Galaxies, Black Holes & Laboratories:

Studies of interstellar medium materials

Obscured AGN, Seeon, June 6, 2007

in energetic environments

Science Case

- Energetic feedback on dust
  - Supernova shocks
  - AGN jets
- ISM dust controls
  - Formation molecules
  - Cooling of ISM clouds
  - Formation stars, planets, life

Wil van Breugel University of California, Merced & Physics and Advanced Technologies, LLNL

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LLNL Assets

- High energy physics
- Computational facilities
- “Astro-materials” expertise

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Plan

- Two ISM dust types
  - Silicates
  - Carbonaceous
- Two dust morphologies
  - Crystalline
  - Amorphous
- Chemistry (organic)
- Studies at LLNL
  - Effects of GeV Cosmic Rays on ISM dust analogs
  - Experimental + numerical simulation ***IR spectra*** !!

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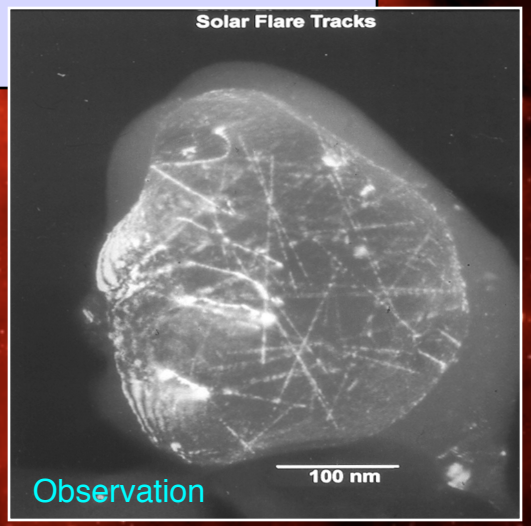
Results

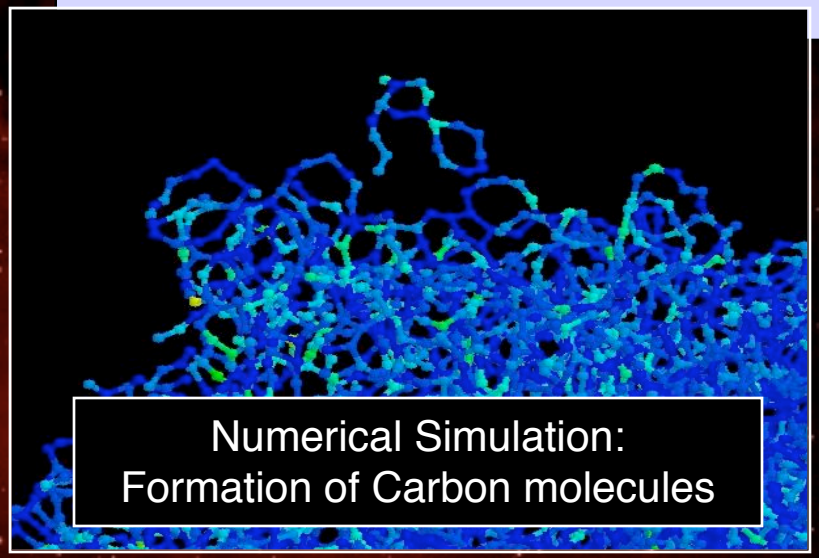
Silicate Dust

• Experiments: low energy CR tracks amorphize crystalline dust grains (Mg_2SiO_4 forsterite)



Carbonaceous Dust

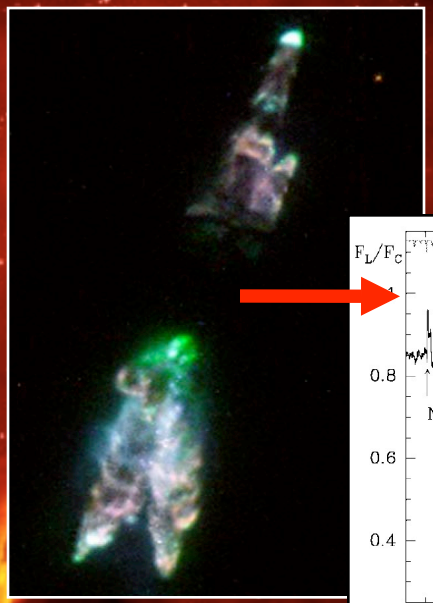
• Numerical simulations show low energy Cosmic Rays change morphology and chemistry

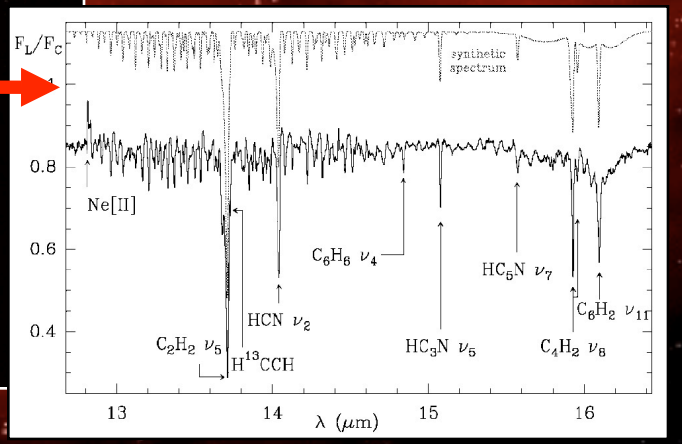


Numerical Simulation:
Formation of Carbon molecules

Goal: IR Spectra

Experimental



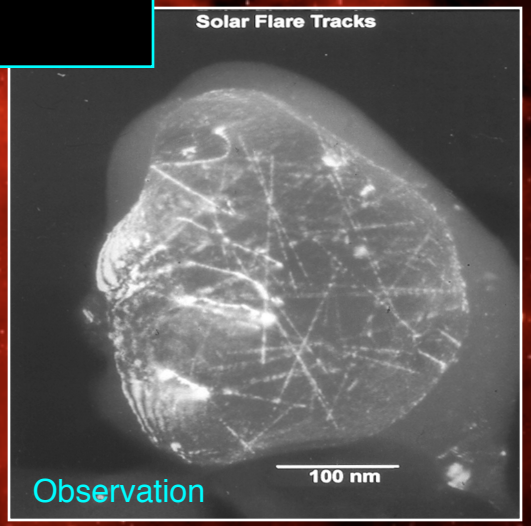


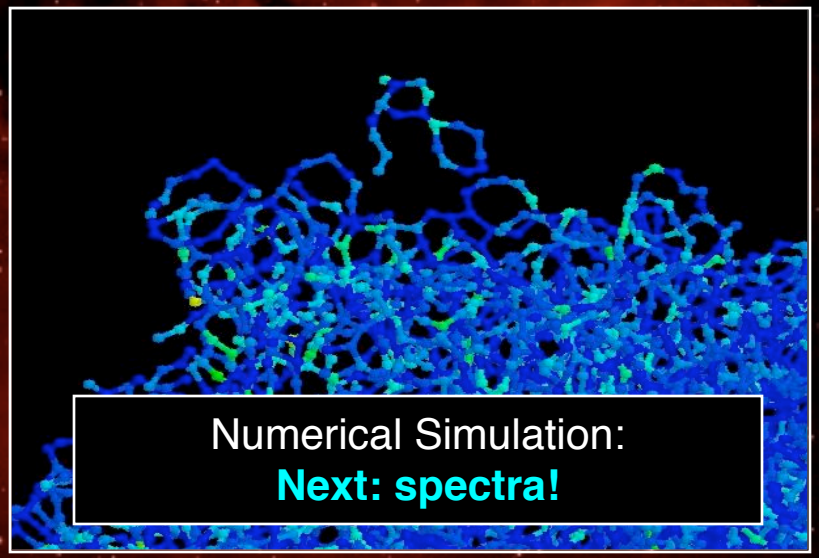
Stellar outflows

For mid-IR spectra of irradiated, amorphous fosterite see

Bringa et al, Ap.J. June 10, 2007

Hydrocarbons (C_mH_n) & organic (C_mH_n + N, O, S, P) molecules





Numerical Simulation:
Next: spectra!