Uranus

The planet on its side
### Vital Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Distance from Sun</td>
<td>19.19 AU</td>
</tr>
<tr>
<td>(2.871 x 10^9 km)</td>
<td></td>
</tr>
<tr>
<td>Mean Orbital Speed</td>
<td>6.8 km/sec</td>
</tr>
<tr>
<td>Sidereal Period</td>
<td>84.04 years</td>
</tr>
<tr>
<td>Rotation Period</td>
<td>17.2 hrs</td>
</tr>
<tr>
<td>Inclination of Axis</td>
<td>97.9 deg</td>
</tr>
<tr>
<td>Inclination of Orbit</td>
<td>0.77 deg</td>
</tr>
<tr>
<td>Mass</td>
<td>14.6 ME</td>
</tr>
<tr>
<td>(8.68 x 10^{25} kg)</td>
<td></td>
</tr>
<tr>
<td>Mean Density</td>
<td>1.27 g/cm^3</td>
</tr>
<tr>
<td>Albedo</td>
<td>0.51</td>
</tr>
</tbody>
</table>
History

First planet discovered since ancient times - 1781
Uranus' axis of rotation lies almost in its orbital plane
It has been suggested that in the final stages of formation Uranus was impacted by a large planetesimal, about the size of the Earth, that knocked it on its side
No models of solar system formation can successfully put Uranus on its side without such a collision happening
Peculiarity of Uranus

Axis of rotation lies almost in the plane of its orbit

Seasonal variations are extreme
Uranian Ring System

Uranus’s rings are narrow
Uranian Ring System

Uranus has a ring system, just as Jupiter and Saturn do.
A total of ten narrow rings have been identified along with two shepherding satellites.
The particles in the ring are coal black and range in size from boulder to house size.
Some have suggested that the rings may be a short-lived phenomena and that they are in the processing of eroding themselves away.
Two shepherd moons keep the epsilon ring from diffusing
Structure and Atmosphere

Has a low density, greater than water, and significantly higher than Jupiter's or Saturn's

Thought to have three major components:

1) Dense silicate rock
   - Rich in iron and magnesium
   - This material is in the core region
   - About the size of the Earth
   - Less than half the mass of Uranus

2) Ices of water, methane, and ammonia
   - Water ice is about half the mass of Uranus

3) Hydrogen, helium, and traces of other gases
   - These gases account for the remaining 10% of the mass
Structure and Atmosphere

The blue color that is seen results from the methane that is the atmosphere.
Wind speeds of up to 700 km/hour are estimated.
Magnetic Field

Has a magnetic field

The magnetic axis is titled at roughly 60 degrees with respect to the rotation axis

Why this is so, is not understood

Must not be produced by dynamos, as the other planets’ fields are
Magnetic Fields

The rectangle within each planet shows a bar magnet that would produce a similar field.

Note that both Uranus’s and Neptune’s are significantly off center.
Rotation of Uranus

Clouds only in lower, warmer layers
These images show Uranus rotating (a–c), and its ring (d)
Uranian Moons

27 total moons

Five major moons:
  - Miranda, Ariel, Umbriel, Titania, and Oberon
  - These moons orbit Uranus in the equatorial plane of Uranus

Ten smaller moons were discovered by Voyager 2

Water ice has been detected on the surface of the five major moons
  - It is expected that methane and ammonia ices play an important role in the interiors of the moons

The surfaces of the moons appear dirty

The moons are all in synchronous rotation about Uranus
Uranian Moons

Two of the small satellites are shepherds.

All of the small satellites are quite dark, probably due to methane ices.

Moons are dark - grayish in appearance.

Carbon in the form of soot or graphite.

Densities 1.5 times that of water.

Mixtures of rocks and ices of methane, ammonia, and water.
Miranda

Various types of terrain.
1) Old heavily cratered
2) Three circular or oval shaped areas
3) Parallel sets of light or dark ridges, scarps.

Results of several cataclysmic impacts.
Ariel

- Youngest surface geologic activity
- Global system of fractures and faults
- Deep rift valleys
- Few large craters
- Two families of craters:
  1) 50 - 100 km in diameter
  2) Small diameter
Umbriel

Much darker than the others

Surface is rather uniform and covered with craters

Oldest surface

No significant geologic activity
Titania

Many craters but few large ones

Large old craters obliterated because of resurfacing

Scarp 2-5 km high

Crisscrossed by rift valleys and faults

Similar geologic activity to Ariel, but not as great
Oberon

Heavily cratered with large craters
Areas resemble ancient highlands
No global patterns of light and dark material
No evidence for major tectonic activity
Largely inactive since period of bombardment 4 billion years ago
Down is up on Uranus, the sideways planet. Amazing moons: Titania, Oberon, Ariel, Umbriel, Miranda. Dark rings. 21-year summers and 21-year winters. Chewy caramel center. Size of Earth.