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Pressure effects in cuprate and iron-based superconductors studied by muon spin rotation[1]

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Pressure effect (PE) studies of physical parameters of solid state systems allow one to investigate the properties of a material as a function of tuned inter-atomic distances. Such studies are performed on the same material with well defined composition and microstructure which is often advantageous, since *e.g.* chemical tuning of material properties (chemical pressure) may give rise to a number of misleading experimental artefacts. Muon-spin rotation (μSR) is a powerful and highly sensitive tool for probing static and dynamic magnetic fields in solids on the atomic scale. In type-II superconductors the nanoscale variation of the local magnetic field in the vortex state can be detected by μSR from which the magnetic penetration depth (superfliud density) can be extracted. Furthermore, μSR is a unique microscopic technique to explore magnetic ordering phenomena and various magnetic phases in solids. At the Paul Scherrer Institute (PSI) a high-pressure set-up was realized which allows to perform μSR experiments at hydrostatic pressures up to 25 kbar and low temperatures ($\simeq 0.3$ K) [1]. Such experiments open a wide spectrum of new possibilities for investigating the superconducting and magnetic properties of novel materials, such as high-temperature superconductors and related magnetic materials. Here, we present some representative examples of such μSR pressure studies carried out at PSI: Iron-based superconductors turned out to exhibit a rich and complex phase diagram which strongly depends on pressure [2,3]. μSR pressure experiments have significantly contributed to a better understanding of these novel class of superconductors [1,2]. In a further μSR study the PE on the magnetic penetration depth in cuprate superconductors was investigated and found to exhibit an interesting relation to the observed isotope effect [4]. Very recently, we also investigated the PE on the magnetic penetration depth in the heavy fermion system $CeCoIn_5$, revealing a strong increase of the superfluid density with pressure [5].

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