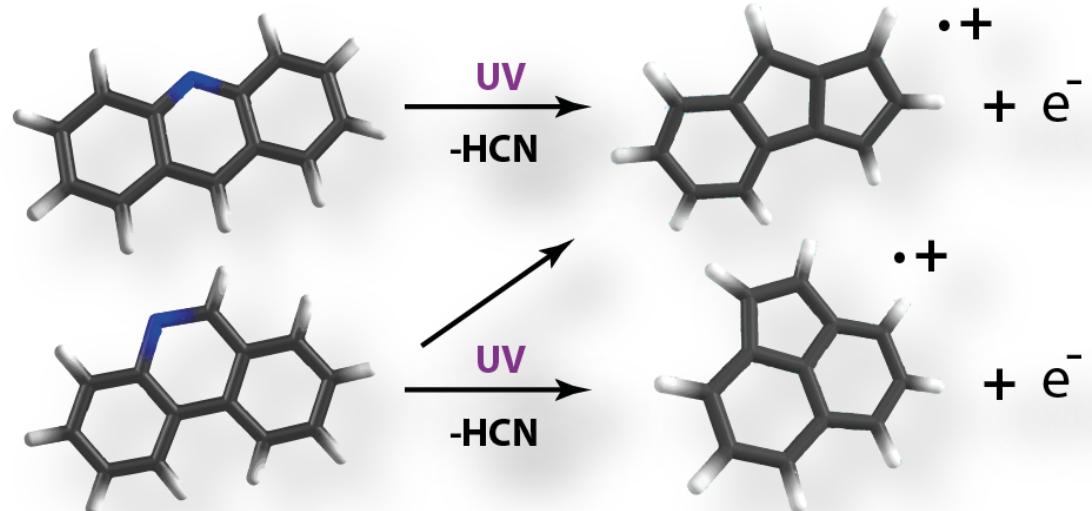
Potential energy surface



Take home message



Bouwman, de Haas & Oomens
ChemComm **52**, 2636-2638, 2016



De Haas, Oomens & Bouwman
PCCP **19**, 2974-2980, 2017

Formation of 5-7 ring defects precedes dissociation

Important clues to the formation of interstellar fullerenes

Work on large aromatic species is in progress

Acknowledgement

Leiden Observatory



Universiteit Leiden



Harold Linnartz
Xander Tielens



Radboud University



Jos Oomens
Arjen de Haas

Funding



Veni grant
Vidi grant

Computational

