Circular polarized light for the photoemission branch at Beamline 12

Who wants it?

U. Of Colorado — Dessau
Stanford U. — Shen
UC Berkeley — Lanzara
Proposal for an experiment to test a theory of high-temperature superconductors

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A theory for the phenomena observed in copper-oxide-based high-temperature superconducting materials derives an elusive time-reversal and rotational symmetry-breaking order parameter for the observed pseudogap phase ending at a quantum-critical point near the composition for the highest $T_c$. An experiment is proposed to observe such a symmetry breaking. It is shown that angle-resolved photoemission yields a current density which is different for left and right circularly polarized photons. The magnitude of the effect and its momentum dependence is estimated. Barring the presence of domains of the predicted phase, an asymmetry of about 0.1 is predicted at low temperatures in moderately overdoped samples.
Argonne group says YES!

Spontaneous breaking of time-reversal symmetry in the pseudogap state of a high-$T_c$ superconductor

A change in ‘symmetry’ is often observed when matter undergoes a phase transition—the symmetry is said to be spontaneously broken. The transition made by underdoped high-transition-temperature (high-$T_c$) superconductors is unusual, in that it is not a mean-field transition as seen in other superconductors. Rather, there is a region in the phase diagram above the superconducting transition temperature $T_c$ (where phase coherence and superconductivity begin) but below a characteristic temperature $T^*$ where a ‘pseudogap’ appears in the spectrum of electronic excitations$^{12}$. It is therefore important to establish if

Device which made this study possible:
Quadruple reflection circular polarizer
If this wave were approaching an observer, its electric vector would appear to be rotating clockwise. This is called right-circular polarization.

The reflection coefficients are different for waves parallel and perpendicular to the plane of incidence.

When light is incident at the Brewster angle, the reflected light is linearly polarized because the reflection coefficient for the H component is zero.
FIG. 1. (a) Schematic of the QR layout. (b) Schematic of the 45°-PM layout. (c) and (d) QR orientation for LCP and RCP.

FIG. 4. Intensity measurements with the 45° PM for different angles of rotation $\alpha$ of the QR. The angle of incidence was $\theta=78^\circ$ and the photon energy was $h\nu=25$ eV.

FIG. 7. (a) Top view of the mechanical layout of the quadruple reflector housing mechanism. (b) Side view of the polarizer.
NSLS has bought and commissioned one for U5 / spin-polarized ARPES /
It
Thanks to Bruce, Glenn and John: we got it straightened up.
If it is indeed true, it can be important. Maybe there are circulating currents of some sort that lead to a very tiny magnetic moment and violate time reversal symmetry. I can see at least Varma and Laughlin saying "I am right" (for different reasons). How can you detect it through PES? I suppose you look for some signature in polarization.

Hi there,
Are you going to attempt the Campuzano expt? We may also do that. However I am not sure that I believe it.
Peter