NEWS RELEASE

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LANCASHIRE

University wins grant for new stellar research

As galaxies collide thousands of light years away the world's leading authority on roAp stars is preparing to investigate the pulsation modes and magnetic fields in some of the universes most peculiar stars.

Professor Donald Kurtz, from the University of Central Lancashire's Centre of Astrophysics, was recently awarded a standard research grant from PPARC (Particle Physics and Astronomy Research Council) for his research proposal 'Stellar Spectroscopy for astroseismology'. The grant will pay for a three year postdoctoral research assistant to work with Professor Kurtz in collaboration with Dr.Gautier Mathys at the European Solar Observatory in Chile. The UK has recently paid an admission fee in the region of £65 million to join the observatory giving British astronomers regular access to the telescopes from 2002. Sitting on top of Mount Paranal in the Atacama Desert, the observatory contains a £200,000 million machine, Chile's largest telescope.

Professor Kurtz specializes in variable stars, which vibrate and change their shape, size and brightness. Variable stars contain sound waves but as the sound can't escape the sound waves moving in the star cause it to pulsate. The rate of vibration varies, simple ones contract like a blown up ball. Others have extremely complex vibrations with various things going in and out, various parts of the star get hotter and cooler. The frequency, or period, and vibrations are down to the sound speed which depends on the temperature, the density and the frequal composition. Breaking the process down Professor Kurtz relates the phenomenon to that of an orchestra.

"If someone was sitting with their back to an orchestra with their eyes closed whilst the orchestra is tuning up. Every instrument is playing the same note but if they listen they'll be able to pick out the oboe, the violin, the flute. They can pick out the different instruments even though they're playing exactly the same note. What makes the sound different with different instruments even though they're playing the same frequency? The shape of the instruments; the resonator shapes the note.

"Musical instruments produce harmonics that shapes the waves, so in many cases it pushes your eardrum in quickly and then let it out slowly. A square wave is where it may push it in quickly and hold it there for a while then let it out quickly. Push it in quickly and let it out slowly is called a triangular wave. The shape of the instrument shapes a sound wave and in your mind you can actually picture the instrument. The character and the frequencies of any oscillating object will tell you what the objects like.

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"We use these vibrations in stars, astroseismology, and in the earth, seismology, to probe the interior and explore its nature. So, when astronomers say that the core of the sun has a temperature of 15.4 million degrees Celsius it's not only calculated, it's measured. If the temperature inside the sun was different the vibration frequencies on the surface would be different and we can pinpoint that for certain because we know what the inside of the sun looks like."

Professor Kurtz became an astronomer almost by accident. Initially attending San Diego State University as a marine biology student he switched to astronomy after attending an introductory course in the subject. Following that he attended the University of Texas and completed his Masters and PhD. At the time Texas had a very strong interest in stellar oscillation and stellar variability, with strong links to South Africa and shortly after completing his PhD on vibrating stars with peculiarities he moved into stellar pulsation. From Texas he travelled to South Africa, initially for a year, to continue his work and take up new research, staying for over twenty years.

Between 1977 and 2000 Professor Kurtz worked for the University of Cape Town starting as a Postdoctoral Fellow and leaving as a Professor of Astronomy. During his time in South Africa he focused his research on a particular kind of pulsating star along with some of the most peculiar stars in the sky. The star that caught his interest was Przybyskli's star, named after the Polish astronomer who discovered it, and further research led to the discovery of a new class of stars.

The spectrum of Przybyskli's star proved to be extremely peculiar and at the time it was thought that it couldn't be a pulsating star because such stars would be stabilised by their strong global magnetic fields, but Professors Kurtz's curiosity got the better of him. No one had looked closely at this type of star and after studying it Professor Kurtz discovered that it did vibrate, but on a scale never seen before. Its period was twelve minutes, a very short period high frequency vibration. From there Professor Kurtz discovered the class of rapidly oscillating peculiar A stars and developed a theory, the standard oblique pulsator model, to give an initial understanding of what the stars are doing. Between him and Peter Martinez, his PhD student at the time, they discovered twenty-five of the thirty-two stars in that class.

Rapidly oscillating Ap or roAp stars are magnetic peculiar stars that pulsate with periods from just under six minutes to roughly fifteen minutes. Frequency analysis of their light curves has provided astroseismic information on the degrees of the pulsation modes, distortion of the modes from normal modes, magnetic geometries, luminosities and the interaction of the magnetic field with the pulsation modes. The stars pulsation modes are aligned with their magnetic axes, which are inclined to their rotation axes. This allows their non-radial pulsation modes from a varying aspect, a property unique to this group, to be examined. The roAp stars are some of the best non-degenerate stars, other than the sun, in which to apply the techniques of astrosiesmology.

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Since joining UCLan's Centre for Astrophysics earlier this year, Professor Kurtz's research direction has shifted completely. Rather than watching the brightness of the stars he is now looking at the variations in their spectrum by probing the vertical variations in the atmosphere of the stars.

Professor Kurtz is also an accomplished public speaker and frequently gives talks to schools, clubs, science festivals and corporations. This year he gave a talk at the Edinburgh Science festival and was the official astronomer on board Rovos Rail during the South African total eclipse of the sun. His recent lecture, 'Big and Beautiful: The Latest and Greatest Hits of the Hubble Space Telescope', was held at the university to a packed auditorium. In March he has been invited to give a lecture at the exotic stars meeting in Miami.

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