

Future Missions to the Mysterious Ice Giant Planets – Uranus & Neptune

by **Dr Adam Masters** on 18 September 2018

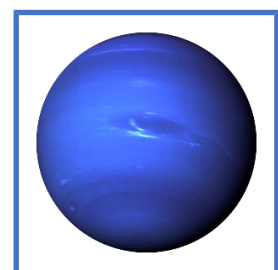
Dr Masters began by saying that Jupiter was already being scrutinised by JUNO, a NASA mission, and JUICE* is in the offing, both visiting its Ice Giant Planets. What we see of most planets is their gaseous atmospheres – their rocky cores can be relatively small.

Uranus & Neptune are both interesting and poorly understood planets, but it is early days yet – there are no fancy new photographs – and it is yet to be decided whether there should be a mission to visit one of them, or both, or have two missions. Projected costings by NASA are, for one planet, \$1.5bn are for a fly-by, \$2.5bn for an orbiter; and for both planets \$3 to \$5bn. These figures give politicians something to go on, and would vary depending on which of them is chosen and what instruments are taken.

These figures assume a free rocket (ie a development model for a Mars mission). The best time to launch a Uranus/Neptune mission would be c2030 for optimum planetary sling shot manoeuvres (but there are doubts about whether the rocket would be ready). Neither do the figures cover analysis of the returned data, the researchers having to pass the hat round for grants.

Voyager 2 took the only close picture we have of Uranus in 1986, and a 1989 picture of Neptune. The Hubble telescope has taken more pictures since. In them Uranus looks like a featureless white globe, while Neptune has evidence of storms in its clouds. Measurements of Uranus & Neptune from Earth show that:

	<u>Earth</u>	<u>Uranus</u>	<u>Neptune</u>
Diameter	12,700 km	50,000 km	49,000 km
Mass	= 1	15	17
Mean Temperature	20 °C	- 216 °C	- 214 °C
Orbital radius	1 AU	19 AU	30 AU
Period	1 year	84 years	165 years
Day length	24 hr	14 hr	16 hr
Axial Tilt	23 degrees	98 degrees	28 degrees
Number of Moons	1	27	14



Studies will focus on the: Interior, Atmosphere, Rings, Moons, Magnetosphere, etc

Uranus Why is there so little heat from the Core?

Why is its Axial Tilt so great? Each pole faces the Sun for 42 years alternately, seasons are extreme, with forty year periods of light and dark.

Is there an Aurora?

Neptune Why is there so much weather? Is there an Aurora?

Triton, Neptune's largest moon, was probably captured – when and where from?

Why is its orbit's motion retrograde?

Momentum for a mission is growing, and money is being promised. The space industry needs work if it is stay in business to go to Mars. Mission planners have several problems to sort out:

Studies of cost v scientific benefit of various instruments; when to use an orbiter or a cheaper atmospheric probe; and travel time, 13 years to Neptune v 11 to Uranus. Or to go to both. How big a rocket is needed, and how quick should the journey time be? If too fast the spacecraft would have

to carry extra fuel to decelerate on arrival; the spacecraft would need a nuclear powered electricity generator.

Communications are slow: 4hr each way for a radio signal.

Neptune is currently favoured despite the longer travel time (extra salary for the ground crew).

Collaboration: Who would build what? Imperial College do not know if they will be involved. It is no longer just the USA and Europe – China, Japan and India now have space expertise.

* see **The Cassini Legacy and “JUICE”** by Dr Greg Hunt on 16th February 2018