3-13 Micron Spectroscopy of Comets

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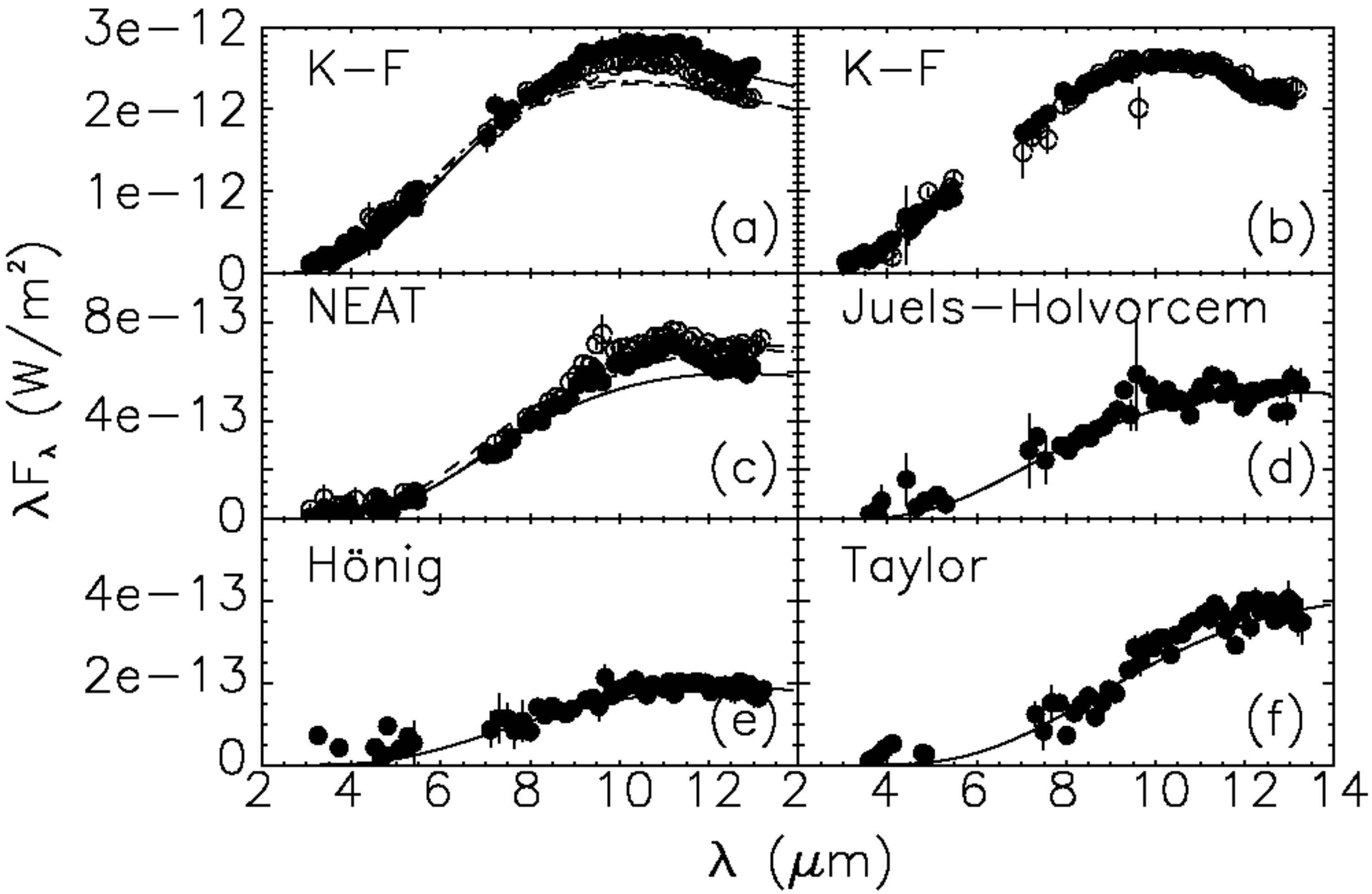
Infrared spectroscopy of cometary dust provides valuable clues about the formation and evolution of the solar system. These grains are true interstellar particles that have survived intact, condensed out of the early nebular gas, or were processed during the earliest stages of nebular development.

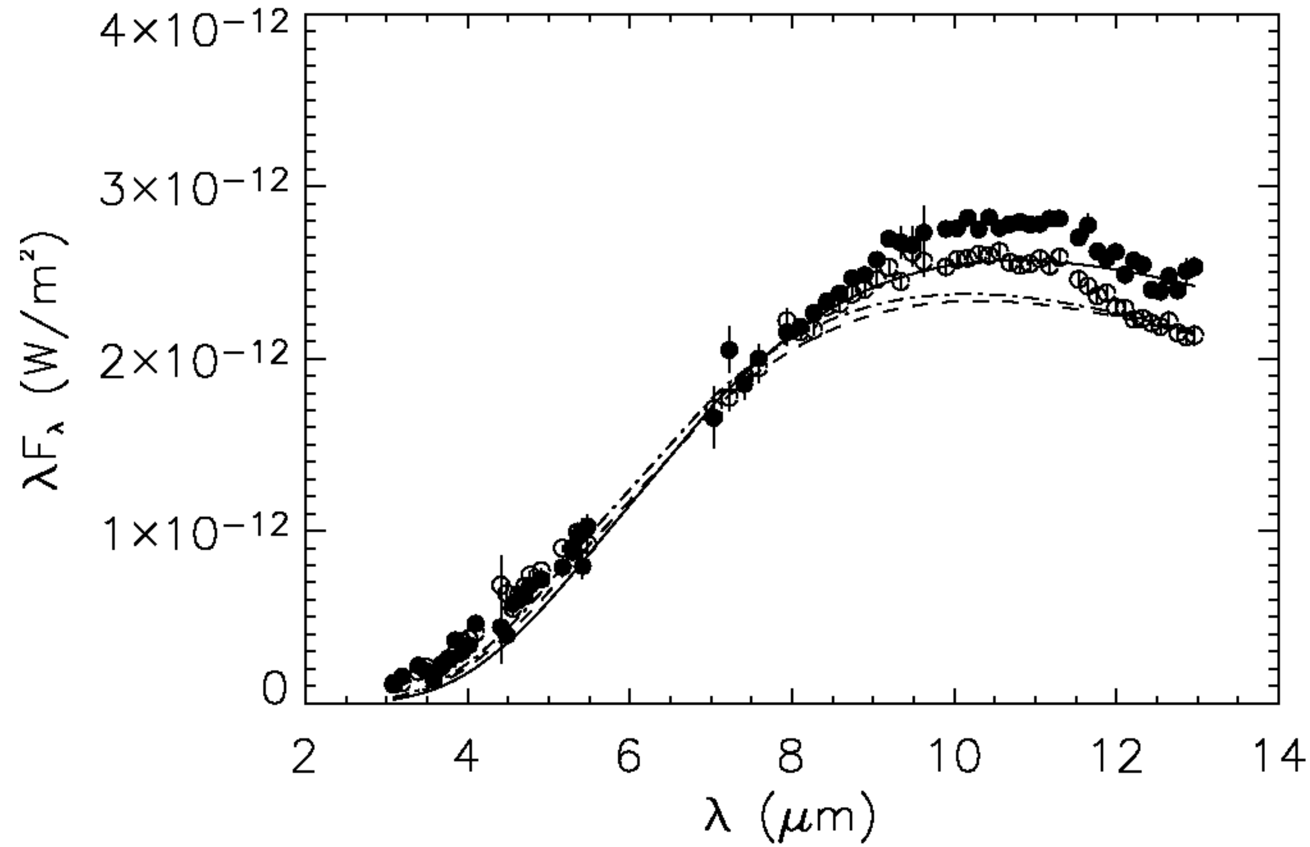
We recently observed 4 newly-arrived comets between 3 and 13 microns using the Aerospace Corporation's Broad-band Array Spectrograph System (BASS). These data, along with that of one short-period comet previously unpublished, were combined with data at similar spectral resolution obtained during the past 2 decades, in order to investigate how cometary dust parameters:

•depend on the orbital dynamics of the parent object

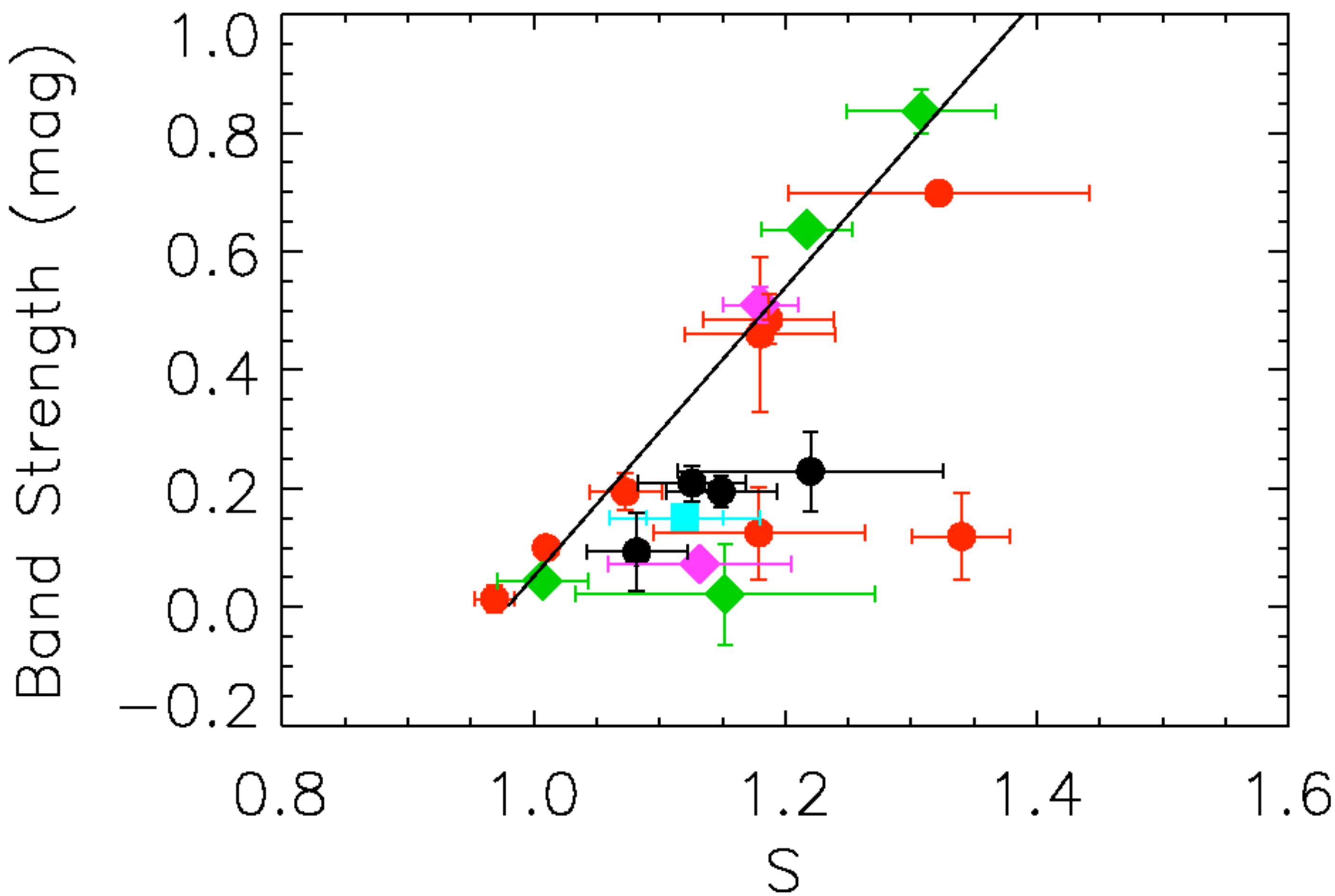
•compare to dust in extrasolar planetary disk systems



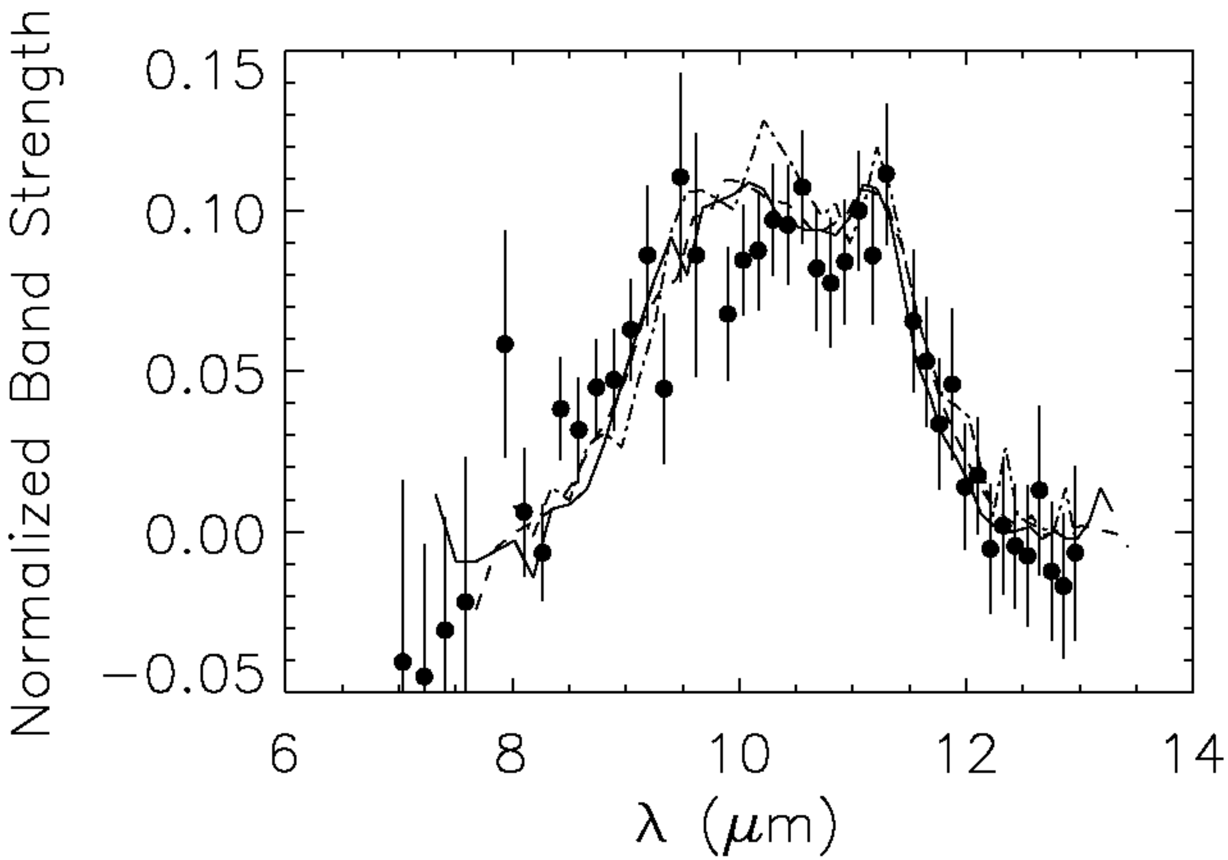
Spectra of comets C/2002 O4 (Hönig), C/2002 V1 (NEAT), C/2002 X5 (Kudo-Fujikawa), C/2002 Y1 (Juels-Holvorcem), 69P/Taylor using BASS on the IRTF.



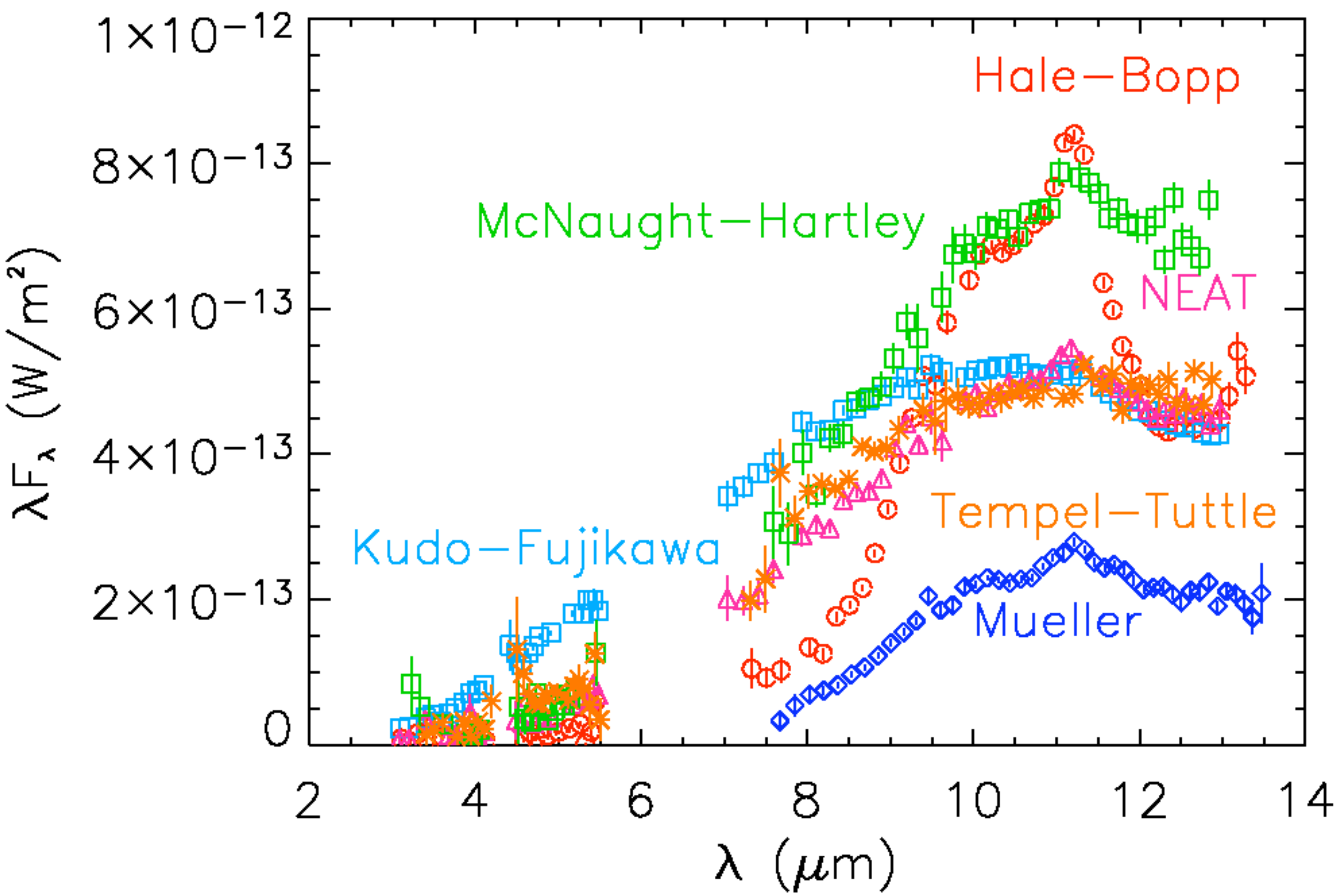
Closeup view of the spectra of Kudo-Fukikawa obtained on 2 consecutive days. Also shown are blackbody fits to the underlying continuum. The temperature derived is often larger than a blackbody at the heliocentric distance of the comet. This "superheat" is usually expressed as a temperature ratio S = T(observed)/T(blackbody). The superheat is caused by very small particles that radiate inefficiently or by material that absorbs more efficiently at visible wavelengths than at infrared wavelengths.



The silicate band strength vs."superheat". Red circles: dynamically new objects; cyan squares: young long-period comets; green diamonds: old long-period comets; magenta diamonds: Halley family comets; black circles: Jupiter family comets. Nearly all of the dynamically new comets define a tight relation between silicate band strength and excess temperature, but the Jupiter family objects fall to the right of this curve.



The continuum-subtracted silicate feature of comet Kudo-Fujikawa (*filled circles*), compared to those of Hale-Bopp (*solid line*) C/1990 K1 Levy (*dashed line*) and HD 35187 (*dot-dashed line*). Despite its weakness, the silicate band in Kudo-Fujukawa is similar to that seen in comets with stronger features, as well as that seen in some pre-main sequence dust disks.



Although the infrared spectra of most comets share some common features, their overall character can be quite varied. More comets need to be observed in order to draw a conclusion.

Note: Much of the data on Comet Kudo-Fujikawa had to be obtained during the daytime. We are grateful to the Director Alan Tokunaga and Telescope Operator Bill Golisch for “making this happen”.