Contribution ID: **79** Type: **not specified**

Exploring the landscape of large-N fermionic theories

Tuesday 24 September 2024 14:30 (1h 40m)

Theories of self-interacting fermions play an important role in particle and condensed matter physics, covering effective descriptions of the strong nuclear force, the critical behaviour of Dirac materials such as graphene, and more. In this talk, I discuss functional RG flows for fermionic systems in the large-N limit. Working directly in terms of fermionic field variables and using a Fierz-complete basis of bilinears, I provide conditions under which fermionic flows become exact, and exactly solvable, and provide the most general form of their quantum effective actions. I exemplify the method for fermionic theories with scalar, pseudo-scalar, vector, axial-vector, and derivative interactions in various dimensions. Results include phenomena such as chiral symmetry breaking and dynamical generation of fermion mass, interacting fixed points, universal scaling dimensions of operators, conformal manifolds with exactly marginal interactions, the spontaneous breaking of scale symmetry, and the appearance of a massless dilaton. Exact dualities with bosonised versions of theories are also discussed.

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Session Classification: Poster Session