"Make more LHC luminosity, earlier"

"Use, develop & preserve unique U.S. resources & capabilities in accelerator science & technology."

Garoby at “Beam07”

Heuer at P5, 2008

Conclusion
- The pace of work is good and will accelerate in the near future.
- We have to strengthen our links with the community and establish new collaborations.

General Remarks -3-

Collaboration in network of HEP laboratories/institutes in Europe, Americas, Asia

Mandatory to have accelerator laboratories in all regions as partners in accelerator development / construction / commissioning / exploitation

Planning and execution of HEP projects today need global partnership

Use the exciting times ahead to establish such a partnership

We need You!
Strategic

1) Perform cutting edge technology in an R&D program: LARP (LHC Accelerator Research Program)

2) Implement mature (low risk) technologies in construction projects: APL (Accelerator Project for LHC)

LARP & APL have natural synergies & dynamic tensions:

Eg 1) Shared (competing?) resources

Eg 2) When is a technology mature – enough?
LARP “waiting for beam”

LARP co-ordinates/d U.S. Hardware & IR Commissioners

Uniquely talented individuals played vital roles in pre-beam commissioning (+ $$ from FNAL & CERN)!

“APL Phase-0” has already been performed (??)
  – one-off R&D beam instruments “waiting for beam”

Schottky: diagnose the statistical noise of the beam
Tune & Chromaticity Feedback: withstand big transients
Luminosity Monitors: schedule issues receding ...
“... this first initiative is to overcome currently known performance limitations ... for ... a peak luminosity of $2-3 \times 10^{34} \text{cm}^{-2}\text{s}^{-1}$ by 2013.

“The need for U.S. contributions to this initial effort is clear, since U.S. labs possess a toolbox of unique skills ...”

Top down

Total cost will not exceed $25M ($30M?)

Initial construction funding in FY10, final in FY13.

Maximum funding rate will not exceed $10M/year
LAUC proposal v0.3 (June 08) included 6 proposed tasks. Since then Magnet System Engineering has been absorbed into D1 Beam Separation Dipole & Cold Powering.

Task prioritization (Oct 13): the remaining 5 tasks have 3 priorities. In descending order:
Priority 1 – directly critical

**D1 Beam Separation Dipole** (P. Wanderer) and **Cold Powering** (M. Lamm) are the most expensive. They are most **directly critical** to “SLHC **IRP1**” IR upgrade. **Must** be delivered on schedule, in time for installation and commissioning with the other IR components.
Block diagram of the Phase 1 IR upgrade (T. Peterson)

- **Current lead box (DFX)**
- **Warm helium from leads**
- **SC link**
- **Service module (includes SC junction box)**
- **Correctors**
- **Quads**

- **Jumper connections from the DFBX-E (IR-5 left) flow schematic**
- **QRL**
  - (LHC cryogenic transfer line)
“CERN-APL Collaboration Meeting CM1” took place at CERN from Sept 29 to October 1, 2008.


A joint CERN-APL Technical Design Report will be released by about June, 2009, a key document at APL CD-2 review.

Detailed minutes on D1 Dipoles & Cold Powering are an important step to the APL CDR & CD-1 review.

Can Laser Profile Monitors & Linac4 LLRF follow (detailed) suite? Collimators?
Priority 2 – relatively inexpensive

Laser Profile Monitor &

Linac4 LLRF tasks (A. Ratti)

Would deliver unique technology to LHC injectors for brighter beams and higher luminosities.

Schedule explicitly synchronized with Phase-I IR upgrade.

The IRP1 long installation period is tied to Linac4 commissioning and its integration into injector chain.

Also note the linkage between SPL+PS2 & IRP2 schedules!

Rhetorical question: How to extrapolate from LARP/APL experience with IRP1/Linac4, to IRP2/(PS2+SPL)?
IR upgrade schedule lines up with injector commissioning

**Linac4 is in construction, PS2 is in R&D**

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**Linac4 approval**

**SPL & PS2 approval**
New Injectors – Linac4, SPL & PS2
Priority 3 – scope contingency

Collimator task (T. Markiewicz) is potentially as expensive as D1 Beam Separation Dipole & Cold Powering tasks.

NOT critically tied to the Phase I upgrade schedule.

It would be natural to contribute Rotatable Collimators to the “Phase-2 collimator” upgrade.

However, most technical collimator upgrade decisions are being deferred until significant experience with LHC beam has been acquired.

IRP1 tertiary collimators
Need decisions & plans for TDR (June 2009)

“Phase-2 collimator” review & decisions in 2nd half of February ????
The APL CDR will include technical descriptions of the proposed tasks & their scopes, so far as possible in 2008.

The CDR will include integrated cost and schedule data with a consistent set of cost-estimating rules.

It will record functional and interface specifications in as much detail as possible, so far as these can be developed in mutual agreement between CERN and U.S. collaborators.

The APL CDR will be one of the key documents to be examined in the CD-1 review, early 2009 ??

CDR lead editor is Sandor Feher
### CERN & APL milestones

#### CERN “SLHC-IRP1” Project
- **Project approval**: Dec 2007
- **Conceptual Design Report**: July 2008
- **Technical Design Report**: Summer 2009
- **String test**: 2012
- **Installation**: shutdown 2013

#### APL
Crucial assumption: **APL will be ready to achieve CD-2 in summer 2009, synchronized with the CERN TDR.**

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<td>CD-4</td>
<td>Approve Start of Operations</td>
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Summary – Oct 17 letter, Evans to Kovar:

“Each proposed [APL] contribution ... addresses essential components in the [Phase-I IR] upgrade.”

“Each lies naturally within the domain of excellence of one or more U.S. labs, & each would extend core competencies ... at the boundaries of accelerator science & technology.”

“... CERN is confident that an external technical review ... would confirm [they] ... are sufficiently low-risk, so that accurate cost and schedules planning would permit them to be part of a well-founded construction project.”

“It is vital that APL planning and technical development advances to the same level of maturity and in synchronism with the activities at CERN, in view of the technical decisions to be taken in preparing the TDR.”
Backup slides
Linac4 Project

In parallel to SLHC-IRP1, CERN is beginning to upgrade its injection chain.


Linac4 will double the brightness & intensity of the output beam, moving towards higher luminosity in the LHC (Opens the door to future injector upgrades, eg 4 GeV Superconducting Proton Linac [SPL] & 50 GeV [PS2].)

SLHC-IRP1+Linac4 provide the 2013 run with a luminosity reach 2 or 3 times greater than the nominal $10^{34}$ cm$^{-2}$s$^{-1}$.

Work is co-ordinated by Maurizio Vretenar.
LARP future technologies

**Electron lenses:** attack beam-beam directly

**Crab Cavities:** Phase-II IR upgrade?, Growing international interest, eg CARE & Japan.

**Crystal collimation:** SPS & Tev experiments UA9 & T980.

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04/2008: FNAL → MoU phase + Conf. 1

- FNAL-conf. 1 and 2
- FNAL – conf. 3 and 4

01/2008: SPS → experiment

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2008  |  2009  |  2010  |  2011

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