Towards a compact 30 T all-superconducting laboratory magnet

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For over a decade now the maximum field achieved by commercial superconducting laboratory magnets has stagnated at a value of around 22 T, due to the limit imposed by the low-temperature superconducting technology (LTS). The initial enthusiasm generated by the discovery of high temperature superconductors (HTS) with critical fields of 60 T or higher quickly died down, in view of the very slow progress made in mastering the many technological challenges associated with the production of long lengths of HTS-based conductors.
This situation is now evolving rapidly, as significant progress has been achieved in the last few years in the development of Bi2223 tapes and YBCO coated conductors, which can now be produced in lengths long enough to be wound into magnet coils. The very high critical current densities and critical field of these tapes make the possibility of introducing commercial 25-30 T laboratory magnets in the not too distant future a realistic one.

A 30 T all-superconducting magnet still represents a big technological challenge and opens up a vast field for the development programs of both industries and universities. From a fundamental and an engineering point of view, there are still many aspects that need to be studied, for example:

- The intrinsic field anisotropy of HTS tapes which should be reduced or circumvented;
- The development of all-superconducting connection between LTS and HTS conductors;
- The propagation properties of normal-zone regions in the transition from superconducting-to-normal state;
- The development of efficient coil protection systems.

In this talk I will present the development program carried out at Bruker to push the magnet technology forward into the HTS era.