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THE FORM OF THE ASTEROIDAL BELT

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Summary. The form of the belt is studied by means of its intersections with planes perpendicular to the mean plane. Six perpendicular sections are considered and some characteristics of the belt are established. Its mean line is determined by means of coordinates of intersection points of asteroidal orbits.

M. Kuzmanoski, IZGLED PLANETOIDSKOG PRSTENA — Oblik prstena sagledan je preko njegovih preseka sa ravnima normalnim na srednju ravan. Posmatrano je 6 normalnih preseka i uočene su neke globalne karakteristike prstena. Pomoću koordinata prodornih tačaka planetoidskih putanja kroz normalne ravni određena je sredina planetoidskog prstena.

Kresak (1977, 1978) has given the picture of the asteroidal belt in its cross-section with a plane perpendicular to the ecliptic. Continuing Kresak's investigations we tried to give a more detailed representation of the asteroidal belt considered through the points of intersections of asteroidal orbits with several orthogonal planes. Since Kuzmanoski (1980) determined the mean plane of asteroidal orbits (its position with respect to the ecliptic plane is defined by the node longitude $\Omega_s = 78^\circ\!.141$ and the inclination $i_s = 0^\circ\!.594$), by using the orbital elements from „EMP for 1979" across area vectors, in this paper we observe the intersections of asteroidal belt by the planes perpendicular to the mentioned mean plane. Considering the intersections of particular asteroidal orbits with such planes we could obtain, in a quite direct way, the spatial picture of the asteroidal belt and establish the characteristics of the distribution of orbits in its different sectors.

Already established characteristics in the distribution of perihelia of asteroids (Kuzmanoski, 1981) allowed us to take, the perpendicular plane through Jupiter's perihelion as the initial one (Fig. 1a). By the rotation of the normal plane for 60°, we obtained the intersections of the belt in its different zones. These intersections are given respectively on Fig. 1b), c) and Fig. 2a), b), c).

One can establish, considering the distribution of intersection points in different normal planes, some characteristics of every normal section, i.e. of the whole

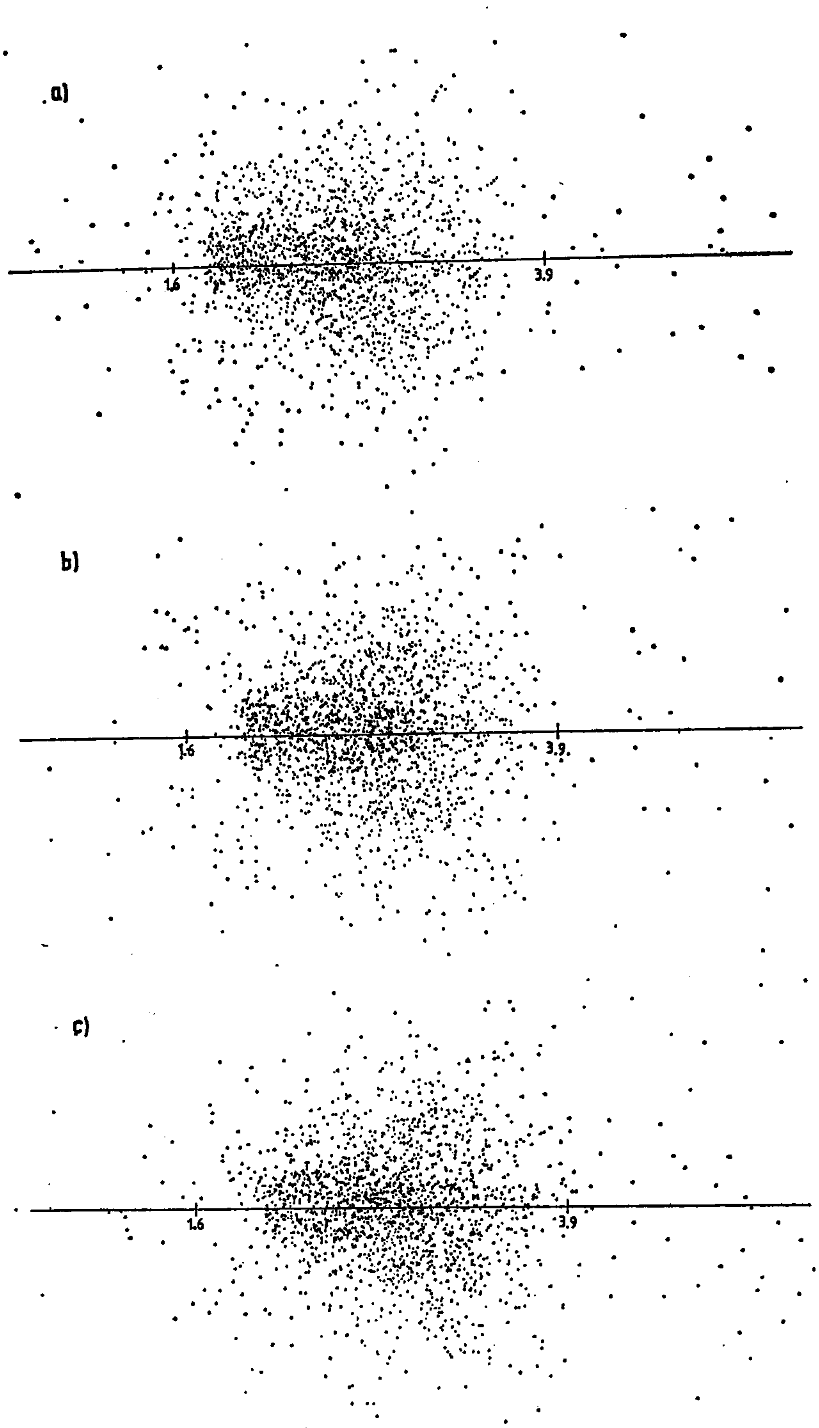

Fig. 1

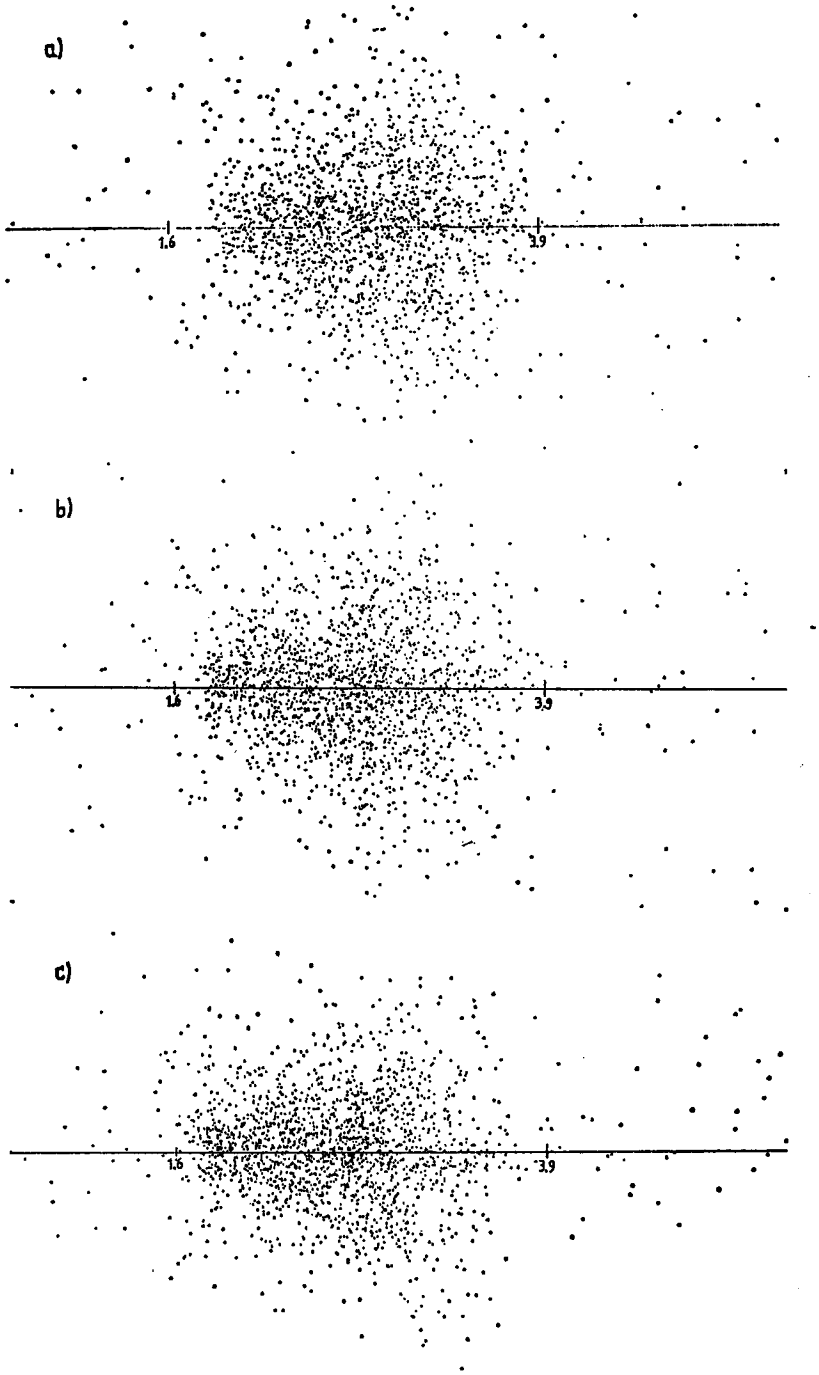

Fig. 2

belt. For the density of intersection points, i.e. the density of orbits, we can divide the asteroidal belt in three regions: the region of greatest density, the region of mean density and peripheric region. The asteroidal orbits with characteristically small and great values of semi axes and those with particularly great inclinations of orbital planes are excluded from those global considerations.

The intersection points show, by the way they grouped, determined particularities. Having in mind the great number of orbits and the characteristics of the distribution of their orbital elements, one could expect in general a hcmogeneous distribution of intersection points as a consequence of the distribution of mean daily motions. However, it appeared that orbits are, in determined sectors, grouped in different ways. The most frequent case is that of a chain grouping of intersection points, which make a kind of agglomerations, with clearly visible empty parts between them, showing sharp borders, with no orbit. We find, in the zone of greatest density, groups with many points, whereas in zone of mean density groups are smaller and distributed in branches. We find, in the peripheric zone, groups of several points and individual points, which recall, in a large sector, a scattered group.

There are some indications about possible communities of some groups of intersection points. That is enpressed by the similarity of major semi-axes, the longitudes of perihelia and the longitudes of ascending nodes, whereas the inclinations and eccentricities of orbits sensibly differ, which excludes the possibility that the groups of intersection points appear as a consequence of the existence of families of minor planets.

One can establish, considering intersections, other global characteristics of belt. The zone of the maximal density is best defined for the position of the normal plane when passing through Jupiter's perihelion. This zone has an asymmetric position with respect to the mean plane, and the asymmetry consists in the fact that it is obviously larger (0.4 AU) on the side near the Sun, being mainly over the mean plane, whereas it is narrower on the side near Jupiter. It extends from 1.85 AU (with clear borders) up to 3.0 AU, where it passes to the zone of mean density.

In other sections the picture of the belt changes gradually. However, in all those sections an obvious symmetry with respect to the mean plane appears and the limits of the greatest density zone are not sharp. The most regular distribution of intersection points and the greatest number of branching groups represents the mean plane passing through the aphelion of Jupiter (Fig. 2a). It can be remarked that the distance of the belt from the Sun is different for the different sections. The belt is most distant from the Sun in the neighbourhood of Jupiter's aphelion and nearest it in the neighbourhood of Jupiter's perihelion. The difference between distances is about 0.25 AU.

By means of the coordinates of the points of intersection we determined the radius-vectors of the middle of the belt (whose coordinates are, in fact, arithmetical means of the coordinates of these intersection points) for different positions of the perpendicular plane. By rotating the perpendicular plane by 10°, starting from the cross-section straight line of the mean and ecliptical planes, we obtained 36 points. It proved that all the points obtained in this way are below the mean plane, yet their distances from it are very small (0.001 to 0.004 AU). In view of such small deviations the middle line of the belt was assumed to lie in the mean plane. Accordingly, the middle line of the belt, resulting from these 36 points, is represented by an ellipse, whose dimensions and orientation are:

$$a_s = 2.709, \quad e_s = 0.050, \quad \omega_s = 287^\circ\!.012.$$

The abside line of this ellipse is in the neighbourhood of the abside line of Jupiter's orbit.

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REFERENCES

Kresak, L. 1977, Mass Content and Mass Distribution of the Asteroid System, *Bull. Astr. Inst. Chechoslovakia,* **28,** No 2.

Kresak, L. 1978, Three-dimensional distributions of the potential sources of interplanetary dust, *COSPAR,* III. C. 2.4.

Kuzmanoski, M. 1980, Mean plane of asteroidal orbits, *Publ. Dept. Astr. Univ. Beograd,* No **10.**

Kuzmanoski, M. 1981, The distribution of perihelia of minor planets, *Publ. Dept. Astr. Univ· Beograd,* No **11.**