Dust in the Interstellar Medium

- **Interstellar grains –**

  SiO, SiO_2, SiC, $H_2O(s)$, NH_3 - micron size

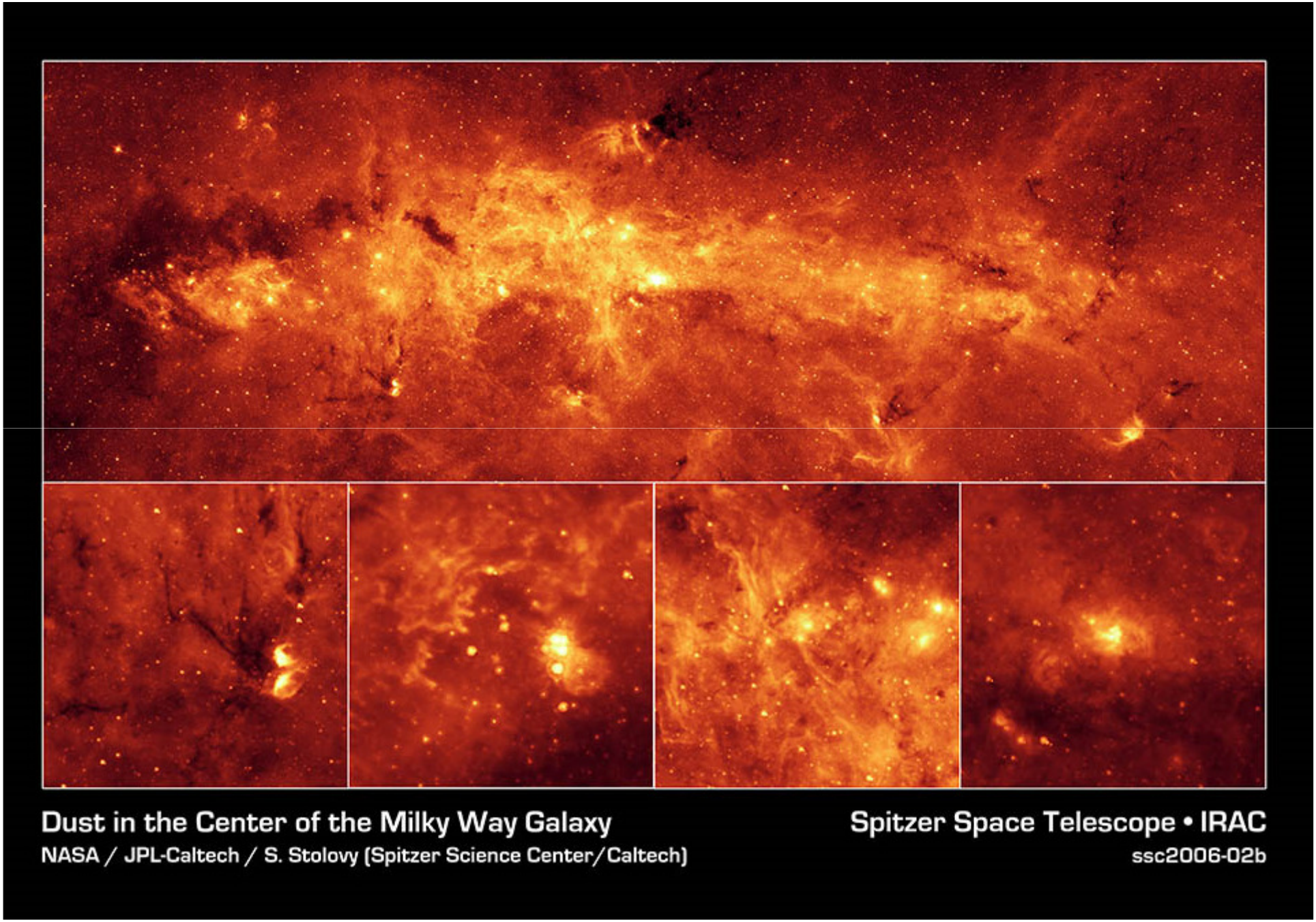
  PAHs (20 – 100 carbon atoms in aromatic hydrocarbon form) - nanometer size

- ***How is the presence of interstellar dust known?***

Direct detection of radiation emitted by heated dust

Indirect detection by the *absorption* and *scattering* of starlight by dust

Direct Detection of Interstellar Dust



The previous page is the 8μm image from the Spitzer infrared space telescope of the dust emission from the centre of the Galaxy, encompassing the region of the central molecular zone, covering a region ~240 x 80 parsecs. Inserts are (from L to R): (i) obscuration from a foreground spiral arm, (ii) the Quintuplet star cluster, dominated by the emission from 5 bright embedded, massive stars (with the Pistol nebula and star to their right-below and the remnant dust pillars of the Sickle to their left), (iii) dust emission from the Arched Filaments and (iv) the Sgr A cluster in the very centre of the Galaxy, around the massive black hole at the Galaxy's core. Credit: NASA and Susan Stolovy.

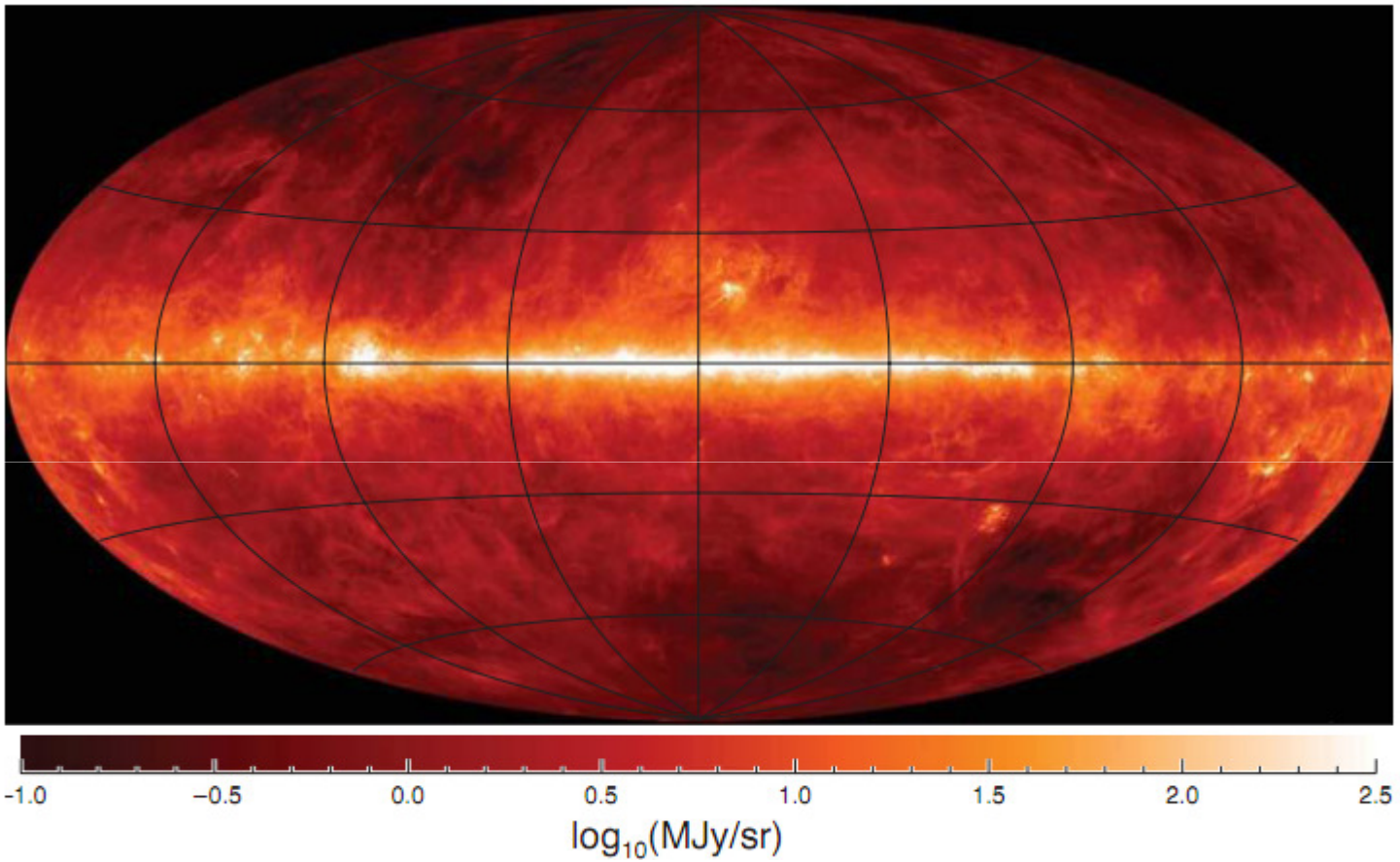
Direct Detection of Interstellar Dust

- Interstellar dust emission dominates the sky brightness between 600 μm and 6 μm

- Thermal blackbody emission dominates at $\lambda > 50$ μm

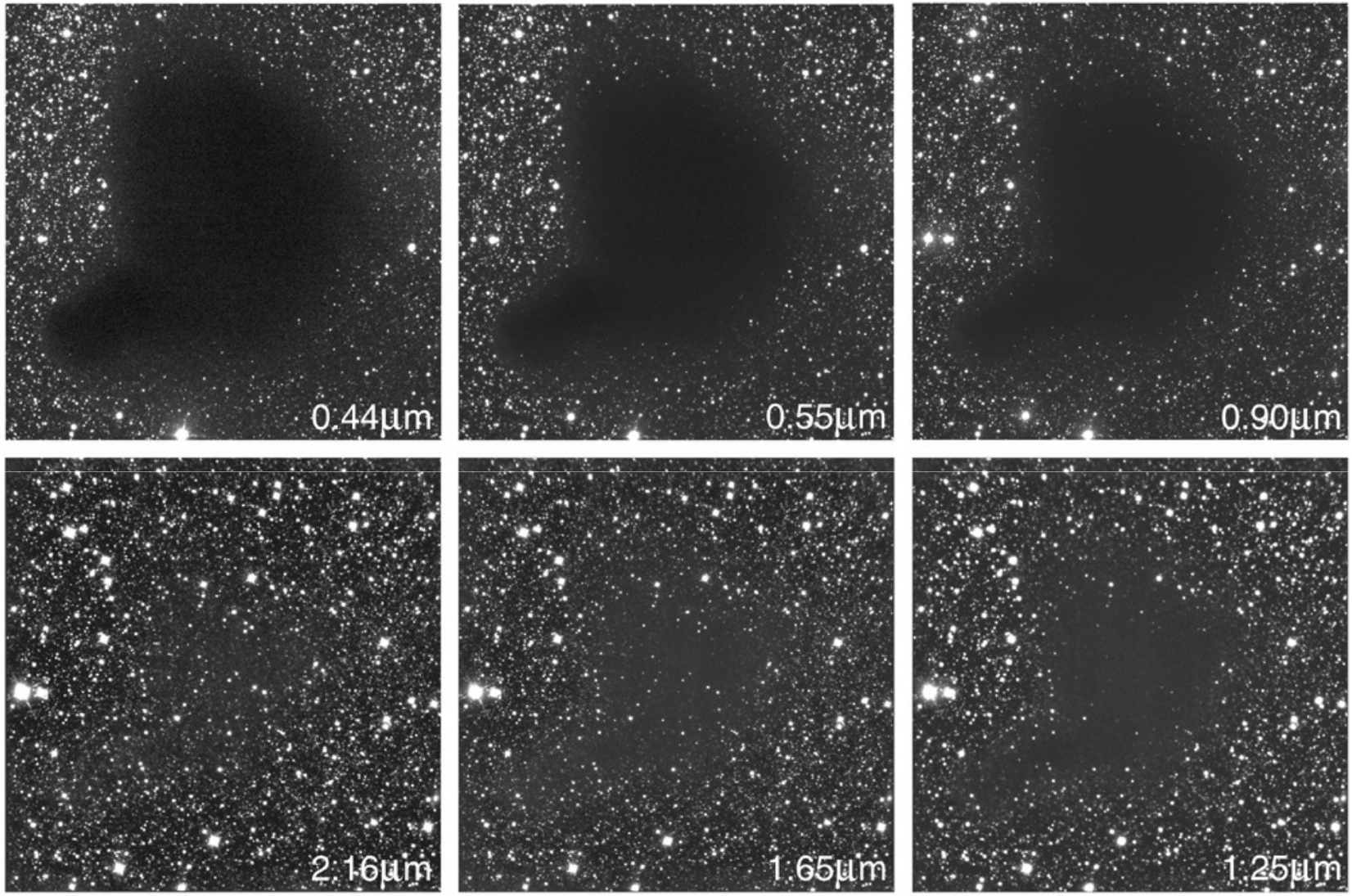
- Vibrational emission by PAH (polycyclic aromatic hydrocarbon) molecules dominates dust emission at $\lambda < 50$ μm (*non-thermal*)

Sky brightness at 100 μm (far-IR) wavelengths dominated by interstellar dust emission (heated by star light)



The $100\,\mu\mathrm{m}$ sky, after subtracting the emission from warm interplanetary dust particles within the Solar system. The LMC and SMC are visible at $(\ell, b) = (280^\circ, -33^\circ)$ and $(303^\circ, -44^\circ)$. The bright emission near $\ell = 80^\circ$ (in Cygnus) corresponds to dust in the Perseus spiral arm and the Cygnus OB2 association, at a distance of ~ 1.45 kpc. Based on observations with the IRAS and COBE satellites. Image courtesy of D. Finkbeiner.

Indirect Detection of Interstellar Dust



The Dark Cloud B68 at Different Wavelengths (NTT + SOFI)

ESO PR Photo 29b/99 (2 July 1999)

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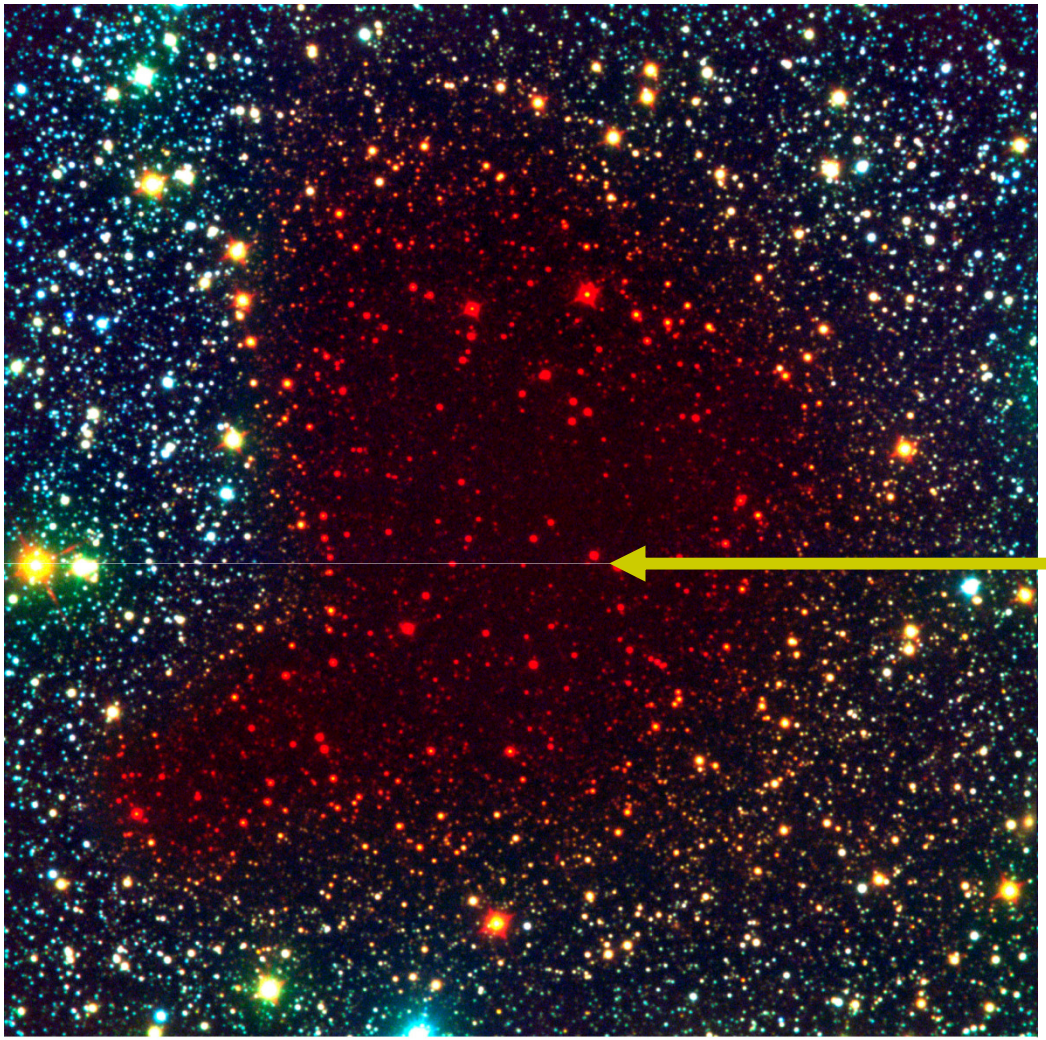
Indirect Detection of Interstellar Dust



Seeing Through the Pre-Collapse Black Cloud B68
(VLT ANTU + FORS 1 - NTT + SOFI)

ESO PR Photo 02b/01 (10 January 2001)

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Indirect Detection of Interstellar Dust

- The presence of interstellar dust is primarily know by the extinction it causes to star light (*It is assumed that we know what the spectrum of the star is before reddening by dust by comparing with the spectrum of another star with similar spectral features in its atmosphere but with negligible extinction*)

- Since HI absorbs strongly for $h\nu > 13.6$ eV, it is possible to measure the contribution of dust to the attenuation of light only at energies $h\nu < 13.6$ eV, or $\lambda > 912$ Å (although dust also absorbs at $h\nu > 13.6$ eV)