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Theory of two-stream plasma instabilities in graphene[1] BEN YU-KUANG HU, The University of Akron, ANTTI-PEKKA JAUHO, Helsinki University of Technology and Technical University of Denmark — We theoretically investigate the possibility of the occurrence of unstable plasma collective modes in graphene (a single layer of carbon atoms in a honeycomb lattice) into which two counter-streaming beams of carriers are injected. The stability of two counter-streaming distributions of carriers is studied by investigating the frequency-dependent dielectric function $\epsilon(\mathbf{q}, \omega)$ of the system. We find that the almost perfectly linear electronic dispersion of graphene at the energies in which the beams of carriers are likely to be injected results in instabilities that are qualitatively different from the standard two-stream instabilities for classical plasmas and parabolic-band systems. Specifically, unstable collective modes occur only if the angle that the wavevectors make with respect to the direction of propagation of the counter-streaming carrier beams is larger than a certain critical angle.

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