# Dynamics of Materials at extreme pressures and temperatures by Infrared/THz spectroscopy

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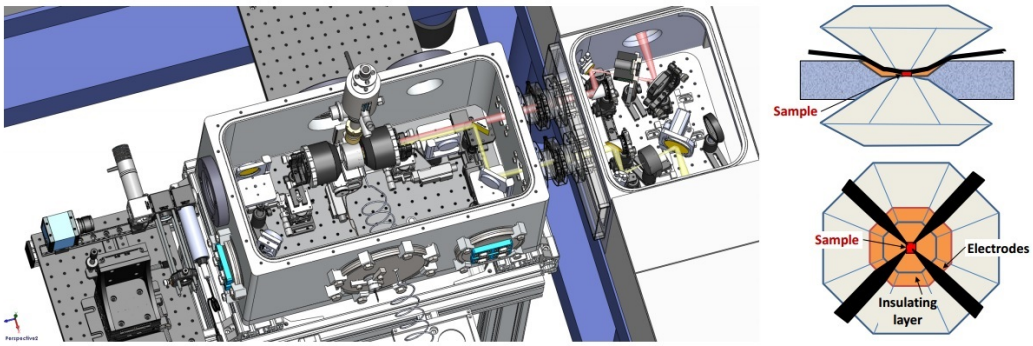
Spectroscopic probes are among the most important techniques for characterizing new physical states induced by changes of temperature and/or pressure. In link with its high brightness, synchrotron infrared radiation is ideally suited for such studies. The AILES beamline on the SOLEIL Synchrotron Light Source is an integrated facility for infrared/THz spectroscopy allowing to measure transmission or reflectivity from ambient to multi-megabar pressures and sub-Kelvin temperatures [1]. Materials analyzed include both inorganic and organic systems, where pressure effects on vibrational, electronic and magnetic excitations have been investigated. These investigations complement x-ray studies, Raman and transport measurements carried out on the same materials. An overview of recent examples will be presented:

- Ionic liquids which reveal new states as the pressure/ temperature is varied such as liquid, glassy, amorphous, crystalline.
- High-pressure studies of hybrid materials, with new structural phases and order-disorder processes of the organic molecules in an inorganic framework.
- Pressure induced superconducting materials, for which the low-frequency dynamics of record high temperature $H_3S$ compounds reveals the mechanism responsible for the superconducting transition. [2]




Schematic view of the high pressure Low Temperature set-up allowing for measurements of the transmission or reflectivity reflectivity (left) and diamond anvil cell showing the diamond anvils, the gasket, the sample and the electrodes

## References

[1] A. Voute et al., Vib. Spectrosc. **86**, 17-23 (2016)

[2] F. Capitani et al., Nat. Phys. **13**, 859-863 (2017).