

**MUTUAL ENHANCEMENT OF MAGNETISM AND  
FULDE-FERRELL-LARKIN-OVCHINNIKOV  
SUPERCONDUCTIVITY IN  $\text{CeCoIn}_5$**

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It was predicted in the middle of the 1960s that unusual superconducting state with non-vanishing momentum of the Cooper pairs may occur at low temperatures and in strong magnetic fields [1,2]. Despite the straightforward nature of the theoretical prediction, actual observations of this state have turned out to be extremely difficult. Unambiguous experimental evidence for its formation has been reported only very recently from specific heat and magnetization measurements on  $\text{CeCoIn}_5$  [3]. Moreover, recent experiments on  $\text{CeCoIn}_5$  suggest an unusual interplay between superconducting and magnetic orders that gives rise to a multicomponent (magnetosuperconducting) phase [4]. We demonstrate that characteristics of  $\text{CeCoIn}_5$  make this system particularly well suited for the onset of such a phase. Based on general considerations, we show that superconductivity with nonzero Cooper-pair momentum may lead to an enhancement of the spin-spin response function and, simultaneously, incommensurate spin-density wave may enhance the Cooper-pair susceptibility [5].

[1] P. Fulde and R. A. Ferrell, *Phys. Rev.* **135**, A550 (1964).

[2] A. I. Larkin and Yu. N. Ovchinnikov, *Zh. Eksp. Teor. Fiz.* **47**, 1136 (1964) [*Sov. Phys. JETP* **20**, 762 (1965)].

[3] H. A. Radovan, N. A. Fortune, T. P. Murphy, S. T. Hannahs, E. C. Palm, S. W. Tozer, and D. Hall, *Nature (London)* **425**, 51 (2003).

[4] M. Kenzelmann, T. Strässle, C. Niedermayer, M. Sigrist, B. Padmanabhan, M. Zolliker, A. D. Bianchi, R. Movshovich, E. D. Bauer, J. L. Sarrao, and J. D. Thompson, *Science* **321**, 1652 (2008).

[5] M. Mierzejewski, A. Ptok, and M. M. Maška, *Phys. Rev. B* **80**, 174525 (2009).