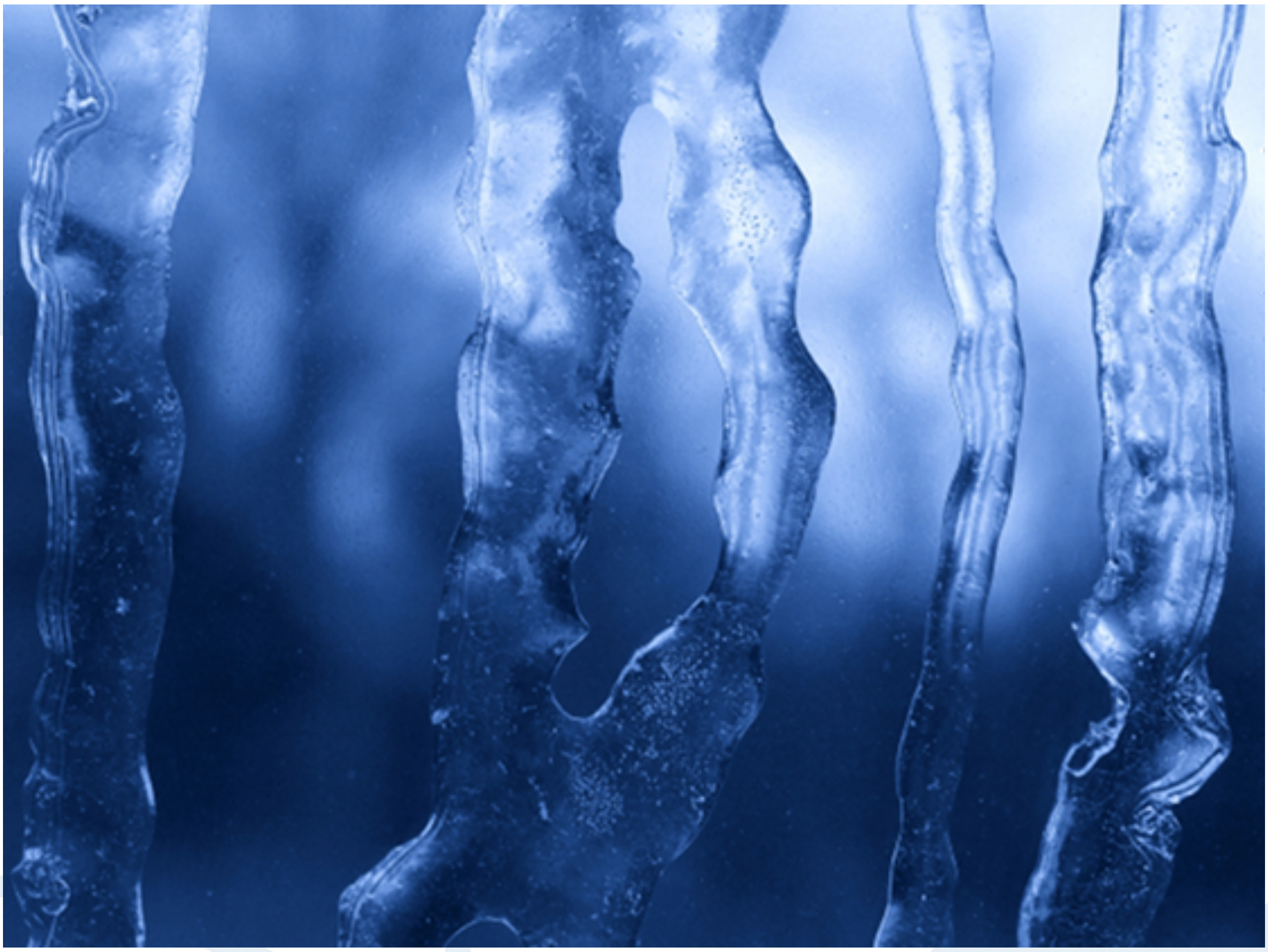
An ERC grant to study Mott transitions



SISSA awarded new funds for the physics of condensed matter

May 2, 2016

The recent round of funding by the European Research Council (ERC) – the prestigious "Advanced Grants" – features the International School for Advanced Studies (SISSA) of Trieste among the grant awardees. Michele Fabrizio, SISSA physicist has won a substantial new grant, which will allow him and his group to study "first-order Mott transitions" for the next five years.

The number of ERC grants awarded to SISSA has reached 16 (since 2008, when these grants were first offered). This time, the recipient a few days ago of an ERC Advanced Grant worth nearly 1.5 million Euro, is Michele Fabrizio, SISSA professor in the Physics area. The research project (entitled “Modeling First-Order Mott Transitions”), which will last 5 years, will take a close look at the mechanisms and applications of first-order Mott transitions, that is, discontinuous metal-to-insulator transitions provoked by a strong Coulomb repulsion between electrons, a physical phenomenon considered promising for the development of new electronic devices. “Mott-tronics” is in fact one of the fields that, according to the scientific community, may complement (or even replace) current silicon-based technology. Fabrizio (the project leader) and colleagues will study the conditions that induce and promote the discontinuous nature of Mott transitions and the physical properties relevant to potential technological applications.

But what is a first-order transition and why is it interesting when it occurs between an insulator and a metallic phase? “Let’s consider an example involving a very common material like water” explains Fabrizio. “We know that water turns into ice at 0°C through a first-order transition. In actual fact, it is possible to make it remain in a liquid state even below this critical temperature: all we need to do is to cool it in the appropriate manner and it can reach -48°C before giving up to ice. In this temperature range, the water may take on both a solid state – the equilibrium phase– and a liquid state – which is instead metastable - and just tapping the container is enough to make the liquid water immediately turn to ice”. If a metal phase were to take the role of liquid water and an insulating one that of ice, it’s easy to imagine the interest this non-equilibrium state of supercooled water could have in the context of a Mott metal-insulator transition.

Until now, the first-order nature of Mott transitions has been relatively overlooked – not to say completely ignored – a gap that the project aims to fill. “Materials that pass through first-order transitions from conductor to insulator , phases which therefore must coexist in a region around the transition just as liquid water and ice coexist in a range of temperature/pressure, etc.”, continues Fabrizio, “may have interesting technological applications. It’s been quite a while since scientists started looking for candidates to overcome the limitations of today’s traditional silicon-based technology, and Mott insulators are among them”.

In the next 5 years Fabrizio and colleagues will study the characteristics of these materials and the conditions under which the phenomenon occurs.

IMAGES:

- **Credits: Mark K. (Flickr: https://goo.gl/nDI9Nr)**

Contact:

Press office:
pressoffice@sissa.it

Tel: (+39) 040 3787644 | (+39) 366-3677586

via Bonomea, 265
34136 Trieste

More information about SISSA: www.sissa.it