Two-Band Superconductivity in $LaFeAsO_{0.89}F_{0.11}$ at Very High Magnetic Fields

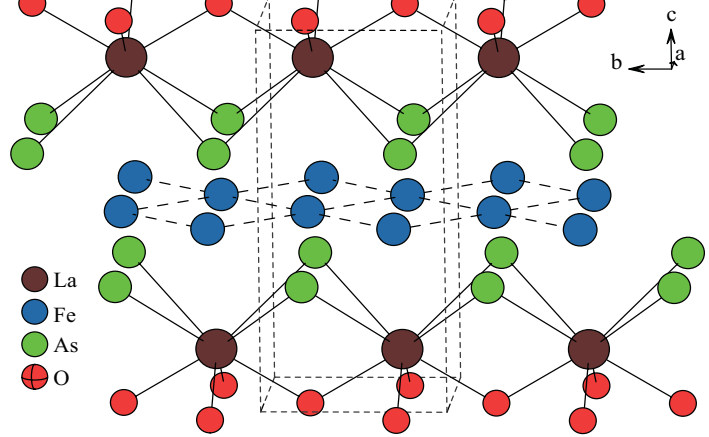
National High Magnetic Field Laboratory

Applied Superconductivity Center, Florida State University

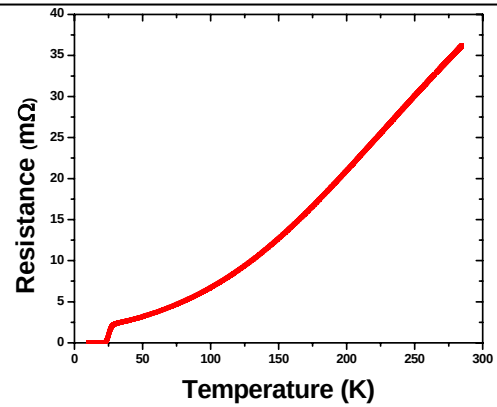
A new family of superconductors known as doped rare earth oxypnictides with transition temperatures ranging from 25K to 55K has been the subject of research worldwide since early 2008. Band structure calculations suggest an unconventional mechanism of multiband superconductivity.

Our recent experiments on LaFeAsOF showed remarkably high upper critical fields in the magnetic field-temperature phase diagram. We suggest that this variation of the upper critical field with temperature is consistent with two-band effects. The results of this research were published in the June 12 issue of *Nature*.

Hunte, F.; Jaroszynski, J.; Gurevich, A.; Larbalestier, D.C.; Jin, R.; Sefat, A.S.; McGuire, M.A.; Sales, B.C.; Christen, D.K. and Mandrus, D., ***Nature***, **453**, 903-905 (2008)



Crystal structure of LaFeAsOF



Temperature dependence of resistance
Resistance shows a Tc onset at 30 K and RRR ~ 15, with a nominal resistivity of ~150 mΩcm at Tc, suggestive of a clean-limit material.

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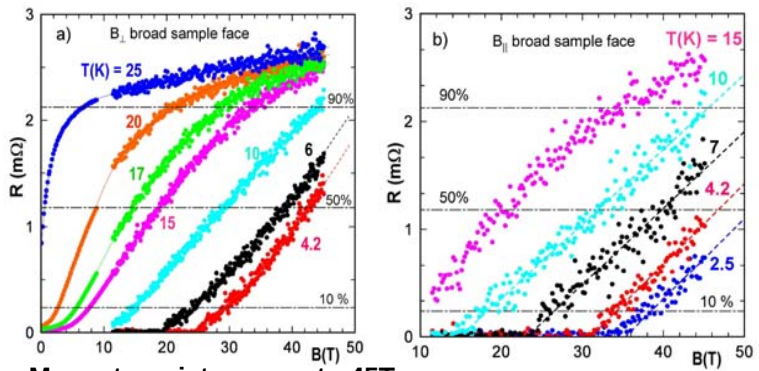
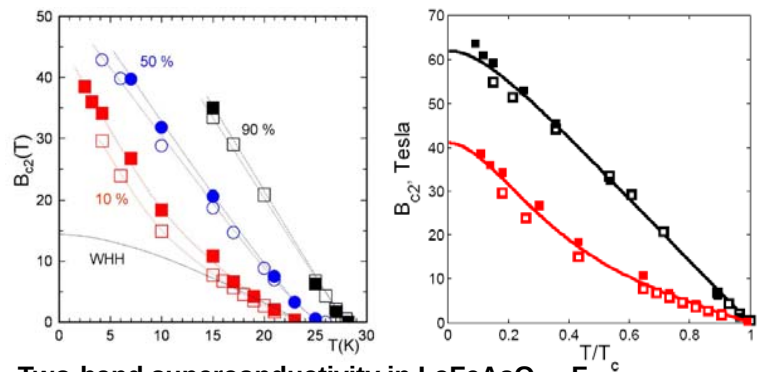


Magnetoresistance up to 45T

R(B) clearly delineates zero resistance in this polycrystal well above 35T at low temperatures. Some small texture is deduced from the angular sensitivity of the transitions.



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Full and open symbols correspond to parallel and perpendicular field orientations of the slightly textured sample. Because of the almost reversible magnetization of the sample, we associate the bottom of the transition with the lower B_{c2} and the top with the higher, which we are assume to be with B perpendicular and parallel to the planes respectively.

This research resulted from a collaboration between researchers at the NHMFL (Frank Hunte, Jan Jaroszynski, Alex Gurevich and David Larbalestier) and David Mandrus's group at Oak Ridge National Laboratory, with principal collaborators Rongying Jin and David Christen.

The principal work at the laboratory was led by postdoctoral scientist Frank Hunte, supported by the NHMFL's User Collaboration Research Program to work on the two-band superconductivity of MgB_2. Immediately, the new and very unexpected material was discovered and we were offered the possibility of samples; we worked to see if they too showed evidence of two band enhancements of H_{c2} as occurs in a few special MgB_2 samples. Indeed they did--our report of this advance was just the fourth paper published in ***Nature*** on these new materials.