

Just 30 years ago took place the unique overview of Uranus

...

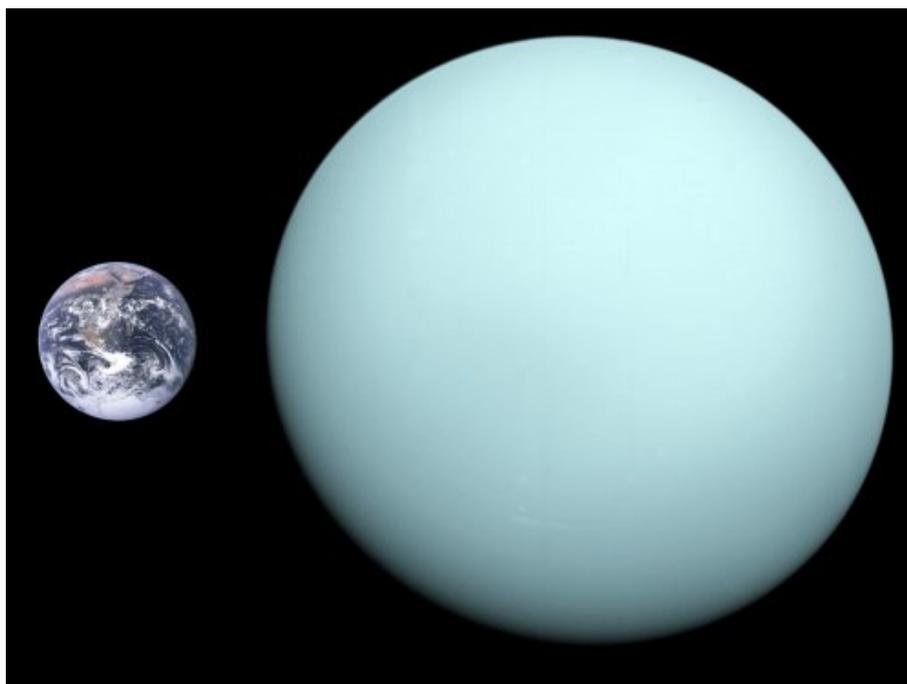


Date de mise en ligne : jeudi 4 février 2016

On January 24, 1986, exactly 30 years ago, the Voyager2 mission flew over Uranus, the seventh planet of the solar system. This unique exploration has never been repeated. Uranus, however, raises many scientific questions and is gaining the interest of space agencies. This is an opportune moment for scientists from the Paris Observatory to re-analyze the Voyager 2 observations.

After its launch in 1977 and the flight over Jupiter, then Saturn, the probe flew over Uranus at a distance of 81 000 km, and revealed a quite surprising planetary system :

- * a complex system of rings and 27 satellites including a number of large ones (Oberon, Titania, Umbriel, Ariel, Miranda),
- * fast axial rotation, with a period of 17,24 h,
- * unique atmospheric chemistry and dynamics,
- * no (or very small) internal energy source
- * a magnetic environment unlike any other in the solar system.



Photographie dans le visible d'Uranus prise à l'époque de Voyager 2, comparée à la Terre. Sur l'image, aucune activité nuageuse n'est visible. © NASA

We did expect that Uranus would spring surprises. Its rotation axis is aligned towards the Sun, probably as a consequence of a collision in the distant past with a giant body, so that its atmosphere is subject to extremely unequal solar heating, one hemisphere being constantly heated. The orbital plane of its satellites is perpendicular to the ecliptic. Moreover, with a magnetic axis inclined at 60° - a record in the solar system ! - this asymmetric magnetosphere became

from the very start an extreme case in the very exclusive club of magnetic planets.

And ever since, interest in this intriguing planetary system has not waned. And that is because the harvest of data obtained by Voyager 2 has left many questions unanswered.

While it is true that regular ground based telescopic observations do enable us to monitor the activity of its clouds and its ring system, the spectral range and sensitivity which can be achieved from the terrestrial orbit (for an object more than 2,7 billion km away) bear no comparison with in-situ observations, some of which can only be done in this way (such as corpuscular studies, magnetic field measurements , etc).

And so, after the numerous terrestrial space missions, after the orbital exploration of Jupiter (Galileo, Juno at the end of this year, and et JUICE in 2025), of Saturn (Cassini-Huygens), of Mercury (Messenger, and soon Bepi-Colombo) and even of comets (Rosetta/Philae), Uranus is the next key step in the exploration of the solar system.

Together with Neptune, it is a member of the class of geant icy planets (less massive than the gas giants, with a core made up of ices and rocks), but since it is twice as close as that planet, it is much more accessible.

The rebirth of interest by the space agencies

A number of scenarios have been under study already for some time :

" Firstly, at NASA d'abord : such a mission has been awarded priority status in a number of recent reports (decadal surveys in planetology and heliospheric physics), while a science definition team for such a mission is currently being organized.

" On the ESA side : the project of the Uranus Pathfinder mission - which includes a very significant contribution from the French community - has been the subject of a recent ESA call for tender, and has been well received scientifically, even though it has so far not been selected.

A first technological challenge concerns the size of the solar panels needed to furnish electricity at a distance of 19 AU (roughly the size of a football field) which makes this option unfavourable compared to that of using nuclear generators, which ESA has not yet mastered.

The second challenge : the duration of the flight is 15 ans for much of which the probe will be in hibernation, which is much longer than for the Rosetta mission. En 2011, the project as submitted to ESA specified a possible arrival time in ... 2037 !

For this kind of long duration mission, it is essential to make the selection as soon as possible, and to anticipate the preparatory work. Note in this context that the CNES has decided to initiate in 2016 a feasibility study for a mission to explore the environment of Uranus.

Reanalysis of the Voyager 2 data

In the meantime, the time is ripe for a reanalysis of the Voyager 2 data, in the light of our current understanding of planetary systems.



Représentation de la sonde Voyager 2, l'antenne à haut gain (en blanc) renvoie les données obtenues vers la Terre. © NASA

The "magnetospheres" group of the Space and Astrophysical Instrumentation Laboratory of the Paris Observatory began this summer to reconstitute the high resolution data of the PRA instrument (Planetary Radio Astronomy), originally stored on magnetic tape and now archived at the CNES in digital form.

At the same time, Uranus aurorae had been detected by the Hubble space telescope in 2011, during a period when the Sun was particularly active. The results obtained are witness to a rich variety of magnetospheric processes which vary with the seasons, and so fuincite farther studies of Uranus, and that as soon as possible.