

Summary: Accelerator Physics and Commissioning

- LARP mini-Collaboration Meeting

- Oct 6, 2005

Agenda: Commissioning

Accelerator Systems Break-Out

Chagall Room

Wed, 2005 Oct 5

Commissioning Discussion

1330 CTF report
1400 Beam Commissioning plans and issues
1430 LHC@FNAL (@US?) idea and plans
1500 LARP database, Web site and Data Analysis tools plans
1530 break

chair: Mike Syphers

Vladimir Shiltsev

Elvin Harms and Mike Lamm

Erik Gottschalk

Elliott McCrory

- ~20 in attendance
- 60% “talks” and 40% “talk” -- good!

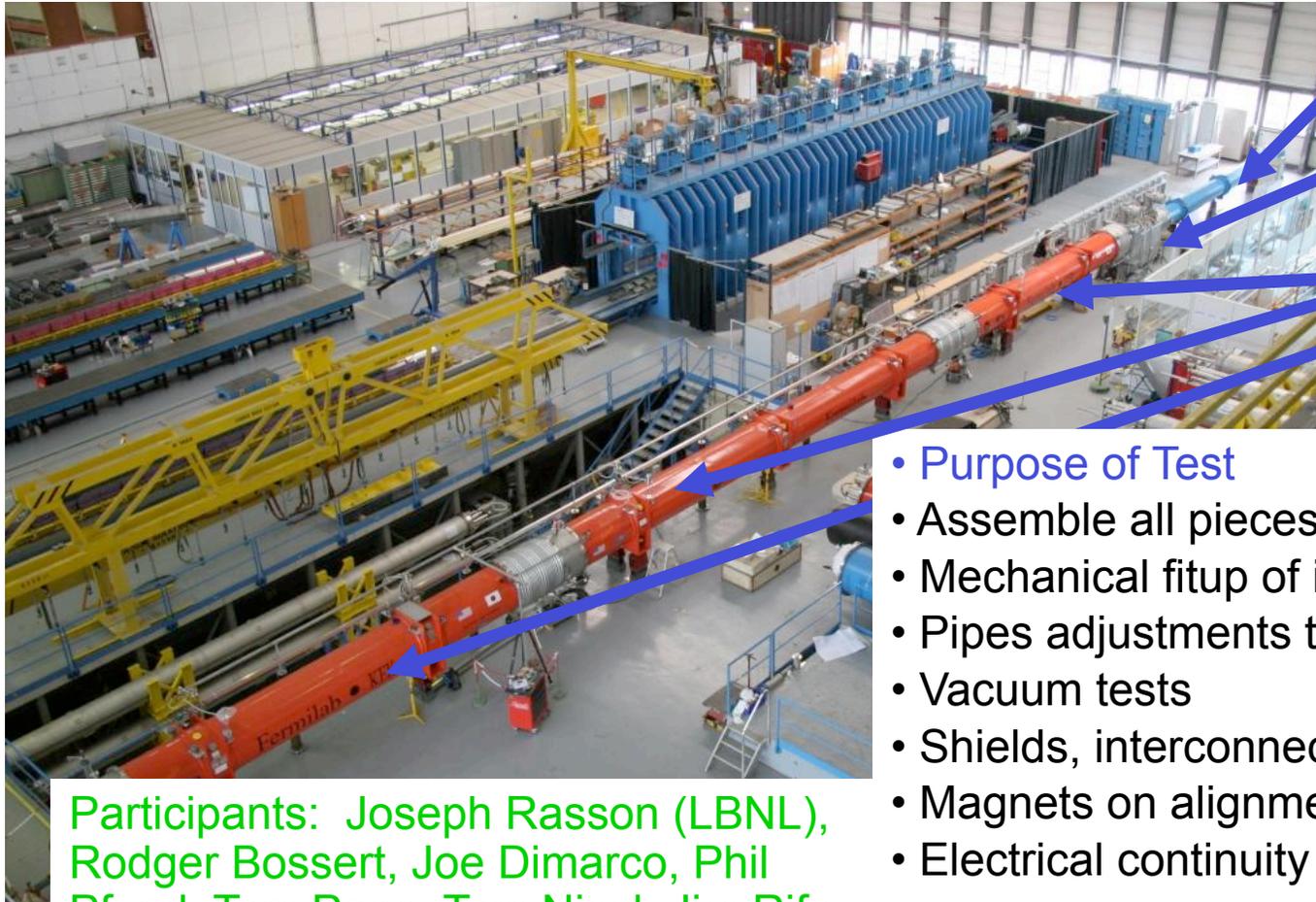
CTF Report

- Report was delivered
- Letter from CERN DG to DOE
 - Response from DOE ~positive
- DOE Labs being approached for help
 - Labs pay salaries, LARP can help with travel, cost of living, etc.
- Need for a Commissioning Oversight Team for overall coordination between all labs?

IR & HW Commissioning



Successful Above-Ground Fitup of US Deliverables LHC Assembly Building March-April 2005



• D1 (BNL)

• DFBX
(LBNL)

• Inner Triplet
(FNAL)

• Purpose of Test

- Assemble all pieces for one complete IR
- Mechanical fitup of interconnects
- Pipes adjustments to install length, dry fit
- Vacuum tests
- Shields, interconnect kits
- Magnets on alignment jacks
- Electrical continuity

Participants: Joseph Rasson (LBNL),
Rodger Bossert, Joe Dimarco, Phil
Pfund, Tom Page, Tom Nicol, Jim Rife,
Michael Lamm (FNAL)

M. Lamm



Commissioning

- Full Commissioning Task Starts Spring 2006
 - Some participation through short visits and possibly through remote monitoring (see LHC@FNAL talk)
 - Peter Limon starts 1 year stay in November 2005
 - Two additional people lined up to live at CERN in CY 2006
 - Cryogenic Expert (1)
 - Experienced in Superfluid testing of US Magnets
 - Magnet Physicist
 - Magnet powering, quench protection
- Expected Hardware Commissioning completion in Summer 2007
- Small carryover into beam commissioning to study dynamic heat loads on magnets and cryosystem (radiation damage?)
 - Important tool for design of IR upgrades



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3 @ CERN soon

IR & HW Commissioning

- IR Commissioning process in full swing
- Fermilab Tech Div willing to send 1-2 additional people beyond the 2-3 already slated for long-term CERN visit
- Fermilab Acc Div: 1-2 possible
- Next Toohig Fellow = ‘engineer’?
- Steps for further action discussed

Beam Commissioning



Beam Commissioning Issues

- Build continuous presence at CERN beginning with Injector start-up
 - Expressions of Interest
 - Identify long-term people
 - Calendar of who/when
 - Remote access (talk later today)

- Milestones
 - Hardware commissioning
 - Sector Test – Chamonix meeting, 23-27 January at Divonne
 - Injector start up
 - Sector Test
 - ...

- Budget

- Commissioning structure (evolving)
 - system support team, in particular CERN is using input provided by LARP to build teams
 - more news in coming weeks
 - Develop LARP commissioning structure



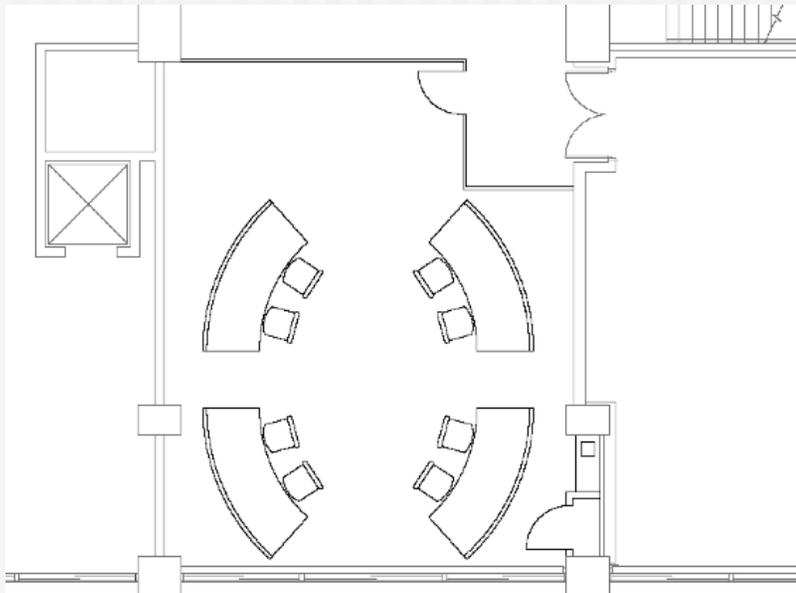
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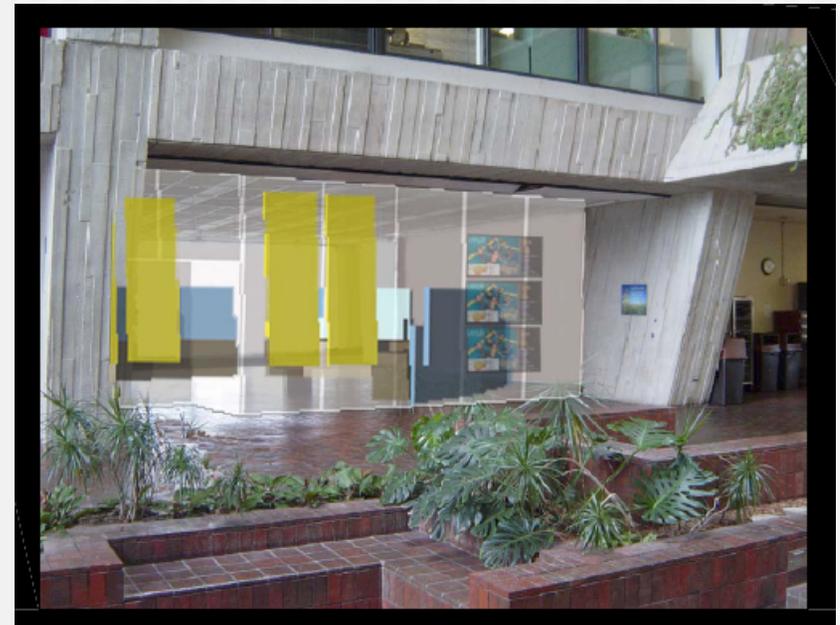
Action Item!!

LHC@FNAL

- Fermilab investigating having a remote “operations center” in High Rise, for use by CMS/LHC collaborators in the U.S.

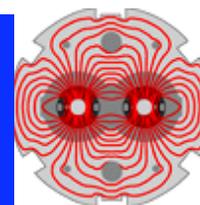


MJS
LARP Closing Plenary





What is LHC@FNAL?



LARP

- 1) **Allow experts located at Fermilab to participate in CMS and LHC commissioning and operations.**
 - Hardware and software necessary to participate effectively in CMS and LHC.

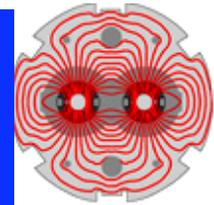
- 2) **Facilitate communication and help members of the LHC community in North America contribute their expertise to CMS and LHC.**
 - An extension of the CERN Control Centre (CCC). For example, to assist members of US/LARP in training and data analysis.
 - An extension of the CMS Control Room. For example, to provide a call center for US-CMS collaborators to access information about CMS and the LHC accelerator.

- 3) **A unique opportunity to have detector and accelerator experts in close proximity to each other solving problems together.**

E. Gottschalk

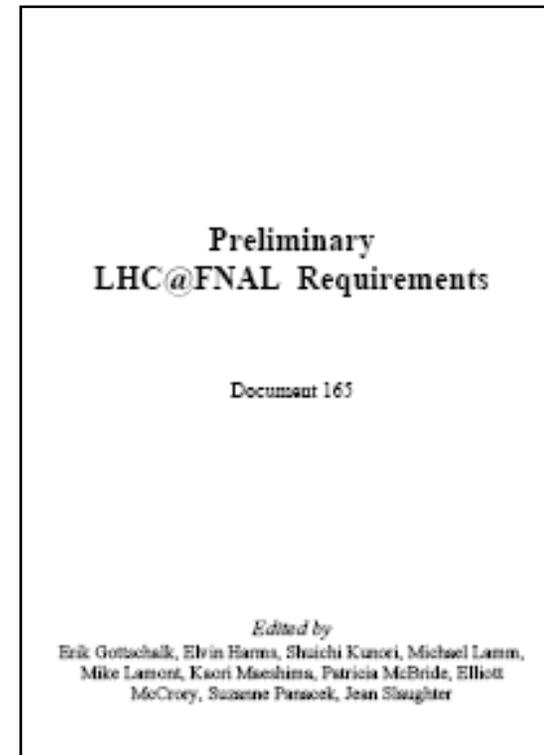


Recent Events



LARP

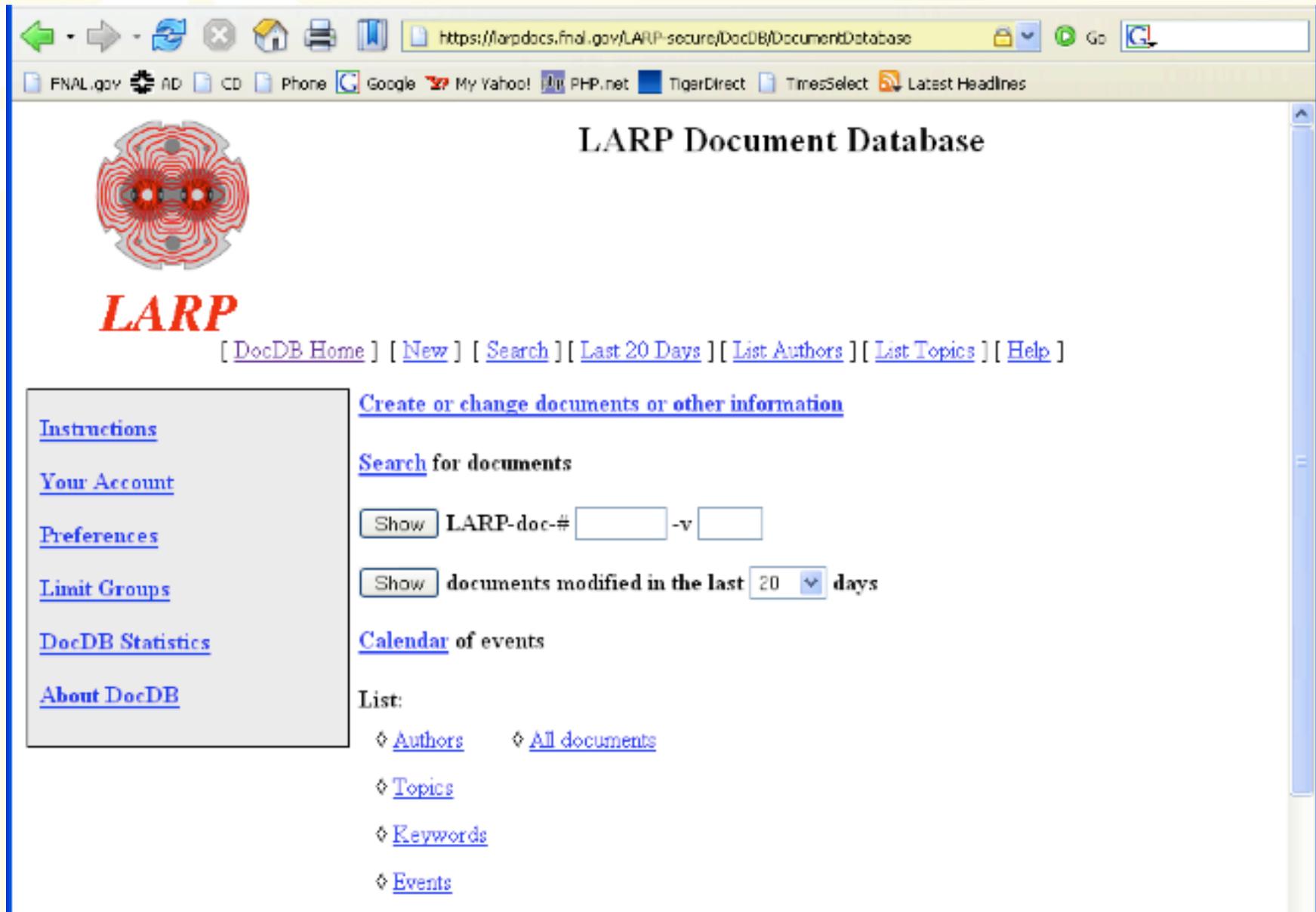
- **Requirements Document reviewed**
 - July 21, 2005
 - Revisions made in response to recommendations from reviewers
- **Document submitted to FNAL Director**
 - July 29, 2005
- **Meeting with Pier Oddone August 1st**
 - Enthusiastic response
 - ...“comprehensive document”
 - Discussed space for LHC@FNAL (FESS)
- **Presentation to CERN AB Management**
 - August 8, 2005 (presented by Mike Lamont)
 - “...project should receive some support from CERN but in view of limited benefits to us, the level of activity should be kept to a bare minimum.”



E. Gottschalk

LARP Documents and Meetings Database

LARP Doc DB: Private Access



The screenshot shows a web browser window with the URL <https://larpdocs.fnal.gov/LARP-secure/DocDB/DocumentDatabase>. The browser's address bar and toolbar are visible at the top. Below the browser, the website header features a logo on the left and the title "LARP Document Database" on the right. The logo consists of a red and black circular pattern with the word "LARP" in red below it. A navigation menu is located below the logo, containing links for [DocDB Home], [New], [Search], [Last 20 Days], [List Authors], [List Topics], and [Help].

On the left side of the page, there is a vertical menu with the following links: [Instructions](#), [Your Account](#), [Preferences](#), [Limit Groups](#), [DocDB Statistics](#), and [About DocDB](#).

The main content area on the right includes a section titled "Create or change documents or other information" with a link to [Search for documents](#). Below this, there are two search filters: "Show LARP-doc-# [input] -v [input]" and "Show documents modified in the last 20 [dropdown] days".

Further down, there is a "Calendar of events" section with a "List:" label. Below the list label are several links: [Authors](#), [All documents](#), [Topics](#), [Keywords](#), and [Events](#).

Comparison of Document Servers

	Doc types	Meetings	Admin	Conf?	Hack Resilience	Acceptance	Ease of Use
Docs DB	<u>All</u>	Sort of	<u>FNAL</u>	No	<u>High</u>	FNAL	<u>High</u> (security??)
Agenda Server	PPT PDF	<u>Yes</u>	<u>CERN</u>	No	Low	<u>World</u>	<u>High</u>
InDiCo	<u>All</u>	<u>Yes</u>	DIY	<u>Yes</u>	?	CERN	?

Commissioning Discussion

- Identify further (confirm), generate appropriate requests for candidates to go to CERN -- esp. re: Hardware Commissioning
- Discuss w/ LBNL their Engineering Internship program; possible HC tie-in?
- Shoot for 2nd Toohig Fellow = engineering?
- Develop Commissioning Oversight Team, for cross-lab commissioning efforts
- LHC@FNAL will be useful to LARP; not part of LARP
 - could open new LARP doors -- S/W, analyses, etc.
- LARP DocDB -- use it!

Agenda: Accelerator Physics

Accelerator Systems Break-Out

Chagall Room

Thur, 2005 Oct 6

Accelerator Physics Discussion

1100 IR and Beam-Beam
1120 e-Cloud Progress
1210 dB/B Monitoring Initiative
1230 Beam-beam Compensation w/ e Beam
1245 lunch

chair: Wolfram Fischer

Tanaji Sen
Miguel Furman
Vladimir Shiltsev
Xialong Zhou

- ~15 in attendance
- much discussion

IR and Beam-Beam

- Doublet Optics -- $L_e/L_r = 1.38$
 - higher chromaticity
 - symmetric optics -- no left/right cancellation
 - beam-beam -- larger L-Range footprint
 - still worth studying further
- Energy Deposition Issues
 - Dipole first vs. Quad first designs
- Beam-Beam
 - RHIC bb experiment
 - Simulations @ LBNL -- numerical noise? pursuing
 - Task proposals...

IR and Beam-beam tasks – FY06-07

■ IR design

Quad first – lowest feasible β^* consistent with gradients and apertures, field quality

Dipoles first – Triplet: β^* , apertures, gradients, field quality

Dipoles first – Doublet: explore feasibility

Extend scaling laws (JPK); gains with lower L^* , chromatic limits

Impact of D0 orbit corrector on downstream optics (with JPK)

Issues left over from IR Workshop

■ Beam-beam compensation

Phase 2: Build wire compensator, machine studies in RHIC and weak-strong simulations with BBSIM

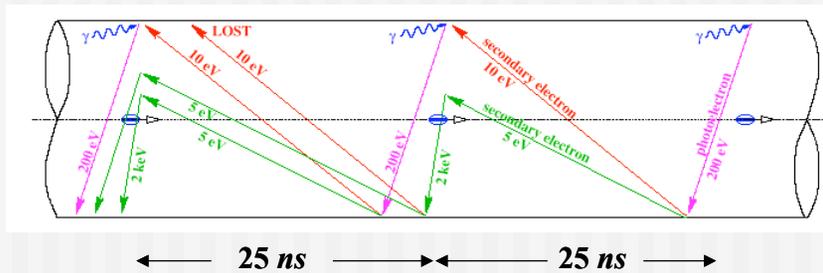
■ Strong-strong beam-beam simulations: emittance growth with swept beams (luminosity monitor), **wire compensation**, and halo formation (Beambeam3D)

■ Energy Deposition

IR designs (quadrupole and dipole first), tertiary collimators, and the forward detector regions (CMS, TOTEM, FP420 and ZDC).

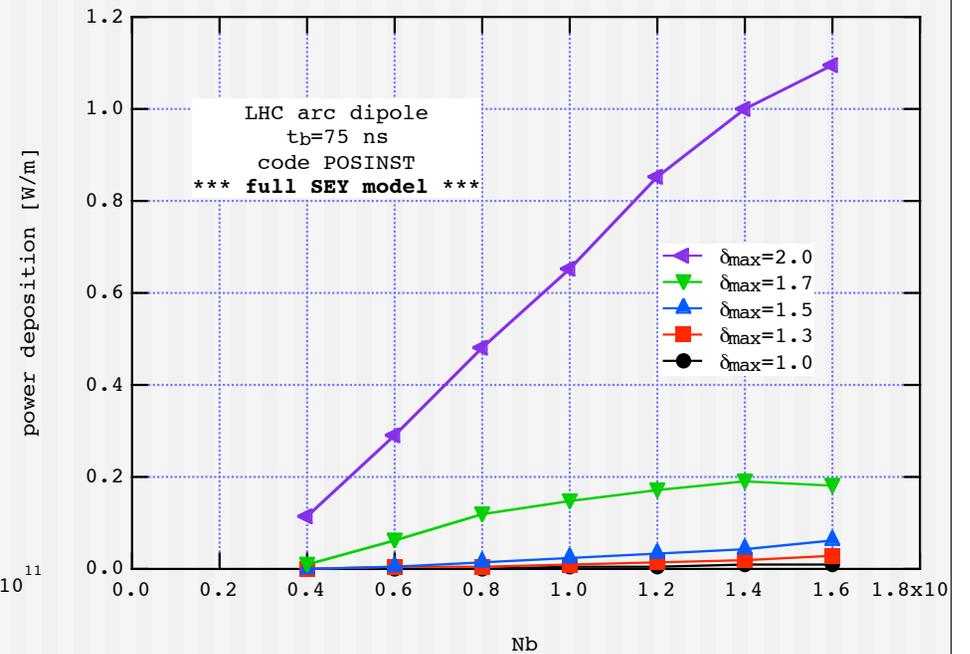
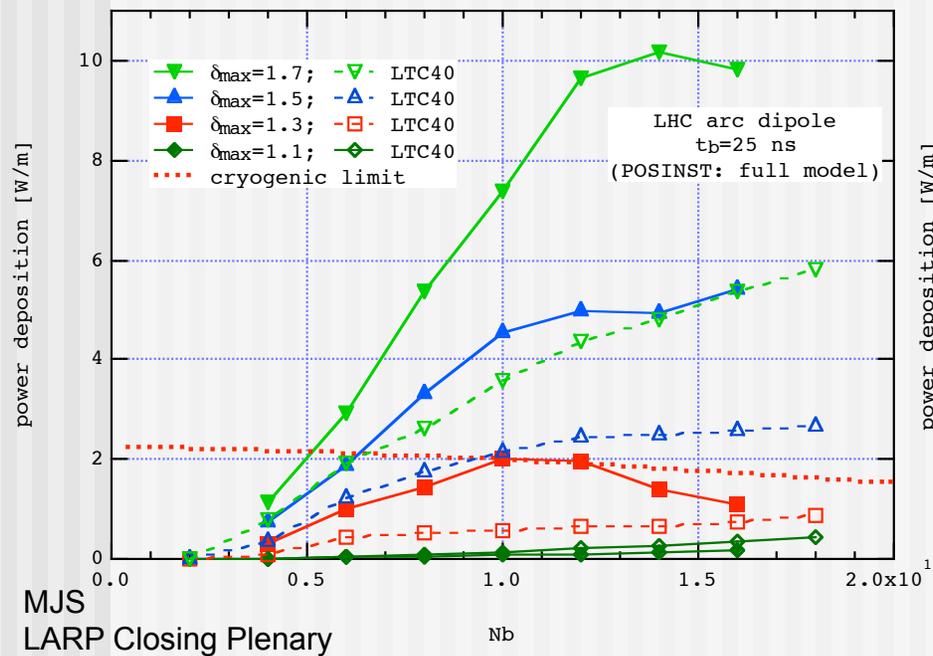
Issues left over from IR Workshop

Electron Cloud



M. Furman

No constraint on 75 ns spacing;
cryo limit ~ 2 W/m





Three components of secondary emission: sample spectrum at $E_0=300$ eV

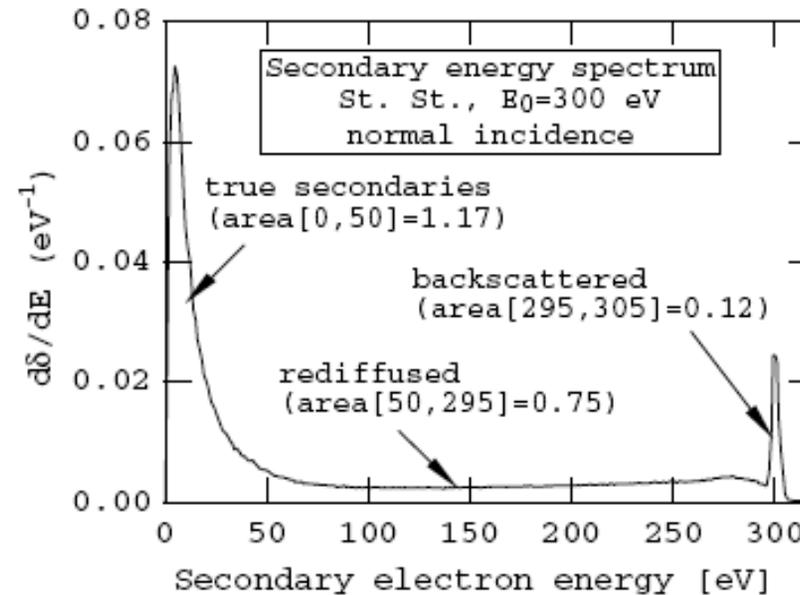


FIG. 2. A sample of the measured energy spectrum $d\delta/dE$ for an unconditioned sample of stainless steel at $E_0 = 300$ eV, normal incidence. The three components of the secondary yield are given by the values of “area $[E_1, E_2]$,” each of which represents the integrated spectrum between E_1 and E_2 . Thus for this case, $\delta_{ts} = 1.17$, $\delta_r = 0.75$, and $\delta_e = 0.12$, for a total SEY $\delta = 2.04$. The upper energy cutoff for the true secondaries is somewhat arbitrarily, but conventionally, chosen to be 50 eV. Data courtesy of R. Kirby.

from M. F. and M. Pivi,
PRST-AB 5, 124404 (2002)



Updated LHC dipole simulations: conclusions

- No problem for $t_b=75$ ns, even up to $N_b=1.6 \times 10^{11}$ and $\delta_{\max}=2$
 - In qualitative agreement with CERN results
- If rediffused electrons ignored, good agreement with CERN simulations
 - As expected (similarity of models)
 - No problem up to $\delta_{\max} \approx 1.4$ (for $N_b=1 \times 10^{11}$)
- But rediffused electrons are there
 - Our model is based on bench measurements of emission spectrum for Cu
 - Maximum acceptable $\delta_{\max} \approx 1.3$ for $N_b=1 \times 10^{11}$
- Caveats:
 - Our estimates based on 1 batch (=72 bunches + gap);
 - Steady-state estimates are higher by ~30-40%
 - Our $\delta(0)=0.3-0.5$ depending on δ_{\max} ; have not assessed sensitivity to $\delta(0)$ separately



Goals for FY05-06 (list from LARP mtg. April 05)

- LHC heat-load estimate: POSINST-ECLOUD benchmarking (*) **essentially done**
- 3D beam-ecloud self-consistent simulations (*) **ongoing**
 - Electrons, gas, ions, ...
 - Main goal: understand effects from ecloud on beam
- Analyze June 2004 SPS data (*) **ongoing**
 - Especially e^- energy spectrum
 - Constrain SEY model for better predictions for LHC
 - Benchmark CERN calculations
 - σ_z dependence
- Help define optimal LHC conditioning scenario (*) **not started**
 - Define optimal fill pattern during first two (?) years of LHC beam
- Apply Iriso-Peggs maps to LHC (*) **not started**
 - Understand physics of map simulation technique
 - Understand global e-cloud parameter space, phase transitions
- Simulate e-cloud for RHIC detectors (**) **just begun**
 - Calibrate code
 - Then predict BBB tune shift
- Simulate e-cloud for LHC IR4 “pilot diagnostic bench” **not started**
 - What to expect when high-N, low- s_b beam turns on

(*) endorsed by CERN AP group

(**) endorsed by CERN vacuum group

Other AP Discussion

- Benchmarking of Beam-Beam codes
 - look for some comparison by ~summer
- New initiatives?
 - dB/B fluctuation monitoring (V. Shiltsev)
 - beam screen fluctuations
 - electron lens initiative?
 - Can demonstrate tune footprint reduction using electron lens? (detectable at all?)

Summary

- Commissioning Discussion
 - Developed “Action Items” for Commissioning Efforts
 - 2 IR Commissioners identified, ready to go
 - For others, the bluff is about to be called...
 - Need to start advertising for 2nd Toohig
 - = engineer??
 - LARP Documents Database (+) is here/near

Summary'

■ AP Discussion

- IR work continues, with much interaction with magnet designers and with energy deposition
 - Elliptical vs. Round looks interesting; may work well with dipole first design
- e Cloud codes (CERN & LBNL) in reasonable agreement, w/o rediffused electrons
 - re-diffuse --> x2 yield
- new initiatives may be on horizon

Summary”

- While hard to discuss all in two 2-hour sessions, ...
 - OK to leave details for Full Collaboration Mtg
 - Spawned good, focused discussions of issues relevant to most/all in the room
- LARP/AS-C L2 supports interleaving format:
 - Full Collab Mtg once per year, ...
 - ... with mini-Collab Mtg interleaved