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The Light Side and the Dark Side of Irradiation

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***Abstract*—Particle beam irradiation of high temperature superconductors has long been studied as a means of controllably introducing well-defined pinning defects into a pre-existing highly complex microstructure [1] and references therein] for fundamental studies [2] if not commercial wire production [3]. Now, with the advent of compact fusion devices (and to a lesser extent other prominent applications in space or aviation), the less beneficial aspects of sustained long-term radiation damage to the HTS (and other) materials are coming to the fore [4]. This has been accompanied by a paradigm shift in the operating regime of intended application of HTS devices to the low temperature (10–20 K), high field (15–20 T) end, necessitating a growing understanding of the nature of effective – and ineffective – flux pins in this regime [5].**

This talk balances the two sides of this dilemma, first examining recent attempts to understand and engineer optimised pinning landscapes for targeted application regimes through systematically combined irradiation processes and treatments (Figure 1) [6] before acknowledging that the present indications are that pinning-optimised conductors may be of limited long-term benefit to operation in a radiation-harsh environment [4].

As a reactor designed from the outset to have the capacity to operate for an extended period under full-power conditions, STEP has an extensive plan to examine the impact of high-fluence irradiation on the HTS material of its conductors. That plan will be outlined [7] and some early results presented [8,9].

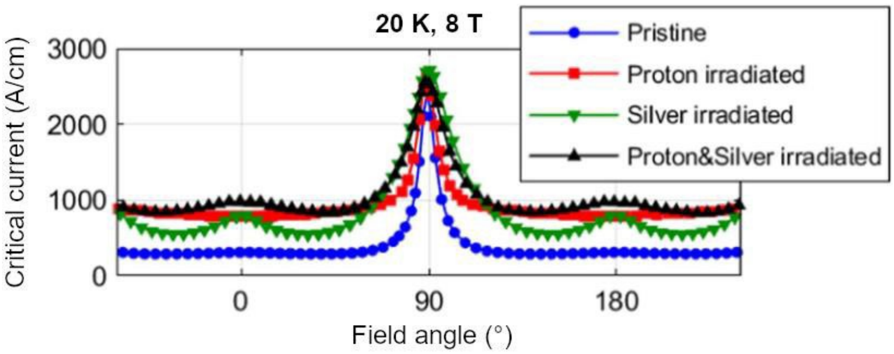

Figure 1: Angle dependence of the critical current of an AMSC wire as received and after various irradiation treatments. From [6].

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