Summary of the 5th IDS-NF Plenary Meeting Chicago April 08-10

https://www.ids-nf.org/wiki/FNAL-2010-04-08

General

Very packed and intense 3-days meeting.

About ~60 registrants, ~20 in parallel sessions.

Parallel sessions organized as:

- **accelerators**
- **physics and performance evaluation group (PPEG)**
- **detectors**

First IDS-NF progress report draft at the end of the meeting.

Deadlines: Dec. 2010 (IDR) – Dec. 2011 (RDR).

Welcome by Young-Kee Kim (Fermilab deputy director):

Fermilab/US strategy+ roadmap for neutrino physics.

Fermilab/US Strategy

Detector Synergy:
ILC/CLIC/μ Collider

Energy Frontier

Intensity Frontier

Tevatron (LHC) ILC / μ Collider

protons

technology injector

NuMI (300kW) → NuMI (700kW) → **Project X** → injector → ν Factory

Booster

2 MW (120GeV) for ν
+ 2MW(3GeV) + 200kW(8GeV)

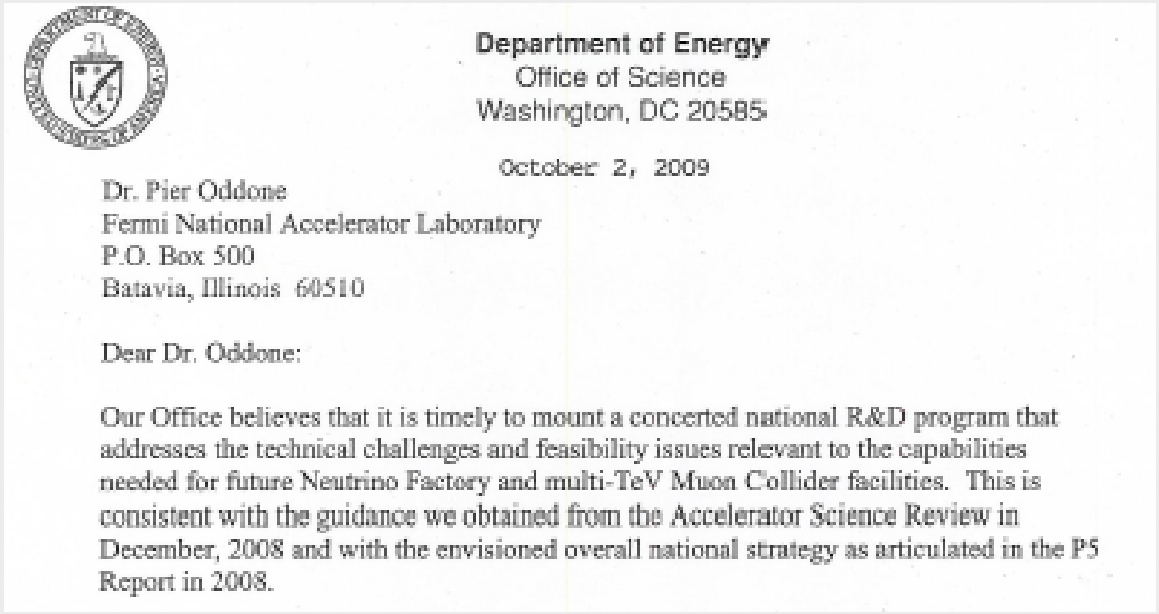
MINOS	NOvA	1300km baseline ν
MiniBooNE	MicroBooNE	WC / LAr
MINERvA	MINERvA	(+Proton Decay,..)
(SciBooNE)	Mu2e	Mu2e II
(ArgoNeuT)	(μ g-2)	μ g-2 II
	(K^+)	K^0/K_L, K^+ II
		EDM, μ, Λ, Σ^+ II
		Nuclear Physics
		....

time →

(Courtesy Young-Kee Kim)

MAP Initiative

- US 5 year R&D proposal submitted to DOE
- DOE's response to this proposal



Department of Energy
Office of Science
Washington, DC 20585

October 2, 2009

Dr. Pier Oddone
Fermi National Accelerator Laboratory
P.O. Box 500
Batavia, Illinois 60510

Dear Dr. Oddone:

Our Office believes that it is timely to mount a concerted national R&D program that addresses the technical challenges and feasibility issues relevant to the capabilities needed for future Neutrino Factory and multi-TeV Muon Collider facilities. This is consistent with the guidance we obtained from the Accelerator Science Review in December, 2008 and with the envisioned overall national strategy as articulated in the P5 Report in 2008.

→ Creating a "DOE project management" structure

→ Muon Accelerator Program (MAP)

(Courtesy Young-Kee Kim)

Proposal for an ECFA neutrino panel:

- Noting timescale defined by the Strategy Session of CERN Council, ECFA proposes to set up a panel that will:
  - Receive IDS-NF IDR and EUROnu interim report, perhaps supported by appropriate presentations from the proponents
  - Review and comment on the IDS-NF IDR:
    - The robustness of the physics case;
    - The specification of the baseline for the Neutrino Factory;
    - The analysis of cost and schedule presented in the IDR; and
    - The plans of the IDS-NF collaboration for the RDR.
  - Review and comment on EUROnu interim report:
    - The strengths of the super-beam, beta-beam, and Neutrino Factory facilities;
    - The development of baseline super-beam and beta-beam facilities;
    - The plans of the EUROnu collaboration for the completion of the study.

(Courtesy K. Long)

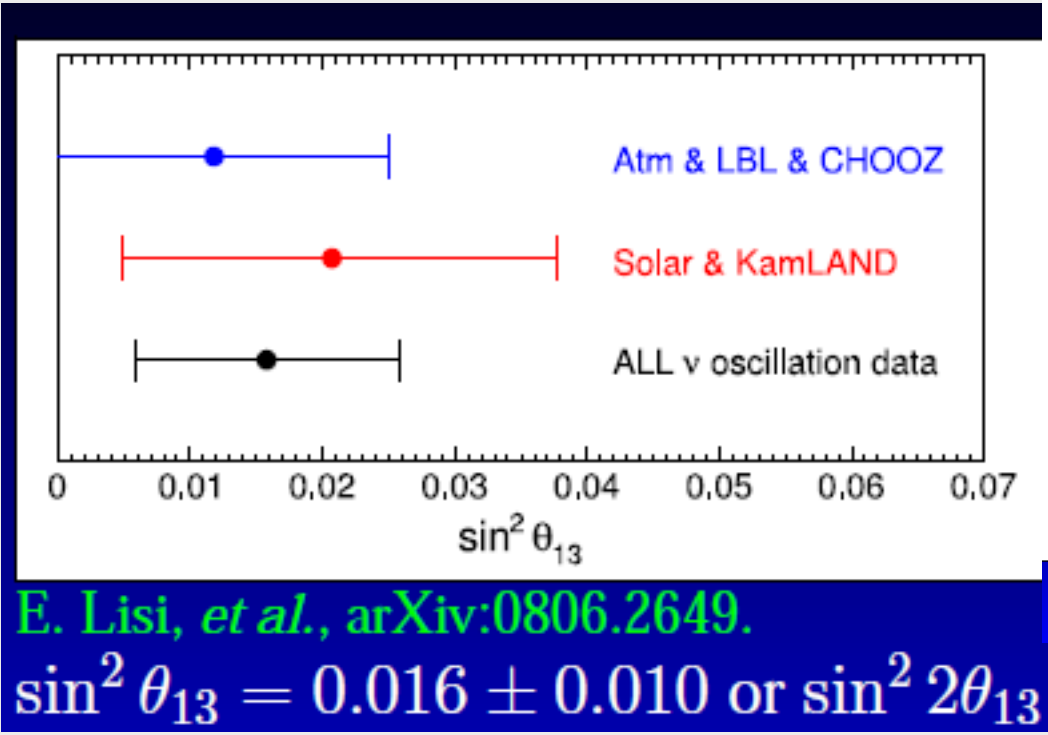
Physics & Performance Evaluation Group (P. Huber) 1/3

A group that still need to grow:

- working on re-organization to increase participation.

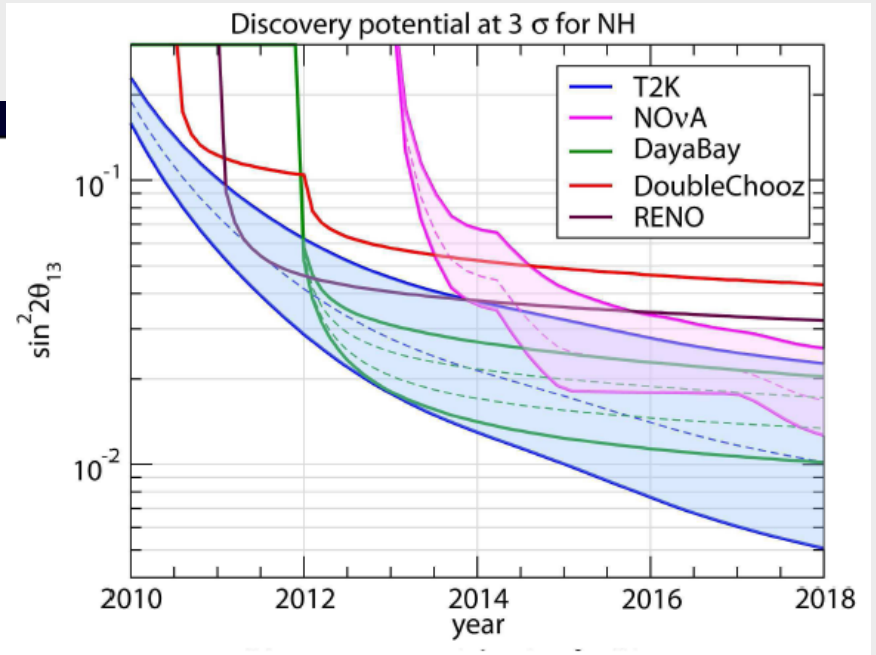
- lack of travel fund but not lack of interest.

Hints for non-zero θ_{13} ?



E. Lisi, *et al.*, arXiv:0806.2649.

$\sin^2\theta_{13} = 0.016 \pm 0.010$ or $\sin^2 2\theta_{13} = 0.06 \pm 0.04$



PH, M. Lindner, T. Schwetz, W. Winter, arXiv:0907.1896v2
M. Mezzetto, T.Schwetz, arXiv:1003.5800

Physics & Performance Evaluation Group (P. Huber) 2/3

LENF – PPEG perspective

- Conceived in the context of Fermilab - DUSEL
- Do we need to rephrase it in an international, site independent context?
- In any case, we need to study the physics optimization (see PPEG parallel talks)
- Non-standard physics study in progress (talk by T. Li)
- Staging (talk by J. Tang)

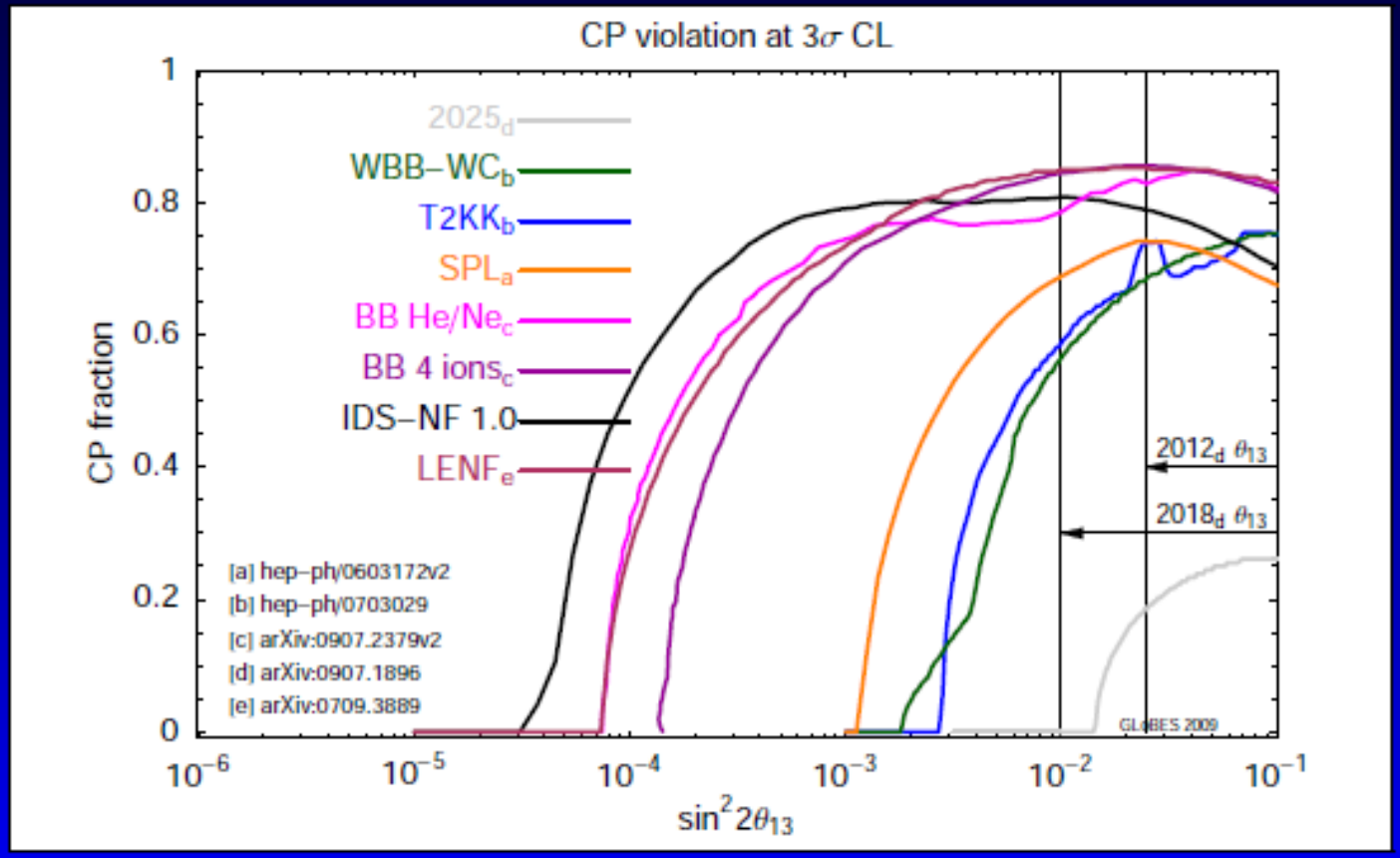
PPEG is working hard and making good progress, to be able to present the physics case for a LENF at equal footing to the one for the HENF.

P. Huber – p. 6

Physics & Performance Evaluation Group (P. Huber) 3/3

Contents II

Review of status of competition (BB,SB) – done, EuroNu 1 year report



Far Detector (A. Cervera) 1/3

Baseline detectors

- MIND is baseline for conventional 25GeV NF. Why ?
  - Based on proven technology (MINOS). Extrapolation is ~simple
  - Golden is the main channel (more statistical power)
    - Other channels have small contribution to standard oscillation physics
  - TASD and MECC are proven technologies (except for the magnet) but are limited by mass
  - LArg is still in R&D phase
- TASD is baseline for LENF
  - Low threshold and excellent resolution
  - Proven technology (NOvA) except for magnet

Far Detector (A. Cervera) 2/3

Conclusions

- MIND performance is being understood. Full simulation/ reconstruction has evolve significantly
  - Threshold is going down
  - Almost at the level of comparing with MINOS data/MC
- INO R&D going on, but missing performance study with simulations
- TASD performance should be further understood
  - Electron charge identification
  - Efficiency and backgrounds in neutrino interactions
- A lot of progress in LArg R&D, but missing performance study with simulations

Far Detector (P. Soler) 3/3

Conclusions

- Tau detector at 4000 km to be considered as no longer in the baseline (but is retained as an option for the future depending on physics opportunities)
- MIND detector at 4000 km has 100 kton mass but magic baseline detector can remain at 50 kton
- We will strive to obtain tau detection capabilities in the near detector for NSI* at source and detection, but it is going to be very tough to define an analysis because of the antineutrino charm background

Near Detector (J. Morfin) 1/

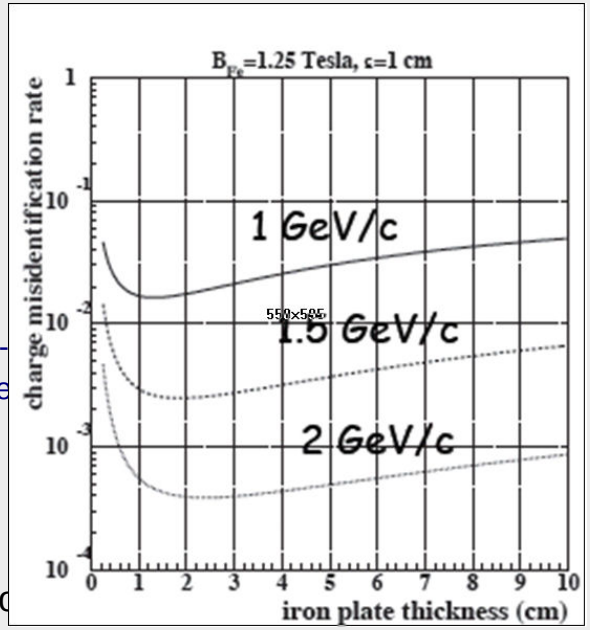
What Are the Objectives for this Meeting

- Update from Roumen on simulations for neutrino flux determination.
  - Presentation by A. Laing on flux measurement extrapolation– DPS4
- Emphasis on "other' near detector physics.
- **Joint IDS/LBNE near detector and R&D sessions to**
  - **review LBNE near detector design alternatives**
  - **Consider a collaborative IDS/LBNE R&D effort.**
- **Consider one of the LBNE near detector designs as candidate for an IDS Near Detector baseline?** We will hear about another design from Roumen.
- Formation of an IDS Near Detector group with regular meetings and distributed responsibilities.

3

Conclusions – Far Detector

- MIND
  - The Baseline is STILL the Baseline (although “baseline” may be not baseline, but something else)
    - Although 100kT
    - Detector performance will likely improve with additional work on simulation/reconstruction
  - R&D well defined and approachable
  - Reliable costing can be made
    - Final $$ may not be palatable
- Options
  - TASD
    - LENF baseline
      - However, MIND E_ν^{thresh} performance keeps improving & possibly Super-MIND (1(ish) cm plates could do even more). 100kT then approachable
    - R&D well defined
      - But not funded for Magnetic Volume
  - LAr
    - International R&D effort underway
    - Concepts being pursued in the US accommodate magnetization (nc clear for Glacier)
    - Technically looking more promising, but cost is still unknown



Conclusions – Near Detector

- Just starting – much work needs to be done
- Performance criteria are understood to a large degree
  - What needs to be measured and with what precision
- Many, many detector options
- Collaboration with Super-beam (LBNE, etc) projects will be very beneficial

Accelerator 1/ (S. Berg)

Overall Goals for this Meeting

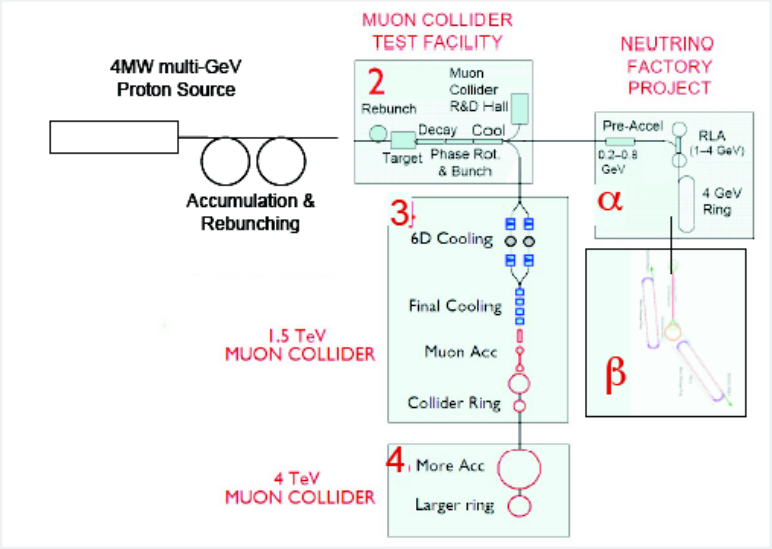
- Specify the machine we describe in the IDR
  - Specify any alternatives we will include, but
  - Stay focused on making the case for the "baseline"
- Work out plans for the IDR
  - What do we need to include there
  - Important components to study

Accelerator 2/ (J. Pozimski)

Imperial College London

Illustrative Staging Scenario

Chuck Ankenbrandt



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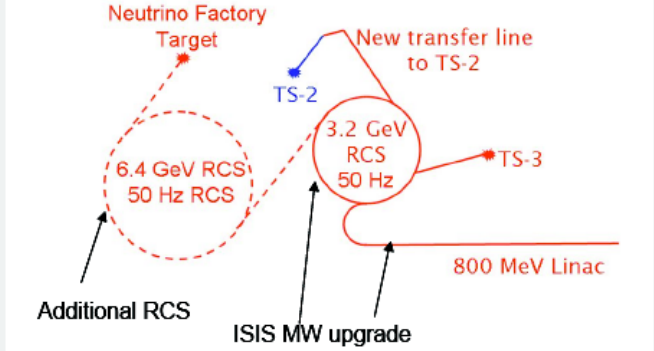
NF- Proton driver and ISIS upgrade

Jaroslaw Pasternak



- Based on MW ISIS upgrade with 0.8 GeV linac and 3.2 GeV RCS.
- Assumes a sharing of the beam power at 3.2 GeV between the two facilities
- Requires additional RCS machine in order to meet the power and energy needs of the Neutrino Factory
- Both facilities can have the same ion source, RFQ, chopper, linac, H- injection, accumulation and acceleration to 3.2 GeV

Gersende Prior

Accelerator 2/ (J. Pozimski)

Progress on Targetry

Liquid Hg jet

- energy deposition calculations in the target area (MARS) w/wo WC shield.
- working on the Hg circulation system (windows, drain, waste).
- jet distribution from nozzle simulations.

Solid target

- lifetime tests with tungsten 1-3 cm rods.
- design of a wheel system.

Simulation of particle production

- G4 toy-HARP MC, muon yield as a function of beam energy for beam < 5 GeV show no dip.
- better yield for low-Z target and low-E beam settings.

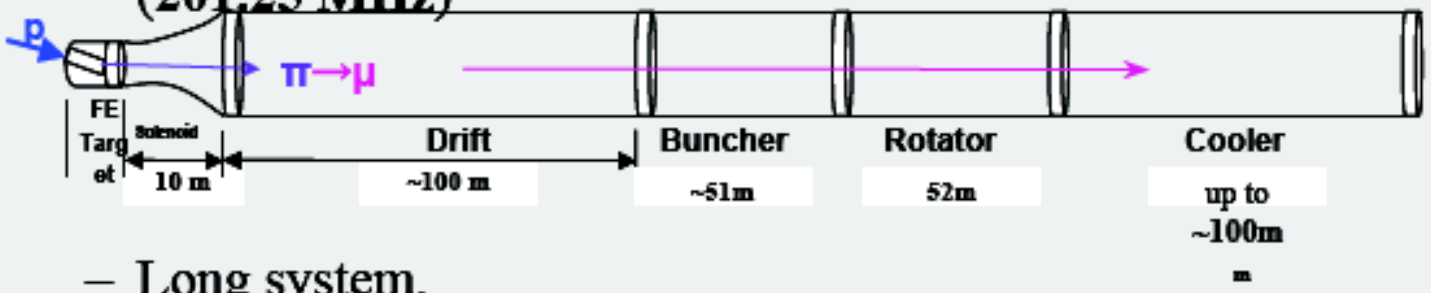
Accelerator 3/ (J. Pozimski)

Imperial College London

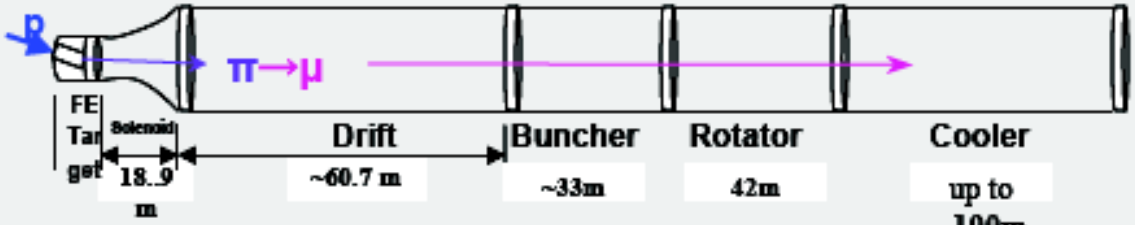
Muon front end

D. Neuffer

- ISS study based on $n_B = 18$ (280 MeV/c to 154 MeV/c)
  - Buncher 0 to 12MV/m; Rotator 12.5MV/m, B=1.75T (201.25 MHz)



  - Long system,
- Try shorter version - $n_B = 10$ (233 MeV/c to 154 MeV/c)
  - slightly lower fields (1.5T, 15MV/m)
  - Buncher 0 to 9 MV/m, Rotator 12MV/m
  - Shorter bunch train



J. Pozimski IDS plenary meeting @ Fermi Lab. 10th April 2010 , P 17 / 12

Accelerator 3/ (J. Pozimski)

Alternative scenario

Shielded RF cooling lattice (C. Rogers) *

- performance degradation study and cell length optimization.

Higher momentum beam (C. Rogers)

- acceleration cell + cooling cell (but extra RF).

44-88 MHz (old CERN)

- rotation performance reported not achieved but information on details how the code is working not available/lost.

Hybrid high-pressure RF (M. Zisman & J. Gallardo) *

- no degradation of RF performance in high-magnetici field.

- need a PoP experiment with beam (to be performed at the MTA).

* retained as alternative for the IDR

Accelerator 4/ (J. Pozimski)

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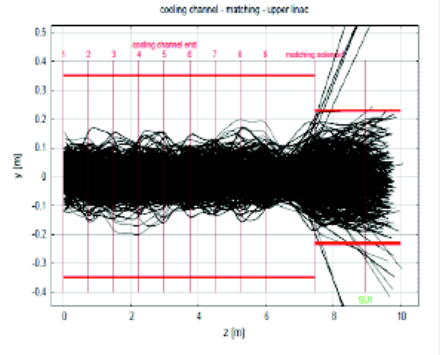
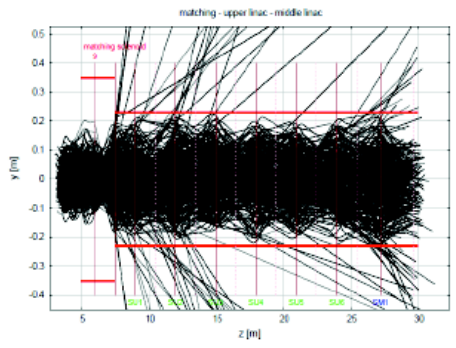
Matching from cooling to linac

A. Bogacz

cooling –> upper linac

upper –> middle linac





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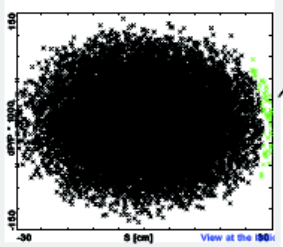
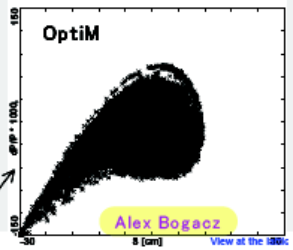
Longitudinal phase space

A. Bogacz

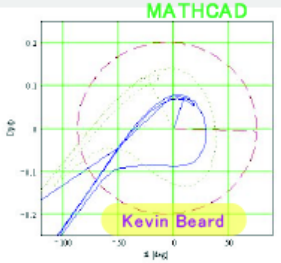
Initial distribution



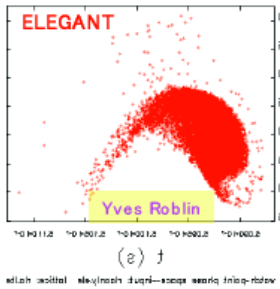
OptiM



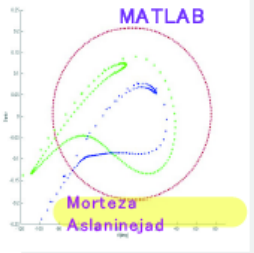
MATHCAD



ELEGANT



MATLAB



Gersende Prior

Conclusion

Content of the IDR (baseline or baseline revision versus alternative) has been decided.

Wherever R&D or study still in progress need to calculate “risk/mitigation” and make a cost estimate.

Other work need to be published as much as possible and referenced in IDR or relevant publications.

We need to identify a CERN proton-driver task leader !