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# Magnetic Imaging at High Pressure inside Diamond Anvil Cells using Ensembles of Nitrogen-Vacancy Centers

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The diamond anvil cell (DAC) is the tool that allows scientists to create pressures comparable to those existing in the Earth core, above the megabar. These conditions lead to new states of matter with specific magnetic and superconducting properties. However, the minute size of the sample and the constraints associated to the DAC make the implementation of magnetic diagnostics highly challenging. We will report the realization of an optical magnetometry technique that can detect the sample magnetic behavior through the diamond anvil, based on Nitrogen-Vacancy (NV) centers located at the surface of the anvil.
The NV center has a spin-dependent photoluminescence. By combining a microwave excitation and an optical excitation/readout, we can reconstruct the full vector magnetic field inside the diamond anvil cell at pressures as high as 60 GPa so far. Furthermore, the relatively simplicity of the setup enables its transportation and use on a synchrotron beamline
As a proof-of-principle, we detected the α-ε phase transition of iron with pressure through the monitoring of its magnetization, while simultaneously following the crystalline phase transition via X-ray diffraction. We will also report experiments performed on MgB2 that demonstrate the detection of a superconducting state through the observation of the Meissner effect.

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