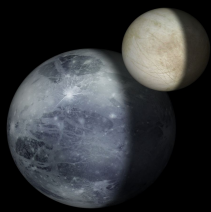


An artist's rendering of the Kuiper Belt, showing a large, cratered planetesimal in the foreground, a smaller one in the middle ground, and a large, glowing protoplanet in the background. The scene is set against a starry field with a galaxy visible in the upper right.

~~Obiekty transplutonowe~~ neptunowe

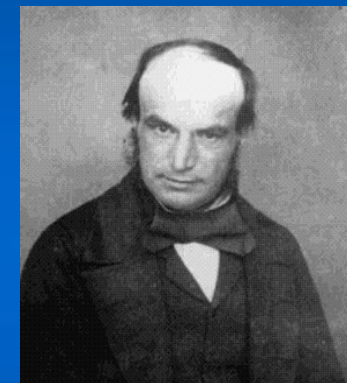
Dr Tomasz Mrozek
Instytut Astronomiczny
Uniwersytet Wrocławski



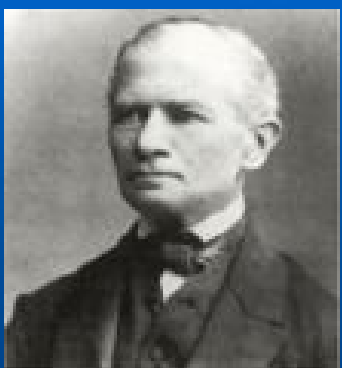
Od początku... Neptun



Urbain Jean Le Verrier



John Couch Adams

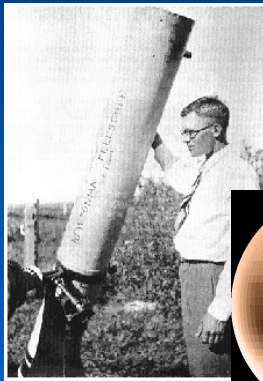


Johann Gottfried Galle

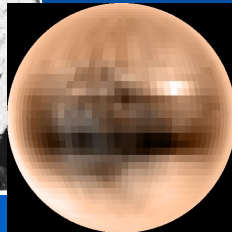




Pluton



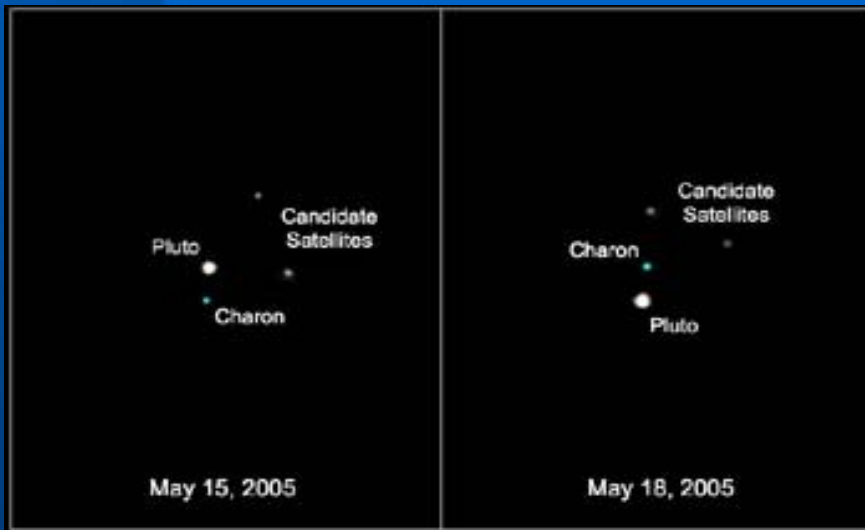
Clyde Tombaugh



James Christy



Pluto and Charon
Obtained from: <http://antwrp.gsfc.nasa.gov/apod/ap990213.html>



Weaver, H. A.; Stern, S. A.; Mutchler, M. J.;
Steffl, A. J.; Buie, M. W.; Merline, W. J.;
Spencer, J. R.; Young, E. F.; Young, L. A.

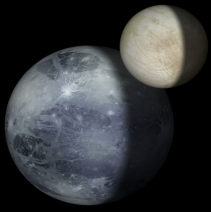


Pas Kuipera

Kuiper (1951): Pluton jest tak masywny, że w jego otoczeniu nie ma innych obiektów.

**Edgeworth(1943) i Leonard (1930):
W okolicach Plutona znajduje się duża liczba drobnych ciał stanowiących rezerwuar komet krótkookresowych.**



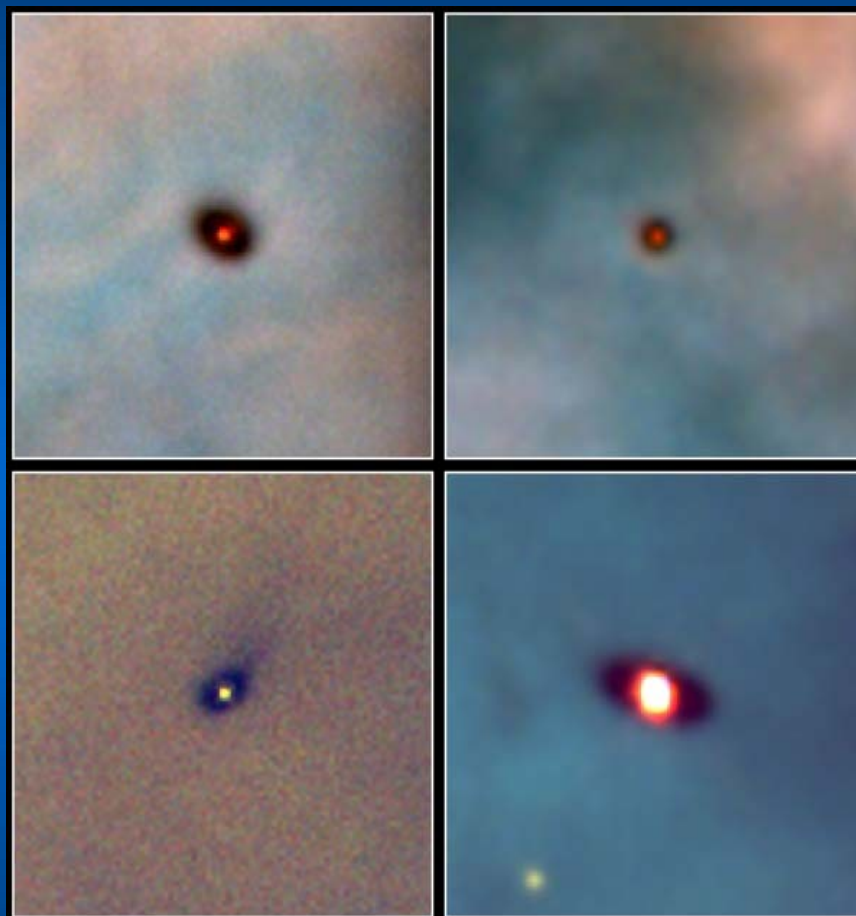


Obiekty transneptunowe - przesłanki

- 1. Komety
krótkookresowe**
- 2. Modele powstawania
układów planetarnych**
- 3. Obserwacje dysków
protoplanetarnych**



Dyski protoplanetarne



**Protoplanetary Disks
Orion Nebula**

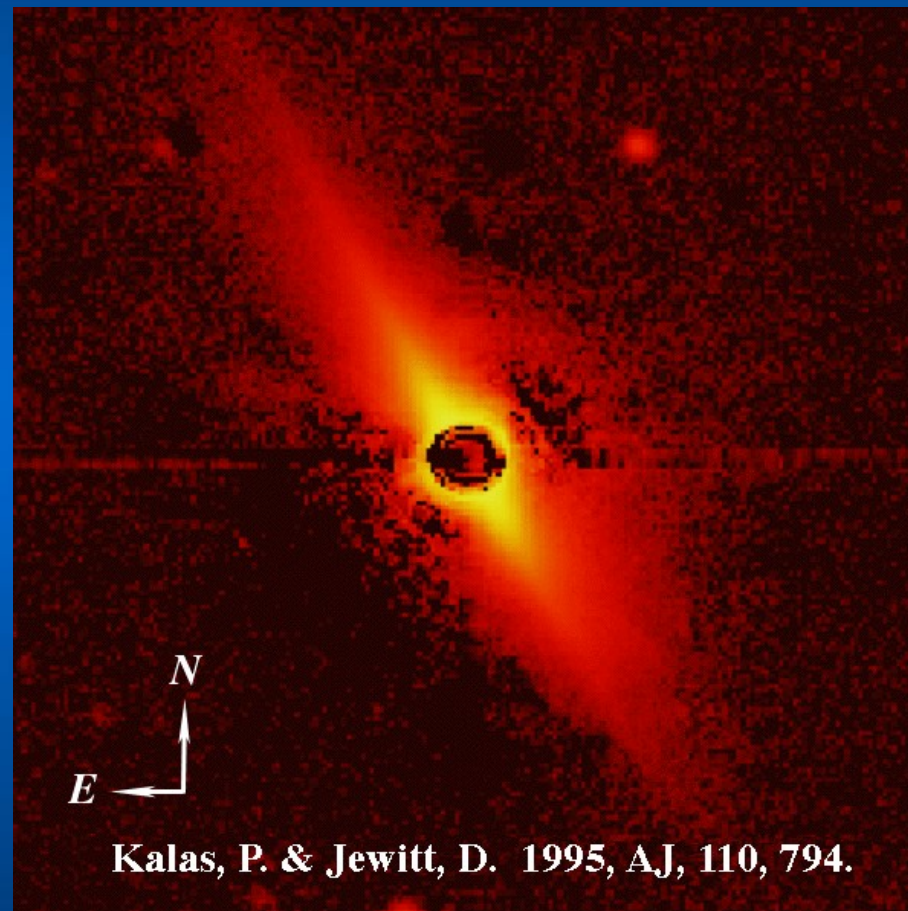
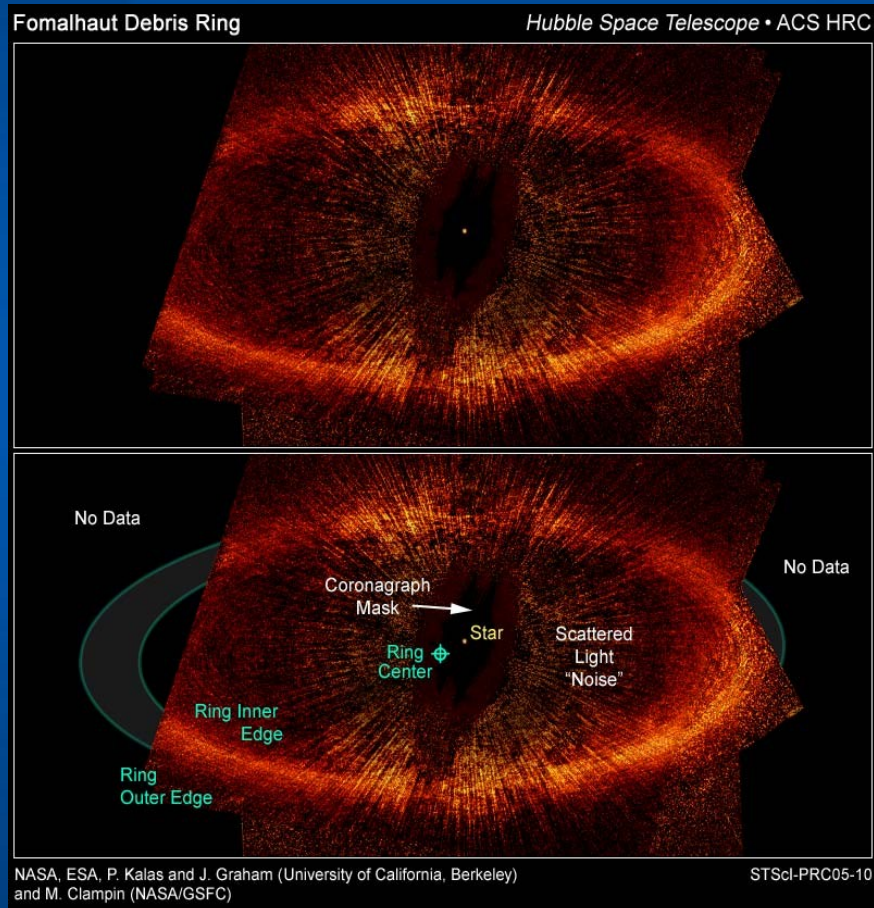
HST · WFPC2

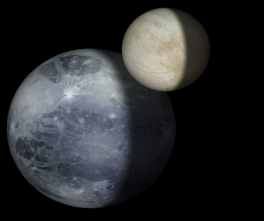
PRC95-45b · ST ScI OPO · November 20, 1995

M. J. McCaughrean (MPIA), C. R. O'Dell (Rice University), NASA



Dyski pyłowe



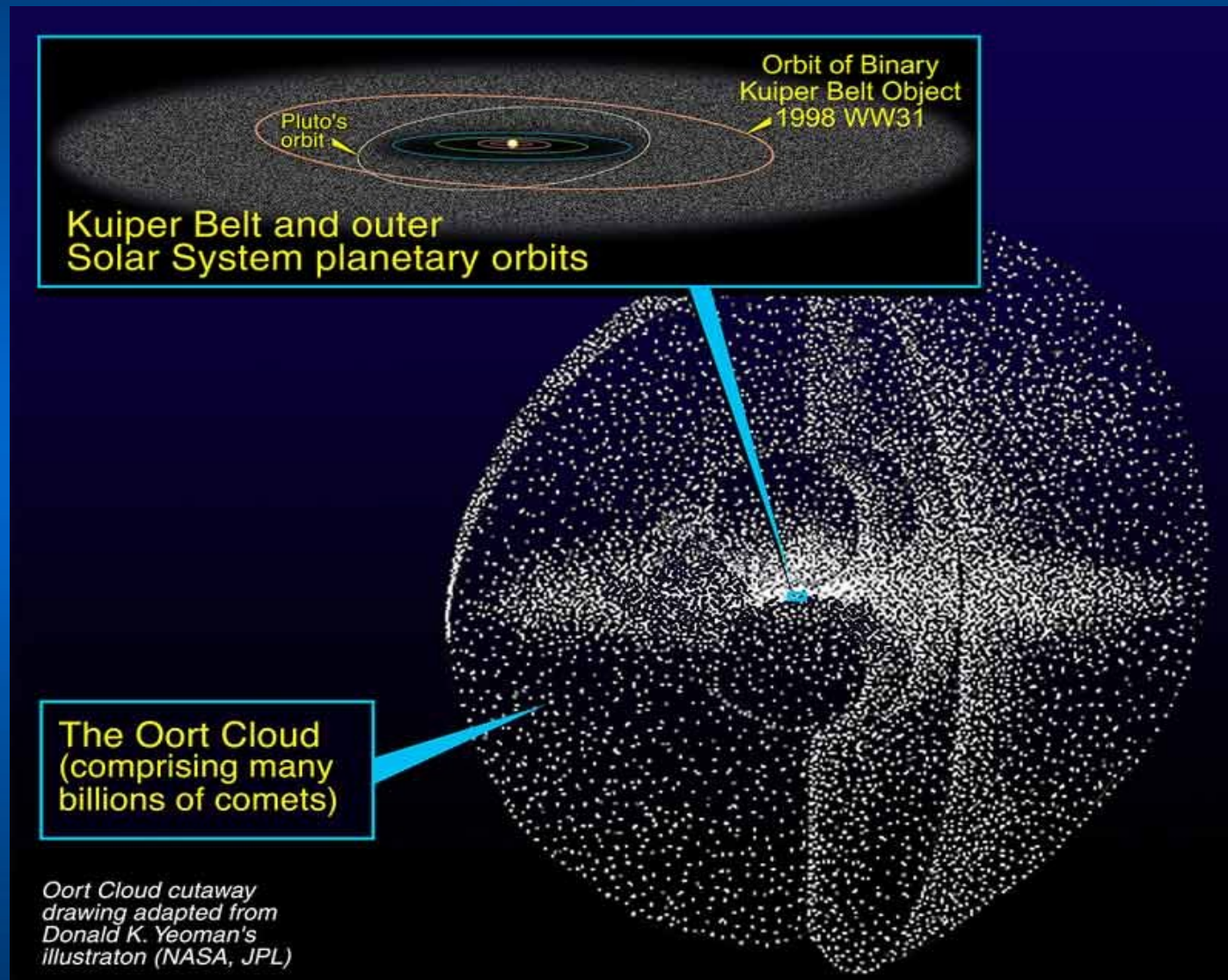


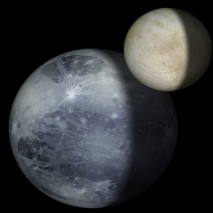
Fomalhaut



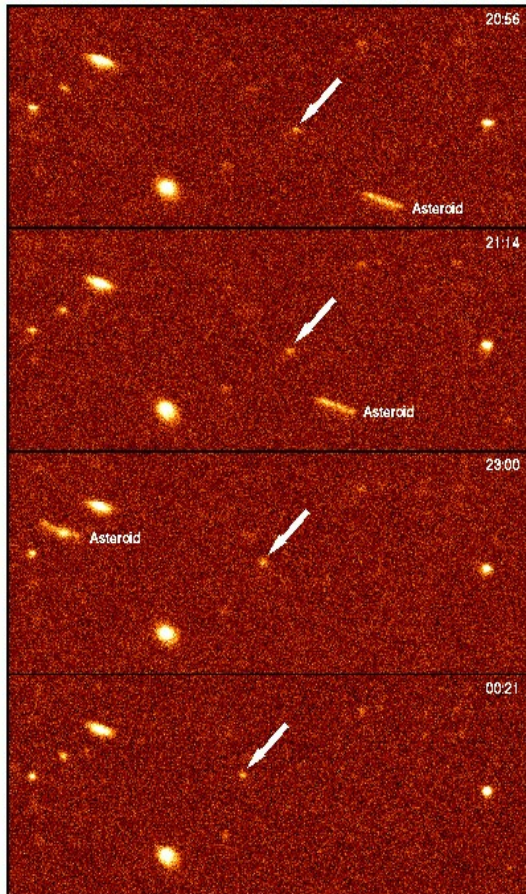


Obiekty transneptunowe i obłok Oorta





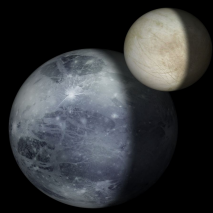
Początek serii



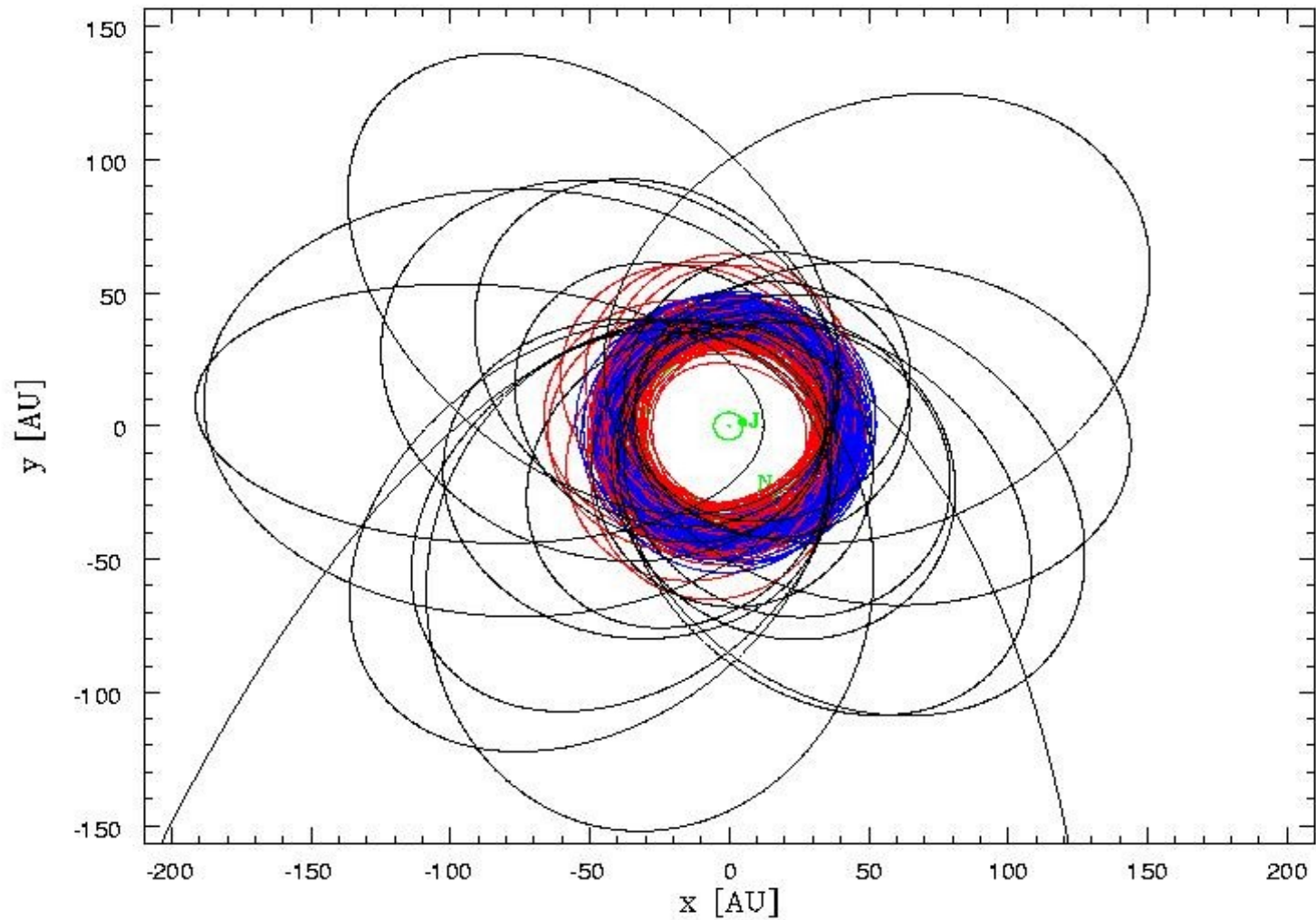
D. Jewitt i J. Luu

**IAU Circular No. 5611
14 wrzesień 1992**

1992 QB1



Obecnie: około 800 obiektów





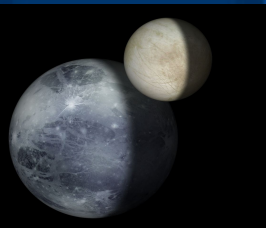
Obiekty transneptunowe-klasyfikacja

Plutonki – obiekty pozostające w rezonansie 3:2 z Neptunem (134340 Pluton, 136199 Eris)

Twotino – obiekty pozostające w rezonansie 2:1 z Neptunem

Cubewano – obiekty nie pozostające w rezonansie

Rozproszone – mocno wydłużone orbity, duże nachylenia do płaszczyzny ekliptyki

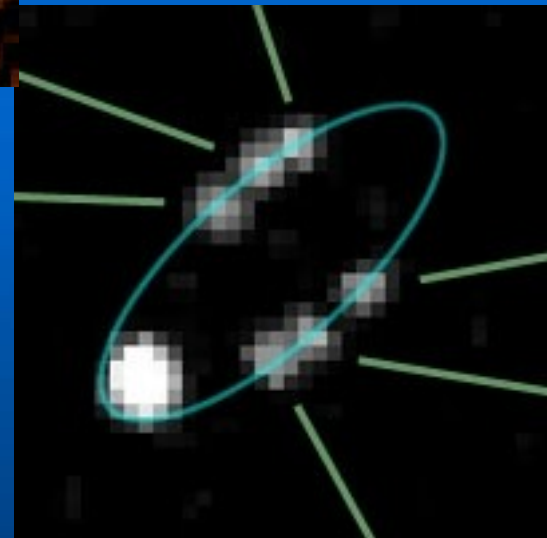
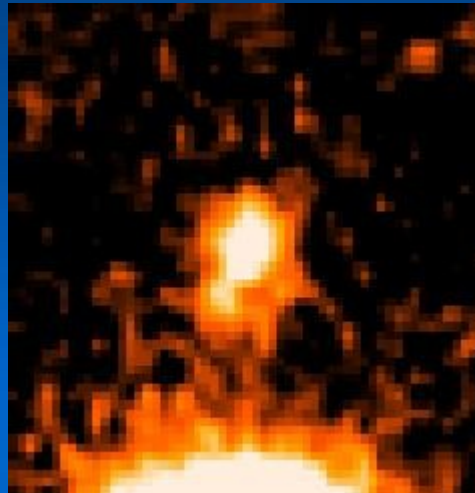
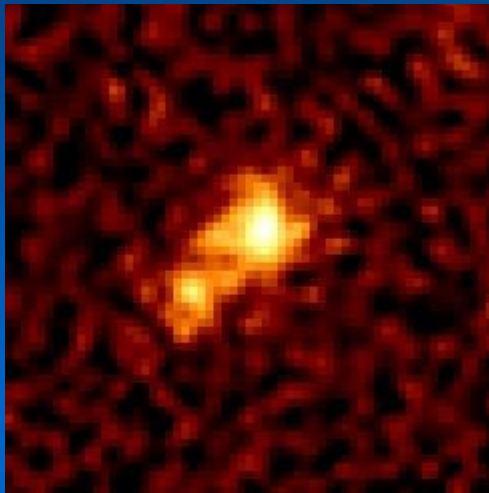


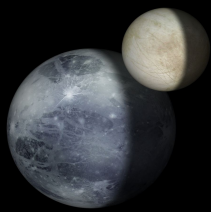
Obiekty podwójne

Object	a [km]	e	i [deg]	Type	Q [arcsec]	P [days]	DMag
Pluto	19,600	0.00	96	PKBO	0.9	6.4	3.2
1998 WW31	22,300	0.8	42	CKBO	1.2	574	0.4
2001 QT297	----	---	---	CKBO	0.6	---	0.5
2001 QW322	---	---	---	CKBO	4.0	---	0.4
1999 TC36	---	---	---	PKBO	0.4	---	1.9
1998 SM165	---	---	---	SKBO	0.2	---	1.9
1997 CQ29	---	---	---	CKBO	0.2	---	0.3
2000 CF105	---	---	---	CKBO	0.8	---	0.9
2001 QC298	---	---	---	CKBO	0.17	---	N/A
2003 EL61	49,500+/-400	0.050+/-0.003	234.8+/-0.3	SKBO	1.5	49.12+/-0.03	3.3

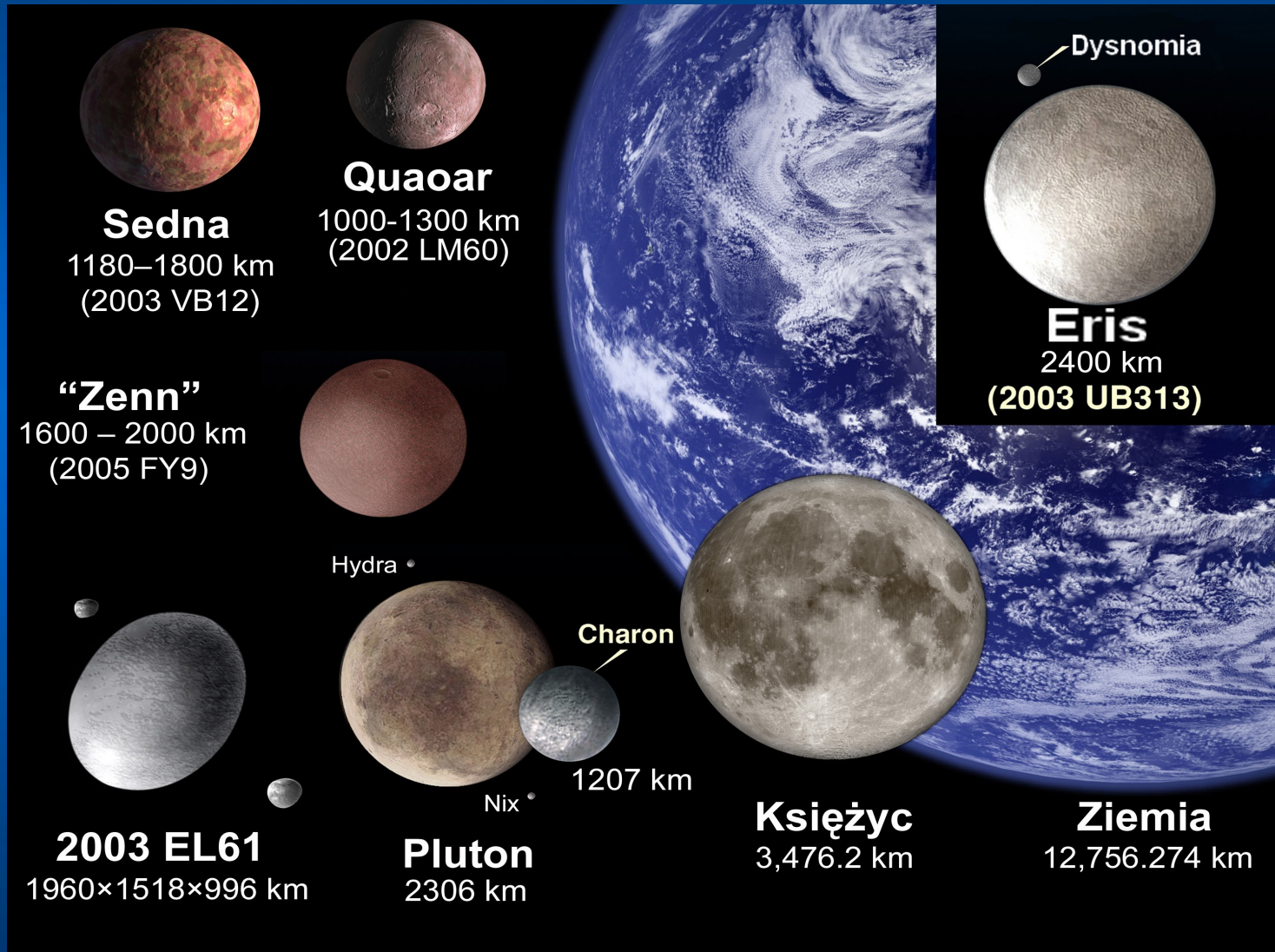


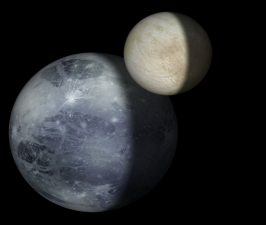
Obiekty podwójne





Duże TNO





Wyznaczanie rozmiarów

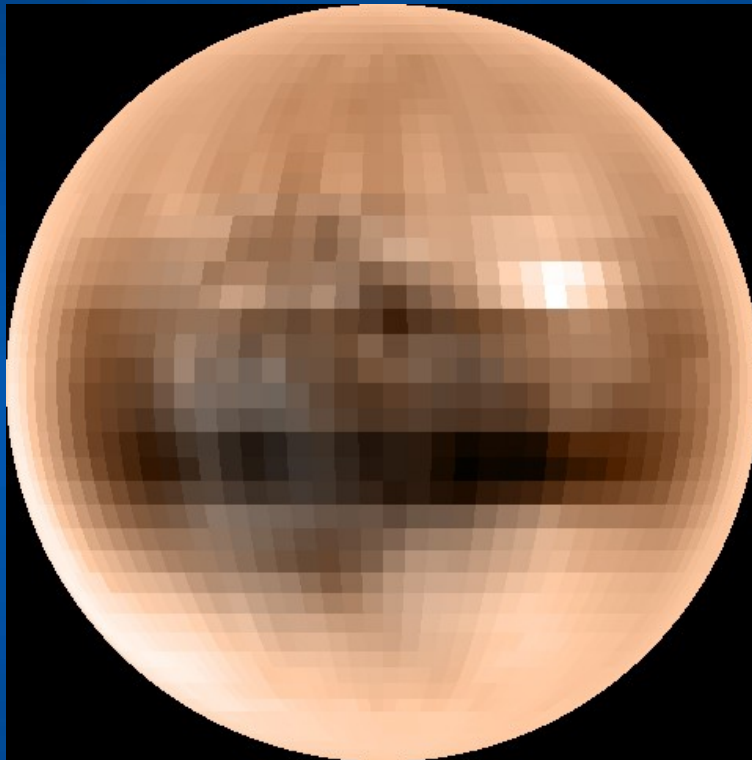
Object	H [mag]	p	D [km]	Type
2003 UB313	-1.2	0.86 \pm 0.07	2400 \pm 100	Scattered
Pluto	-1.0	0.6	2320	Plutino
2003 EL61	0.4	0.6?	1200?	Classical
2005 FY9	0.3	0.6?	1250?	Scattered
Charon	1	0.4	1270	Plutino
Sedna	1.6	0.2?	<1500?	Detached
2004 DW	2.2	0.04/0.12	~1500	Plutino
Quaoar	2.6	0.12	1200 \pm 200	Classical
Ixion	3.2	0.09	1065 \pm 165	Plutino
2002 AW197	3.2	0.1	890 \pm 120	Scattered
Varuna	3.7	0.07 \pm 0.02	900 \pm 140	Classical

- jasność absolutna

- powierzchnia



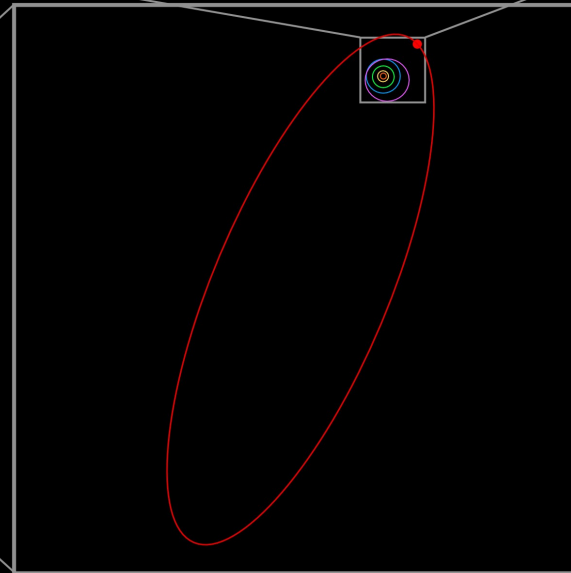
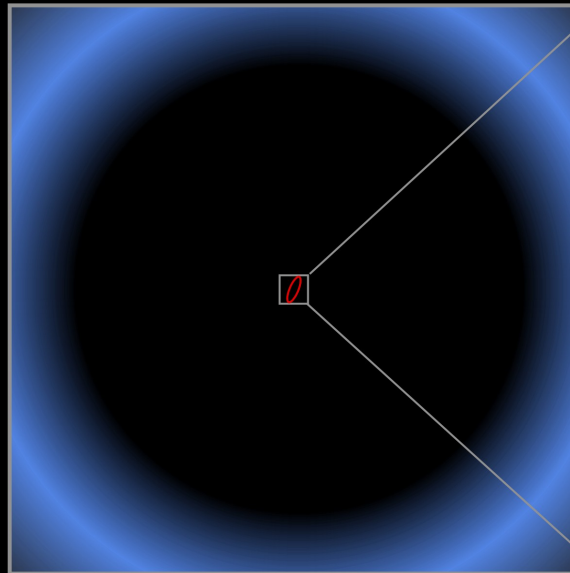
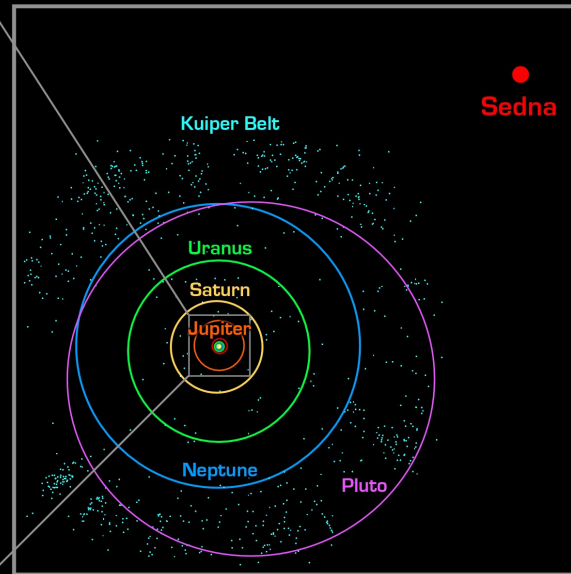
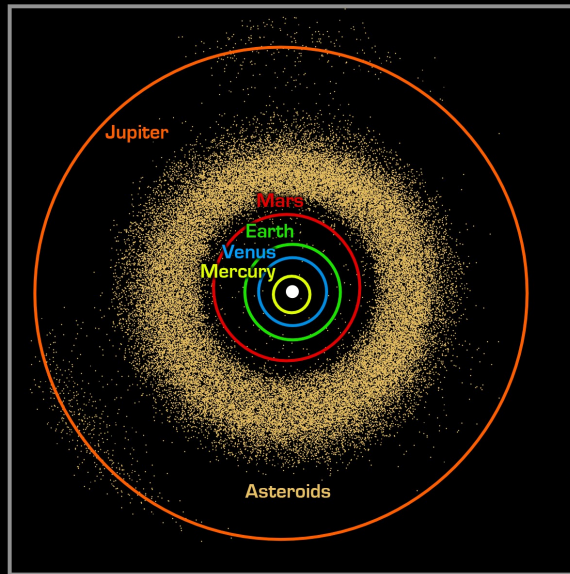
Jak wyglądają TNO



- metody spektroskopowe
- powierzchnie wystawione na ciągłe działanie promieniowania kosmicznego
- zderzenia prowadzące do odsłaniania głębszych warstw
- Quaoar



A obłok Oorta ?



Sedna (2003 VB12)

Rozmiar:

1000 – 1500 km

Peryhelium:

76 AU

Aphelium:

990 AU



Epitafium dla Plutona



THE PLANET HYGEA.

M. GASPARIS, of Naples, who discovered this planet on April 12, 1849, has furnished the following elements of its orbit, derived from several observations : —

Epoch, May 1, 1849.	
Mean anomaly,	326 34 22.44
Longitude of perihelion,	242 47 3.44
“ node,	285 32 29.72
Inclination,	3 46 51.27
Mean daily motion,	590".3784

This newly discovered planet belongs to the same group with *Astræa*, *Hebe*, *Iris*, *Flora*, and *Metis*, all of which are, as will be seen below, of very recent discovery. The planets known from high antiquity are *Mercury*, *Venus*, *Earth*, *Mars*, *Jupiter*, and *Saturn*. To these, in 1781, was added *Uranus*, or *Herschel*, as it is sometimes called, from the name of its discoverer. Early in the present century, astronomers became convinced that a planet existed between Mars and Jupiter, and an association of twenty-four observers was formed to examine the whole heavens. But, early in January, 1801, the present planet *Ceres* was accidentally discovered by Piazzi, in Sicily. In March, 1802, *Pallas* was discovered by Olbers, in Bremen, and this was followed, in 1804, by the discovery of *Juno*, and, in 1807, by that of *Vesta*. On December 8, 1845, *Astræa* was discovered by Professor Hencke, and on July 1, 1847, he also discovered *Hebe*. *Iris* was discovered August 13, 1847, and *Flora*, October 18 of the same year, both by Mr. Hind. *Metis* was, we believe, discovered by Mr. Graham, in Ireland, on April 25, 1848. The recent extraordinary discovery of *Neptune* is familiar to all. The total number of primary planets discovered, up to the present time, is, it will be seen, 18. Many of them are never visible to the naked eye. — *Editors*.





KONIEC