spots. Instead, the variation of $\mathbf{q}_{CDW}$ with doping suggests that the CDWs connect the ends of two adjacent Fermi arcs [15].

D. Pair Density Wave

Another prediction of the SU(2) model is the existence of a pair density wave (PDW) with the *same* repeat distance as the CDW. This feature has recently been detected by Josephson tunneling using an STM [17]. Since both SC & SDW share similar *d*-wave symmetry, the PDW due to their mutual interaction is expected to show close to *s* symmetry, as indeed is the case [17].

IV. COMMENTS AND QUESTIONS

All observations of CDWs show short range order in at least one of the basal plane directions. It is perhaps surprising that this can give rise to such well-defined quantum oscillation signals from the small Fermi surfaces that are believed to be associated with biaxial CDW order. The picture in Fig 4 is not reproduced by ARPES in underdoped materials; ARPES shows merely a Fermi arc, without others joining it to make a square electron-like surface. Necessarily, ARPES is a zero magnetic field measurement, whereas QO data is taken in high field, but CDWs are seen by other techniques in zero field. This remains a puzzle.

Other phenomena have been reported to occur in the pseudogap region [18, 19]. If the SU(2) picture is the fundamental cause of the pseudogap, then (for instance) Kerr rotation [18] may be a spectator effect. There are indications of intra-unit cell loop currents [19], a zero-**q** order which has not been confirmed by NMR [9] and muon spin rotation [20] measurements, but they seem not to be universal [21].

The SU(2) picture given here does not appear to make direct contact with the rather different "stripes" seen in underdoped La-Ba & La-Sr cuprates. These stripes have elements of both CDW and AFM order. If the SU(2) theory is to succeed as a universal model for the basic physics of cuprates, this contact needs to be made. There are advocates of stripes who would claim that they represent the basic physics of all cuprates, but they also struggle to make good contact with the qualitatively different behaviour of CDW's in the other cuprates.

It is now 31 years since the discovery of High-T_c cuprates, and although applications are finally becoming more widespread, one feels that we should soon come to a full understanding of their basic physics also. The SU(2) model is a strong contender and is continuing to develop. Refs. [2, 3] also propose how exciton-like structures may account for the "strange metal" behaviour above the SC T_c at optimal doping. Other developments of the theory may account for the Raman response associated with the superconducting state and the "resonance" seen with neutron scattering [22] and further recent applications of the theory are on the arXiv [23-25].

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