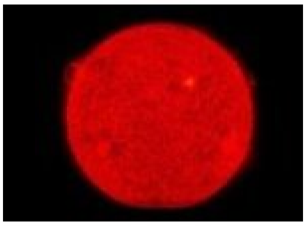
The most evolved red giants vibrate like the Sun



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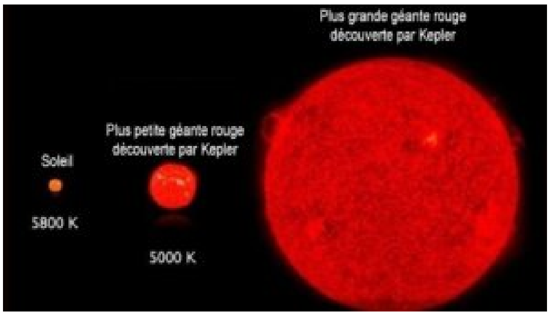
Description :

The most evolved red giants vibrate like the Sun

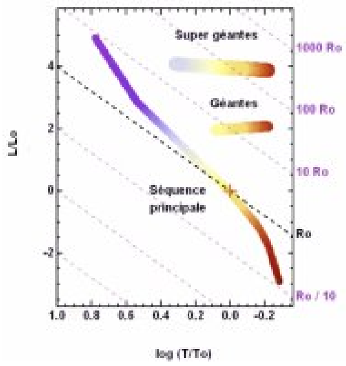
Observatoire de Paris - PSL Centre de recherche en astronomie et astrophysique

An international team of astronomers, led by scientists from the LESIA department of the Paris Observatory (Observatoire de Paris/CNRS/Université Paris Diderot/UPMC), have recently shown that red giant stars of spectral type M1 have oscillations like those of the Sun. This discovery leads to a better understanding of how these stars function, and will help us use them for measuring distances in the neighbourhood of the Milky Way. This work has recently been published in the journal Astronomy & Astrophysics.



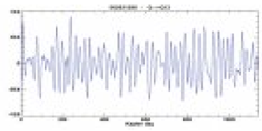
Comparaison des tailles des géantes rouges découvertes par Kepler. *(University of Sydney/CNRS)*

The oscillations of cold red giant stars, of spectral type M, are so large (on the order of a thousandth of a relative magnitude) that they have been observable since a long time using ground based telescopes. As a consequence, their study in the Magellanic Clouds via the large infra-red surveys such as OGLE2, has shown that the observed periods are related to the stellar magnitude. Various relations have been fjound, but the nature of the oscillations has not been identified.



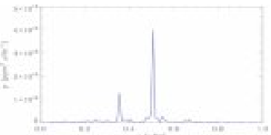
Le diagramme HR, les grandeurs T0, L0 et R0 sont respectivement les température, luminosité et rayon solaires. *(Fenêtres sur l'Univers http://media4.obspm.fr/public/FSU.)*

These stars are on the red giant branch, (cf. the Hertzsprung-Russell diagramme on the left). The CoRoT3 satellite has studied their oscillations in detail, but for globally relatively less evolved stars. The observations made by CoRoT have uncovered a particular property of the oscillations of giants - the spectral pattern has a univeral form. A single parameter, proportional to the mean stellar density, determines the pattern4. Since the radius increases as the star evolves along the red giant branch, the density decreases and the oscillation spectrum drifts towards the low frequencies. However, CoRoT's observations, which are limited to at most 5 months, are unable to probe the large M type giants, whose radius can be up to 200 times the solar radius RS).



Série temporelle de la géante M KIC 2831290 observée pendant 1150 j par Kepler *(Nasa/Kepler))*

Observations made by the Kepler5 satellite for over 3 years, have forged the link between the lower and upper part of the giant branch. The extrapolation of the observations to the very low frequencies (200 day periods, compared to the solar period of 5 minutes) has been validated by iteration. Ground based observations are in good agreement with observations made from space.



Spectre de la géante M KIC 2831290 observée pendant 1150 j par Kepler *(Nasa/Kepler)*

It follows that the oscillations of M type giants are like those of the Sun.. For giants whose radius exceeds 100 RS, these oscillations are essentially radial. The identification of the physical process responsible for these oscillations will enable fresh analyses of ground based data for about 100 000 stars. Astronomers hope that in this way they will obtain a better understanding of how these stars « function », of how they evolve, and of related physical phenomena. An example is the enormous mass loss of these stars. In effect, stars exceeding 60 RS have oscillations such that their surface layers have an acceleration comparable to that of their graviational field : these latter layers are thus not bound to the star and can be ejected by the stellar wind. Another important byproduct of this work concerns the use of these stars as standard candles for the measurement of distance on the scale of the Galaxy, and its neighbours (the Magellanic clouds, M31).

