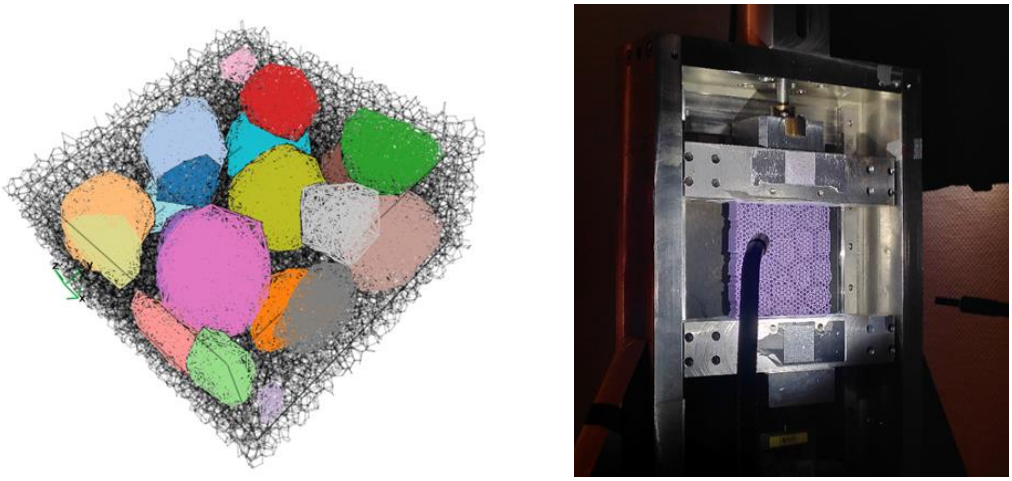
SPHYNX, CEA Orme des Merisiers, Service de Physique de l'Etat Condensé
http://iramis.cea.fr/spec/SPHYNX/

INTERNSHIP OFFER

Mechanical Characterization of 3D-Printed Metacomposite Lattice Materials

Reducing the quantity of raw material is a preferred method to reduce both the production cost and the energy footprint of structural materials. One method to create less massive materials, widely explored in research, consists in replacing them with 3D-printed truss-based structures. These structures are very porous and, by adjusting the spatial arrangement of beams — their architecture — it is possible to obtain spectacular stiffness values, much higher than those observed in materials of equivalent lightness (such as aerogels or solid foams, for example). The SPHYNX and LIONS groups at CEA have thus obtained a lattice metamaterial with a random architecture that exhibits perfect structural isotropy, which allows standard material constants to be defined (Young's modulus, yield strength, toughness), and a stiffness-to-density ratio very close to the theoretical limit possible in a porous material. However, this material remains very brittle, and different methods for including heterogeneities are being explored to make it resistant to fracture.



Left: 3D representation of a truss-based metacomposite. The different hard grains are shown in colors. **Right**: Preliminary axial compression test on a quasi-2D metacomposite.

The objective of this internship is to characterize the resistance to deformation and fracture, in tension and compression, of *metacomposites*, that is to say, a truss-based metamaterial with zones of different connectivities creating effective hard *grains* linked by soft joints. Numerical tests may also be carried out on a model of the material.

This internship project is mainly experimental and will be conducted at the *Service de Physique de l'État Condensé* (SPEC) of CEA Saclay, part of Université Paris-Saclay, located at the *Orme des Merisiers* site, 91191 Gif-sur-Yvette, France, in collaboration with the Nanoscience and Innovation for Materials, Biomedicine and Energy Laboratory (NIMBE) of CEA Saclay. It involves researchers with different areas of expertise. The selected candidate will have to integrate into this consortium and interact with all its members. In return, they will benefit from strongly multidisciplinary supervision: physics, chemistry, and mechanics of structures and materials, as well as numerical physics and mechanics. The internship could be followed by a PhD on a related topic.

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