Enhancement of Superconductivity through γ-Irradiation

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The ability to probe disorder in superconductors is a valuable asset in determining the nature of the superconductivity, namely the order parameter. Disorder is typically difficult to induce without introducing unwanted, extrinsic variables. A very powerful (high activity) γ-ray source at the University of Maryland, College Park was used to determine the viability of γ-irradiation as a source of non-magnetic impurities and, hence, a source of crystal disorder. Three different superconducting materials ($CeCoIn_5$, YPtBi, $Ba_{0.6}K_{0.4}Fe_2As_2$) were irradiated and their electrical transport properties were measured before and after the irradiation.

Rather than destroying the superconducting state, γ-irradiation enhanced the superconducting transition of many materials. Annealing due to ionization and electron scattering in absence of macroscopic thermal heating is promising for improving the quality of transitions in heat sensitive superconductors via local heating. This contrasts sharply with the intuitive idea that γ-irradiation causes disorder, and confirms that for doses up to about 60 MRad we see no pair breaking.