



## Bubbles to beat cancer: Identifying the magic bullet

**TakeAIM Winner 2014:**  
James Francis Cowley

**Institution:**  
University of Strathclyde  
Dept. of Mathematics &  
Statistics, Livingstone Tower  
Level 9, 26 Richmond Street  
Glasgow G1 1XH

Microbubbles typically composed of a protein shell are loaded with a cancer treating drug, coated with chemical receptors that act as a targeting mechanism, and injected into the bloodstream. Ultrasound is used to enhance the porosity of the capillaries that surround the tumour creating a “doorway” to the tumour’s surface where the bubbles are then burst in a localised manner using a high powered ultrasound signal. This procedure aims to minimise the pernicious side effects of conventional chemotherapy treatments whilst enhancing the effectiveness of the cancer treating drug.

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The aim of my PhD is to develop mathematical models that will help to identify the most suitable material for the shell of the microbubbles. A key area of my research involves developing a mathematical model to describe the dynamical behaviour of the microbubble, which is dependent on the material parameters of the shell, when it is subjected to an external ultrasound signal. What makes my research highly original is that it models the shell as a liquid crystal, describing both the solid and liquid characteristics, whereas all previously published research applies a purely solid mechanics based approach.

My model will then be used to determine the rupture time of the liquid crystalline shell which is a key physical parameter in determining the stability of the drug loaded microbubble.

The use of mathematics has profound consequences in all walks of life, but the opportunities that it opens up often go unrecognised or underexploited. The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the fourth annual TakeAIM competition in 2014 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to all undergraduate and postgraduate students working in the mathematical sciences. The author of the best entry received £1,000 of Apple vouchers as his prize, with £500 of Apple vouchers being awarded to authors of the four entries that tied for second place.