Abstract Submitted
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Superfluidity Without Boson Condensation A.M. KADIN, Princeton Junction, NJ — Superfluidity is generally attributed to condensation of boson wavefunctions. He-4 atoms have zero net spin in the nucleus and in the electrons, and so are bosons, while He-3 atoms have a nuclear spin of $1/2$, and are fermions. This fits the conventional understanding that the superfluid transition of He-4 at 2.2 K is due to boson condensation, while the lack of such a transition in He-3 is due to the absence of bosons until atomic pairing into boson-like Cooper pairs occurs in the mK range. However, Kadin [1] has extended a novel non-boson superconducting condensation mechanism to superfluids. This is based on an interleaved two-phase structure of close-packed electron orbitals (analogous to an ionic liquid), whereby each orbital is surrounded by multiple anti-phase orbitals, with nodes between them to maintain orthogonality. This entire structure moves together as a superfluid, preserving long-range phase coherence. The lack of superfluidity in He-3 is attributable *not* to these atoms being fermions, but rather to the presence of unpaired nuclear spins that destroy the phase coherence due to spin-flip scattering. This is consistent with the behavior of mixtures of He-3 and He-4. Only at mK temperatures, when the nuclear spins order and spin-flip scattering is suppressed, is superfluidity again possible. A similar picture may also be extended to "Bose-Einstein condensates" in dilute concentrations of alkali metal atoms, but *only* if one assumes the presence of close-packed atomic clusters or droplets, rather than a dilute gas. [1] A.M. Kadin, http://arxiv.org/abs/0909.2901 (2009); http://arxiv.org/abs/1107.5794 (2011).

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