Neptune

The Blue Giant
## Vital Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Distance from Sun</td>
<td>30.06 AU</td>
</tr>
<tr>
<td></td>
<td>(4.497 x 10^9 km)</td>
</tr>
<tr>
<td>Mean Orbital Speed</td>
<td>5.4 km/sec</td>
</tr>
<tr>
<td>Sidereal Period</td>
<td>164.8 years</td>
</tr>
<tr>
<td>Rotation Period</td>
<td>16.11 hours</td>
</tr>
<tr>
<td>Inclination of Axis</td>
<td>29.6 degrees</td>
</tr>
<tr>
<td>Inclination of Orbit</td>
<td>1.77 degrees</td>
</tr>
<tr>
<td>Mass</td>
<td>17.23 ME</td>
</tr>
<tr>
<td></td>
<td>(1.03 x 10^{26} kg)</td>
</tr>
<tr>
<td>Mean Density</td>
<td>1.66 g/cm³</td>
</tr>
<tr>
<td>Albedo</td>
<td>0.35</td>
</tr>
</tbody>
</table>
History

Perturbations in Uranus' orbit indicated something further beyond Uranus' orbit

Predictions of where to look for Neptune were published in 1845

Was observed in 1846

Neptune was a triumph for Newtonian mechanics

Neptune has not made a full orbit around the Sun since its discovery because of its long sidereal period

It is the last of the gas giants
Internal Structure

Structure is similar to that of Uranus
Iron and rock core accounting for 45% of mass
Icy materials - water, methane, and ammonia ices
Hydrogen and Helium gases containing methane
Methane in the hydrogen, helium atmosphere causes the blue coloration that is seen
Internal Structure

1. Upper atmosphere, top clouds
2. Atmosphere consisting of hydrogen, helium and methane gas
3. Mantle consisting of water, ammonia and methane ices
4. Core consisting of rock and ice
Magnetic Field

As with Uranus, Neptune has a distinctive magnetic field. It is tilted at $50^\circ$ with respect to its rotation axis. The center of the magnetic field is also offset from the center of the planet by 50% of the distance to the surface. Unlikely that two planets are undergoing magnetic reversal. There must be some other mechanism causing the observed orientation and centering.
Atmosphere

Voyager 2 discovered a storm system similar to the Great Red Spot on Jupiter - The Great Dark Spot
Because of its rotation, we knew that it was a high pressure system
This storm system has now vanished
Clouds were observed in the atmosphere of Neptune
The clouds were observed to change rapidly
The clouds are of methane. They are
1) Convective upwellings that condense and crystallize
2) Tops of atmospheric waves that crest high enough for the methane to freeze
Atmosphere

(a) 

(b)
Atmosphere

Neptune has a band structure
Atmosphere

Three layers to the clouds of Neptune

Top
This is a photochemical smog made from complex hydrocarbons

Middle
This layer of clouds is made from methane crystals

Bottom
This layer of clouds is made from hydrogen sulfide
Ring System

Neptune, as the other gas giants, has a ring system

There are 3 principal rings and several diffuse sheets

All are within the Roche limit for Neptune

Disruptive tidal forces

Ring arcs observed in the outer ring
Ring System

Neptune has five rings

Three narrow and two wide
Triton - Neptune's Odd Moon
The Cantaloupe Moon
Triton - Neptune's Odd Moon

In a nearly circular, synchronous orbit

However, it is a retrograde orbit

Only large satellite to do so

This retrograde motion is causing Triton's orbit to slowly decay

Eventually Triton will come closer than Neptune's Roche limit and then ??

Triton's orbit about Neptune is tilted at 21° with respect to Neptune's equator
Triton

The retrograde motion of Triton and the tilt of its orbit cannot have resulted from accretionary formation.

Triton was gravitationally captured.

Triton is therefore suspected of being captured from the Kuiper belt.

Initially highly eccentric orbit.

Tidal flexing produces internal heating.

Keeps interior warm for billions of years.
Triton

Nitrogen ices are most plentiful, though ices of methane and ammonia are seen on the surface.

The surface temperature of 37 K is the coldest that has been seen so far in the solar system explorations.

Complicated seasonal variations occur on Triton because of the tilt of Triton's orbit about Neptune and because of Neptune's own tilt.

Significant variation in amount of solar energy received.
Triton’s Terrain

Three distinctive terrains noticed:
1) Highly fractured plains,
2) Flooded volcanic plains,
3) Polar ice caps

No heavily cratered terrains were observed.
Highly Fractured Plains

Fractures are the results of rifting of the lithosphere.
Fractures filled by linear protrusion.
Icy volcanism, extrusions of a viscous nearly solid material, ices.
Watery methane, nitrogen, and ammonia.
Multiple generations of fractures.
Complex topography.
Oldest Terrains.
Flooded Volcanic Plains

Relatively smooth plains that are cut by scarps
Some regions are defined by low scarps
Floods of fluid volcanic liquids that are different than those found in the fractured plains
Polar Ice Caps

Besides Triton, only Earth and Mars have ice caps.
Nitrogen ice that is a constantly changing feature.
Youngest and brightest terrain on Triton.
Extends nearly to Triton's equator.
Extremely irregular edge that contains many dark patches which are the underlying terrain.
Sublimation of nitrogen.
The ice caps are sinks for atmospheric volatiles.
Enigmatic Dark Streaks

Parallel to each other
Eruption plumes - geyser like

Active Volcanism
Powered by vaporization of liquid nitrogen
No special heating - normal temperature gradient changes
Triton

There also appear to be ice volcanoes
GREETINGS from NEPTUNE

THE LAST GAS PLANET

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