Guggenheim Update

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5 Summary
$P_{\text{ref}} = 201 - 204 \text{ MeV}$
(25th harmonic)
RF grad=$11.451 - 12.835 \text{ MV/m}$
RF freq=$201.25 \text{ MHz}$
Cells=12
Circumference=33 m
Coil Tilt=3 deg
1/2 turn at a time

Introduce RF to Guggenheim

- Simulate a single layer (12 cells), but fill only 6 of them with cavities & absorbers

Avoid interference

\[ \text{end half-turn} \]

\[ \text{start half-turn} \]

\[ \text{3 m pitch} \]

(circ.=33m)
Transmission issue

Performance (II)

transmission falls!
(higher gradient seems a little better)
Before Amit left

The future

- Understand (solve!) transmission/matching problem
- Use G4BL simulation to design a complete cooling channel
  - More realistic: include RF & absorber windows
  - Simulate smaller helixes (402, 805 MHz) and match between stages (incl. bunch merging)
  - Design a realistic 805-MHz helix (R. Palmer?)
Randomseed time = Problem solved
Transverse emittance

![Graph showing transverse emittance vs. number of turns for RFOFO ring and Guggenheim helix]
Longitudinal emittance

![Graph showing longitudinal emittance over number of turns for RFOFO ring and Guggenheim helix.](attachment:image.png)
RFOFO Helix cooling

“6D cooling seems to work” ⇒ “6D cooling works” ???
3 layers
3-layer RFOFO

RF grad = 11.607 MV/m
Transmission: 1 vs 3 layers

The graph shows the transmission over the number of turns for two different layer configurations: 1 layer and 3 layers. The transmission decreases as the number of turns increases, with the 3-layer configuration showing a steeper decline compared to the 1-layer configuration.
From RFOFO to Guggenheim, full turn: not so promising

As reported at the NFMCC Friday meeting on March 8
Transmission: 3 layers

[Graph showing transmission over number of turns for RFOFO and Helix with 3 layers]
Comparing no shielding and “worst case” (norm.) at $r = 10 \text{ cm}$

![Graphs comparing no shielding and “worst case”](image-url)
Limit the field in the coils: “fake shielding”
3 layers to 1 layer

3-layer layout performs o.k. Let’s try removing extra layers:

- Simple removal of the two extra layers with the corresponding tuning of parameters, such as the reference momentum and the RF gradient does not help much;
- Solution: keep an extra pair or two of the coils at the edges;
- Method works with both “shielding” and no “shielding”.
1 layer, one extra coil on each side
Transmission

Number of turns

Transmission

- RFOFO: 1 layer
- Helix: 3 layers
- Helix: 1 layer
Longitudinal emittance
Transverse emittance
$\varepsilon_{6D}$ goes from $3 \cdot 10^{-6}$ to $2 \cdot 10^{-8}$
Next steps:

- implement more realistic elements (absorbers, RF cavities);
- consider alternative geometries (some words below);
- consider alternative lattices.
RFOFO snake
Transmission problem is solved;
Various parameters are tuned in such a way that the 3-layer “shielded” model transmission is 51%, and the 1-layer “non-shielded” model transmission is 45% versus the RFOFO 60%;
6D emittance after 10 turns (330 m) reduces 150 times;
Overall I’d say “6D cooling in the Guggenheim seems to work” should be replaced by “6D cooling in the Guggenheim works!”