Non-BCS superconductivity in fulleride superconductors

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$C_{60}$-based solids are archetypal examples of molecular superconductors with $T_c$ as high as 33 K. $T_c$ of the face-centered cubic (fcc) $A_3C_{60}$ ($A =$ alkali metal) fullerides increases monotonically with the inter$C_{60}$ separation, which is in turn controlled by the sizes of the $A^+$ cations – this physical picture has remained unaltered since 1992. Pressure-induced trace superconductivity ($s/c$ fraction $<<1\%$) at $\sim 40 K$ was reported in 1995 in multiphase samples in the $Cs_xC_{60}$ phase field. Despite numerous attempts by many groups worldwide, this remained unverified and the structure and composition of the material responsible for superconductivity unidentified. This has hindered any attempt to push $T_c$ even higher and make contact with theory which predicts correlation-enhanced superconductivity for expanded fullerides near the metal-insulator transition. Here I will present our recent work in this field that led to the discovery of pressure-induced bulk superconductivity emerging out of a parent antiferromagnetic insulating state at the highest $T_c$ currently known for any molecular material [1,2].