Master 2 Internship

Title: **3D temperature scanning for microfluidics**

Type: experimental

Supervisor(s): Jeremie Maire and Stephane Chevalier

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PhD funding (if any): Regular openings in the team

Project:

To understand heat transfer in a complex system, obtaining three-dimensional temperature measurements is a valuable source of information. In microfluidic systems, which cover many cutting-edge applications, from biology to energy, temperature can have a critical impact on device performance or reveal insights into the physical or chemical reactions taking place. However, achieving this in microfluidics remains a significant scientific and technological challenge due to both the geometry (a few millimeters in thickness) and, for certain optical techniques, the low sensitivity of the measurement.

The transmission heterodyne photothermal imaging (TPHI) technique recently developed at the I2M laboratory [1] is a new technology that enables 3D measurement of temperature elevation fields in a microfluidic system (PDMS, water, silicon, glass). This method is based on the principle that the reflectance and absorbance of incident light in a medium vary with temperature, and solves sensitivity problems through modulated signal acquisition. It is associated with a numerical model to measure quantitative temperature variations.

The objective of this internship is to continue the characterization of microscopic samples, in microfluidics and for energy applications with components present in micro-batteries. The student will learn how to use the 3D scanner, take measurements on different samples, and analyze the results. The student will then tackle a more complex operando microfluidic device. Depending on progress, the student may participate in the manufacture of samples and/or the extension of the measurement to scattering media.
PhD funding is regularly available within the I2M TIFC team. If the objectives of the internship are achieved, the candidate may be offered the opportunity to continue with a PhD within the research team.

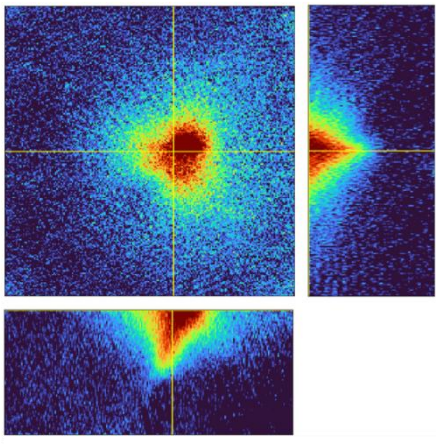

Figure 1. 3D temperature field generated by a laser absorbed in a glass layer.

Reference :

[1] Letessier, J., et al. Infrared photothermal heterodyne imaging in thermally thick medium for thermo-optic property characterization. arXiv:2505.00244 [physics.app-ph]