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Relict substance of comets

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Abstract

Properties of frozen organic matrix of cometary nuclei and coma FHPs are considered. Concepts of hydrocarbon sources and organic relicts of comets are proposed. New identifications of unknown cometary emissions are presented.

1. Introduction

Resonance-fluorescence emissions of rarified cometary atmospheres mark basic gaseous components forming these atmospheres. Emissions of molecules and ions, C_2, C_3, CH, CN, CO_2, NH, OH, CHII, COII, OHII, are basic components of cometary spectra. Basing the modern views on composition of cometary atmospheres on identification of emissions of resonance-fluorescence nature, it is concluded that the molecules of comas represent daughter formations. Solar UV radiation and fluxes of electrons prevent heat of parent molecules into comas and tails, providing photodissociation and photoionization of these molecules. The spectrum of any comet rich in emissions witnesses only daughter molecules and ions. There exists different component of cometary spectra, representing series of narrow emissions not subject to standard identification. Multiple narrow lines of unidentified nature are found in the spectra of comets. There are also some relatively wide bands not subject to standard identification.

2. FHP Luminescence

Interest in unidentified cometary emissions is caused, firstly, by unknown nature of these lines and, secondly, by impossibility of applying standard methods of identification to them. Origin of these lines has more than once become the object of investigation. Main conclusion of these studies came to supposition on ionic nature of some emission lines of such type [5]. If relatively wide bands of unidentified nature observed in the spectra of ionic tails can be linked with the corresponding ion, then multiple quite narrow unidentified lines observed in the spectra of comas demand thorough identification and discussion of other mechanisms of their excitation. Icy and mineral particles of cometary halos approaching the Sun may exhibit luminescence under the influence of the solar UV radiation, and the fluxes of high energy electrons. Solid cometary matter, processing the absorbing UV radiation of the Sun, will emit luminescent photons of smaller energies. Registration of cometary solid matter luminescence suggests an opportunity to establish chemical composition and some physical parameters of this matter. Our attention is concentrated at the unidentified emissions of cometary spectra. Polycyclic aromatic hydrocarbons, are contained in the substance of comets [1]. It was proposed in [4] that the cometary nuclei and comas can contain frozen mixtures of polycyclic aromatic hydrocarbons and n-alkanes, for example, Anthracene + n-hexane. As the comet approaches the sun, during intensification of the processes of ice sublimation and mechanical destruction of cometary nucleus surface layers, there takes place ejection of fine-grained icy particles into cometary atmosphere. This process, in greater extent, causes formation of icy cometary halos of characteristic size and shape. Halo of comets are contained fine-grained icy particles consisting of frozen mixture of PAHs and n-alkanes. Icy particles can contain additional impurities as the component of solid solution or mechanical inclusions - carbonaceous particles of submicron sizes. Fine-grained icy particles, the matter of which consists of frozen mixture of hydrocarbons are formed icy halo of comets, being microfragments of polycrystalline solutions of relict organic, constituent of icy cometary nuclei. Solar ultraviolet radiation excites photoluminescence of FHPs of icy cometary halo. UV photons, absorbed by icy particles re-emit in the form of photons of smaller energies within the visible range of the spectrum. Fluxes of electrons of high energies can also excite luminescence of FHP-cathodoluminescence of icy particles. Spectral composition of FHP luminescence depends on: a) chemical composition of concrete icy particle; b)

PAH concentration in the particle substance; c) particle substance temperature; d) presence or absence of additional luminescent impurities; e) solar activity phase. Complex organic mixtures at room temperature are characterized by the luminescence spectra in the form of wide featureless bands. Laboratory experiments revealed that: if PAH molecules are dissolved in n-alkanes at 77.3 K or less, aromatic molecules will isolated each from other and fixed in the solvent/matrix. Such microcrystal is characterized by luminescence spectra in the form of series of narrow lines - quasilinear spectra [3]. In cometary ices frozen mixtures of PAHs and n-alkanes may emit narrow luminescence lines on the specific heliocentric distances were temperature of ices is around 77 K or less. The laboratory data point to the fact that analogs of FHP of cometary halo can potentially possess: photoluminescence spectra in the form of wide featureless bands; photoluminescence spectra containing series of very narrow lines. Existence of Schpolski matrix in cometary ices is highly possible due to of low temperature of cometary nuclei and numerous organic compounds in cometary substance. Detectability of photoluminescence emissions of cometary FHPs is rather easy instrumental task. In [2] proposed that quantum yield of luminescence of small grains containing organic mixtures variate within 90–100%. These data point to bright luminescence of organic mixture excited by UV radiation. Among others we are considered in this paper structural property of FHPs substance and peculiarities of its interactions with exciting radiation. We are suggested new concept of hydrocarbons sources of cometary nuclei. The special attantion is directed to consideration of cometary relicts and its remote detection. New data in identification of prevoiusly unidentified cometary emissions are also presented. We are found particularly that no less 10 per cents of unidentified emissions of C/1995 O1(Hale-Bopp) and C/1996 B2 (Hyakutake) comets spectra belong to photoluminescence of frozen hydrocarbon particles of icy cometary halos (fig.1).

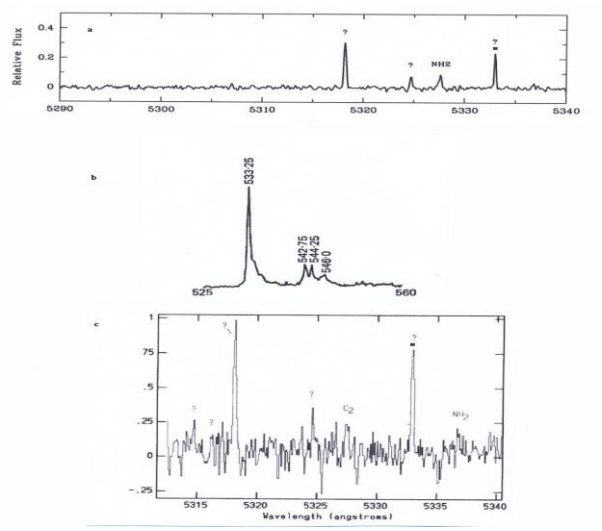

Figure 1. Unidentified emissions in spectra of Hale-Bopp (5333.01 A) and Hyakutake (5332.92A) comets (a,c); luminescence of 1,2-benzopyrene (b).

3. Conclusion

Some unidentified emissions are marked complex organic cometary relicts. FHPs investigation will continued in obtaining cometary spectra and new labdata.

References

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