Excitonic condensation in systems of strongly correlated electrons

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The ordered electronic phases are typically characterized by modulations of spin or charge density on inter-atomic scale, although exceptions like superconductivity are well known. Excitonic condensation is a specific type of 'unconventional' instability which leads to spin-multipole or spin-current order. We have used the dynamical mean-field theory to investigate possible long-range order in systems close to a spin-state transition. We will report the results of several types of studies: i) unbiased search for divergences of the particle-hole susceptibility in the two-band Hubbard model, ii) direct simulation of the ordered phases of the same model and iii) static-mean field (LDA+U) calculations for real materials. The main result is an observation of condensation for spinful excitons both in the model [1] and materials [2]. The excitonic phase is characterized by spontaneous appearance of hybridization between atomic states with different spin quantum numbers, i.e., breaking the spin rotational symmetry. We will summarize our numerical data and discuss the concept of the spin-triplet excitonic condensation.

[1] J. Kunes and P. Augustinsky, Phys. Rev. B 89 (2014) 115134

[2] J. Kunes and P. Augustinsky, arXiv:1405.1191