



MUON COLLIDER & NEUTRINO FACTORY R&D AT FERMILAB

Overview of organization,
budgets, and plans



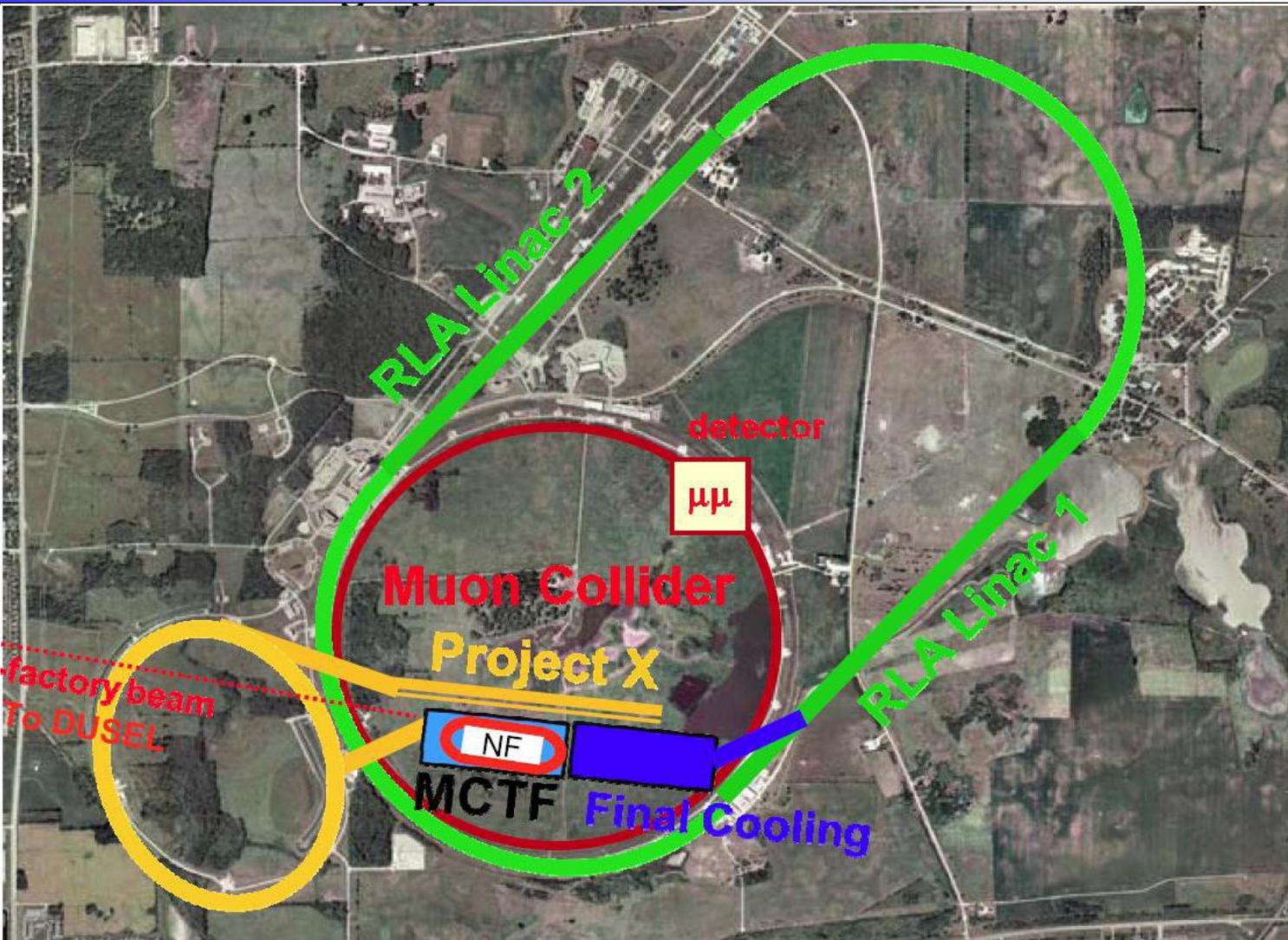
INTRODUCTION: NFMCC & MCTF



- Neutrino Factory & Muon Collider R&D has been pursued in the U.S. by the Neutrino Factory & Muon Collider Collaboration (NFMCC) over the last decade.
- Fermilab is one of the 3 founding laboratories (along with LBNL & BNL) of the NFMCC, has provided some of the past & present co-spokespeople for the collaboration, and hosts the cooling channel component development (MUCCOOL).
- In July 2006 the Fermilab Director initiated the “Muon Collider Task Force” (MCTF) at Fermilab to enhance the activities of the NFMCC, and give multi-TeV Muon Collider R&D a boost.
- NFMCC & MCTF planning is co-ordinated by the Muon Collider Co-ordinating Committee consisting of the NFMCC & MCTF leadership. This has worked well so far.

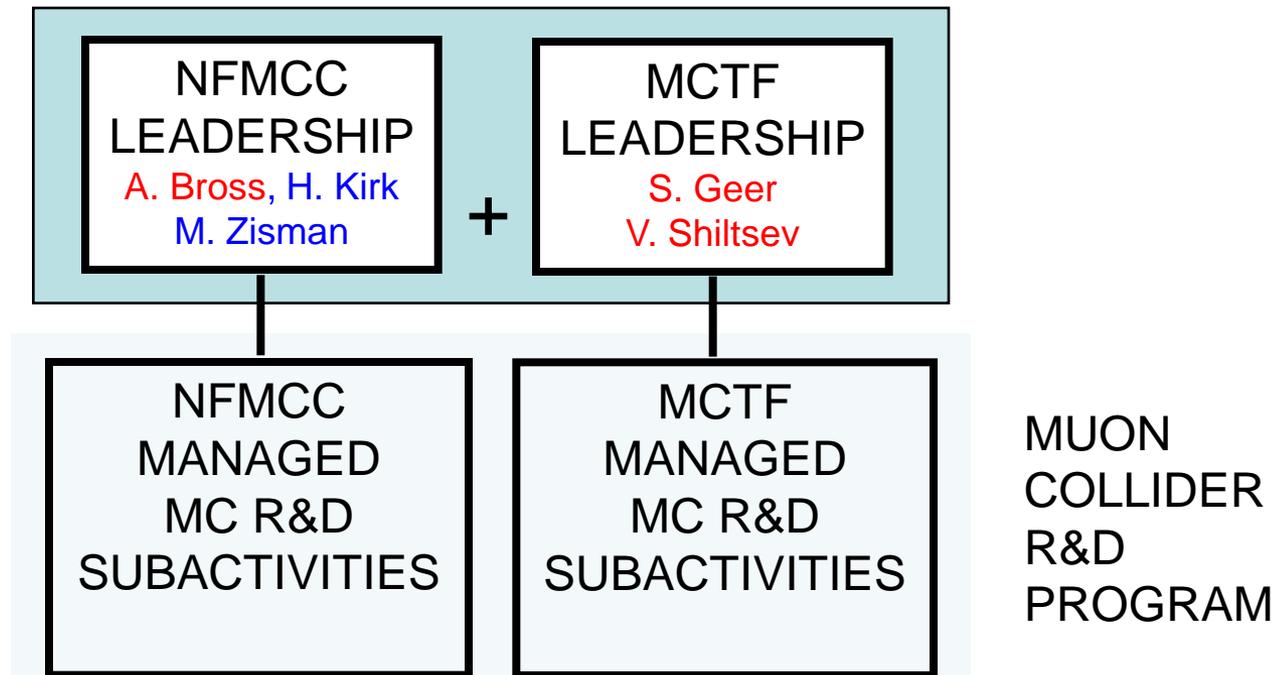


1.5-4 TeV Muon Collider (P.Oddone at P5)



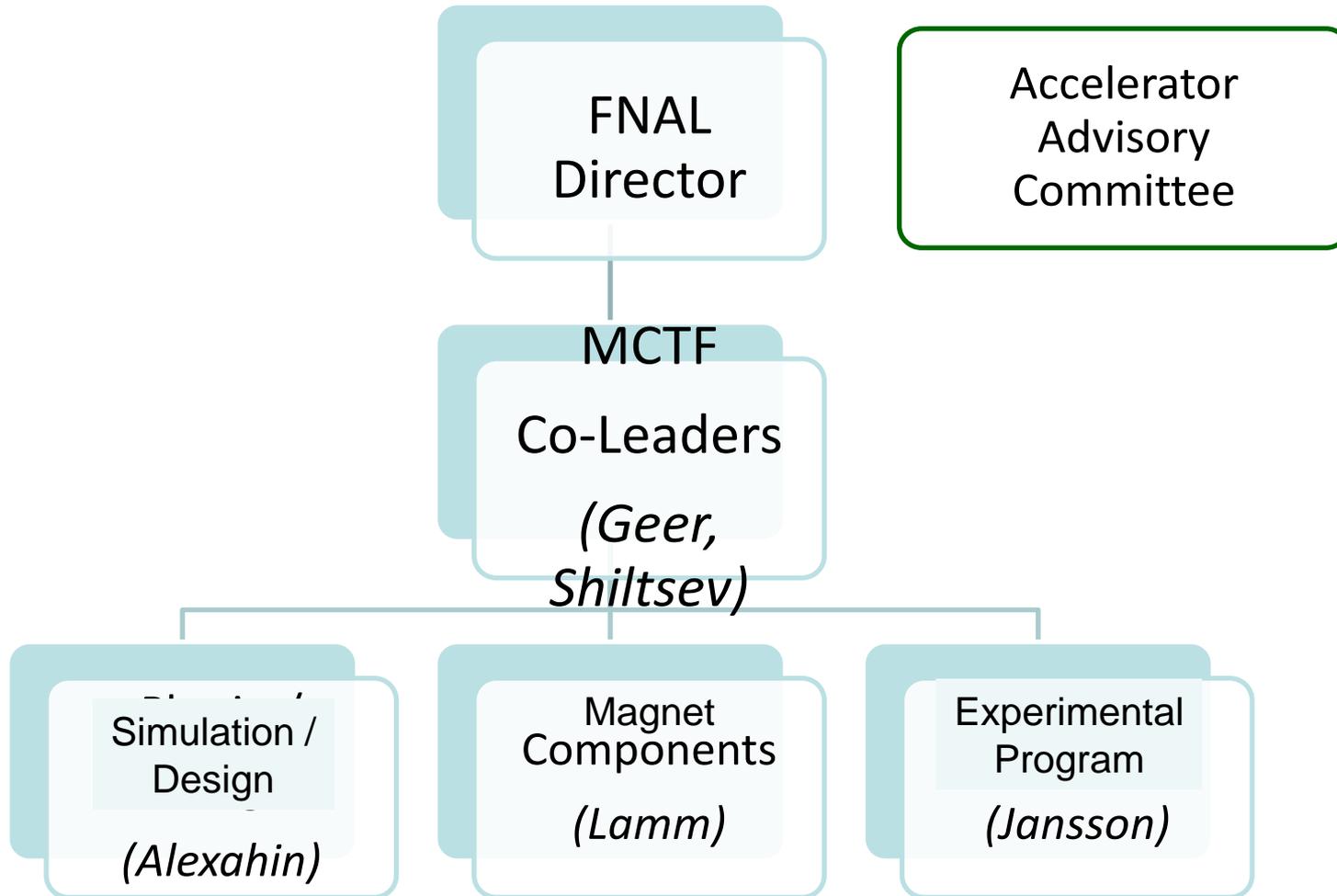
PURPOSE: To co-ordinate the NFMCC and MCTF proposed & ongoing R&D activities to maximize their joint effectiveness & facilitate cross-participation in these activities where it makes sense.

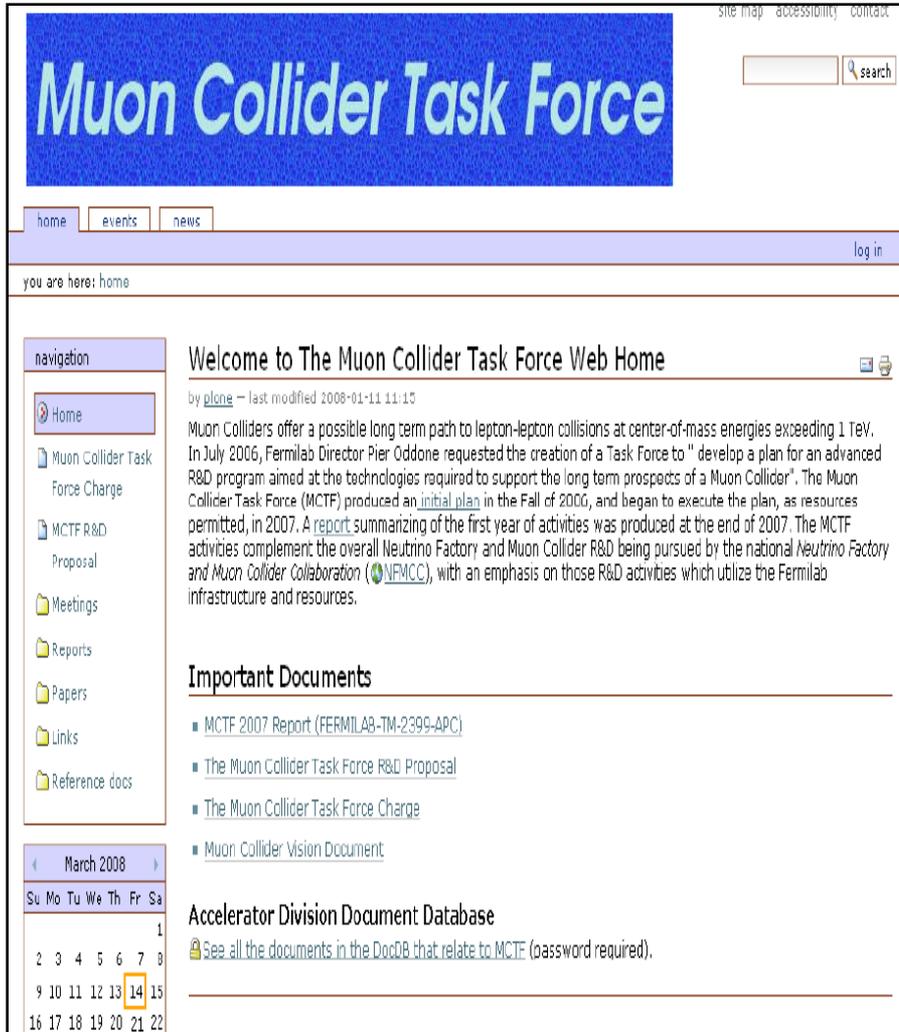
MUON COLLIDER R&D CO-ORD COMMITTEE



- Charge from the Fermilab Director (July 2006)
 - “...the Muon Collider represents a possible long term path for extending the energy frontier in lepton collisions beyond 1 TeV.”
 - “...Task Force to develop a plan for an advanced R&D program aimed at the technologies required to support the long term prospects of a Muon Collider. “
 - requested for September 2006: A report outlining a plan for developing the Muon Collider concept based on recent ideas in the realm of ionization cooling.
- Initial proposal delivered Sept. 2006
 - https://mctf.fnal.gov/muoncollider_aard_proposal_v3.doc
- Report on first years activities delivered in Dec. 2007
 - FNAL-TM-2399

ORGANIZATION





The screenshot shows the homepage of the Muon Collider Task Force website. At the top, there is a blue banner with the text "Muon Collider Task Force". Below the banner are navigation links for "home", "events", and "news", and a "log in" link. A search box is also present. The main content area features a "Welcome to The Muon Collider Task Force Web Home" message, dated 2008-01-11 11:11:15. The text describes the task force's mission and mentions a report from 2007. A sidebar on the left contains a "navigation" menu with links to Home, Muon Collider Task Force Charge, MCTF R&D Proposal, Meetings, Reports, Papers, Links, and Reference docs. Below the navigation menu is a calendar for March 2008, with the 14th highlighted. At the bottom of the main content area, there is a section for "Important Documents" with links to the MCTF 2007 Report, the R&D Proposal, the Task Force Charge, and the Vision Document. A link to the "Accelerator Division Document Database" is also provided.

- MCTF website:
<http://mctf.fnal.gov>
- APC Muon Dept. website:
<http://apc.fnal.gov/groups2/muon.shtml>

FERMILAB-TM-2399-APC 10-Jan-08

MUON COLLIDER TASK FORCE REPORT

C.Ankenbrandt, Y.Alexahin, V.Balbekov, E.Barzi, C.Bhat, D.Brommelsiek, A.Bross,
A.Burov, A.Drozhdin, D.Finley, S.Geer, N.Gelfand, E.Gianfelice-Wendt, M.Hu,
A.Jansson, C.Johnstone, J.Johnstone, V.I.Kashikhin, V.Kashikhin, M.Lamm, V.Lebedev,
N.Mokhov, C.Moore, A.Moretti, D.Neuffer, K.-Y.Ng, M.Popovic, I.Rakhno, V.Shiltsev,
P.Spentsouris, A.Striganov, A.Tollestrup, A.Valishev, A.Van Ginneken, K.Yonehara,
C.Yoshikawa, A. Zlobin
FNAL

J.Norem
ANL

J.S.Berg, J.C.Gallardo, R.Gupta, H.Kirk, R.Palmer, R.Fernow, P.Wanderer
BNL

A.Bogacz, Y.-C.Chao, Y.Derbenev, R.A.Rimmer
JLAB

G.Sabbi, P.Ferracin, S.Caspi, M.Zisman
LBNL

R.Abrams, K.Beard, R.P.Johnson, M.A.Cummings, S.A.Kahn, S.Korenev, D.Newsham,
T.J.Roberts
Muons Inc.

D.B.Cline, Y.Fukui, A.Garren
UCLA

G.Hanson, A.Klier
UC Riverside

L.M.Cremaldi, D.J.Summers
University of Mississippi

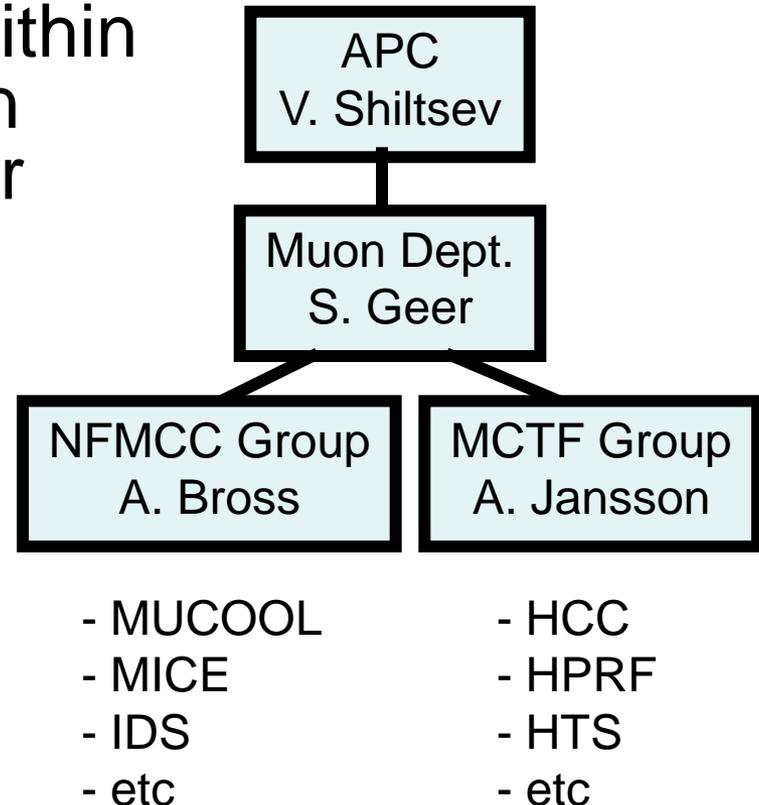
- Report on first year of MCTF activities:

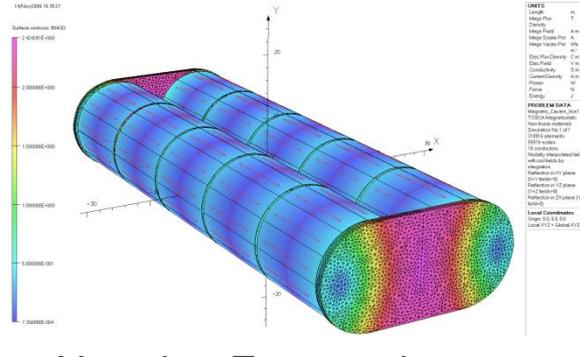
https://mctf.fnal.gov/annual-reports/mctf-report-2007_v9.doc

- Delivered Dec. 2007 (final version Jan 2008)

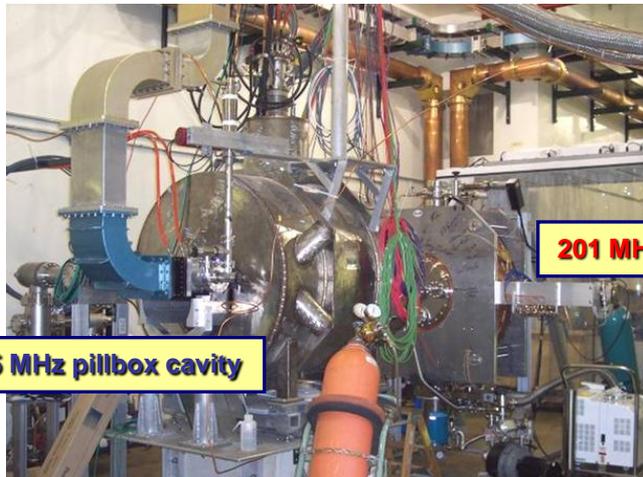
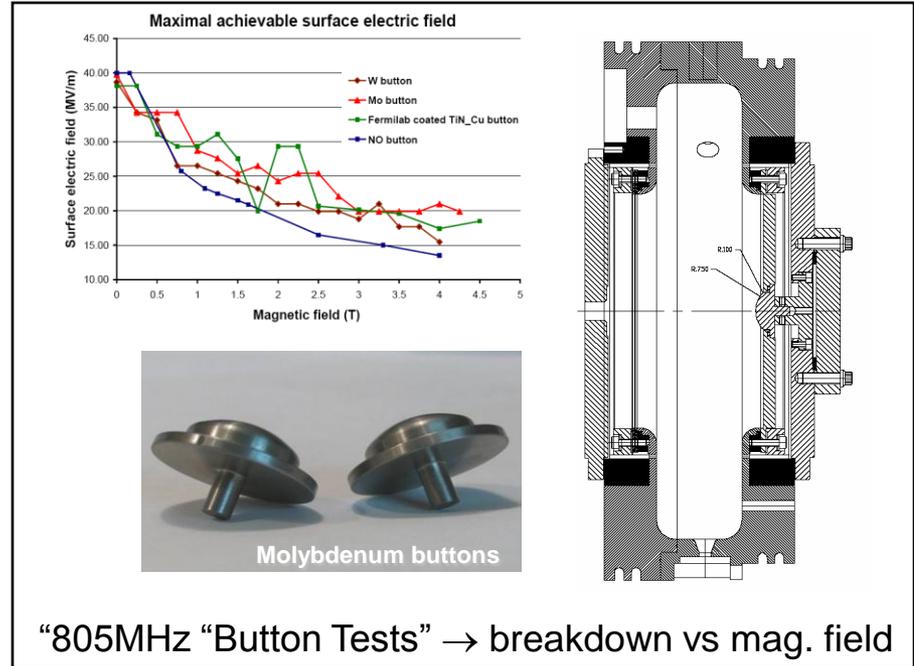
- Participation from:
 - 9 Institutions
 - 64 People

- All MCTF & NFMCC activities at Fermilab are pursued within the framework of the Muon Dept. within the Accelerator Physics Center (APC).
- Provides mechanism for allocating resources to support both NFMCC & MCTF activities at FNAL
- Worked well in this last (very tough) year

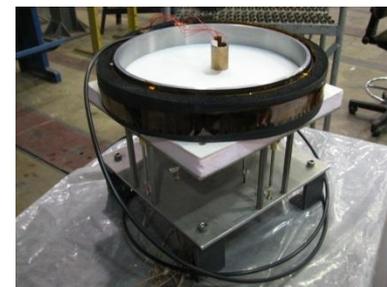




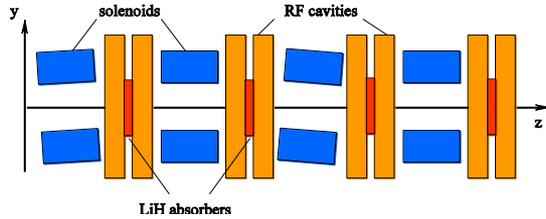
Neutrino Factory detector magnet studies



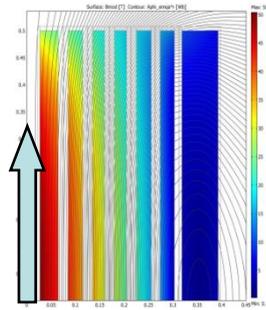
201 MHz & 805 MHz RF in magnetic field studies in MTA



LiH Absorber R&D for cooling channel



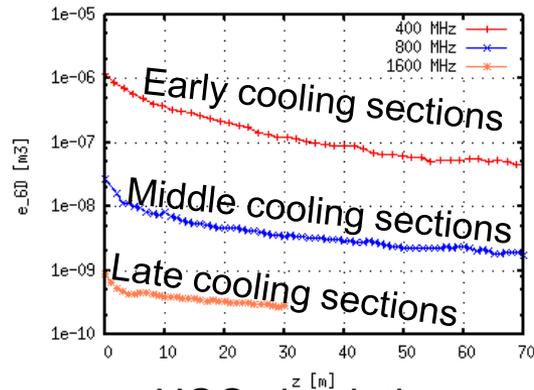
“FOFO Snake”
cooling channel studies



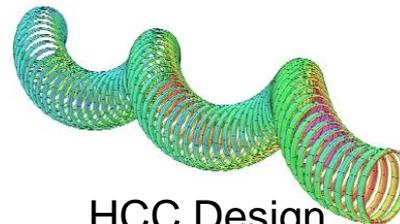
50T HTS magnet studies



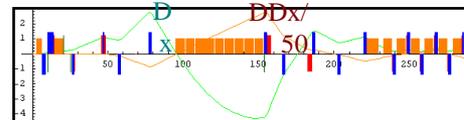
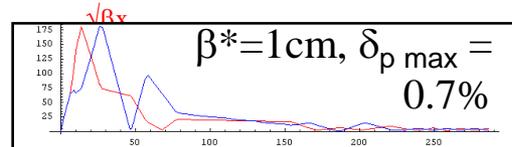
New MTA beamline constructed



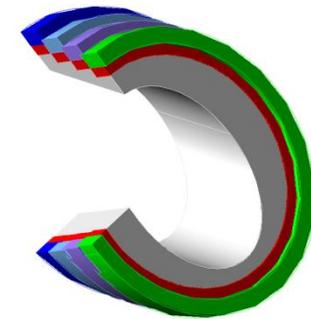
HCC simulations



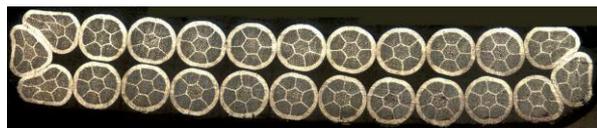
HCC Design



Mun Collider Lattice Studies
(new “dipole first” scheme)



4 coil HCC
model magnet



HTS cable studies

APS Muon Dept. Resources (M\$)

	FY07 Spent	FY08 Allocated *
	4.4	4.1
M&S	1.1	0.9
SWF	3.3 **	3.2 **

**DoE specified funding cap on all muon accelerator R&D at Fermilab*

** ~14 FTEs → ~ 50% for MCTF & 50% for NFMCC activities



FY08 M&S DIRECT vs REQUEST



Activity	FY07 Spent	FY08 Allocated	FY08 Request
HCC Magnet	58	60	230 ²⁾
HTS	0	50	200 ³⁾
MTA Beamline	573	220	300 ⁴⁾
MUCOOL	50	160	280 ⁵⁾
MICE	160	60	60
MCTF RF			120 ⁶⁾
6D HCC Section			100 ⁷⁾
Travel	91	30	80 ¹⁾
TOTAL	932	580	1370



FY08 FUNDING REQUEST NOTES



- 1) Needed for MICE detector installation and commissioning
- 2) To move beyond initial “4 coil test” towards building an HCC section.
- 3) to exploit HTS conductor R&D momentum initiated with SBIR, and to push ahead with initiating a national HTS magnet collaboration needed to get our feet on the ground with this technology.
- 4) The MTA beamline estimate is 300k\$. Completing the beamline so that the first HPRF test can be made in FY08 is a priority.
- 5) Needed to complete the presently planned MUCOOL RF R&D in FY08 before the MICE solenoid arrives early FY09 (→ scheduling conflict)
- 6) Needed to extend the RF R&D to explore “magnetic insulation” against RF breakdown.
- 7) Needed to begin work towards bench testing an HCC 6D cooling section ... first step towards a 6D cooling experiment.



MUTAC REVIEW



- The NFMCC & MCTF activities over the last year, and plans for the future, have just (April 8-10) had an annual review by MUTAC (Muon Technical Advisory Committee):
 - “The committee congratulates the NFMCC and MCTF on the impressive technical progress in the last year.”
 - “Impressive results were reported from the MERIT experiment at CERN“
 - “The MICE beamline construction is done & has begun testing.“
 - “The committee endorses the proposal that DOE/NSF fund a coordinated national effort to develop HTS for ... Muon Collider solenoids.”
 - “The addition of the MCTF effort to the NFMCC has significantly increased the overall resources available”
 - “The NFMCC & MCTF management have been very effective at keeping the R&D program moving forward to answer the critical questions, in the face of limited funding.”
 - “The committee supports the effort that has begun to create a 5 year integrated NFMCC & MCTF plan”
 - “A crucial part of the integrated R&D plan will be timely estimates for the costs of a neutrino factory and/or a muon collider to demonstrate that such machines are both technically and financially feasible.”
- Alan and Andreas will describe the role that activities at Fermilab have played in the NFMCC and MCTF R&D



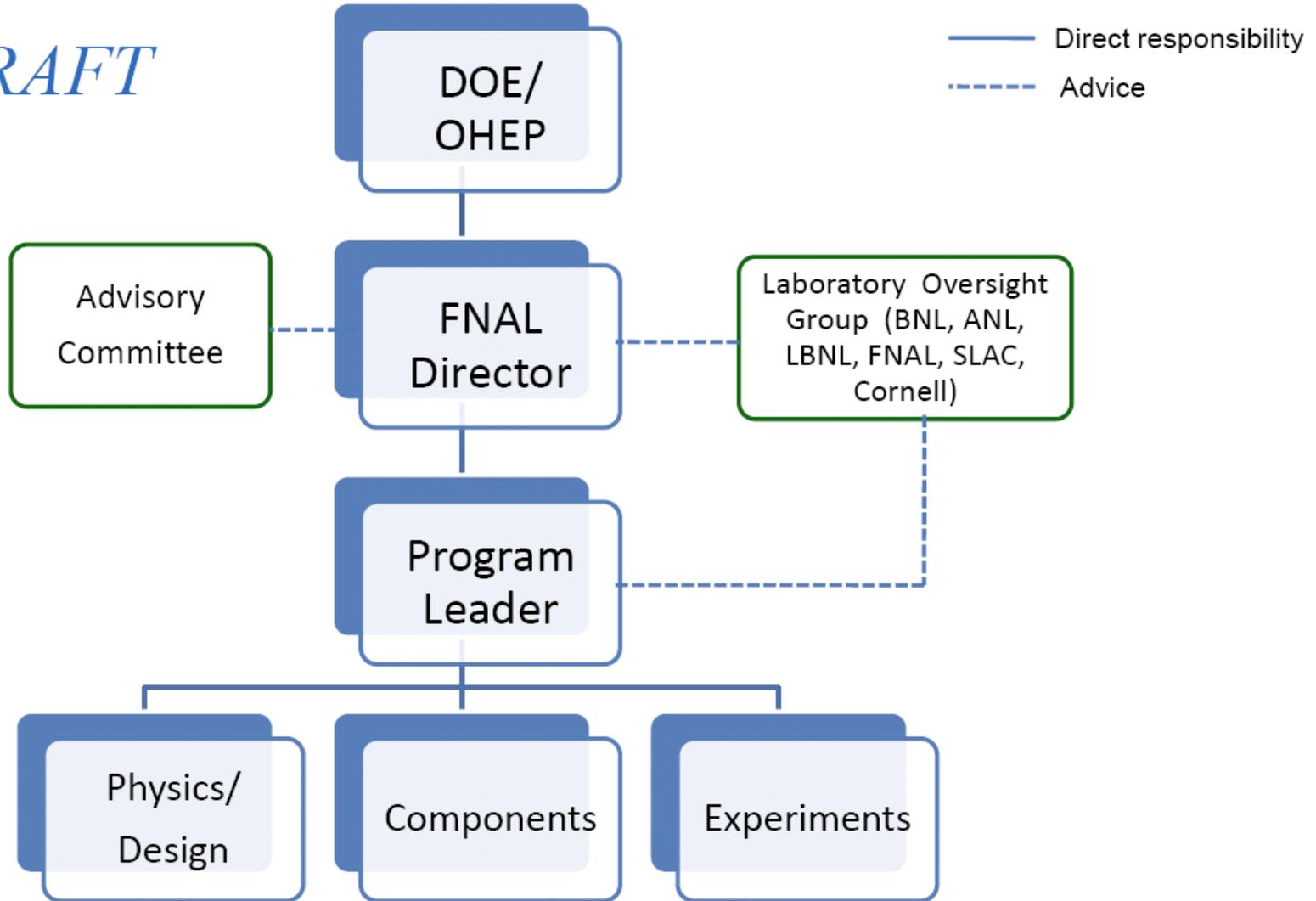
TOWARDS A 5 YEAR PLAN



- Have started working towards a joint NFMCC-MCTF 5 year plan (coordinated by the MCCC)
 - Many uncertainties about funding levels we should be planning for, but we have a first understanding of the resources that would be needed if the community wanted us to deliver a “Muon Collider Feasibility Study” by FY011-12.
 - Activities at Fermilab would need to be ramped up significantly over the next few years (to support both NFMCC and MCTF activities). We are working on a more detailed plan, but we believe the required scale will be:
 - Ramp up FNAL effort to 24 FTEs (SWF = 6M\$/yr)
 - Ramp up FNAL M&S to 3M\$/yr (assume total national investment (SWF+M&S) in NF+MC R&D ramped up to 25 M\$/year)
- We are working towards having a joint NFMCC-MCTF draft 5-year plan by August.
 - Encouraged by MUTAC

- **What is needed for MC to be considered as a credible lepton collider candidate in 2013:**
 1. **Coherent MC design at the level of ZDR**
 1. **MICE experiment (successful) results**
 1. **Key RF questions answered**
 2. **Prospects of HTS magnets understood**
 3. **Muon acceleration techniques explored**
- **The way: *Muon Collider R&D Program***
 - ✓ **To carry out exp. R&D and prepare MC ZDR**

DRAFT





FINAL REMARKS

- At Fermilab both NFMCC & MCTF activities are supported within the Muon Dept. of the Accelerator Physics Center its first year of activities
 - Seems to be working well, in spite of a very tough funding year.
- The MCTF has just completed its first year of activities
 - We have made a solid start within the present tight funding constraints
 - Progress documented in the MCTF “annual report”
 - Invigorated Muon Collider R&D
- It has been a productive year for both the NFMCC & the MCTF, and activities at Fermilab have made crucial contributions to the critical activities (see talks by Alan and Andreas).
- The NFMCC & MCTF are working towards a 5 year plan that will enable a Muon Collider Feasibility Study (ZDR) by ~2013, and participation in the NF International Design Study (RDR by ~2013). We expect activities at Fermilab to make central contributions to both these studies and the associated R&D.
 - Strong support by P5 and the funding agencies for an increase in MC & NF R&D will be important if this is to happen
 - We estimate that we will need to ramp up the present support by about a factor of 3 ... our goal is to have a more detailed draft plan by the end of the summer.