DETERMINATION OF MASS OF COMET HALLEY DUST PARTICLES; M.N.Fomenkova, E.N.Evlanov, L.M.Mukhin, O.F.Prilutsky, Space Research Institute, Academy of Sciences, Moscow, USSR

Dust–impact time–of–flight mass–spectrometers Puma–1,2 onboard VEGA spacecrafts were intended to investigate elemental composition of comet Halley dust envelope. More than 2000 spectra were obtained by PUMA–1 instrument and more than 500 spectra were obtained by PUMA–2. In (1) an attempt was made to estimate mass of registered dust particles and it was shown that this mass value may be in the range from $5 \cdot 10^{-17}$ g to more than 10^{-12} g. Thus, estimation of dust particle mass (DPM) is necessary for correct determination of bulk elemental composition of dust component.

The ions current intensity seems to be not always adequate characteristic of DPM, that is why we used an independent information about dust particle impact on target: data from front end channels (in (2) the detailed description of instruments is given). In both instruments 4 electrical signals were measured at the moment of dust particle impact and recorded with each mass–spectrum:

– a signal TG on target generated by plasma cloud moving away from it;

– a signal AC on acceleration grid generated by ions moving through it;

– a signal PM on photomultiplier generated by an ultraviolet burst during an impact;

– a signal CA on catcher where secondaries were settled after the impact.

Amplitudes of all these signals are determined by total number of ions generated by impact. Therefore, their total combination is to some extent characteristic of DPM.

All the totality of spectra from each instrument was subdivided into groups in accordance with signals TG, AC, PM. Each signal could accept one of 4 values in 2 modes of sensitivities. Thus, theoretically, 126 combinations are possible (0, 0, 0 is impossible). The real number of combinations is 26 for 2031 spectra of PUMA–1, 17 for 517 spectra of PUMA–2. It means that signals TG, AC, PM are well correlated, and proves their validity for DPM determination.

On the next step distributions of CA values in groups were considered and, CA values being taken into account, some combinations rare in primary subdivision were combined together. Thus we obtain 16 groups for PUMA–1 and 15 groups for PUMA–2. About 10% of spectra were not classified because their CA values stand out against distribution of corresponding group. To classify these spectra an additional set of parameters was used: digital time of silver (target) ions registration, number of silver ions and mean number of ions of main elements constituting a dust particle.

To define DPM for each group the distribution of number of spectra in these groups was compared with data on mass distribution obtained by SP–2 dust counter (3). For PUMA–1 we also used preliminary results of (1): the lowest mass of dust particle with measured spectrum is $5 \cdot 10^{-17}$ g in high sensitivity mode and 10^{-15} g in low sensitivity mode. For PUMA–2 we supposed that the upper value of mass of registered dust particles is the same as for PUMA–1. (The minimum mass for PUMA–2 is greater than for PUMA–1 because of lower sensitivity of ions detector due to an unexpected voltage drop). Groups with close mass values in high and low sensitivity modes were combined together. In the table the calculated values of dust particle mass for both instruments are given; final mass distributions are shown on the figure.

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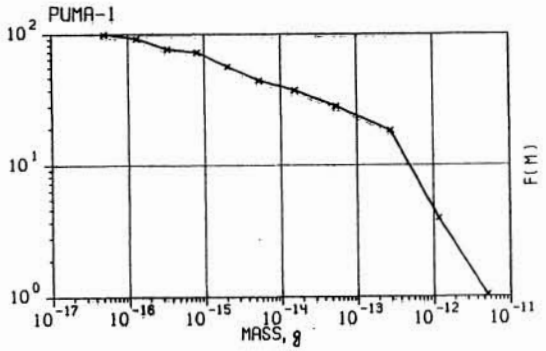
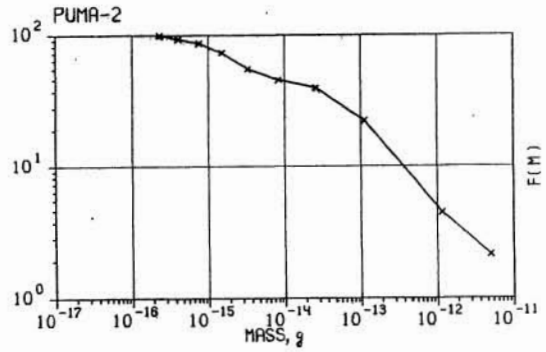
Table. Correspondance between group number and dust particle mass (in g).

group number	number of spectra	mean mass	minimum	maximum
		PUMA–1		
1	155	8.28E–17	4.84E–17	1.32E–16
2	312	2.13E–16	1.32E–16	3.32E–16
3	87	5.35E–16	3.32E–16	8.14E–16
4	329	1.30E–15	8.14E–16	2.02E–15
5	249	3.34E–15	2.02E–15	5.30E–15
6	144	9.33E–15	5.31E–15	1.54E–14
7	181	2.99E–14	1.54E–14	5.39E–14
8	200	1.29E–13	5.39E–14	2.77E–13
9	293	5.18E–13	2.77E–13	1.17E–12
10	60	2.24E–12	1.17E–12	5.0E–12
11	21	5.0E–12	5.0E–12	
		PUMA–2		
1	32	3.10E–16	2.30E–16	4.08E–16
2	34	5.65E–16	4.08E–16	7.63E–16
3	67	1.09E–15	7.63E–16	1.53E–15
4	96	2.28E–15	1.53E–15	3.35E–15
5	51	5.40E–15	3.35E–15	8.36E–15
6	32	1.52E–14	8.36E–15	2.56E–14
7	89	5.48E–14	2.56E–14	1.13E–13
8	93	3.33E–13	1.13E–13	1.17E–12
9	12	2.41E–12	1.17E–12	5.0E–12
10	11	5.0E–12	5.0E–12	





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