# Common behaviors of unconventional superconductors indicating non-BCS condensation and spin-mediated resonant pairing

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In unconventional suprconductors, including high-Tc cuprates, FeAs, organic BEDT, A3C60 and heavy-fermion CeCoIn5 systems, we notice a few common behaviors which point towards novel condensation and pairing mechanisms. They include: (1) superconducting phase emerging adjacent to the competing antiferromagnetic / SDW states; (2) scaling of resonance-mode energy with Tc analogous to rotons in superfluid He; (3) scaling of the spin fluctuation energy scale with Tc; (4) scaling of the superfluid density with Tc in the underdoped region; (5) scaling of the superfluid density with Tc in the overdoped / pressurized region; (6) scaling of the specific heat jump C/T at Tc with Tc in the overdoped / pressurized region.

Together with accumulated results, we show our new data on (Sr,Ca)2RuO4 for (1) and CeCo(In,Sn)5 and Ba(Fe,Co)2As2 for (5).

While (3) is expected for a BCS-like condensation, (2), (4), (5) and (6) point towards Bose-Einstein condensation where Tc is governed by the condensing boson density and mass. In particular, we notice that the spin fluctuation (mediating boson) energy scale is comparable to condensing charge energy scale (derived from superfluid density) in many of these systems, suggesting a resonant behavior in condensation and pairing. This may be a key concept to understand highly unusual non-BCS like behaviors (5) and (6) in the overdoped / pressurized regions of these unconventional superconductors. Scaling of Tc on the soft-mode energy (2), in addition to superfluid density (4) and (5), may be understood by BE condensation and BE-BCS crossover in the vicinity of magnetic competing states (1).