COROT: UPDATE ONE YEAR AFTER LAUNCH

The CoRoT satellite (for Convection, Rotation and planetary Transits) has completed its first year in Space. It was launched by a Soyuz rocket from the Baikonur Cosmodrome on 27 December 2006 and began to collect scientific data on 2 February 2007. What is there to report after more than 300 days of observations?

CoRoT, a CNES satellite, pioneering acquisition of precise and long-term data

CoRoT keeps a very large number of stars under continual observation and takes very precise measurements of variations in the intensity of light emitted by each one. About **12,000 light curves** have been plotted in this way for every series of observations. CoRoT measures data for these curves over **durations as long as 150 days** and almost continually. This is a **world first**.

CoRoT is capable of measuring these variations to the nearest millionth. In other words, if CoRoT were to observe the million light bulbs that shine along the Champs-Élysées at Christmas, it would be able to detect whether a single bulb was flashing.
Such **totally unprecedented precision** has allowed CoRoT to demonstrate that the stars have a **very wide range** of behaviour. One consequence of CoRoT will no doubt be a new classification of the stars.

On 10 December last, a first series of data obtained by CoRoT was made available to the French scientific community, as well as to the project partners (European Space Agency, Brazil, Germany, Austria, Spain and Belgium).
They are currently analysing the data. New deliveries will take place as observations continue, the next being scheduled for February 2008.

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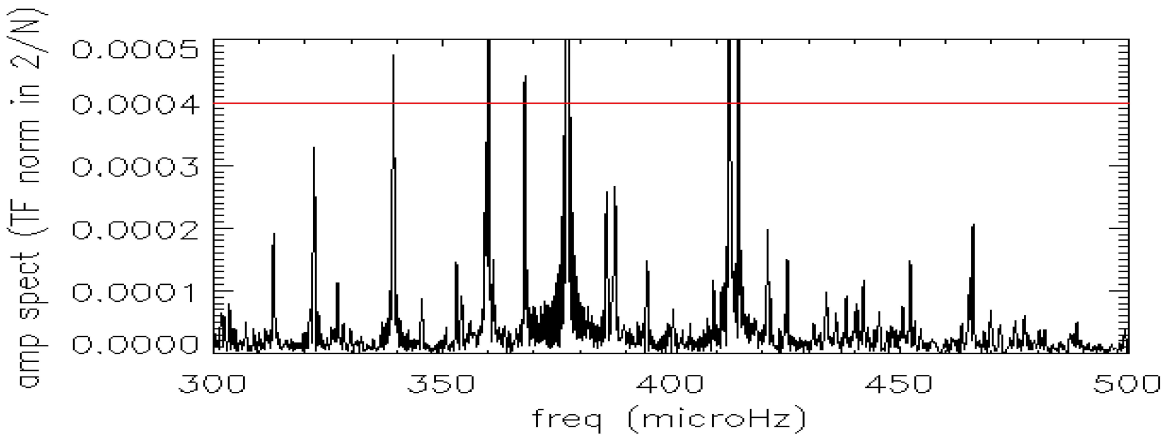
A mine of information for 'stellar seismology'

To date, 30 stars have been observed from a 'seismology' point of view for periods between 20 and 150 days. They include a diverse collection of objects, ranging from stars with properties similar to those of the Sun to stars that are much more massive or much older.

Although processing has only just begun, the data are providing very exciting results.
- The quest for solar type oscillations is one of the cornerstones of the CoRoT mission**.** Such oscillations have **already been detected in two stars similar to the Sun,** first in HD49933, then in HD181420. These oscillations have very low amplitudes and short coherence times[1], which makes detecting and measuring them more difficult than was initially foreseen.
- The oscillation spectra of more massive stars are extremely rich. It is impossible to obtain these spectra using even the largest ground-based telescopes, but CoRoT's very high precision associated with long-duration continual observations have produced very good results; detailed analysis will improve our knowledge of the age of these stars, their chemical composition, their rotation, their different internal chemical processes and the way they evolve.
The spectra provide a mine of scientific information for researchers who will be able to confront their theories with data from these new observations.



Caption: This diagram compares the amplitudes of the oscillation modes of a Delta Scuti star as a function of their frequency (between 300 and 500 micro-Hertz) at the best quality of detection possible from the ground (represented by the red line).

Discovery of a second exoplanet: CoRoT-exo-2b

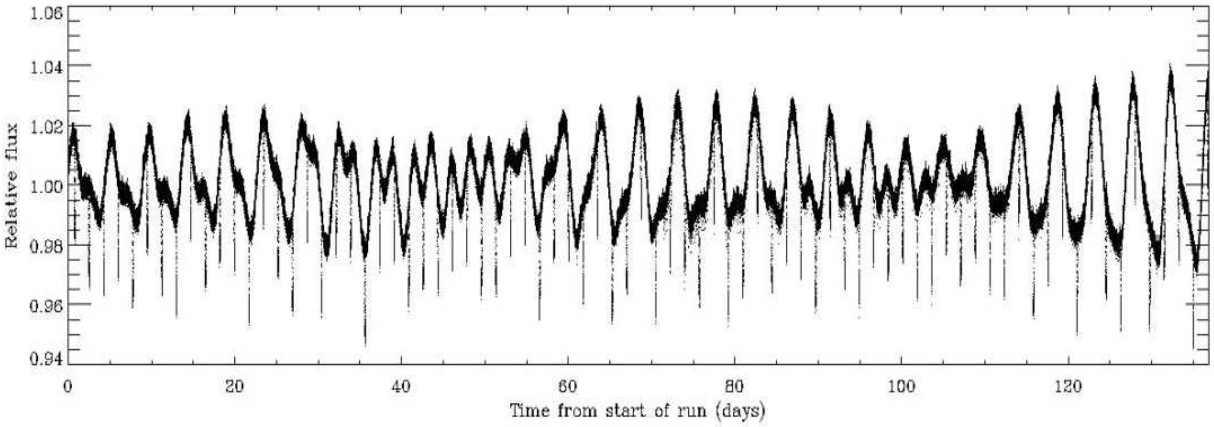
The detection of a 'transit' by the CoRoT instrument is not in itself sufficient proof that an exoplanet has been observed, as other phenomena can mimic a planetary transit. Ground observations are necessary to confirm any detection by CoRoT, which means that although CoRoT may be first with the news, patience is required before announcing the discovery of exoplanets, with a timing imposed by the practicalities of mobilising the great telescopes around the world.

In the spring of 2007 (see Press Release of 3 May 2007) CoRoT discovered a first exoplanet, named **CoRoT-exo-1b**.
Only two weeks into its third series of observations (see box) it was able to report the 'transit' of **CoRoT-exo-2b** across the face of its star to the specialists of the exoplanet programme. The confirmation procedure was immediately implemented with the data being analysed 'on the fly', allowing measurements to be taken at a faster rate. At the same time, the CoRoT ground observation consortium organised observations using the SOPHIE spectrograph at the *Observatoire de Haute Provence* and with HARPS at the 3.60 m.

[1] Period during which an individual oscillation of a star is observed.

telescope of the European Southern Observatory at la Silla, Chile. These confirmed that it was indeed a planet and produced measurements of its mass.

CoRoT-exo-2b's parent star is comparable to the Sun, slightly smaller and cooler but much more active. It is located approximately 800 light years away in the direction of the Serpens Cauda constellation.
CoRoT-exo-2b is a giant planet, 1.4 times larger and 3.5 times more massive than Jupiter. Its mean density (1.5 g/cm^3) is also slightly higher than that of Jupiter. This very massive planet orbits its star in a little less than 2 days (1.74), at a distance equivalent to 6 times the star's radius.



Caption: light curve for the parent star of CoRoT-exo-2b.

This observation was carried out over a period of 140 days. The light curve contains 78 transits of the planet across the disk of its star, a record number at this time when compared with ground observations interrupted by alternating night and day. The photometric precision is also unprecedented and constant throughout the observation. It reaches 160 millionths for a 2.5-minute pause, a value that remains beyond the reach of ground instruments.
This light curve also contains a lot of information about the star itself. It shows periodic modulations that are most likely a signature of a rotation speed that varies from the equator to the poles.
This is a brilliant demonstration of CoRoT's capabilities, and the impact that the mission will have on our understanding of stellar activities and our knowledge of extrasolar planets.

These two discoveries (**CoRoT-exo-1b and CoRoT-exo-2b) have been described in** three papers that will be submitted to peer-reviewed journals in the near future.
However, some forty light curve have been recorded containing the signals of possible planets. Observations are currently being made from the ground to confirm the hypothesis. The list includes two particularly promising candidates: a planet half the size of Saturn and a planet the size of Jupiter but with unusual density ...

CoRoT's fields of observation
CoRoT has observed 4 carefully-selected regions of the sky:
- first a region in the direction of the Unicorn constellation for 60 days;
- then two regions in the opposite direction, towards Serpens Cauda, one for a short period (26 days), followed by another for a very long period (150 days);
- again in the direction of the Unicorn, it is currently targeting another region for a very long period.

Paris, 20 December 2007