TITLE: Non-equilibrium Quantum Field Theory

CFU 2 – 14 hours

Teaching staff

Name Surname: Giuliano Chiriacò

Email: giuliano.chiriaco@dfa.unict.it

Office: 216

Reception hours: Mon 10-12, Wed 17-19

Program of the course: Review of Green's functions. Differences with equilibrium Green's functions, Keldysh contour. Advanced, retarded, Keldysh components of the Green's function.

Keldysh action formulation and path integral formalism. Kinetic equation formulation. Equivalence of the two approaches.

Perturbation theory in the Keldysh formalism. Feynman diagrams, self-energy, Dyson equation. Application to case studies (electron-phonon interaction). Quantum kinetic equation, recovery of the Boltzmann kinetic equation.

Optional topics (depending on timeframe). Application of Keldysh Green's functions: non-equilibrium

superconductors, disordered conductors. Gauged quantum kinetic equation, simple cases. Derivation of the Caldeira-Leggett equation. Keldysh formulation of the Lindblad equation.

Bibliography:

H. Haug, A-P. Jauho, Quantum kinetics in transport and optics in semiconductors, Springer (2008).

J. Rammer, Quantum Field Theory of Non-equilibrium States, Cambridge University Press (2007).

A. Kamenev, Field Theory of Non-Equilibrium Systems, Cambridge University Press, 2nd edition (2023).