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High energy muon acceleration chain – issues and questions –

F. Batsch, H. Damerau, I. Karpov

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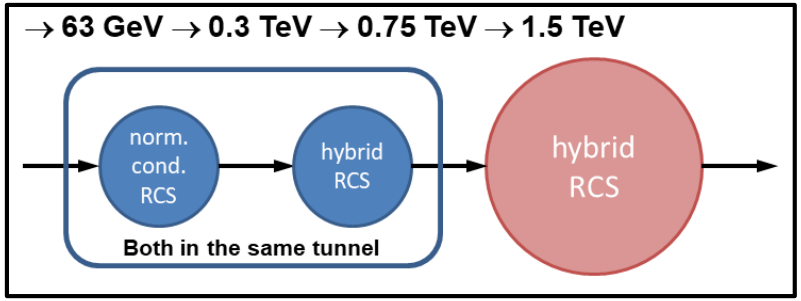
High-energy acceleration parameters

- **Input/output energy of RCS chain: 60 GeV → 1.5 TeV → 5 TeV**
- **2 or 3 acceleration stages to 1.5 TeV? + 1 stage to 5 TeV**
- **Combination of normal conducting and two hybrid RCS?**
  - **First two RCS in the same tunnel?**
  - **Major design constraints due to that choices?**
  - **Options: HTS fast ramping magnets? What is ramp rate of cycling RCS magnets?**
  - **Find transition energy between normal conducting and hybrid RCS!**
- **How to optimize intermediate energies?**
  - **Minimize losses through entire RCS chain**
- **Make educated-guess assumptions for unknown parameters, e.g., feasibility of huge ramp rates?**
  - **Shape of magnetic ramp?**
  - **Power consumption?**



Potential show-stoppers

- **Muon decay: could it exclude superconducting RF cavities?**
  → Question for WP RF!
- **Are the huge ramp rates realistic?**
  → Power converters? Expensive!
- **How strong is the induced voltage from the short-range wakefields? Possible cures?**
  → Short range wake of TESLA cavities (K. Bane et al.)
- **Challenges of first hybrid RCS being built?**

Transverse beam dynamics aspects

- **Impact of energy dependent trajectory?**
  - **Required aperture**
  - **Orbit length change due to hybrid RCS design?**
- **Cell length is very important!**
  - **Constraints on momentum compaction?**
- **Separate vacuum chambers for μ^+/ μ^-?**

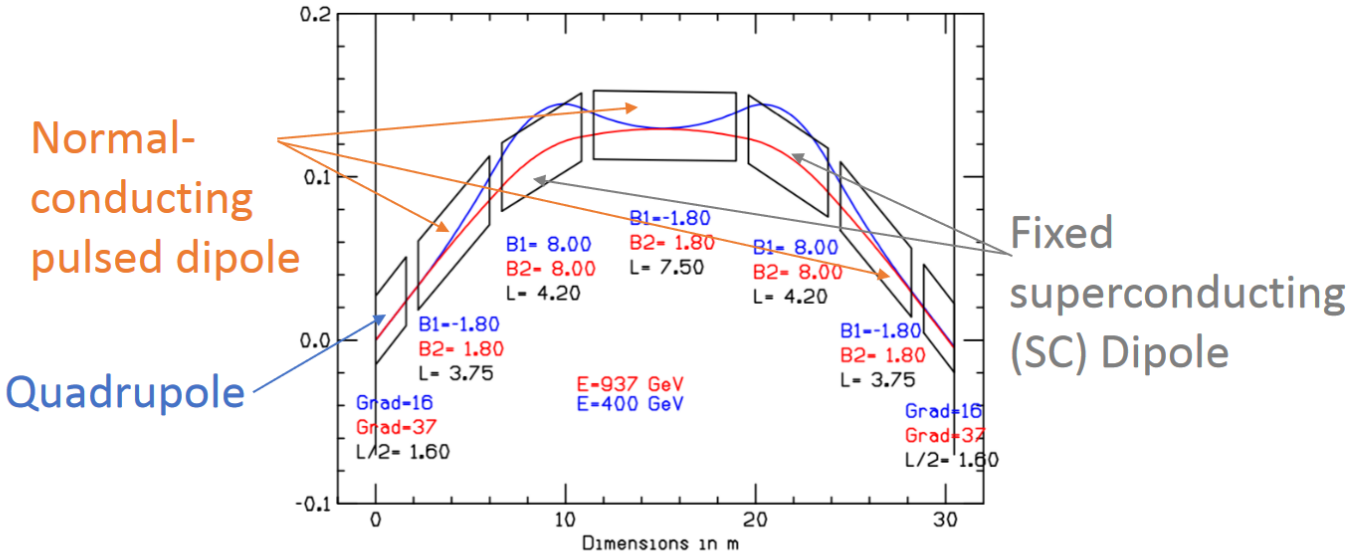


Diagram Ref: Summers, D.J., Cremaldi, L.M., Godang, R., Kipapa, B.R. & Rice, H.E., Muon acceleration to 750 GeV in the Tevatron tunnel for a 1.5 TeV $\mu^+\mu^-$ collider, Particle Accelerator Conference (PAC 07), Albuquerque, NM, 25-29 June 2007, THPMS082.

From: https://indico.cern.ch/event/867138/contributions/3654250/attachments/2003892/3346162/RCS_MC_JAI_Presentation_FINAL.pdf

Longitudinal aspects and RF system design

- **Number of RF sections/stations?**
  - **Just 1-2 or a large number distributed around the ring?**
  - **Large synchrotron tune or small phase slip factor, η?**
  - **Maximum energy difference of counter-rotating beams, before/after RF section?**
  - **Consequences on energy gain per turn and synchrotron tune**

- **Bunch rotation required to achieve short bunches?**
- **Possible reuse of RF section(s) for at least two RCS stages?**
- **Uncontrolled (longitudinal, and transverse) emittance blow-up during transfer between RCS. If unavoidable, by how much smaller emittance should be at the start of acceleration (smaller emittance $\rightarrow$ stronger collective effects)**

Simulation techniques

- **Coordination of longitudinal and transverse simulations?**
  - **BLonD code to explore longitudinal plane, then 6D-tracking?**

- **Which assumptions built into conventional simulation codes may not be correct?**
  - **Multiple RF stations per turn combined with intensity effects**
  - **Very large energy gain per turn**
  - **Impact of kA/s ramp rate? Betatron acceleration?**

Agenda

- **How to define goals and plans, e.g.**
  - **Self-consistent parameter table**
  - **What do we consider as basic machine design?**

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