Organic and iron-based superconductors: can you have the best of both worlds?

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In this talk I will review some of my group's work on organic and iron-based superconductors and look at the issue of trying to incorporate organic groups within iron-based compounds. One recent example of this is the development of intercalated compounds based on FeSe. Superconductivity is found in FeSe, which contains neutral layers similar in structure to those found in the iron arsenides but without the spacer layer. We demonstrated the synthesis [1] of $Li_x(NH_2)_y(NH_3)_{1-y}Fe_2Se_2$ ($x \sim 0.6$; $y \sim 0.2$), with lithium ions, lithium amide and ammonia acting as the spacer layer, which exhibits superconductivity at 43(1) K, higher than in any FeSe-derived compound reported so far and four times higher at ambient pressure than the transition temperature, T_c, of the parent $Fe_{1.01}Se$. This new synthetic route opens up the possibility of further exploitation of related molecular intercalations in this and other systems in order to greatly optimize the superconducting properties in this family.

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[1] M. Burrard-Lucas, D. G. Free, S. J. Sedlmaier, J. D. Wright, S. J. Cassidy, Y. Hara, A. J. Corkett, T. Lancaster, P. J. Baker, S. J. Blundell and S. J. Clarke, Nature Materials **12**, 15 (2013).