# Unveiling the Vortex Glass Phase in the Surface and Volume of a Type-II Superconductor

**Yanina FASANO**[1]

[1] *Centro Atómico Bariloche and Instituto Balseiro, Avenida Bustillo 9500, Bariloche, Argentina*

Order-disorder transitions between glassy phases are quite common in nature and yet a detailed description of the structural changes entailed at microscopic scales remains elusive. This issue is experimentally challenging since scales are typically tiny, constituents move rapidly, and few of them, in most cases, take part in the structural transformation. Vortex matter in type-II superconductors is a playground where some of these difficulties can be tackled by conveniently choosing the host superconducting sample. $Bi_2Sr_2CaCu_2O_{8+y}$ is a paradigmatic type-II superconductor presenting a glassy-to-glassy first-order transition between the Bragg and the vortex glass phases on increasing vortex density (magnetic field). The structural properties of the quasicrystalline Bragg glass have been extensively studied, but in the case of the vortex glass phase this information has remained elusive up to now. Here we image with single-vortex resolution the structural changes occurring at this order-disorder transition and reveal large field-of-view snapshots of the vortex glass phase. By combining real-space surface magnetic decoration and reciprocal-space bulk small-angle neutron scattering imaging techniques we found that this phase presents large crystallites with a proliferation of bounded and unbounded edge dislocations at the surface. Within the crystallites, the exponentially decaying orientational order and the fast algebraic growth of the positional displacement correlator are at odds with a hexatic phase. In addittion, in the vortex glass the radial and azimuthal in-plane correlation lengths are depleted at the surface as well as at the volume of the sample. Nevertheless, no dramatic change in the correlation length along the direction of vortices is observed within our improved experimental resolution, ruling out the possibility of the vortex glass being a glassy phase with layered vortices internally decoupled along the thickness of the sample.

E-mail: Yanina.Fasano@cab.cnea.gov.ar