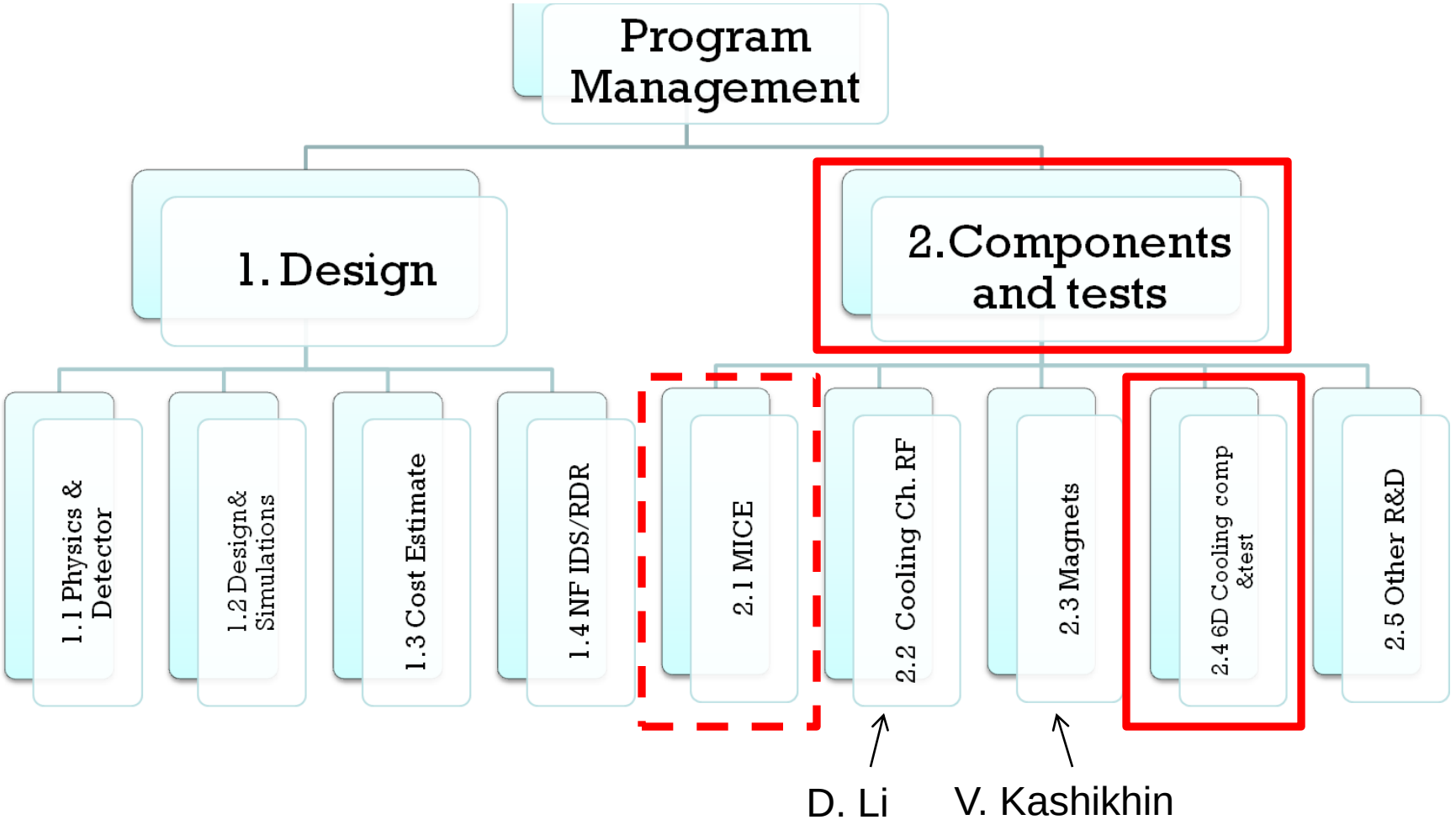
5 YEAR PLAN: EXPERIMENTS AND TESTS

Andreas Jansson

5 YEAR PLAN

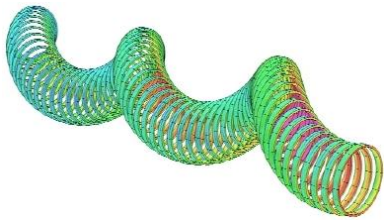

Program Management
1. Design
2.Components and tests
1.1 Physics & Detector
1.2 Design& Simulations
1.3 Cost Estimate
1.4 NF IDS/RDR
2.1 MICE
2.2 Cooling Ch. RF
2.3 Magnets
2.4 6D Cooling comp &test
2.5 Other R&D
D. Li
V. Kashikhin

COMPONENTS AND TESTS

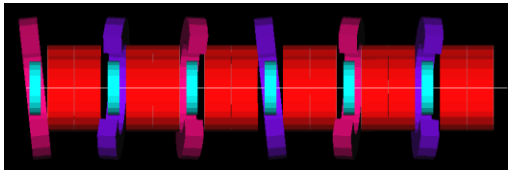
- The purpose of this part of the plan is to build and test hardware in order to inform the design study by demonstrate feasibility of critical components and enabling down-selection of cooling channel options.
- We plan to build and bench test a section of baseline cooling channel.
  - Face engineering and safety details
  - Provides cost estimate basis

6D COOLING CHANNEL STATUS

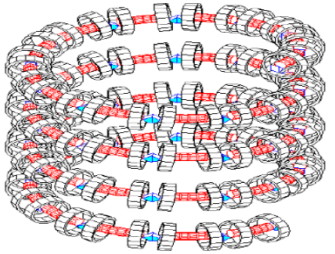
- Three main types (and many variants) of 6D cooling channel have been proposed, and **shown to cool in simulation**.



HCC
(Derbenev/Johnson)



FOFO snake
(Alexahin)

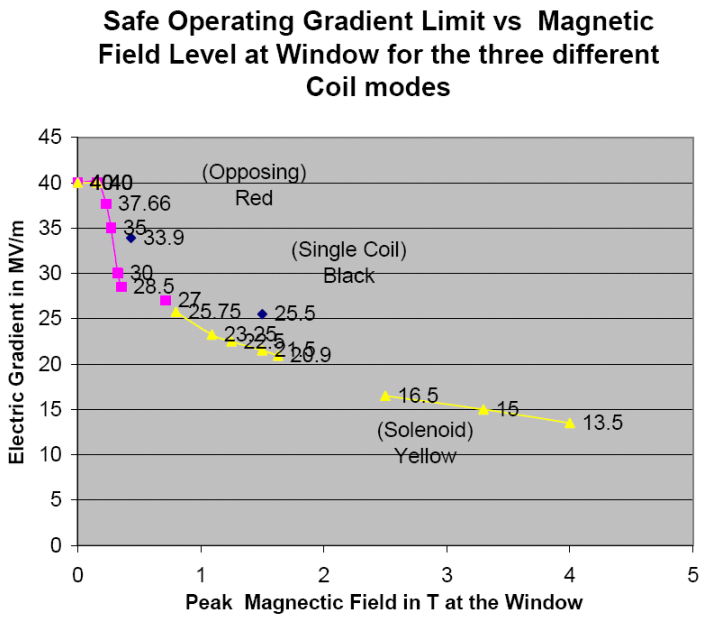


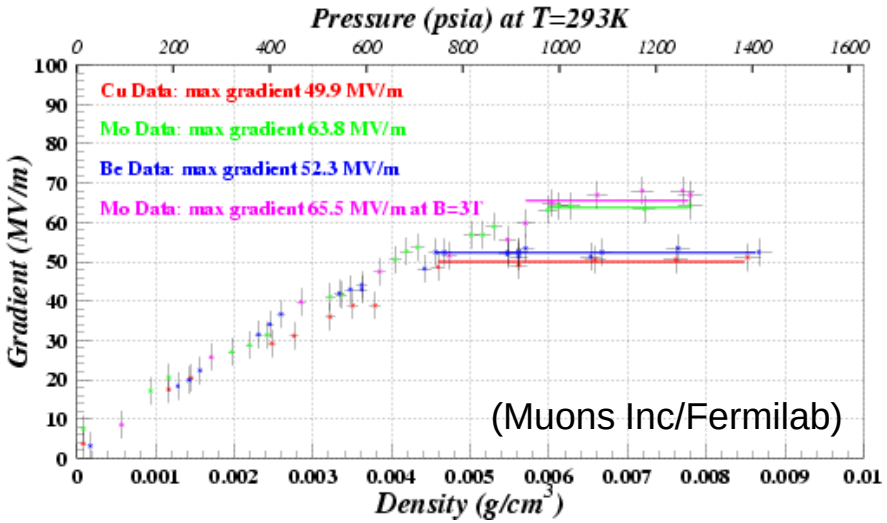
Guggenheim
(Palmer)

- They all require RF cavities operating in strong magnetic fields.
  - This is currently our biggest challenge

THE $E_{max}(B)$ CHALLENGE

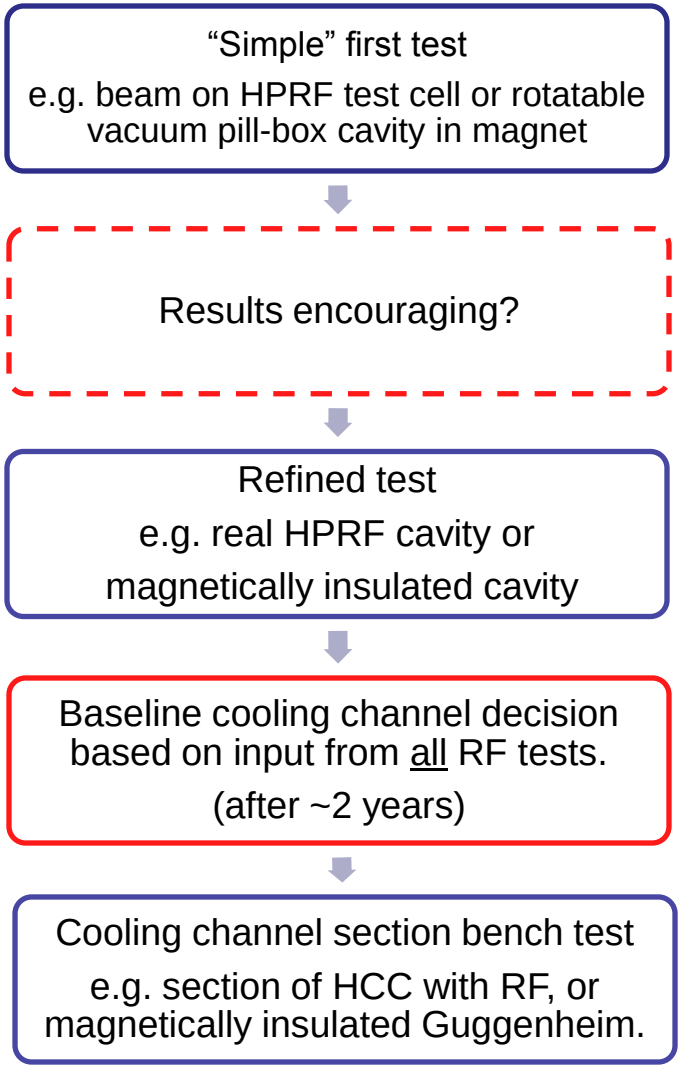
- Vacuum RF suffers significant reduction in stable gradient in magnetic fields
- High Pressure RF is not sensitive to magnetic fields, but have not yet been tested with beam.





TOWARDS A BASELINE COOLING CHANNEL

- Candidate paths to solve the $E_{max}(B)$ challenge include
  - Improved surface
    - Better cleaning (SC techniques)
    - Atomic Layer Deposition
    - Different bulk/coating materials
    - Dielectric filled cavities
  - Gas-filled cavities
  - Magnetic insulation
- We have identified a series of tests to explore these paths.
  - Focus in the first two years
- Based on the outcome of these tests, we will <u>select a baseline cooling channel</u>
- Proceed to build and bench test a section of that channel.
  - Focus in the last three years



WHAT ABOUT DEMONSTRATING COOLING?

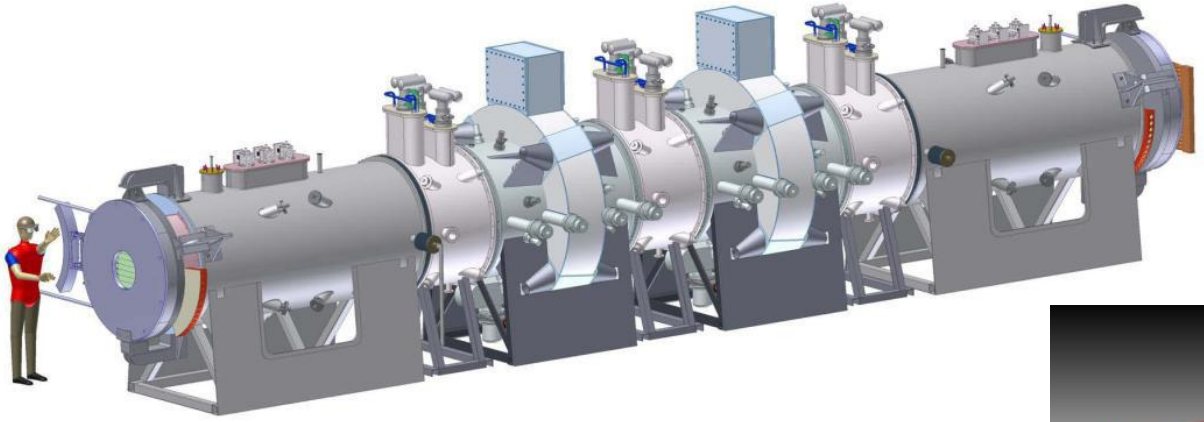
- From last years review:

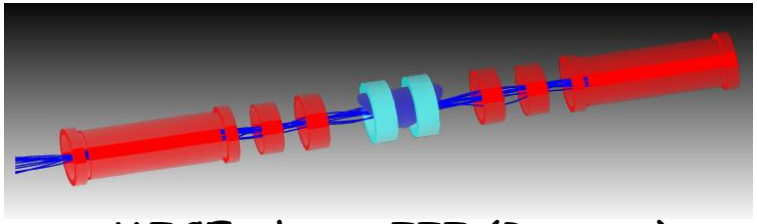
  "The committed recommends that the 5-year plan include the initiation of planning for a 6-D cooling demonstration experiment"

- Planning for a 6-D cooling demo is indeed in the plan
  - Should be based on the baseline cooling channel
    - Implies waiting for RF results
  - Might be able to use hardware built for bench test
    - Coordinate bench test and 6D demo preparations
  - End-to-end simulation studies (including error studies) in 5-year plan will inform us on what needs to be demonstrated.

MICE

- In its final phase, MICE is essentially a section of NF study II prototype cooling channel.
- During the next 5 years, we expect MICE will demonstrate transverse (4D) cooling.
  - US contribution supported in the plan
- Might also be able to e.g. demonstrate emittance exchange using wedge absorber (this and other extensions are under discussion).

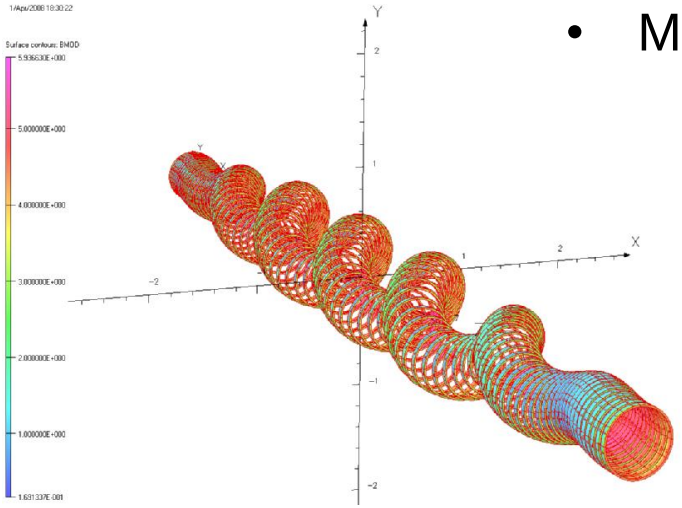




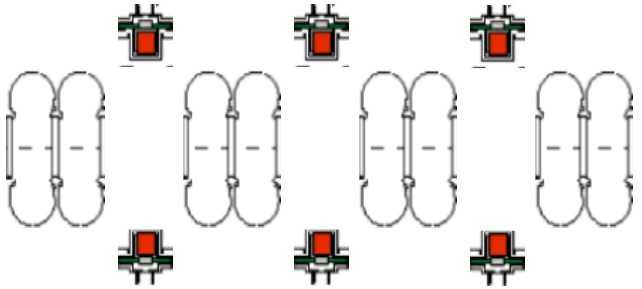
LiH wedge as MICE phase III (Rogers)

POSSIBLE 6D FOLLOW-UPS

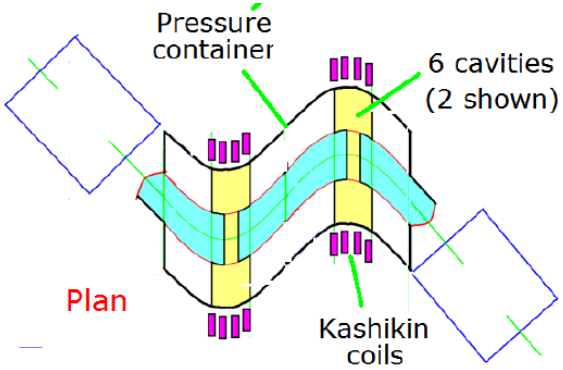
- More work needed



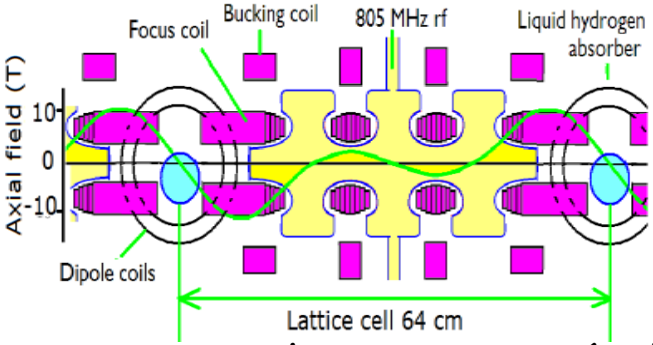
MANX w LHe, no RF (Muons Inc)



MICE rebuilt as FOFO snake (Alexahin)



HCC w. HP H_2 RF (Palmer)



Mag. ins. Guggenheim section (Palmer)

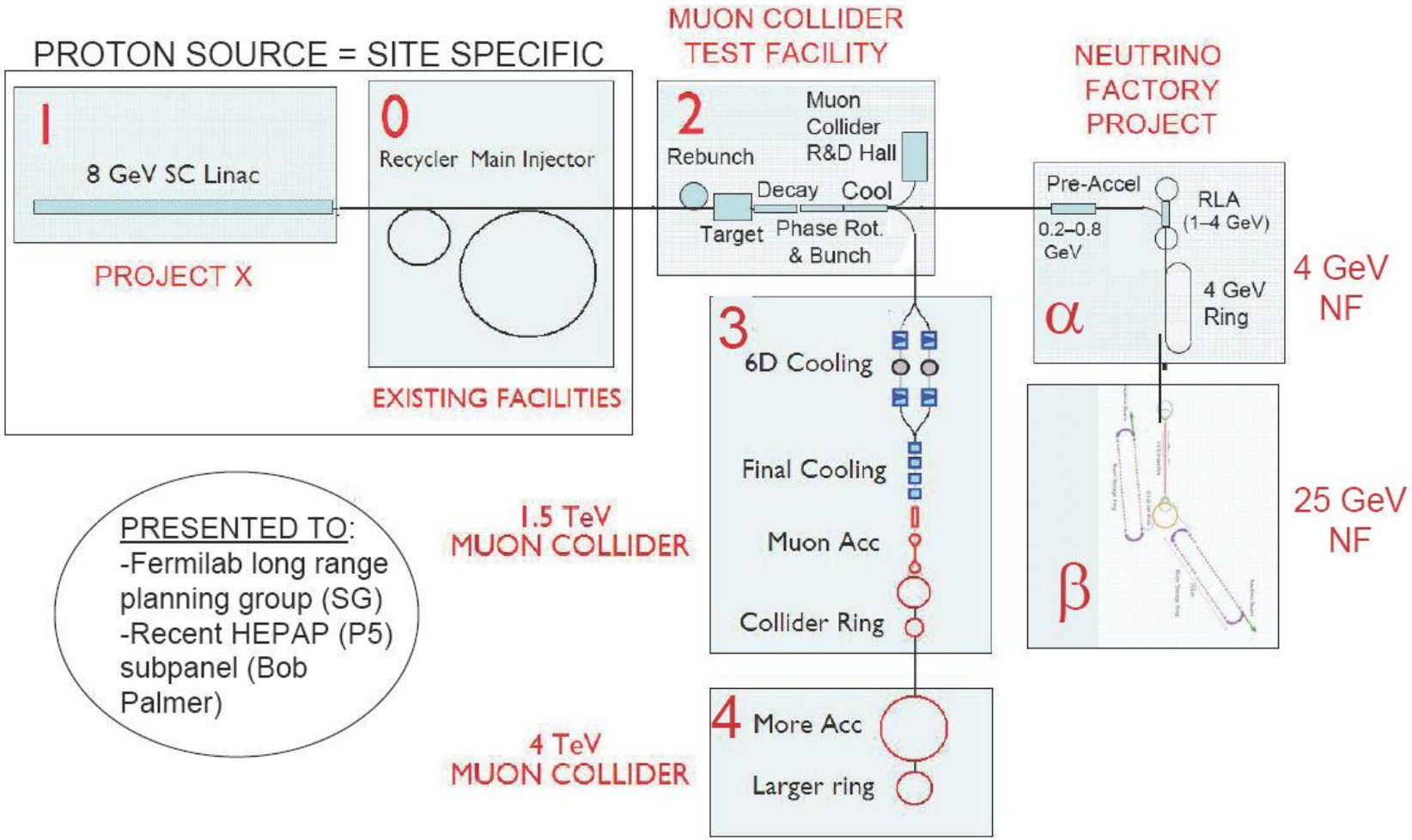
Summary

- A Muon Accelerator R&D 5-year plan was written up in the last 12 months and presented to DOE in December
  - Still waiting for a formal response
- The “components and test” part of the plan aim to
  - Investigate the possible solutions to the RF problem
  - Enable an informed choice of baseline cooling channel
  - Build and bench test a section of baseline cooling channel
  - Prepare for a 6D cooling demonstration, which would be part of the follow-up to the plan (the next 5-year plan).
- While waiting for the 5-year plan to be approved and funded, we have continue working on the most critical issues (RF) using available resources.

MCTF

Resource requirements

	Y1	Y2	Y3	Y4	Y5
2.1 MICE	12	11	10	8	0
2.2 RF R&D	7.5	11.5	8	5.5	4.25
2.3 Magnet Studies	12.2	12.45	14.25	12.2	9.4
2.4 6D Cooling Sections & Tests	0	12.1	10.6	10.7	10.7
2.5 Other R&D	0	0	0	0	0
3 Management	3.8	4.4	5	5.5	5.5
TOTAL	**48.4**	**78.85**	**81.25**	**79.2**	**42.85**


PROTON SOURCE = SITE SPECIFIC
1
8 GeV SC Linac
PROJECT X
0
Recycler Main Injector
EXISTING FACILITIES
MUON COLLIDER TEST FACILITY
2
Rebunch
Target
Decay
Cool
Phase Rot. & Bunch
Muon Collider R&D Hall
NEUTRINO FACTORY PROJECT
Pre-Accel
0.2–0.8 GeV
RLA (1–4 GeV)
4 GeV Ring
α
4 GeV NF
3
6D Cooling
Final Cooling
Muon Acc
Collider Ring
1.5 TeV MUON COLLIDER
β
25 GeV NF
PRESENTED TO:
-Fermilab long range planning group (SG)
-Recent HEPAP (P5) subpanel (Bob Palmer)
4
More Acc
Larger ring
4 TeV MUON COLLIDER