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Electrically Controlled Coherent Excitonic Steady States in Semiconductor Bilayers MING XIE, ALLAN MACDONALD, Department of Physics, University of Texas at Austin — Spatially indirect excitons are long lived bosonic quasiparticles that can form quasi-equilibrium condensed states. Optical access to these excitons has been limited by their small optical matrix elements. Here we propose a promising electrical process that can be used both to populate and to probe fluids of indirect excitons, and is analogous to the crossed Andreev reflection (CAR) process of Cooper pairs in superconductors. We consider vertically stacked multilayer heterostructures containing two transition metal dichalcogenide (TMD) layers that host the indirect excitons, graphene layers on the top and the bottom of the heterostructure, and hBN tunnel barrier layers of variable thickness. When the bias voltage between the graphene leads is smaller than the indirect gap, tunneling between the graphene leads and the TMD hetero-bilayer is possible only through the CAR process. Both DC and low frequency AC bias cases are explored and establish that electrical measurements can be used to determine crucial properties such as the condensate density, interaction strength and CAR tunneling amplitudes. We have also proposed a way to electrically manipulate another type of bosonic quasiparticles, cavity exciton-polaritons, in a laterally contacted structure.

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