Contribution ID: **156** Type: **Talk**

µSR investigation of the interplay between magnetim and superconductivity: from cuprates to oxypnictides

Friday, 16 September 2011 09:55 (25 minutes)

Here we present an extensive µSR study of the microscopic behaviour of the two prototypes of the cuprate and pnictide families, namely YBa2Cu3O6+x and REFeAsO1-xFx (RE=La, Sm, Ce). We compare the effect of carrier doping, magnetic dilution, disorder and pressure on the electronic properties of both compounds mainly at the magnetic (M) to superconducting (SC) crossover.
The studies on cuprates show a 3D phase diagrams, as a function of carrier doping and disorder, indicating the presence of a quantum critical point around which a thermally activated antiferromagnetic phase competes with SC. Here disorder suppresses both the competing order parameters and the quantum critical point, unveiling an underlying frozen magnetic state which may coexist with SC. This frozen state, which is related to the Mott- insulator character, is obviously absent in oxypnictide. In the REFeAsO family it is found that SC and static magnetism strongly compete and hardly coexist simultaneously, apart for RE=Sm and Ce within a small doping range where both order parameters are depressed. In case of coexistence both cuprates and pnictides display a short range magnetic order, related to magnetic clusters nanoscopically mixed with SC regions.
A combination of recent µSR and NQR experiments on SmFe1-xRuxAsO0.85F0.15 show that superconductivity and magnetism are tightly related to two distinct well defined local electronic environments of the FeAs layers, which can be finely tuned by isoelectronic and diamagnetic Ru substitution. Indirect evidence is given that superconductivity is assisted by Fe magnetic fluctuations, which are at least partially frozen when static order appears and are absent above the Fe/Ru spin dilution threshold.

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Session Classification: Multiple Order Parameter Systems

Track Classification: Multiple Order Parameter Systems