DRAFT PRESS RELEASE

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Kepler satellite taking the "pulse" of distant stars

Exploring distant stars has taken on a new life thanks to a wealth of data from NASA's Kepler spacecraft. In results to be published this month, scientists have characterized hundreds of stars targeted by Kepler, using the natural pulse of their light waves.

These variations in brightness can be translated into vibrations, or oscillations within the stars, using a technique called stellar seismology. The oscillations reveal information about the internal structure of the stars, in much the same way that seismologists use earthquakes to probe the Earth's interior.

"We're essentially taking the vital signs of these stars, measuring their size, structure, and age, using methods that will also be useful for planet-hosting stars," says Danish astronomer Jørgen Christensen-Dalsgaard, who leads the seismology team.

NASA's Kepler satellite, launched in March 2009, is designed to discover Earth-like planets orbiting other stars. In the process it is capturing large quantities of data on the target stars. The satellite is using a huge digital camera to monitor continuously the brightness of more than 150,000 stars in its field of view as it orbits around the Sun.

Kepler searches for distant worlds by looking for "transits," when a planet passes in front of a star, briefly causing it to dim. The amount of dimming reveals the size of the planet compared to the size of the star. Many of the stars observed by Kepler are measured so accurately that one can detect the variations in brightness caused by the stellar vibrations and then used for seismology of the stars, also known as *asteroseismology*.

Asteroseismology allows scientists precisely to measure the size of the star, and therefore to obtain the absolute size of any planet. The technique also provides the age of the star, so that the many planets discovered by Kepler can lead to insights into how planetary systems change over time. Based on detailed measurements of light variations in one of the stars observed by Kepler it is shown that asteroseismology is indeed working. “We have shown that Kepler can make precise measurements of the radius and age for individual stars,” said one of the lead authors Travis Metcalfe from the National Center for Atmospheric Research. “These techniques will help the mission characterize stars that host exoplanets.”

The results from NASA’s Kepler spacecraft provide us with new information on a number of specific phenomena related to our fundamental knowledge of stars, their internal properties and evolution in time.

In about 5 billion years from now our Sun will expand to a size many times the current size of the Sun and also shine hundreds of times brighter than at present. The Sun will at this stage be a so-called red giant star. Stars older or more massive than our Sun have already evolved to be red giants today, and using the Kepler spacecraft scientists have now detected oscillations in thousands of these stars which allow us to measure stellar masses and radii of stars that are so distant that they could not be measured by any other telescope. The quantity and quality of these measurements give a clear picture of the red-giant stars in our Milky Way.

“It is thrilling to have the possibility to work with these data, which are better than anything we have seen before,” says Daniel Huber, lead author on one of the studies of red giant stars and graduate student at the University of Sydney. “Kepler data allow us to study in unprecedented detail how these stars work, and ultimately will give us a better understanding of the future of our Sun and the evolution of our Galaxy as a whole.”

"We are just about to enter a new area in stellar astrophysics" says Thomas Kallinger, lead author on another study of those fascinating stars and postdoctoral fellow at the Universities of British Columbia and Vienna "because Kepler provides us with data of such good quality that they will change our view of how stars work in detail and this is pretty exciting for young scientists like us to play in this scientific league."

Kepler is also used to study even more exotic stars and phenomena. One of the types of stars studied are the so-called RR Lyrae stars which are pulsating stars where the brightness over a few hours may fluctuate by a factor of two. Our understanding of both the size and nature of our Universe would be far more incomplete without the RR Lyrae stars. Because their pulsation periods - on average half a day - are directly connected to their intrinsic brightness, they serve as cosmic light houses, helping to determine distances in the Universe. Kepler has given us the closest look ever at the prototype of this type of stars. By observing the star with Kepler, scientists have discovered and successfully understood a previously unknown vibration feature.

"It is striking that only a few months of uninterrupted Kepler data of the star RR Lyrae uncover phenomena that were never detected before, not even with a century of high-quality ground-based data meticulously investigated by numerous astronomers. These findings have caused a dramatic overhaul in our understanding of these cosmic light houses" says Katrien Kolenberg lead author of one of the papers and postdoctoral fellow at the Institute of Astronomy in Vienna.

When Kepler looks at a binary star, a pair of stars, various phenomena can be seen that give extra information about the stars, even when no stellar pulsations are detected. Kepler is so sensitive that in some cases we can detect the effect of the motion of stars in their orbit. The Kepler spacecraft was used to study two small stars - a so-called subdwarf star and a white dwarf star – which are in orbit around each other.

“We were studying the light curve of two stars that are orbiting each other in close orbits. The two stars consists of a subdwarf star and a white dwarf. At times when the subdwarf moves towards the Earth in its orbit, Kepler detected about 0.2% more light than when it moves away from Earth. This effect, predicted by Einstein’s special theory of relativity, could never be measured so accurately before Kepler was

launched and allowed us to determine the orbital velocity of the star. From the velocity information, the masses of the stars can be determined, allowing us for example to distinguish between planets and white dwarfs, which are only about as large as the Earth but as massive as stars." says Steven Bloemen from Instituut voor Sterrenkunde in Leuven in Belgium.

"The published results show how the Kepler spacecraft is in the process of revolutionizing our understanding of stars, their evolution and specific properties. We are thrilled by the steady stream of amazing high-quality data from this spacecraft" says Hans Kjeldsen from Aarhus University in Denmark who is responsible for running the seismology science centre connected to Kepler.

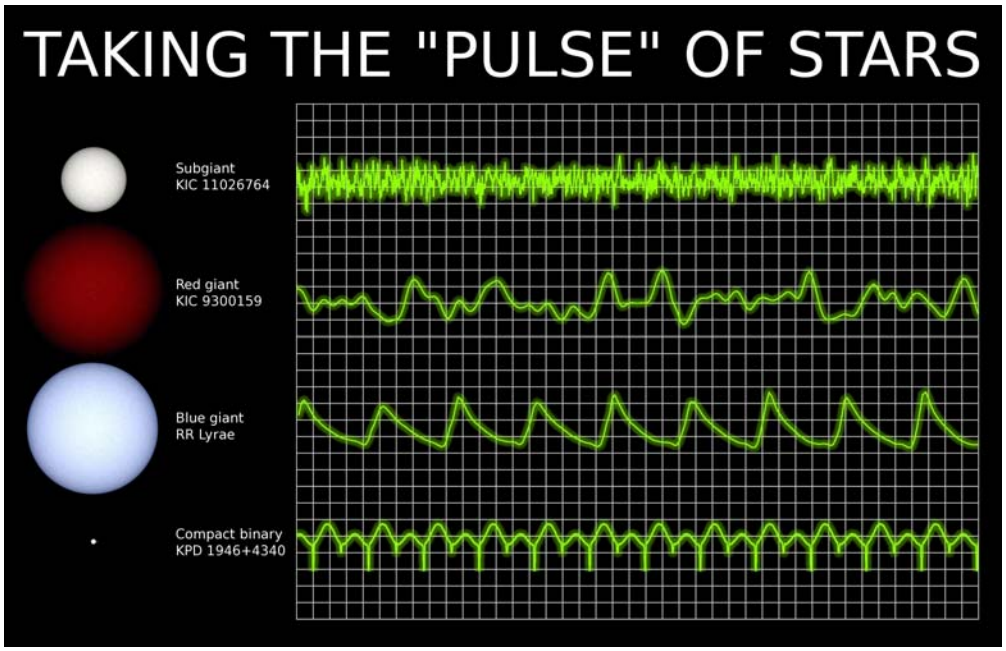

Figure 1: Light variations as observed by the Kepler spacecraft. Using the observed pulsations in the subgiant star KIC 11026764 scientists were able to measure the precise age and size of the star. Kepler also observed thousands of so-called red giant stars and the diagram shows one example of the detected variation in one of those stars. Observations of RR Lyrae – a hot blue giant star – gave for the first time scientists a clear picture of the detailed vibration features in this star, something that was impossible before the launch of Kepler. Finally Kepler have detected the brightening and dimming of light caused by the motion of two stars (compact binary).

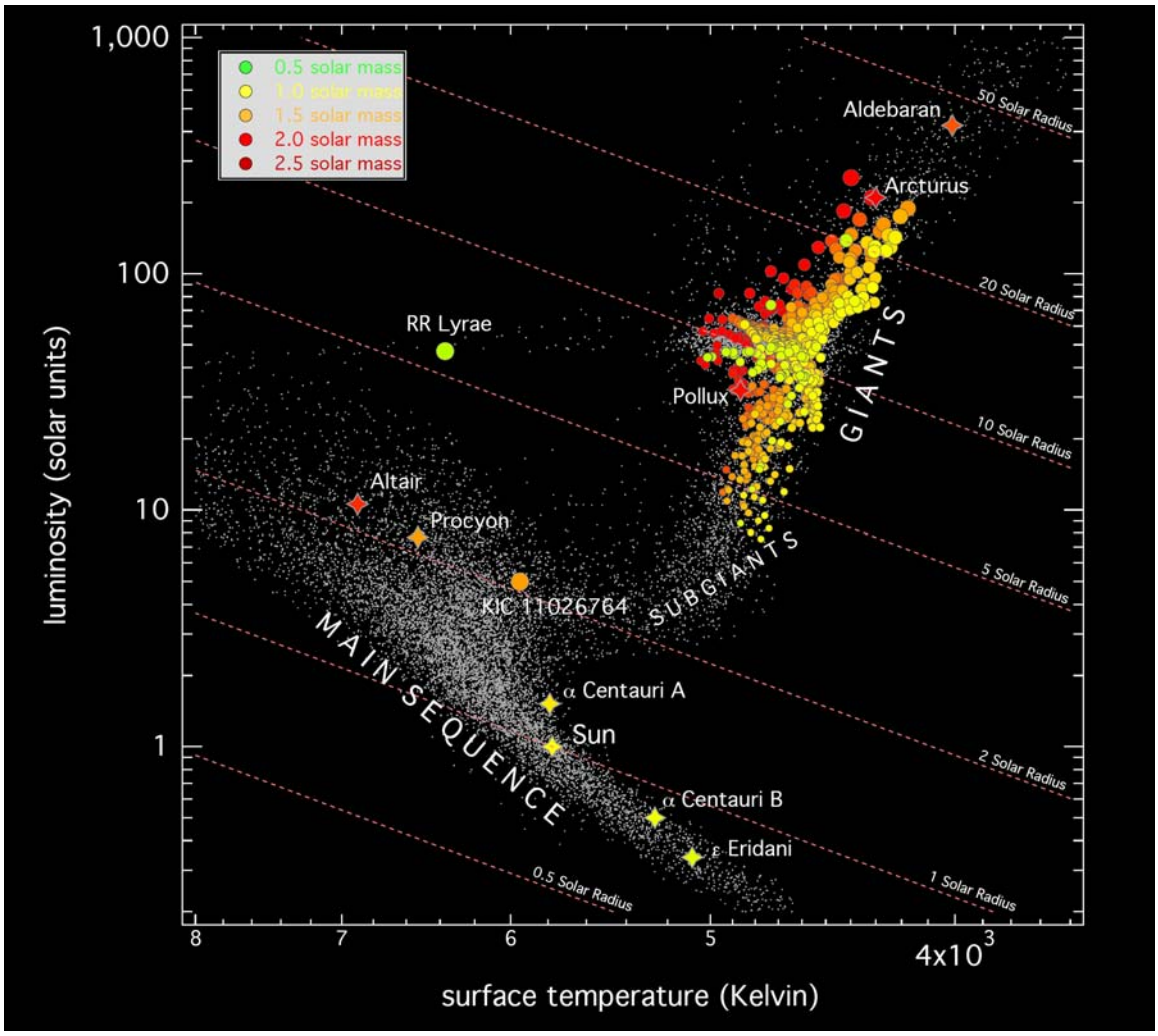

Figure 2: A so-called HR-diagram which shows stellar surface temperatures and luminosity (energy release) for different stars. The diagram show the position of the two stars described in this press release (KIC 11026764 and RR Lyrae) as well as the large number of red giant stars studied in detail by use of the Kepler spacecraft.

More figures….

Names of contact people: