Abstract Submitted
for the DAMOP10 Meeting of
The American Physical Society

Strongly interacting two-dimensional Dirac fermions LIH-KING LIM, ACHILLEAS LAZARIDES, Institute for Theoretical Physics, Utrecht University, ANDREAS HEMMERICH, Institut für Laserphysik, Universitat Hamburg, C. MORAIS SMITH, Institute for Theoretical Physics, Utrecht University — We show how strongly interacting two-dimensional Dirac fermions can be realized with ultracold atoms in a two-dimensional optical square lattice with an experimentally realistic, inherent gauge field, which breaks time-reversal and inversion symmetries [1]. We find remarkable phenomena in a temperature range around a tenth of the Fermi-temperature, accessible with present experimental techniques: at zero chemical potential, besides a conventional *s*-wave superconducting phase, unconventional superconductivity with non-local bond pairing arises. In a temperature versus doping phase diagram, the unconventional superconducting phase exhibits a dome structure, reminiscent of the phase diagram for high-temperature superconductors and heavy fermions [2].

[1] Lih-King Lim, C. Morais Smith, and Andreas Hemmerich, PRL 100, 130402 (2008).
[2] Lih-King Lim, Achilleas Lazarides, Andreas Hemmerich, and C. Morais Smith, EPL 88, 36001 (2009).

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Date submitted: 28 Jan 2010 Electronic form version 1.4