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Excitonic and marginal Fermi liquid instabilities in 2D and 3D Dirac semimetals JOSE GONZALEZ, Instituto de Estructura de la Materia (CSIC), Madrid, Spain — We study the quantum electrodynamics of 2D and 3D Dirac semimetals by means of a self-consistent resolution of the Schwinger-Dyson equations, aiming to obtain the respective phase diagrams in terms of the relative strength of the Coulomb interaction and the number N of Dirac fermions. In this framework, 2D Dirac semimetals have just a strong-coupling instability characterized by exciton condensation (and dynamical generation of mass) that we find at a critical coupling well above the estimates made with RPA screening (large-N approximation), thus explaining the absence of that instability in free-standing graphene samples. On the other hand, we show that 3D Dirac semimetals have a richer phase diagram, with a strong-coupling instability leading to dynamical mass generation up to N = 4 and a line of critical points for larger values of N characterized by the vanishing of the electron quasiparticle weight in the low-energy limit. Such a marginal Fermi liquid boundary marks the transition to a kind of strange metal that can still be defined in terms of electron quasiparticles, but with parameters that have large imaginary parts implying an increasing deviation at strong coupling from the conventional Fermi liquid picture.

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