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**PRESS RELEASE**
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# A stream of superfluid light

**Montreal, June 5, 2017** - Scientists have known for centuries that light is composed of waves. The fact that light can also behave as a liquid, rippling and spiraling around obstacles like the current of a river, is a much more recent finding that is still a subject of active research. The “liquid” properties of light emerge under special circumstances, when the photons that form the light wave are able to interact with each other.

Researchers from CNR NANOTEC of Lecce in Italy, in collaboration with Polytechnique Montreal in Canada have shown that for light "dressed” with electrons, an even more dramatic effect occurs. Light become superfluid, showing frictionless flow when flowing across an obstacle and reconnecting behind it without any ripples.

Daniele Sanvitto, leading the experimental research group that observed this phenomenon, states that "Superfluidity is an impressive effect, normally observed only at temperatures close to absolute zero (-273 degrees Celsius), such as in liquid Helium and ultracold atomic gasses. The extraordinary observation in our work is that we have demonstrated that superfluidity can also occur at room-temperature, under ambient conditions, using light-matter particles called polaritons."

"Superfluidity, which allows a fluid in the absence of viscosity to literally leak out of its container", adds Sanvitto, “is linked to the ability of all the particles to condense in a state called a Bose-Einstein condensate, also known as the fifth state of matter, in which particles behave like a single macroscopic wave, oscillating all at the same frequency.
Something similar happens, for example, in superconductors: electrons, in pairs, condense, giving rise to superfluids or super-currents able to conduct electricity without losses."

These experiments have shown that it is possible to obtain superfluidity at room-temperature, whereas until now this property was achievable only at temperatures close to absolute zero. This could allow for its use in future photonic devices.

Stéphane Kéna-Cohen, the coordinator of the Montreal team, states: "To achieve superfluidity at room temperature, we sandwiched an ultrathin film of organic molecules between two highly reflective mirrors. Light interacts very strongly with the molecules as it bounces back and forth between the mirrors and this allowed us to form the hybrid light-matter fluid. In this way, we can combine the properties of photons such as their light effective mass and fast velocity, with strong interactions due to the electrons within the molecules. Under normal conditions, a fluid ripples and whirls around anything that interferes with its flow. In a superfluid, this turbulence is suppressed around obstacles, causing the flow to continue on its way unaltered".

“The fact that such an effect is observed under ambient conditions”, says the research team, “can spark an enormous amount of future work, not only to study fundamental phenomena related to Bose-Einstein condensates with table-top experiments, but also to conceive and design future photonic superfluid-based devices where losses are completely suppressed and new unexpected phenomena can be exploited".

These experiments are published today in the June 5th issue of Nature Physics and are the result of work carried out at the Advanced Photonics Laboratories of the Institute of Nanotechnology of the Italian National Research Council in Lecce, in collaboration with Polytechnique Montreal in Canada, the Center of Excellence at Aalto University in Finland and Imperial College London.

Reference:
"Room-temperature superfluidity in a polariton condensate",
G. Lerario, A. Fieramosca, F. Barachati, D. Ballarini, K. S. Daskalakis, L. Dominici, M. De Giorgi, S. A. Maier, G. Gigli, S. Kéna-Cohen, D. Sanvitto,
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**Figure description:**
The flow of polaritons encounters an obstacle in the supersonic (top) and superfluid (bottom) regime.