A SEARCH FOR SATELLITES AND DUST BELTS AROUND ASTEROIDS: NEGATIVE RESULTS; Jonathan Gradie and Luke Flynn, Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822.

In spite of several dedicated optical searches (1-4), the existence of binary asteroids, asteroidal satellite swarms, or asteroidal dust clouds suggested by asteroid-star occultation events (5) has yet to be confirmed. Zones of gravitational stability can exist around an asteroid, the gravitational sphere of influence being 200 to 400 times the radius of the primary (6,7). Gehrels, et al. (4) have argued that the collisional stability of asteroidal satellites is the same as the disruption time scale for asteroids assuming that a disruptive collision would de-orbit the satellite. This time scale, which becomes increasingly short as the diameter of the secondary decreases, limits the diameter of a secondary in a potentially existing, widely separated binary to >30 km. None has been found around the 22 asteroids examined (1-4). Indeed, we can conclude that widely separated asteroid binaries are rare, if they exist at all.

Circum-asteroidal material may be produced during cratering events. Cintala, et al. (8) note that some impact ejecta may go into orbit particularly around highly irregular bodies where the gravitational equipotential surfaces are other than spherical. The lifetimes of these orbits is controlled by instabilities due to resonances with the periodic gravitational field variations of the irregular primary, collisions with other asteroidal and cometary debris, and solar gravitational and radiation pressure perturbations. Although the lifetimes of these orbits may be impossible to calculate, we can place limits on the existence of such debris clouds from the optical observations and compare them with estimated timescales for removal.

Seventeen asteroids, observed with the coronagraphic technique (1,3), have been examined for the existence of satellites and dust clouds. These observations are summarized in Table I which lists the asteroid and class, dates of observation, distance from earth (delta), radius of the asteroid (r), maximum and minimum radii (r_{max}, r_{min}) of the search volume around the asteroid (the region inside the minimum radius was occulted and could not be observed), the limiting size for satellites (r_s), and the equivalent surface area for an orbiting debris cloud. The observations, taken with a CCD camera on the UH 2.2 m telescope on Mauna Kea Observatory, consisted of either five minute exposures separated by hours or days as in the case of the 1985 and 1986 observations, or a series of four or more 120 sec exposures separated by several hours or one day.

The surface brightness limits for the dust cloud are not exceedingly stringent since the limiting areas listed are equivalent to a surface density of about 10^{12} particles/arcsecond^2 for 100 μm size particles. The possibility of a residual dust cloud in the observed region or a substantial dust cloud in the unobserved inner region can not be ruled out.

Table I. Summary of coronagraphic observations of asteroid.

Asteroid	Class	Date Obs. (UT)	Delta (a.u.)	Radius (km)	r_{max} (km)	r_{min} (km)	r_s (m)	Surface (m^2/arcsec^2)
1 Ceres	C	03/03/86	1.588	475	180	9	3000	2×10^6
2 Pallas	U	10/06/85	1.964	270	360	18	500	8×10^5
4 Vesta	U	11/19-20/87	2.029	278	400	21	180	4×10^4
11 Parthenope	S	10/06-07/85	1.495	78	1000	58	500	8×10^5
13 Egeria	C	11/20/87	1.647	123	800	40	290	1×10^5
15 Eunomia	S	10/07/85	1.222	130	480	24	200	1×10^5
18 Melpomene	S	10/07/85	1.361	50	1400	70	300	3×10^5
20 Massalia	S	11/19-20/87	1.144	70	960	48	100	1×10^4
29 Amphitrite	S	07/01/85	2.035	100	2000	75	1000	3×10^6
39 Laetitia	S	11/20/87	1.885	79	1400	70	200	5×10^4
40 Harmonia	S	11/20/87	1.271	59	1240	62	120	7×10^4
46 Hestia	C	11/20/87	2.929	67	2600	127	624	4×10^5
52 Europa	C	11/20/87	1.896	146	760	38	400	2×10^5
192 Nausikaa	S	10/07/85	0.830	50	840	42	100	3×10^4
216 Kleopatra	M	10/06-07/85	1.362	50	1400	70	300	3×10^5
324 Bamberga	C	11/20/87	1.312	128	600	30	210	5×10^4
349 Dembowska	R	11/19-20/87	1.791	73	1400	71	180	6×10^5

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