Damage limits of superconducting magnets due to beam impact

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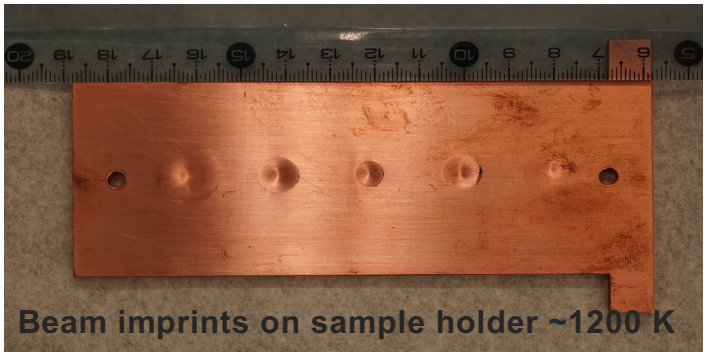
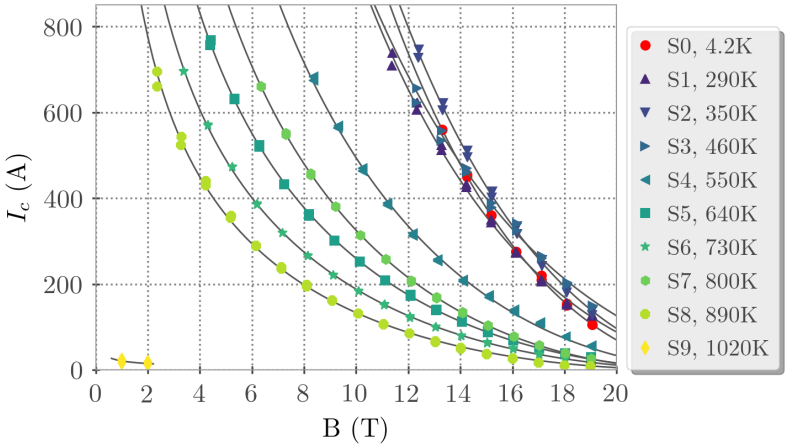
Damage limits of superconducting magnets due to instantaneous beam impact

- Increasing beam brightness and stored beam energy in HL-LHC **increase** significantly the **criticality of** fast and ultra-fast **failures**. In combination with the installation of **novel Nb_3Sn magnets** in the LHC tunnel, this raises the question of the **damage limits** of superconducting magnets **due to the impact** of high energy charged particle beams
- Damage limits of sc. **magnet components** (insulation, Nb-Ti & Nb_3Sn strands, HTS tapes) have been **successfully studied at CERN** (with and without beam, at room temperature and 4.2 K) over the past 6 years (the last 3 years in collaboration with KIT)
- Important next step for research: **verify the damage** limits derived from the previous experiments with Nb-Ti and Nb_3Sn **sample coils (incl. radiation aging)**
  - Design & build re-presentative samples / coils & age parts of the samples
  - Design & build an experimental setup for a beam experiment at 4.2 K
  - Perform experiment & analyse samples after the irradiation
  - Perform thermo-mechanical simulations of experimental setup and samples
  - Derive damage limits and mechanisms based on experimental and simulation results
- **Resources required:**
  - 1 FTE 36 months (Postdoc)
  - 1 FTE 18 months (technician)
  - Travel expenses 30 kEuro
  - Investment:
    - Cryostat instrumentation 100 kEuro
- **Collaboration partners:** KIT-LAS, KIT-IBPT, KIT-ITEP





Plot from A. Will et al. *Impact of 440~GeV Proton beams on Superconductors in a Cryogenic Environment*, Proceedings of EUCAS2019