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COMPARISON OF THE 3.36μm FEATURE TO THE ISM

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It has been noted that the 3.36μm emission feature is not the same as that of any ISM band at 3.4μm (ref. 1,4,6,12,13,22). This short contribution documents this fact.

In Figure 1, the 3.36μm emission feature is compared to that of the 3.4μm absorption feature in the Galactic Center source IRS 7. The primary differences between the two features are the small shift in the maximum of absorption of emission and the somewhat broader width of the Galactic Center feature. While the similarity of the features is suggestive that they are the same type material, it is important to bear in mind that the Galactic Source IRS 7 absorption is unique. There is only one source in the Galaxy in which this feature is seen. This indicates that the material giving rise to the 3.4μm absorption feature in the Galactic Center may be rare and that it may not be abundant in comets.

Figure 2 shows infrared spectra of two protostellar sources (Mon R2 IRS-2 and IRS-3) and an evolved star with a circumstellar disk (OH 0739-14). The spectrum of the OH 0739-14 source shows that classical water ice band at 3.05μm which is well fitted by a model (the solid line). In contrast, the spectrum of Mon R2 IRS-2 is not fitted so well by the model and it also shows a weak absorption feature at about 3.42μm. The material giving rise to the 3.42μm feature is probably carbonaceous, but its precise composition is also unknown. (The spectrum of Mon R2 IRS-3 is not understood at all – it is unique.)

Figure 3 compares the emission feature in Comet Halley with the ISM emission features at 3.3-3.6μm. The peak of the 3.36μm feature in Halley does not correspond at all in wavelength to the emission features seen in the ISM. However, the emission features in the ISM have been identified with the polycyclic aromatic hydrocarbons ("PAHs," ref. 14) or similar material in composition such as "QCC" (ref. 18). If PAH material is present in Comet Halley, it is present in a relatively small amount compared to the material giving rise to the 3.36μm feature (ref. 1).

We list the comets for which both 3.4 and 10μm spectroscopy have been obtained in Table 1. There is no clear pattern to the presence or absence of the 3.4μm feature relative to the silicate feature or to whether the comet is new or old. Clearly, further spectroscopy of comets is needed. Also, some caution is required in the case of Comet Wilson, the 3.4μm feature was observed strongly but the silicate feature was weak (Gunych and Bregman, private communication).

In summary, there is no convincing analog to the cometary 3.36μm emission feature seen in the ISM. This fact suggests that if the carbonaceous material in comets came from the ISM, it was either further processed in the solar nebula or has a different appearance because of the different excitation environment of the sun and the ISM (as suggested by ref. 13).

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TABLE I
COMPARISON OF THE 3.4μM AND SILICATE FEATURES

Comet	Type	3.4μ Feature Present?	r(AU)	Ref.	Silicate Present?	r(AU)	Ref.
West	New	No	0.5	17	Yes	0.2-1.0	16
IRAS-Araki-Alcock	Old	No	1.0	10	Yes(weak)	1.0	10
Halley	Old	Yes	0.9-2.0	1,4,6, 12,13	Yes	0.6-1.3	7,9,20
Wilson	New	Yes	1.3	2	(weak)	1.3	11,15
Encke	Old	No	0.5	21	No	0.5	8

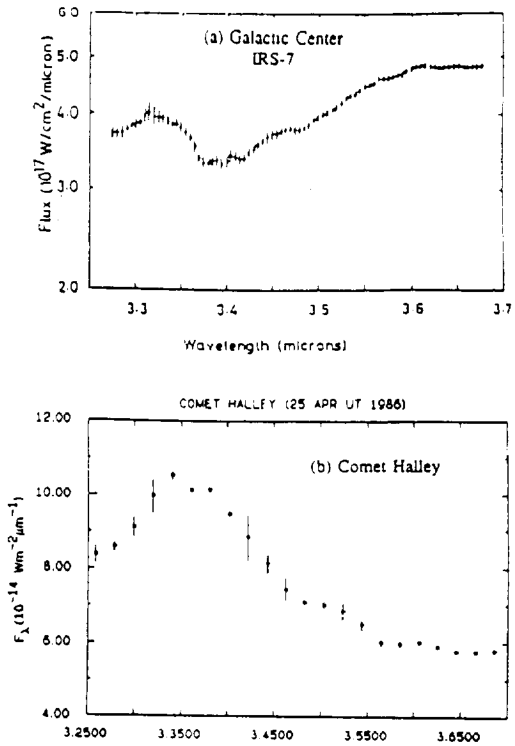

Figure 1. Comparison of the Galactic Center IRS-7 source (ref. 3) to Comet Halley (ref. 12). Note the slight offset in the maximum absorption in IRS-7 and the emission peak in Comet Halley.

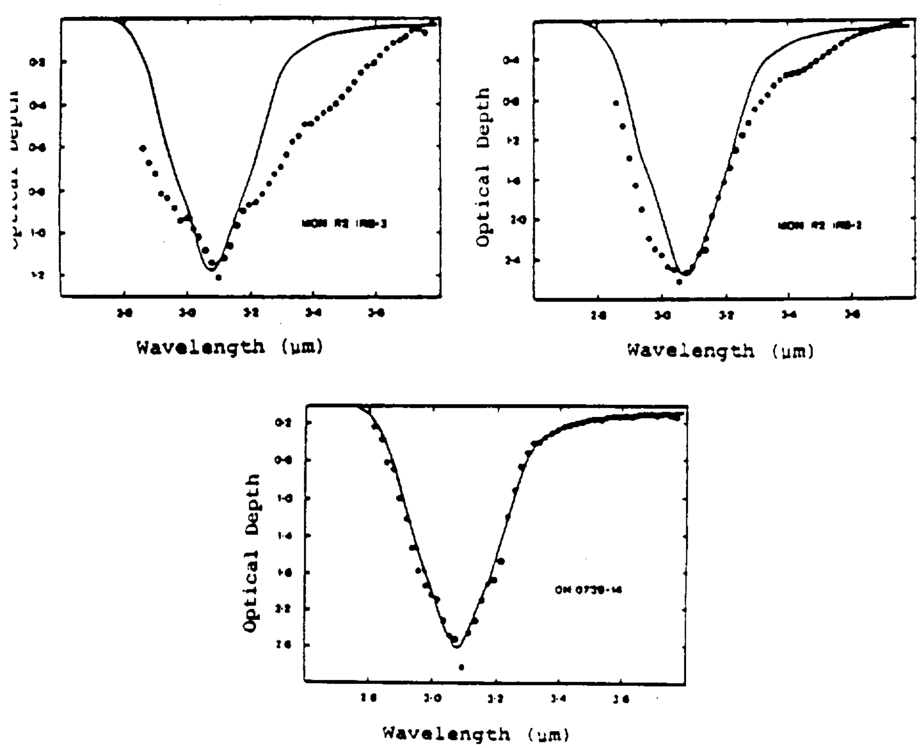

Figure 2. 3 μm spectra of the interstellar ice band. Note the weak 3.4 μm absorption band in Mon R2 IRS-2. The center of the absorption is approximately at 3.45 μm. Spectra from ref. 18.

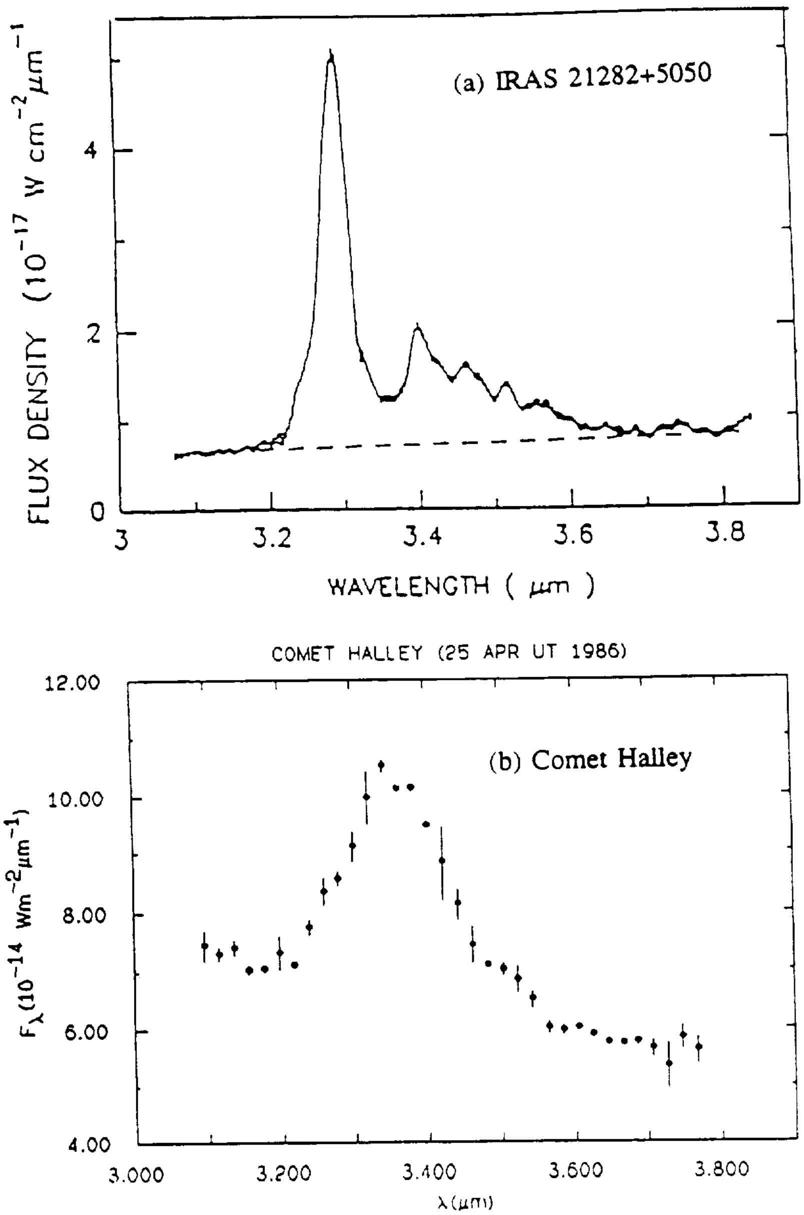

Figure 3. Comparison of the interstellar 3 μm emission features (ref. 5) with that of Comet Halley (ref. 12). Note that the peak of the Comet Halley feature is approximately at a ***minimum*** of series of emission features seen in IRAS 21282+5050.