



The University of Sydney
School of Physics

Alumni UPDATE

- Institute of Photonics & Optical Science
- Sydney Institute for Astronomy



Dates to Remember

- 3 September The University of Sydney's Graduate Options Expo
www.usyd.edu.au/graduateo
- 11 September School of Physics Postgraduate Information Day
For more info:
www.physics.usyd.edu.au
- 12-16 September Chancellor's Committee Book Fest in The Great Hall, Main Quadrangle
- 19 September Spring Back to Sydney Alumni Festival. ALL alumni welcome.
Register now at:
www.usyd.edu.au/spring_back

Ultrasound for Teeth

When David Hsiao-Chuan Wang (above) accepted the challenge of a University of Sydney scholarship proposal of 'using optics for dental health' he had no idea he would make a pioneering breakthrough in the area of painless analysis of tooth density.

A postgraduate student in the Institute of Photonic and Optical Science (IPOS), Wang has developed an Ultrasonic Evaluation Technique using laser-generated ultrasound to measure the elasticity of the surface of teeth. Normally a needle or probe is used for such evaluations and this can be painful and cause unnecessary damage.

His painless technique uses a short laser pulse to generate an ultrasonic surface acoustic wave on the surface of the tooth enamel. This ultrasound pulse propagates across the area of interest on the enamel, while probing some distance under the surface, and is detected for analysis.

The calculated propagation velocity of the ultrasound then reveals the elasticity of the tooth, from which the early stages of decay can be diagnosed. (Continued on page 2)



FRONTIERS OF SCIENCE

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Alumni UPDATE

Cosmic Trailblazer

Neutron stars are almost the proverbial diamond in the sky. To date less than 2,000 are detected in our galaxy, which is filled with billions of 'normal' stars. But Dr Stephen Ng, a Postdoctoral Fellow at the Sydney Institute for Astronomy (SIfA) in the University of Sydney, and his team have discovered an extremely rare neutron star or pulsar; one caught in the act of bursting out of a supernova remnant leaving behind it a long trail or 'handle'.

The neutron star's long and linear trail is extremely rare and this is the only known example that connects all the way back to the supernova shell revealing, for the first time, the complete history of the system and confirming that the neutron star was created in the supernova explosion.

The supernova remnant, formally known as G315.9-0.0, is a shell of glowing gas left over from a stellar explosion that occurred 100,000 years ago. The newly discovered neutron star is an extremely dense, very compact star that has the mass of the sun yet is smaller than the city of Sydney. The shell and the 'handle' leaves behind one of the longest trails ever discovered in radio astronomy, resulting in a highly unusual image which astronomers have dubbed *The Frying Pan*.

Ng says it's the neutron star's incredible velocity that has made it a trailblazer. "It could travel from Sydney to Melbourne in one second."

The Frying Pan is approximately 24,000 light years away and the neutron star's radio emission is so weak that detection is challenging. Ng's team, which includes Dr Fernando Camilo from Columbia University in New York and University of Sydney colleague Professor Bryan Gaensler, have only been able to observe this new neutron star at the tip of 'the frying pan's' handle using one of the world's most powerful facilities, the CSIRO Parkes Radio Telescope in NSW.

Ng says that the next step will be to understand exactly why the tail stays so straight over a large distance. The paper reporting this work, "*Out of the Frying Pan; A Young Pulsar with a Long Radio Trail Emerging from SNR G315.9-0.0*" is to be published in August 2009 in *The Astrophysical Journal (Letters)*. To see images of *The Frying Pan* visit: www.physics.usyd.edu.au/~ncy/g315/

Ultrasound for Teeth

(cont.)

"There are many things that made the measurements difficult, such as the small dimensions of the tooth area and the surface conditions," explains Wang, "The use of optical fibre is important for our work because it allows us to make precise measurements on the small dimension samples without being in contact." After 18 months of research in optics Wang, supervised by Professor Simon Fleming and working in collaboration with dental researchers at the University of Sydney, needed someone who understood ultrasonic methods. Enter Professor Yung-Chun Lee from the National Cheng Kung University in Tainan City, Taiwan, who worked with Wang for a further 14 months researching and adapting equipment.

The first successful measurement on teeth was carried out in mid-2008. "It was a mixture of relief and excitement as we had a good result. Actually, after more than three years of work it was very exciting," grins Wang.

He hopes to develop the dental ultrasound evaluation technique further by making it a hand-held dental tool. "We still have a long way to go and it's important to get funding otherwise we cannot do any more research and development. It's a great chance for the dental industry to become more involved."

We all hope this is one opportunity dentists will want to sink their teeth into.

David Hsiao-Chuan Wang is the lead author of the paper "*Laser Ultrasonic Surface Wave Dispersion Technique for Non-Destructive Evaluation of Human Dental Enamel*" was recently published in *Optics Express*.



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School of Physics/Science Foundation for Physics www.physics.usyd.edu.au email: a.muir@physics.usyd.edu.au tel: +61 2 9036 5194