

# Exeter physicist bends light waves on surfboards

August 6 2012

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Image: Jim Wileman

(Phys.org) -- Scientists across the globe are trying to develop materials that can refract light to create ‘invisibility cloaks’, which are of particular interest to the aerospace industry. ‘Invisibility cloaking’ means building properties into a material that allow the device to guide light waves around an object, making it invisible.

Dr Matt Lockyear grew up in Exeter and completed his undergraduate Physics degree at the University of Exeter as a mature student. He returned for his PhD after working as an engineering manager at BNFL Sellafield, and now works as a Research Fellow in the Electromagnetic and Acoustic Materials Group in Physics. His research focuses on metamaterials: materials that consist of specifically engineered ‘pseudo-atoms’ to provide bulk material or interface properties that are not found in nature.

For his work, Dr Lockyear needed to find a material that is uniformly dense, and in response to electromagnetic radiation, behaves in a similar way to air. He discovered that the foam inside his surfboards was ideal for his experiments. Luckily, his friend Tris Cokes owns the Redruth-based surfboard blank manufacturing company Homeblown. Tris was able to provide him with samples of the material, and then lent him the factory to test the loading of the foams with high refractive index powders.

Dr Lockyear has recently built what he describes as a ‘surface wave black hole’ using the surfboard foam. He has created a circle of material that has a radially graded index (the higher the index, the slower the light travels through the medium), and placed it on the surface of a metamaterial. The radiation propagating across the metamaterial is then refracted, spiralling inwards to an absorbing core. Dr Lockyear is now working on the surface wave invisibility cloak as a stepping stone to his current research project’s ultimate goal, a free space 3D [invisibility cloak](#).

Dr Matt Lockyear said: “I never thought I’d be able to combine my passion for physics with my love of surfing - usually one competes with the other. But the foam inside the boards I’ve been riding for all these years has proved absolutely perfect for my research. I was having a discussion with a colleague regarding suitable materials for the project whilst looking at one of Tris’s foam blanks propped up against the office wall, which I had been meaning to turn into a 6ft 10 single fin pintail. I am also very lucky to have an office opposite the theory guys who, quite literally, wrote the book on transformation optics.”

The Electromagnetic and Acoustic Materials group undertakes pioneering studies with metamaterials and is developing new designs for radio frequency identification, anti-counterfeiting, and sound proofing technologies. The group’s research is primarily built around the

development and subsequent study of metallic surfaces with exceptional properties and a range of applications.

Dr Lockyear's interests including stealth materials, light-weight flexible ultra-thin radar absorbers, cloaking, beam steering, smart antennas, electronic tagging and frequency selective wallpaper, and of course surfing.

Provided by University of Exeter

Citation: Exeter physicist bends light waves on surfboards (2012, August 6) retrieved 4 April 2024 from <https://phys.org/news/2012-08-exeter-physicist-surfboards.html>

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