Preliminary conceptual study

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Conceptual design of a novel and compact superconducting recoil separator for radioactive isotopes

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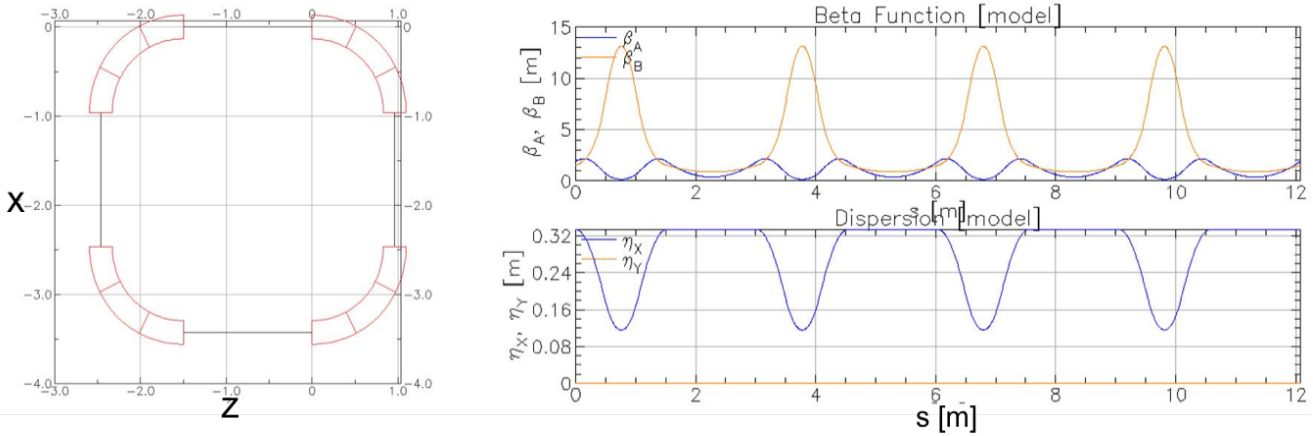
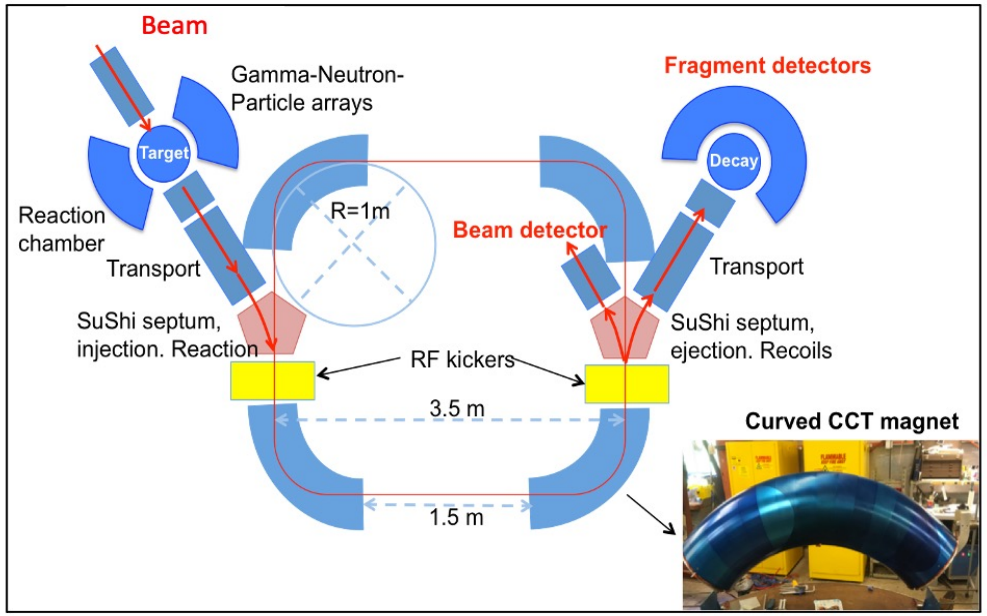


Model with ring diameter 3.5 m. Footprint of the optics, betatron functions and first order dispersion for a FDF optics configuration.



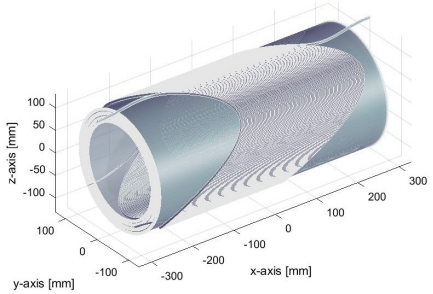
- Preliminary FFAG optics calculations provide very large solid angles > 100 msr (angular divergence ~ 18°) and momentum acceptances Δp/p > 20%. 100% storage efficiency from ^{11}Li to ^{234}Ra @ 10 MeV/u, mass resolution better than 1/2000.

- R&D recently endorsed by the International Neutron and Time of Flight Committee (CERN) -INTC66, February 2021.

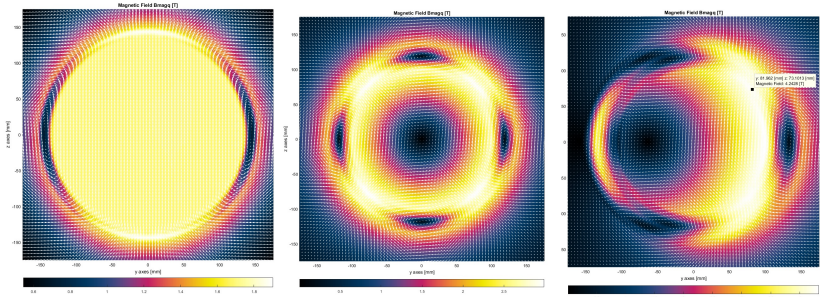
Conceptual layout of the separator. The ring consists of curved CCT magnets, straight sections, injection/extraction systems and beam diagnostics. A prototype of an assembled curved CCT magnet (Berkeley, US) is showed on the bottom right (NIM A (2020) 163414). ***Ring diameter: 3.5 m.***

Technological challenges involved

1. Beam dynamics: FFAG optimisation for ring configuration and operation.
2. Multifunction SC magnets, with **straight** and **curved configurations,** iron free option.
3. SC magnet test bench for the above configurations.
4. In-ring beam diagnostic systems.
5. Injection/extraction system based on SC magnets and RF kickers (SuShi style).
6. Multi-harmonic buncher system (MHB).
7. Re-buncher system (RBS).
8. Focal plane detectors and particle trajectory reconstruction.
9. Detailed study of the charge breeder operation (EBIS, ISOLDE case).
10. Cryocoolers vs LHe cooling.



straight coil segment


Dipole Quadrupole Combined

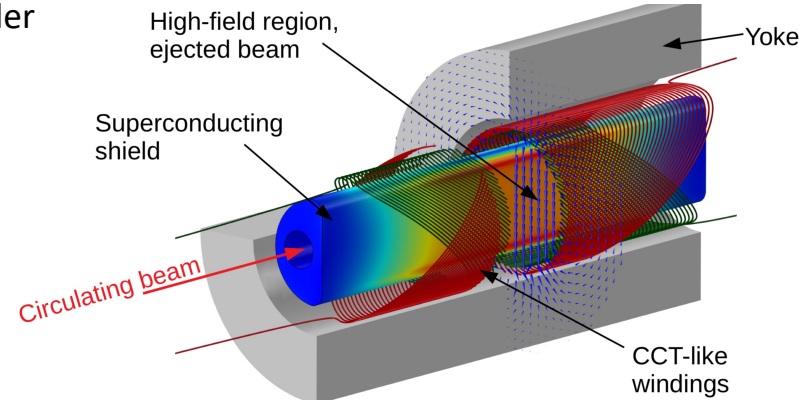
Modulated Double Helical Coils technology with layout of Canted coil Cos-Theta.
Courtesy of G. Kirby (CERN).

Synergies with other communities

Interdisciplinarity technological breakthrough with strong impact on many fields.

- Storage rings.
- Beam purification at RIB's
- Fragment separators.
- Mass spectrometry.
- High-energy colliders.
- Gantries for hadron therapy.
- Mini-accelerators for radioisotope production and hadron therapy.

SuShi: Superconducting septum magnet for the Future Circular Collider



D. Barna. Rev. Sci. Inst. 90 (2019)