The Galileo Galilei Institute for Theoretical Physics
Arcetri, Florence

Defects and Extended Excitations in Quantum Field Theory, Quantum Matter and Statistical Models

May 18, 2026 - Jun 19, 2026

All known quantum and statistical systems support defects and extended excitations, which are both described by extended operators in quantum field theory. Examples are Wilson loops and their higher-dimensional generalizations. Extended excitations are instrumental in characterizing the phases and dynamics of physical systems: for example, Wilson lines in the confinement-deconfinement transition, and boundaries/interfaces in topological phases of matter. They also implement generalized symmetries, whose recent paradigm-shifting discovery has already found many applications, ranging from condensed matter systems to statistical models and four-dimensional gauge theories.

Defects are physically interesting observables in many contexts. For instance, defects describe boundaries and impurities in materials at criticality (modeled by Wilson and 't Hooft lines of heavy probe particles). Furthermore, many information-theoretic quantities map directly to defect observables, such as in the calculation of entanglement entropy and in the description of measurement protocols.

The growing interest in defects and extended excitations, their generalized symmetries, inner dynamics, and diverse applications is evidenced by a large number of recent works. Several research groups, in high-energy, condensed matter, and statistical physics, each employing distinct methods and terminologies, share common interests in these topics. The goal of this GGI activity is to bring together theoretical physicists working on extended operators in different domains, to foster cross-disciplinary collaborations..

Topics:

- Generalized symmetries and higher categorical structures
- Defect dynamics
- Phases of gauge theories
- Defects on the lattice and exact results
- Defects and quantum information

Organizing Committee:
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Deadline for applications: Sep 30, 2025