



LARP strategies

S. Peggs

Snapshot

Injector upgrades PS2, SPL

IR upgrades ~2012, ~2016

Accelerator Systems



Themes & phases

The **DG stands firm** behind 3 “White Paper themes”:

Theme-1: “**Consolidation of the .. injectors** for the LHC”

Theme-2: “**Optimization** of the LHC for the achievement of **design luminosity**”

Theme-3: “**R&D** directed towards **possible future upgrades of the luminosity**”

LARP Magnet R&D strategy aims squarely at Nb₃Sn magnets in **Theme-3 IR Upgrade ~2016**

Magnet R&D tactics may include **Theme-2 IR Upgrade ~2012?**

Accelerator Systems topics include **Theme-1 Paper Studies?**

In all cases, LARP **R&D enables accelerator component contributions**, should the U.S. so decide.



Snapshot



LQ Magnetic Structure Review

DOE Review: "... it is unclear to what extent **remnant rivalries** have been sufficiently scrubbed from the program. Such matters must not be allowed to interfere with the progress of the **magnet program.**"

DOE Review: "LARP should ... proceed with both **collar and shell**-structure designs in the upcoming LQ tests, but the conditions for the **branch point** in the LQ magnet series should be clarified by early fall 2007 through a formal technical review of results-to-date."

The LQ Magnet Structure Review, scheduled for Nov 28 & 29, will advise Wanderer & Peggs, who will certify a structure choice.

Able planning (Ambrosio) makes this more of a "**readiness review**" for a consensus plan, than a "**shoot-out**".

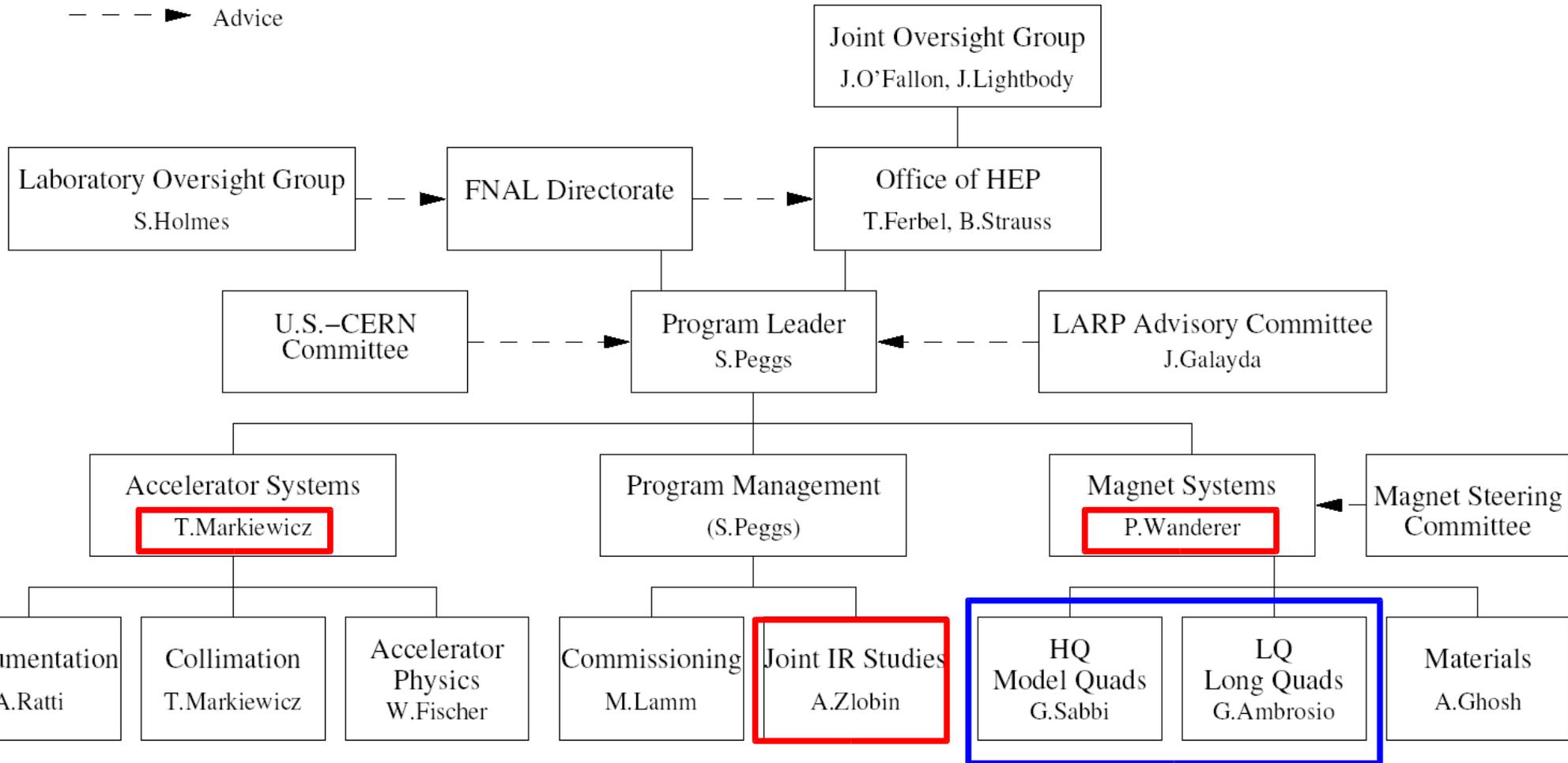


Arrivals, departures, re-structuring

US LHC Accelerator Research Program (LARP) Organization Chart

Sep 6, 2007

———— Direction and reporting
- - - - Advice



Jim Kerby replaced Limon as LARPs "Local Leader" at CERN



Top level FY08 budget

Sept 17, 2007			Total
WBS			
US LHC Accelerator Research Program			12000
1	Accelerator Systems	Markiewicz	2700
1.1	Instrumentation	Ratti	950
1.3	Collimation	Markiewicz	1050
1.4	Accelerator Physics	Fischer	700
2	Magnet Systems	Wanderer	4950
2.2	HQ Model Quadrupoles	Sabbi	0
2.3	LQ Long Quadrupoles	Ambrosio	0
2.4	Materials	Ghosh	0
3	Program Management	Peggs	2370
3.1	Administration	Peggs	1550
3.2	Commissioning	Lamm	500
3.3	Joint IR Studies	Zlobin	320
4	Contingency		1980
	Accelerator Systems		240
	Magnet R&D		1500
	Program Management		240

Take advantage of the Continuing Resolution to **fine-tune** budgets.

- **Acc Sys:** Enhanced SLAC involvement? PS2? Crystal expt?
- **Mag Sys:** "Baseline" (\$5.0M) + "Contingency" (\$1.5M)?



Injector upgrades

PS2 & SPL

Garoby's closing message at BEAM'07

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.



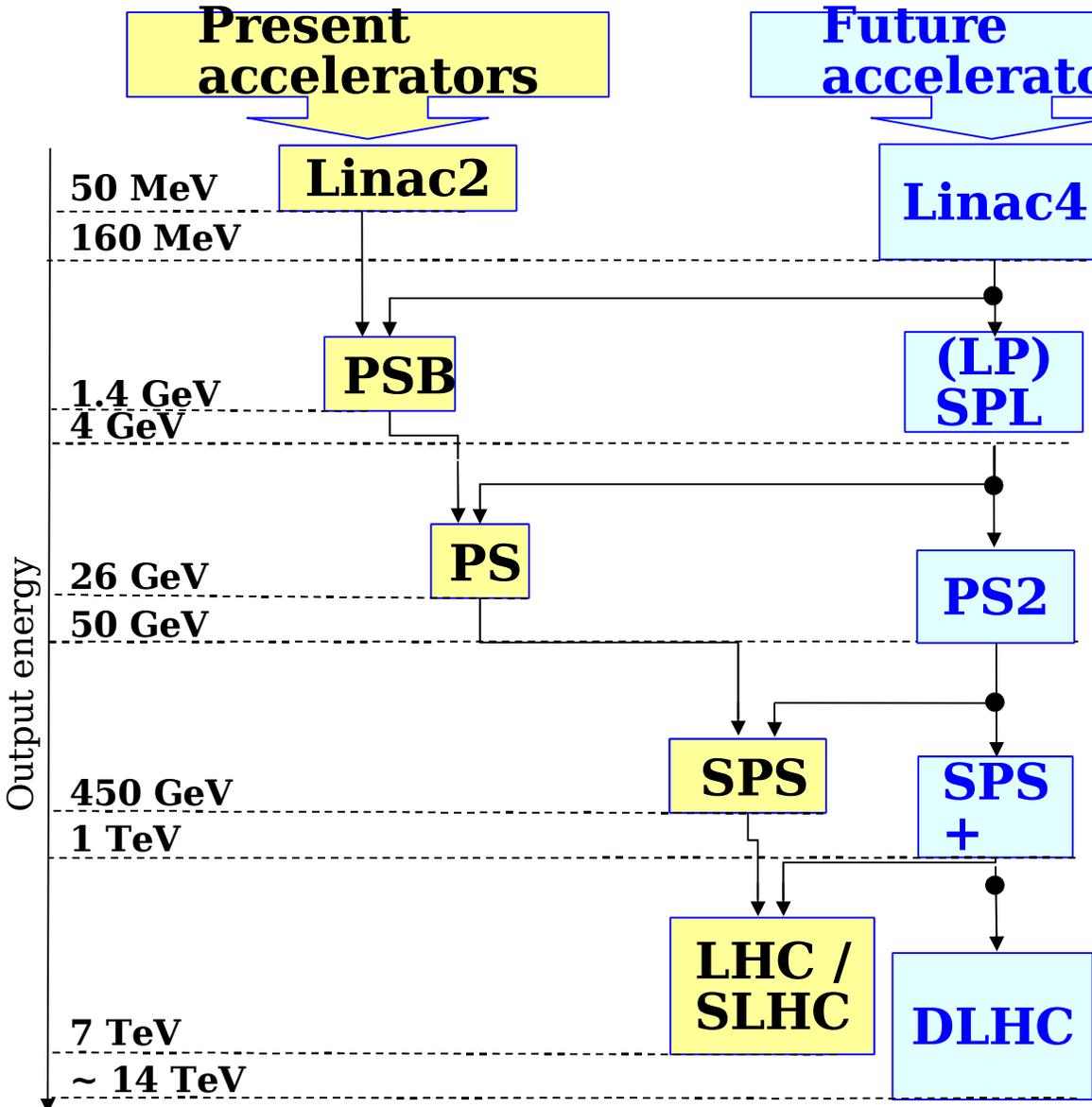
We need You!

R.G. – 2/10/2007

LHC injectors' upgrade plan

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Future accelerators



“DONE” DEAL Linac4

THEME 1

NEAR TERM FOCUS ~2012

(LP)SPL (Low Power)

Superconducting Proton
Linac (4-5 GeV)

PS2 High Energy PS

(~ 5 to 50 GeV – 0.3 Hz)

THEME 3

LUMI UPGRADE ~2016

SLHC “Superlumi” LHC

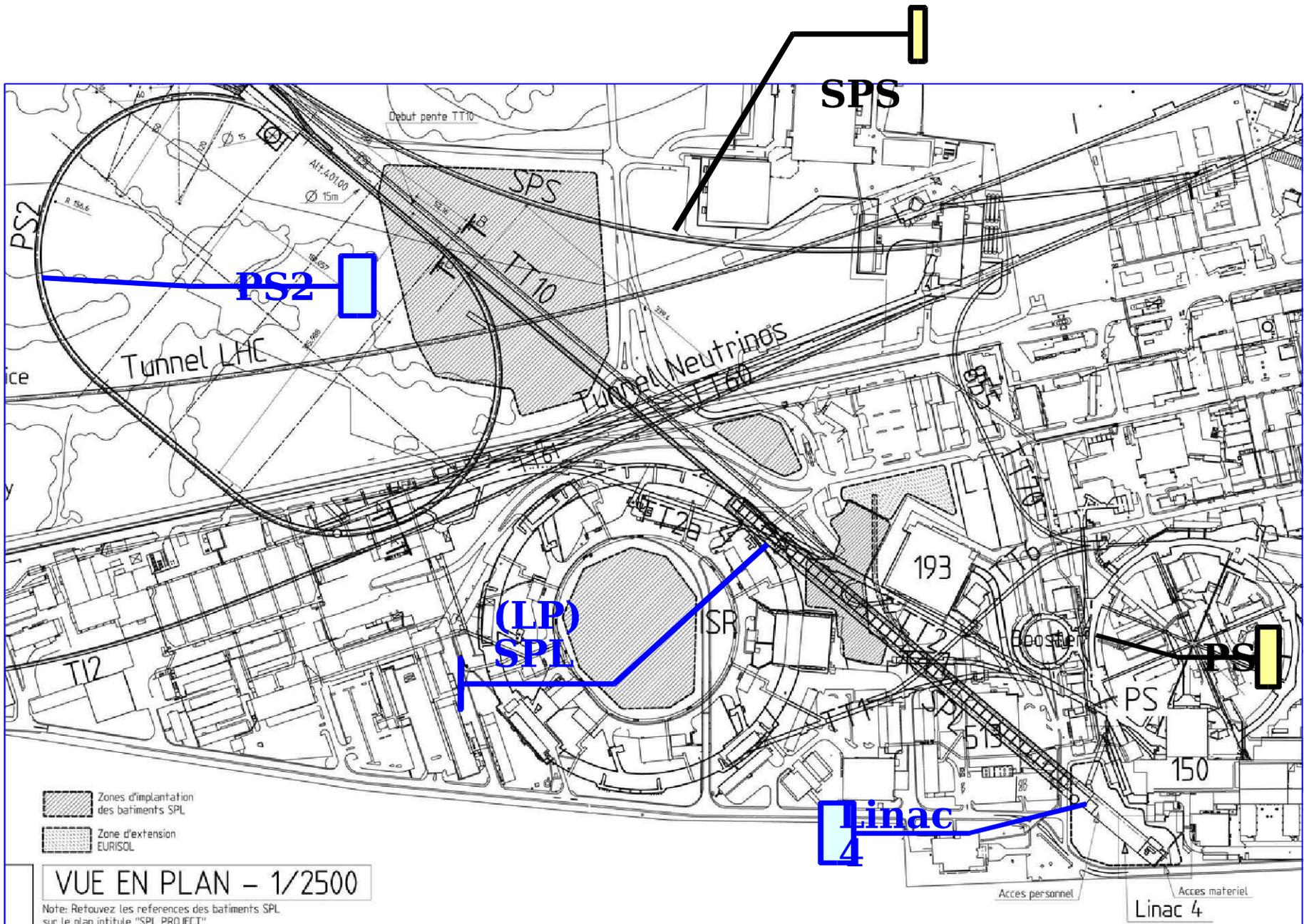
(up to 10^{35} cm⁻²s⁻¹)

LONG TERM FANTASY

SPS+ Superconducting SPS

DLHC “Double energy” LHC

SPL & PS2: a tightly linked package





PS2 & SPL

PS2

CERN asks that LARP participate in PS2 paper studies, towards a Conceptual Design Report. **The devil is in the details – what are they?**

The PS2 is technically similar to the Main Injector upgrade (with Project X), to RHIC and to J-PARC.

Perhaps **PS2 “in-kind” contributions** could be considered – perhaps not. Yes or no, modest and well focused paper-study involvement by LARP makes sense, at little or no extra cost.

SPL

The **SPL** is technically similar to the **Project X** linac, and also to the **SNS**, with hardware connections also to **ESS** & **CEBAF** &

LARP involvement in SPL would open **multiple complications**, even if simply limited to paper studies and a CDR. Eg, **add multiple new labs?**



LARP-2 ?

Hypothesis: U.S. needs a LARP-like “collaboration between U.S. DOE labs and CERN, for proton accelerator science and technology”.

Include proton-SRF, but **exclude electron-SRF (ILC) and ions.**

Benefits through co-operation on SPL R&D of common interest.

Avoid multiple parallel disconnected U.S. R&D efforts.



IR Upgrades

~2012 & ~2016



First operational Nb₃Sn quad – QA

DOE Review: “The importance of establishing closer relations between the magnet and accelerator sectors of LARP cannot be overstated, especially in view of the fact that it is not clear what should follow the completion of the LQ magnet.”

“Joint IR Studies” merges Magnet & Accelerator folk

DOE Review: “After completing the LQ program, LARP should find a way to **install an appropriate Nb₃Sn magnet** at some functioning accelerator facility.”

QA quads. Gain operational experience with an “easy” Nb₃Sn quadrupole, **well before the full Phase 2 IR Upgrade ~2016**, using existing magnet tooling if possible.

One of the JIRS goals: define and evaluate a **short list of potential QA locations** at CERN.



JIRS & the Phase-1 IR upgrade

Potential locations include (but are not limited to) **Q1 quads** in a Phase-1 “hybrid” upgrade, and quadrupoles vulnerable to accidental radiation in the **collimation region**.

D1 dipoles are a significant alternative, in a Phase-1 upgrade.

JIRS must **work closely with**:

- LARP Magnet Liaison (Rossi)
- CERN-AB & AT divisions (many)
- “LHC Insertions Upgrade Working Group” (Ostojic)

CERN will definitively state upgrade parameters, on a timescale that may be informed by, but will not driven by, the LARP magnet R&D schedule.

JIRS & LIUWG match schedules for Nb₃Sn & NbTi ?



Phase-1 IR Upgrade

DOE Review: “It would be wise for LARP to *eschew* participation in the development of the *large-bore NbTi quads* for the Phase-I upgrade of LHC IRs.”

LARP and the individual magnet labs concur.

Mantra: LARP Magnet R&D strategy focuses on the long term goal of enabling the U.S. to provide Nb₃Sn magnets for the LHC “Phase 2” IR upgrade, around 2016.



Full IR Upgrade - ~2016

Assuming a 5 year project with a flat funding profile

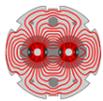
Item	Total Cost \$M	Technical Risk	Lumi Gain	LARP R&D
MAGNETS	100			
IR triplet Nb3Sn quads	90	Low	High	Ongoing
Slim magnets in detectors	10	Low	Moderate	FY08+
Magnetized TAS absorbers	-	Moderate	Moderate	
BEAM-BEAM COMPENSATORS	4			
Electron lenses for head-on	3	High	High	FY08+
Wires for long range	1	Low	Moderate	Ongoing
Small angle crab cavities	-	High	Moderate	Prelim.

Notes:

- **Triplet quads:** “low risk” assumes LARP R&D success in 2009.
- **Slim magnets:** ongoing discussion of scenarios at CERN.
- **Electron lenses:** R&D with beam at TeV & RHIC to lower risk.
- **Crab cavities:** back up plan for worst case beam-beam scenario.



Accelerator Systems



Crab cavities

DOE Review: “The crab cavity effort seems well matched to the LARP program, and **should be given sufficient resources** to move forward.”

LARP cannot currently afford a major involvement

Initial **JIRS** activities do not include crab cavity issues, although:

- LARP participates lightly in a **broad crab cavity collaboration**
- CERN enthusiasm is mounting, even for **in-kind contributions**
- A crab task may be added to JIRS, eg in **FY09**.

Advanced Energy Systems (Long Island) submit an **SBIR** proposal

Calaga has joined the Program Committee of the **Shanghai** workshop (2008) to help merge “**deflecting cavity**” (light source) and **crab** (ILC, LHC) topics.



Long Term Visitors

LARP presence at CERN is shifting from “Hardware & IR Commissioning” to “Beam Commissioning” (short term) and “Long Term Visitors”

Limon is evolving the LTV program, building on the solid foundations left by Syphers and the LTVAC.

There is a mature list of LTV candidates (including Peggs).

Issues for discussion at Collaboration Meeting 9:

1. How to recruit more qualified candidates;
2. Dealing with the problem of an uncertain schedule;
3. What areas we should concentrate on;
4. Practical help and financial ground rules.



Crystal collimation experiment - Tevatron

Fermilab AAC: “The committee supports ... the unique opportunity ... to confirm the **accelerator science**, and to build a case for an LHC implementation of a **collimation scheme that incorporates crystals** as a key component.”

“[This experiment] could **revolutionize collimation systems** in the LHC and other future accelerators.”

How to add North Americans to an **expanded collaboration?**

Co-PI's Mokhov & Scandale are constructing an **LoI** to be delivered to Holmes, simultaneously establishing the name list and the “constitution”.

Debate continues about the need for **Roman Pots & single particle tracking** capabilities.

Ready for installation in the next Tevatron down period?



Summary



Increased U.S. Involvement?

CERN presses for increased U.S. involvement in the upcoming injector upgrades, and for other LHC accelerator components:

LARP should pursue details of a modest involvement in PS2 paper studies, which could enable accelerator component contributions.

Crab cavities prosper despite LARPs benign neglect?

One idea being floated is for LARP to construct 5 Nb₃Sn quads for the Phase-1 IR upgrade ~2012 ?

Taking up this challenge would be an important step towards the highest performance quads for the Phase-2 IR upgrade but it cannot be taken within current budget guidance.

LARP must move with “speed but not haste” to present expanded possibilities to the DOE.