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Exotic p-wave superfluidity of single hyperfine state Fermi gases in optical lattices[1] MENDERES ISKIN, School of Physics, Georgia Institute of Technology, CARLOS SA DE MELO, School of Physics, Georgia Institute of Technology — We consider p-wave pairing of single hyperfine state ultracold atomic gases trapped in quasi-two-dimensional optical lattices. We discuss superfluid p-wave (triplet) states that break time reversal, spin and orbital symmetries, but preserve total spin-orbit symmetry. We calculate the atomic compressibility, and spin susceptibility as a function of band filling for tetragonal (e.g., trapping potentials with same field intensity and same wavelengths) and orthorhombic (e.g., trapping potentials with same field intensities but different wavelenths) optical lattices. In the case of tetragonal lattices, we show that the atomic compressibility (or spin susceptibility) has a peak at low temperatures exactly at a half-filling, but this peak splits into two as the wavelength of the optical lattice is changed in one direction. These peaks reflect the p-wave structure of the order parameter for superfluidity and they disappear as the critical temperature is approached from below. We also calculate the superfluid density tensor, and show that for the orthorhombic case there is no off-diagonal component, however in the tetragonal case an off- diagonal component develops below the superfluid critical temperature, and becomes a key-signature of the exotic p-wave state.

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