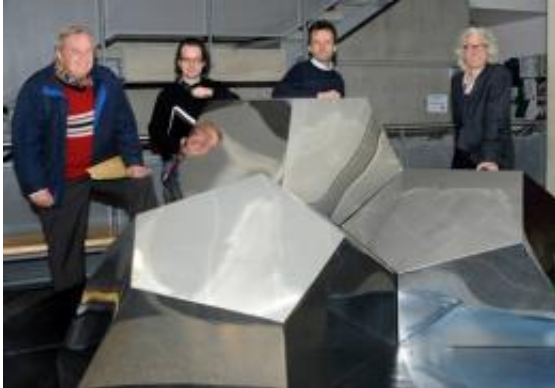


Foam bubbles finally brought to order

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Professor Denis Weaire, Aaron Meagher, Dr. Ruggero Gabbrielli, Professor Stefan Hutzler.

Scientists have succeeded for the first time to turn the Weaire-Phelan foam model – a celebrated geometrical concept which received additional notoriety when used in Beijing’s Olympic Games iconic building the Water Cube – into real foam.

In 1994, Denis Weaire and Robert Phelan of Trinity College Dublin’s School of Physics made a landmark discovery in [foam](#) physics, and created a new ideal structure of foam. It is the most efficient way to partition space into equal volume cells while minimising surface area – something soap bubbles strive to do in nature. Their geometry of soap bubbles improved on a previous principle devised by the physicist, Lord Kelvin a century ago.

The Weaire-Phelan structure consists of two kinds of polyhedral bubbles with twelve and fourteen sides respectively. The structure can be cut along planes, showing the existence of layers of bubbles. Since its introduction in 1994 it has played an important role in theory and simulation of foams, for example in the study of elastic properties.

The structure went on to inspire the design of the 2008 Olympic Games' iconic building, the Water Cube in the National Aquatic Center in Beijing. Many millions have admired its elegant framework of steel beams, which follow the pattern of the ideal foam.

The physicists have now gone a step further and this month succeeded in turning the mathematical concept into real foam.

Now it exists in reality, thanks to the work of a team led by Dr. Ruggero Gabbrielli, from the University of Trento, in an SFI-funded visit to Trinity College. Back in 1994 while the concept was computed, with the help of the software by Kenneth Brakke, they were unable to fabricate the new foam.

Acknowledging that the previous failures could be put down to the shape of the containers used, Gabbrielli along with Brakke designed a receptacle whose walls had an intricate form that would encourage and accommodate the Weaire-Phelan bubbles. It was made in Trinity's nanoscience institute, CRANN and proved an instant success when [bubbles](#) of the right size were introduced into it.

“Wonderful!” says Weaire, now an Emeritus Professor in the School of Physics. “We shall call this the Italian Job. It opens up a lot of further possibilities.”

In response to whether the new foam could be of any practical use: “Not immediately”, says Professor Stefan Hutzler, Head of the Foams and

Complex Systems Research group in the School of Physics. “Let’s just admire its extraordinary beauty first. But in solidified form and on various scales, such exotic ordered foams could find applications as chemical filters, heat exchangers and optical components.”

“It’d be interesting to come up with a proof of optimality,” Ruggero says. “Scientists have been looking at this problem for quite a while, but a rigorous result is still missing.”

The paper reporting the fabrication of the Weaire-Phelan structure was accepted for publication in the time-honored science journal *Philosophical Magazine Letters* on the 25th of November 2011. This is the same journal in which both Kelvin (in 1887) and Weaire and Phelan (in 1993) published their work on the [structure](#) of ideal foam.

Provided by Trinity College Dublin

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