TITLE:

Superconductivity on the verge: nanostructures and inhomogeneity

DESCRIPTION FOR THE WEBSITE:

The recent technological developments in the synthesis and characterization of superconducting materials enhanced greatly our possibilities to test the ability of superconductivity not only to survive but even to be enhanced under extreme conditions. A typical example is the case of strongly **disordered films** of materials like NbN, InOx or TiN, where it has been clearly established that electrons remain paired both above Tc and across the superconductor-to-insulator transition. Interestingly, pseudogap features emerging out of a bad metallic state have been reported also in a second class of low-dimensional superconductors, i.e. superconducting LaAlO3-SrTiO3 **hetero-structures.** The analogies between these two classes of materials is however deeper than this. In both cases the survival of pairing occurs via the spontaneous emergence of **inhomogeneity** of the local electronic and superconducting properties, with good superconducting regions eventually coexisting at the **micro-scales** with metallic regions. What is an intrinsic tendency toward inhomogeneity in disordered films and heterostructures can be nowadays created and tested artificially in the labs by means of **superconducting nanostructures,** ranging from single nano-grains of Sn to arrays of Nb islands on a metallic substrate to the disordered/ordered array of Sn grains on a graphene substrate, tunable by field effect.

The open questions raised by the experimental and theoretical progresses made in the last 5 years in all these fields are often very similar: Is the survival of SC properties at strong disorder or low carriers a signature of localization of bosonic pairs? What are the relevant fluctuations above the ground state able to support the coexistence of local pairing and low critical temperature? What controls the typical length scales over which local and global superconductivity is established?

However, despite these analogies, the scientific communities involved in these apparently different classes of material remain substantially separated. The main goal of this workshop is instead to bring together some leading scientists working in the fields of strongly disordered superconductors, hetero-structures and artificial nanostructures with the twofold aim to establish the analogies and differences between these areas and to promote a cross-fertilization of ideas that can bring new perspectives on the research agenda for the future.