

S. Peggs, Interim APL Leader

“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.



**We need You!**

## 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**



# Innovative R&D versus Low risk construction?



## Strategy:

- 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 ...



# APL-1 “mission need”

Aymar to Orbach, Jan 08



“... this **first** initiative is to overcome currently known performance limitations ... for ... a peak luminosity of **2-3  $10^{34} \text{cm}^{-2} \text{s}^{-1}$**  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



# Prioritization



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

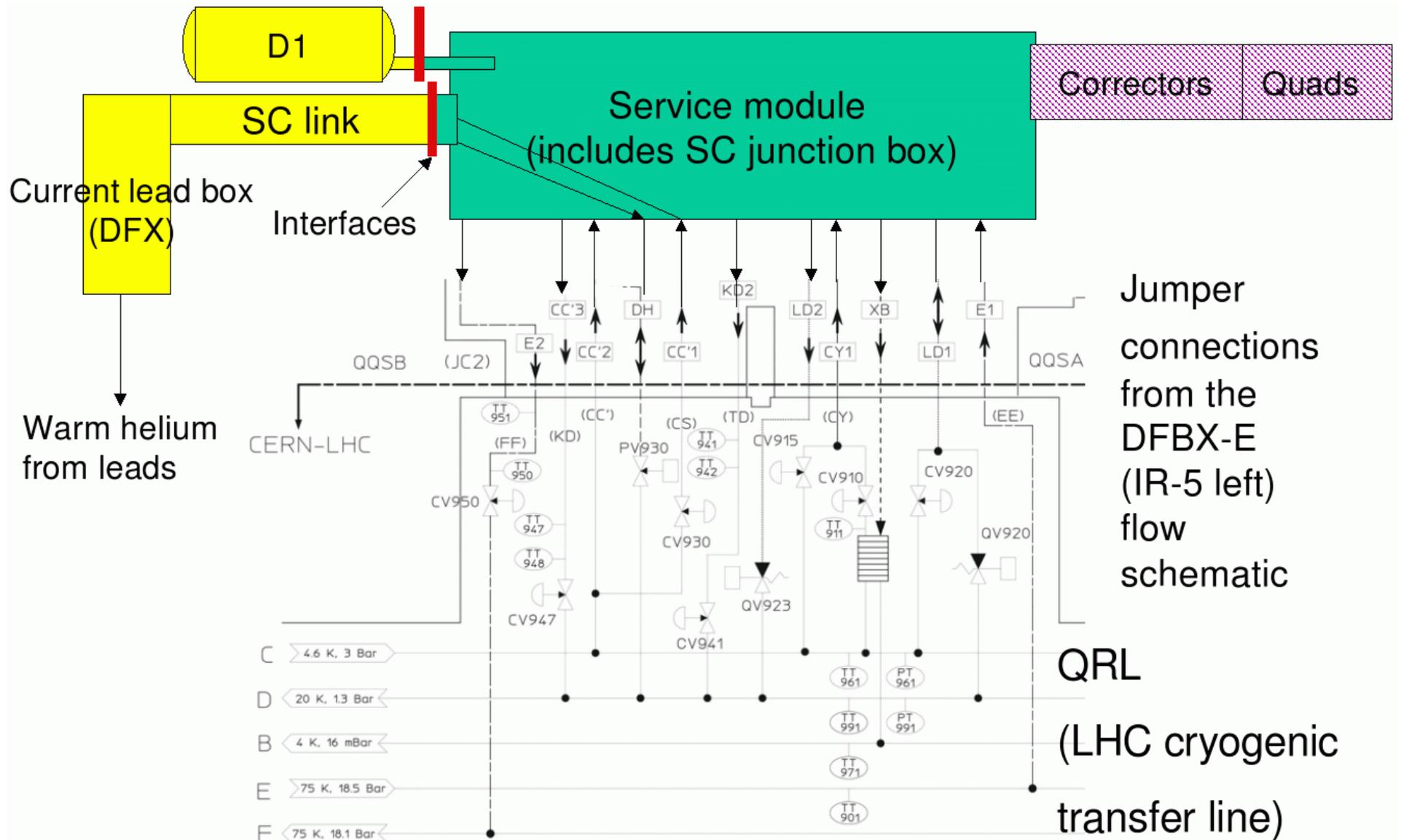
They are most **directly critical** to “SLHC IRP1” IR upgrade.

**Must** be delivered on schedule, in time for installation and commissioning with the other IR components.



# APL priority-1 components

## Block diagram of the Phase 1 IR upgrade (T. Peterson)





# LHC-APL Collaboration Meeting 1



“CERN-APL Collaboration Meeting CM1” took place at CERN from Sept 29 to October 1, 2008.

A. Ballarino, R. Denz, [S. Feher](#), P. Fessia, [M. Lamm](#), D. Nisbet, R. Ostojic, [S. Peggs](#), [T. Peterson](#), [J. Strait](#), T. Taylor, R. VanWeelderen, L. Walckiers, and [P. Wanderer](#).

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

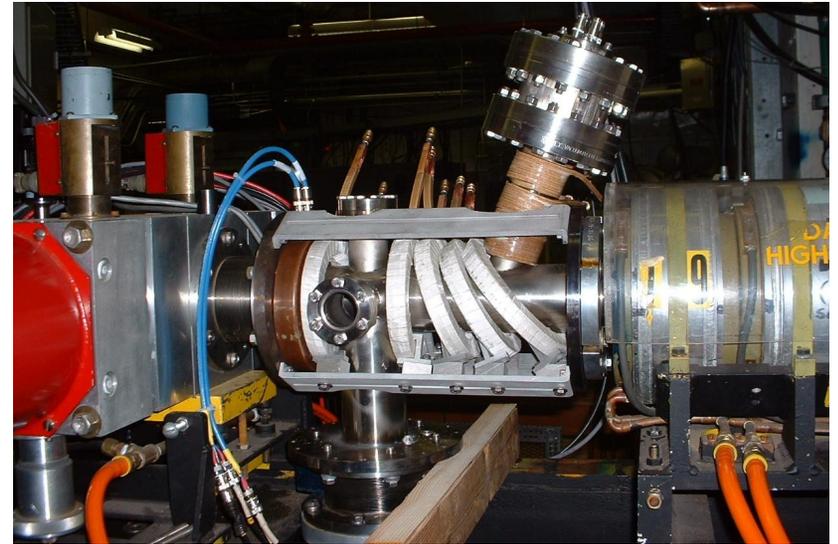
Detailed minutes on [D1 Dipoles](#) & [Cold Powering](#) are an important step to the APL CDR & CD-1 review.

Can [Laser Profile Monitors](#) & [Linac4 LLRF](#) follow (detailed) suite? [Collimators](#)?

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.

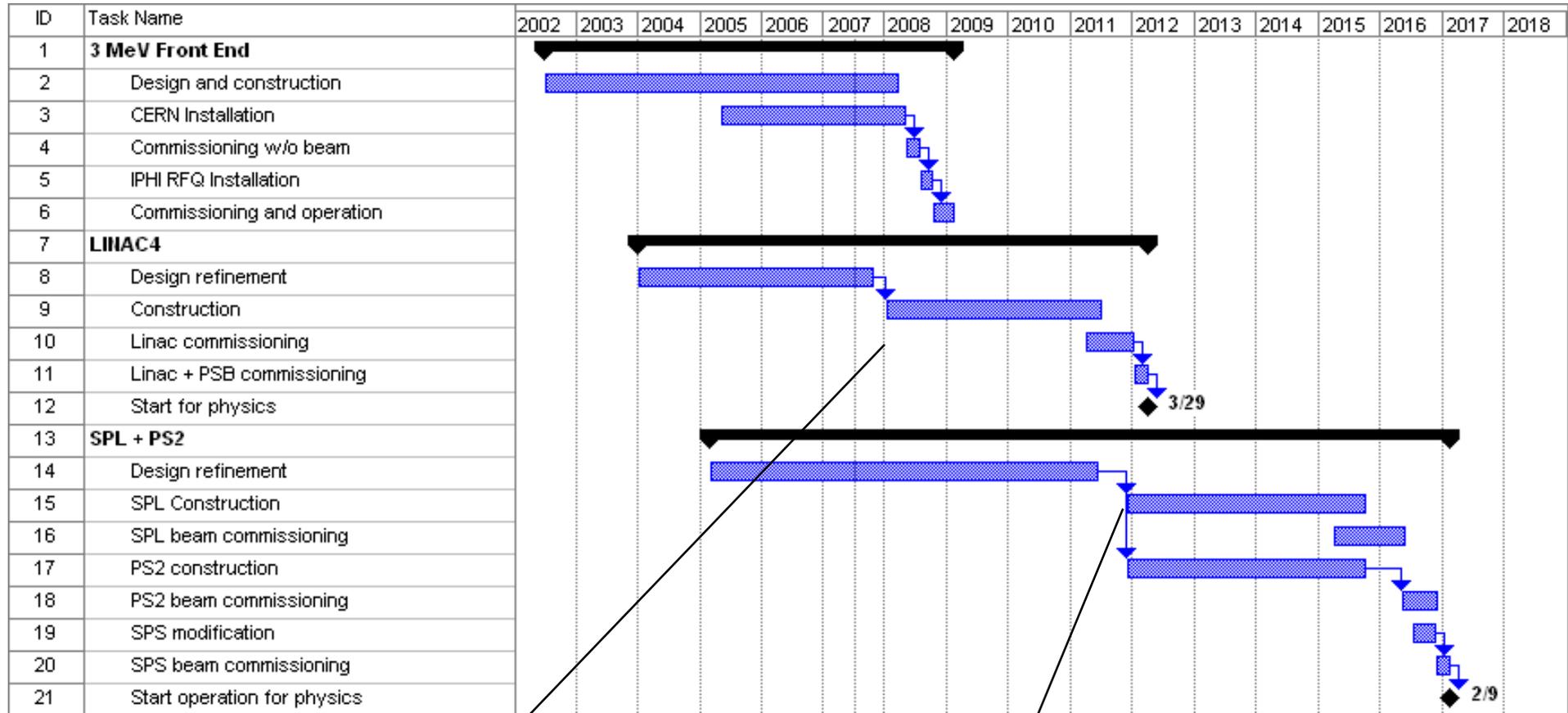
The IRP1 long installation period is tied to Linac4 commissioning and its integration into injector chain.

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

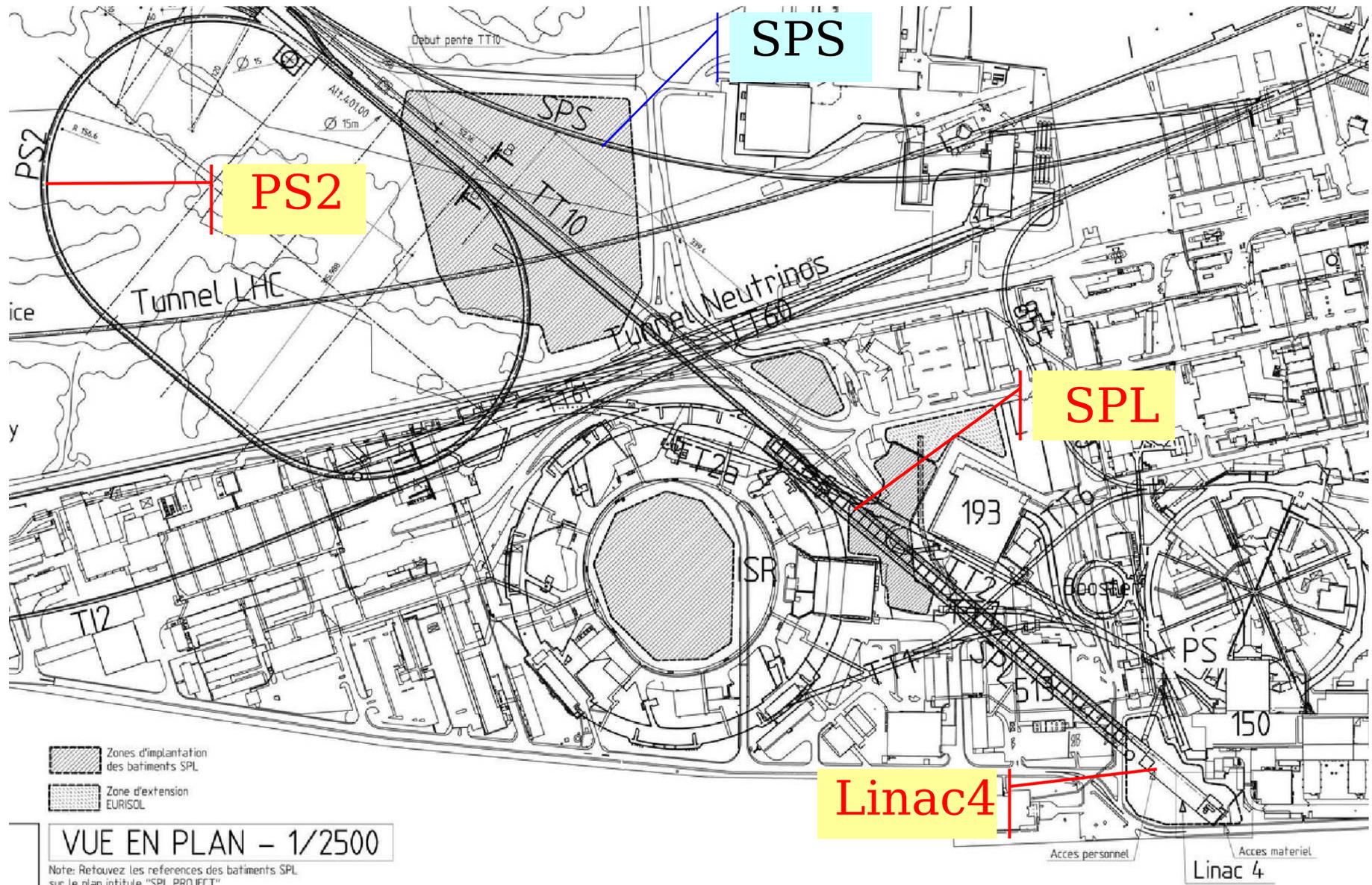
Linac4 is in construction, PS2 is in R&D



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.

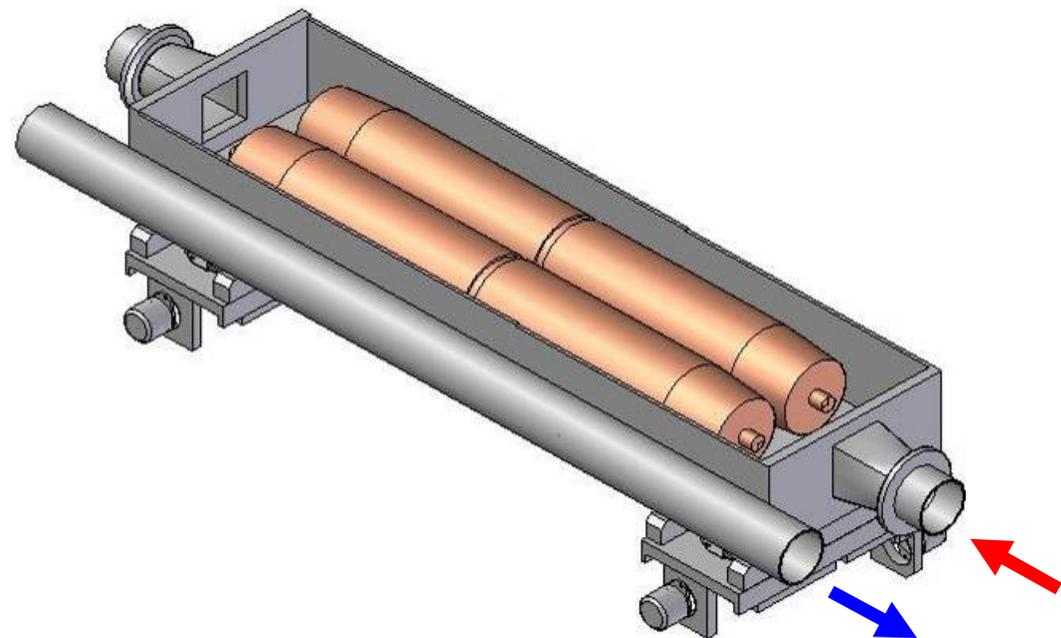
**NOT critically tied** to the Phase I upgrade schedule.

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 2<sup>nd</sup> half of  
February ???





# APL Conceptual Design Report

(Eds. S.Feher & S.Peggs)



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
<b>Technical Design Report</b>	<b>Summer</b>	<b>2009</b>
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.**

CD-0	Approve Mission Need	<b>Q1 FY09?</b>
CD-1	<b>Approve APL CDR</b>	Q2 FY09
CD-2	Approve Performance Baseline	<b>Q4 FY09</b>
CD-3	Approve Start of Construction	Q2 FY10
CD-4	Approve Start of Operations	Q4 FY12



## 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

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

Construction of the 160 MeV normal conducting H- **Linac4** started in January 2008, to be completed in 2012.

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].)

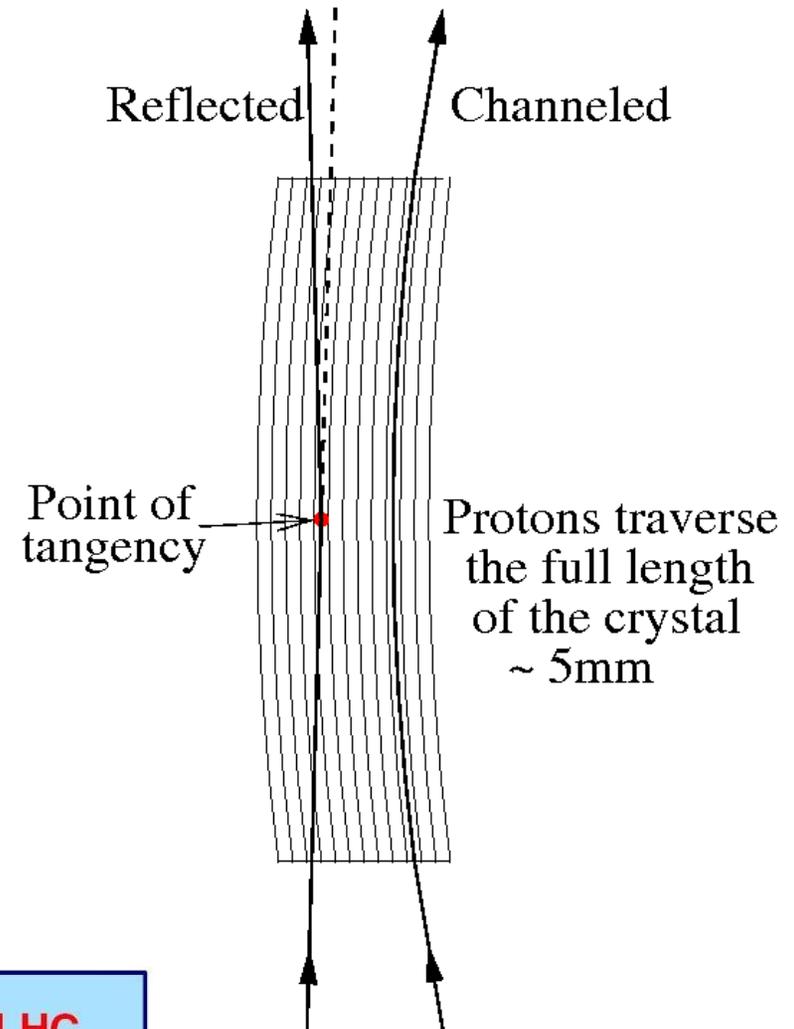
**SLHC-IRP1+Linac4 provide the 2013 run with a luminosity reach 2 or 3 times greater** than the nominal  $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ .

Work is co-ordinated by **Maurizio Vretenar**.

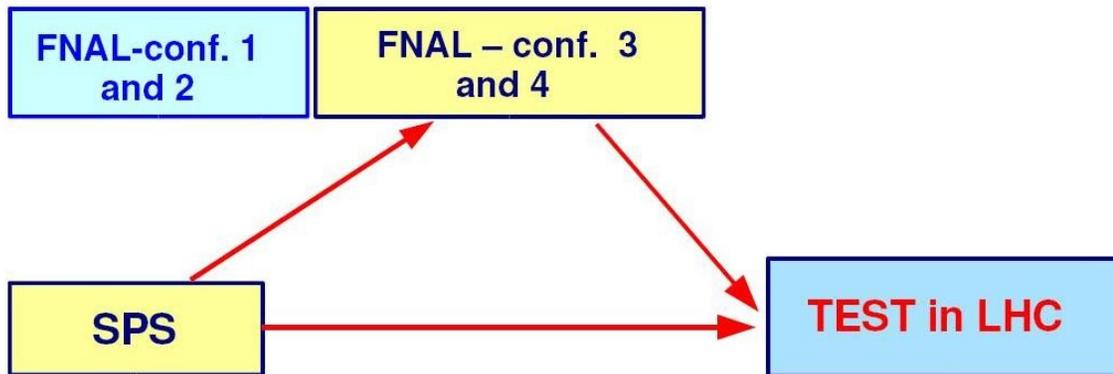
**Electron lenses:** attack beam-beam directly

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

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



**04/2008: FNAL → MoU phase + Conf. 1**



**01/2008: SPS → experiment**

