LARP PS2 Task

U. Wienands

SLAC

Introduction

- 1st Interest in subject came up at CM10
  - UW was asked by ASAC to coordinate a LARP effort
- At CM11:
  - We identified the areas for collaboration
  - each lab presented it interest.
    - 7 proposals involving all 4 LARP labs
- At CM12:
  - 6 subtasks, 3 of which actively working
  - all 4 LARP labs involved

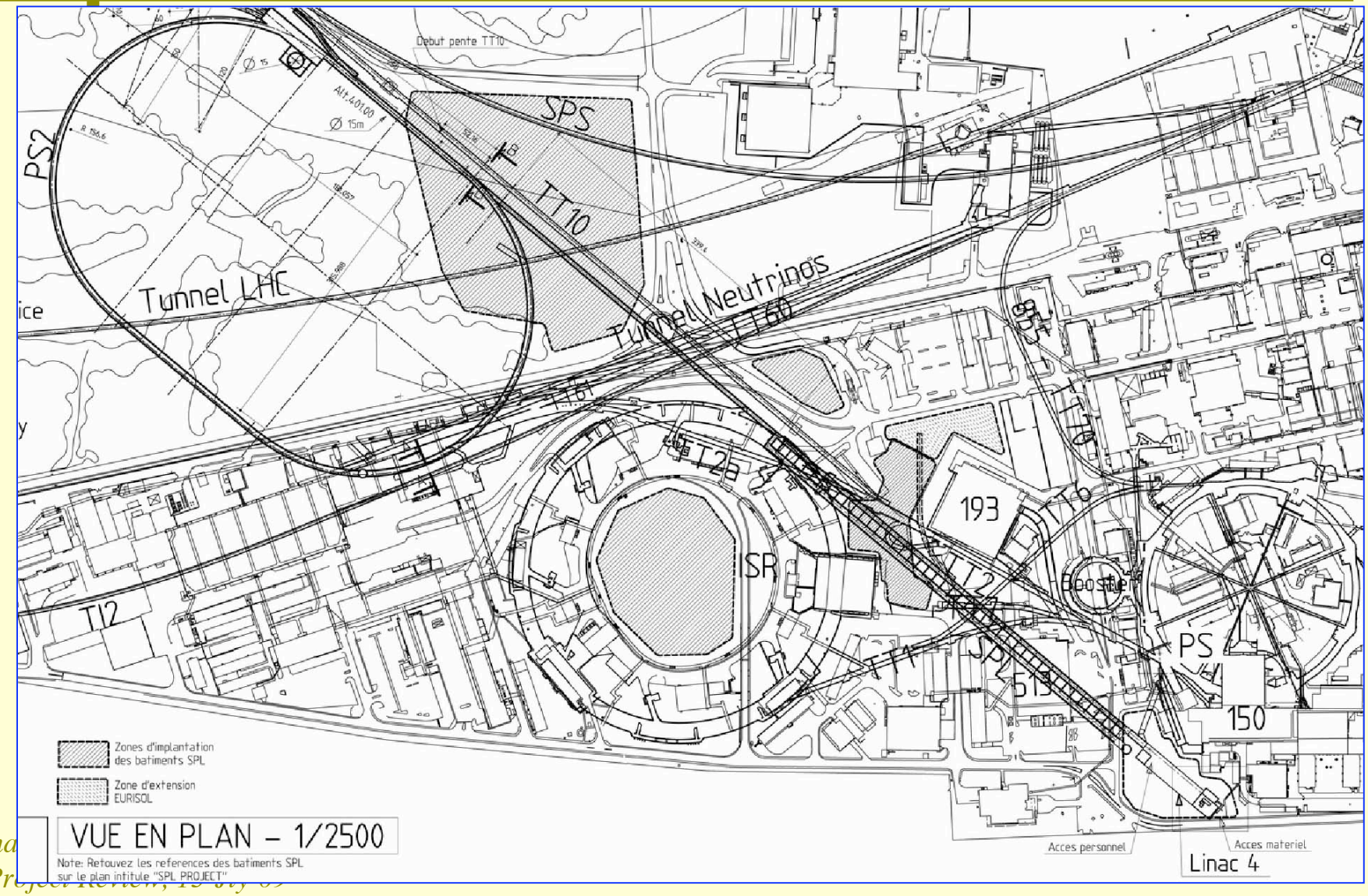
Why PS2?

- PS2 is a crucial element in the LHC upgrade plans
- There is a lot of synergy with labs' efforts:
  - Project X
  - SciDAC (COMPASS): LBNL, FNAL
  - *e*-cloud (LBNL, SLAC)
  - Beam diagnostics (BNL)
- It appears clear that new accelerator efforts are now mostly international
  - e.g. *SuperB* in Italy
  - e.g. Project X
- There is a clearly expressed need by CERN to help with the upgrade designs

Synergies to other Programs

- Project X:
  - MI upgrades face similar issues as PS2:
    - *e*-Cloud
      - FNAL-SLAC collaboration on coating development
      - FNAL-LBNL collaboration in physics understanding
      - CERN development of carbon coating
    - Space-charge issues
      - FNAL-LBNL collaboration (SciDAC)
- BNL is developing IPM technology directly applicable to PS2 (and Project X as well)
- $e^-(e^+)$: ILC DR; SuperB (SLAC-LNF Frascati, IT)
  - *e*-cloud investigations & understanding
  - TiN coating experience at PEP-II
  - Bunch-by-bunch feedbacks, PEP-II simulation codes

LHC Injector Upgrades



CERN PS2 Study Contacts

- M. Benedikt, PS2 Study Leader
  - Y. Papaphilippou (lattice, beam dynamics)
  - B. Goddard (injection, extraction)
  - W. Bartmann (H^- stripping, ph. sp. painting)
  - G. Rumolo (e-cloud, collective effects)
  - E. Jensen (rf system)
  - E. Mahner (vacuum system)

CERN Near-Term Schedule

from
O. Brüning

Priorities			2010				2011				2012				2013				2014			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	LHC Operation assumed	O	O	O	O	O	Sh	Sh	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	O	O
1	SPS operation and exploitation	O	O	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	O	O
1	PS Operation and Exploitation	O	O	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	O	O
1	Booster Exploitation and Operation	O	O	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	O	O
1	Source/LINAC2 op and exploitation	O	O	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	Sh	Sh
	Linac3/LEIR/Ions Operation	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	O	O
1	LHC 3-4 magnet repair for spares		C	C	C	C																
1	Consolidation all accelerators	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
2	LINAC4 assumed	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	Sh	Sh	Sh	O	O
2	Inner Triplets assumed	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	Sh	Sh	Sh	O	O
1	AD assumed	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	Sh	Sh	Sh	O	O
1	AEGIS		C?	C?	C?	C?		O?	O?	O?		O?	O?	O?		O?	O?				?	?
1	ELENA						??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
1	CNGS	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	Sh	O	O
1	East Hall (PS)	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	Sh	O?	0?
1	ISOLDE (REX)	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	Sh	O?	0?
1	nToF	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	Sh	O?	0?
1	North Area (Compass etc)	Sh	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	O	O	O	Sh	Sh	O?	0?
2	CAST/OSQAR	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
2	CTF3 Operation	O		O	O	O	O	O	O?	O?	Sh	O?	O?	O?	Sh	O?	O?	O?	Sh	O?	O?	O?
2	CLIC/ILC	St	St	St	St	St	St	St	*St?	St?	Td?	Td?	Td?	Td?	Td?	Td?	Td?	Td?	Td?	Td?	Td?	Td?
2	Collimation Phase 2	St	St	St	St	St	St	St	St	St	C?	C?	C?	C?	C?	C?	C?	C?				
2	PS2 Study	St	St	St	St	St	St	St	St	St	St	St	*									
2	PS2 Construction														C?	C?	C?	C?	C?	C?	C?	C?
2	SPL (LP)	St	St	St	St	St	St	St	St	St	St	St	*									
2	SPL Construction														C?	C?	C?	C?	C?	C?	C?	C?
3	HIE ISOLDE										C?	C?	C?	C?	C?	C?	C?	C?	C?	C?	C?	C?
3	High Field Quadrupoles R&D	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St
3	Medical Applications		St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St	St
3	Radiation Facilities (HiRadMat)						C?	C?	C?	C?	C?	C?	C?	C?	C?	O?	O?	O?	Sh	Sh	O?	O?

scarcity of protons

U. Wienands, SL
LARP Project Re

Present State

- 3 subtasks are actively working
  - Space-charge tracking, *e*-cloud and impedance/instabilities
- 1 subtask is ready pending more detail of PS2
  - bunch-by-bunch feedbacks
- We have an infrastructure for information exchange
  - PS2 Wiki (CERN, R. de Maria [Toohig Fellow@BNL])
  - PS2 Web area (SLAC, TWM & UW)
- We meet regularly, usually with CERN attendance
  - Y. Papaphilippou, W. Bartmann, G. Rumolo et al.
- ≈ 2/year direct discussion UW <–> M. Benedikt.

PS2 Wiki

R. de Maria, Y. Papaphilippou

You are here: TWiki > Main Web > TWikiUsers > RiccardoDeMaria > PS2Collaboration r23 - 08 Apr 2009 - 21:07:39 - RiccardoDeMaria

PS2 collaboration page

This is a page for exchanging information on the PS2 within CERN and LARP.

Feel free to edit or add additional informations. In order to edit the page is necessary to register at Registration using CERN credential. External user may get an account going to the External account registration.

Tentative Machine Parameters 2009-04-02

Circunference	m	1346.4
Harmonic Number		180
Number of bunches		168
Bunch spacing	ns	25
RF Frequency	MHz	40
Transition gamma		35i
Injection Energy	GeV	4
Extraction Energy	GeV	50
Max Bending Field	T	1.7
Max Gradient	T/m	18
Ramp time	s	1.2
Cycle time	s	2.4

PS2 Meeting Announcements

Minutes attached to most of these

Indico [PS2 Studies]

http://indico.fnal.gov/categoryDisplay.py?categId=115

Uli Wienands' Home Page | Accelerator Department H... | LARP CM12

PS2 Studies

Events in this category:

2009

July 2009
- 09 LARP PS2 Meeting

May 2009
- 28 LARP PS2 Meeting

April 2009
- 02 LARP PS2 meeting

March 2009
- 26 LARP PS2 meeting
- 19 LARP PS2 meeting
- 05 LARP PS2 meeting

February 2009
- 26 LARP PS2 meeting
- 05 PS2 meeting

January 2009
- 15 PS2 meeting

2008

December 2008
- 18 LARP PS2 meeting
- 04 PS2 meeting

November 2008
- 17 PS2 meeting

October 2008
- 06 PS2 meeting

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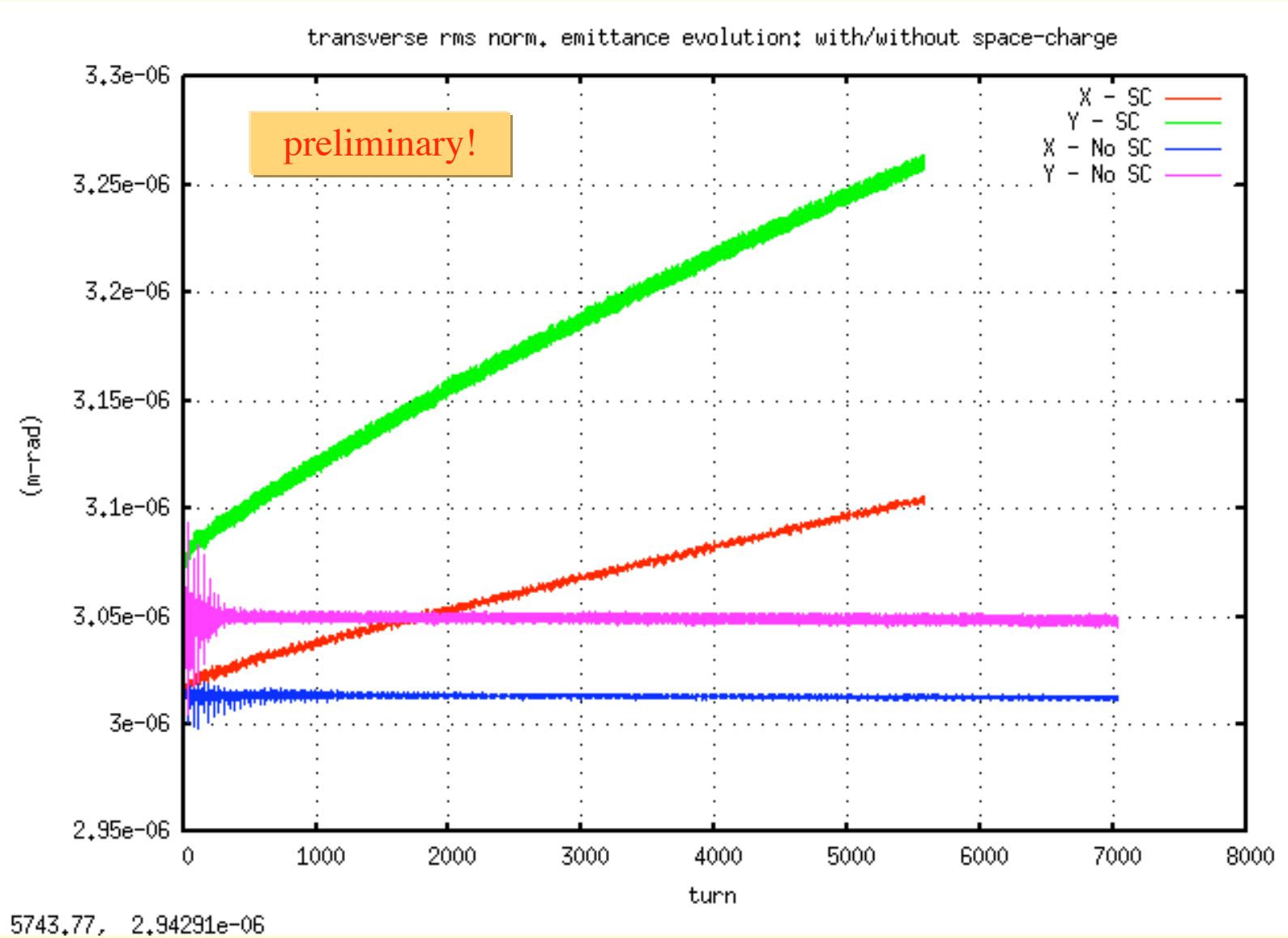
Example: Space-Charge Tracking

J. Qiang



Example: *e*-Cloud build-up

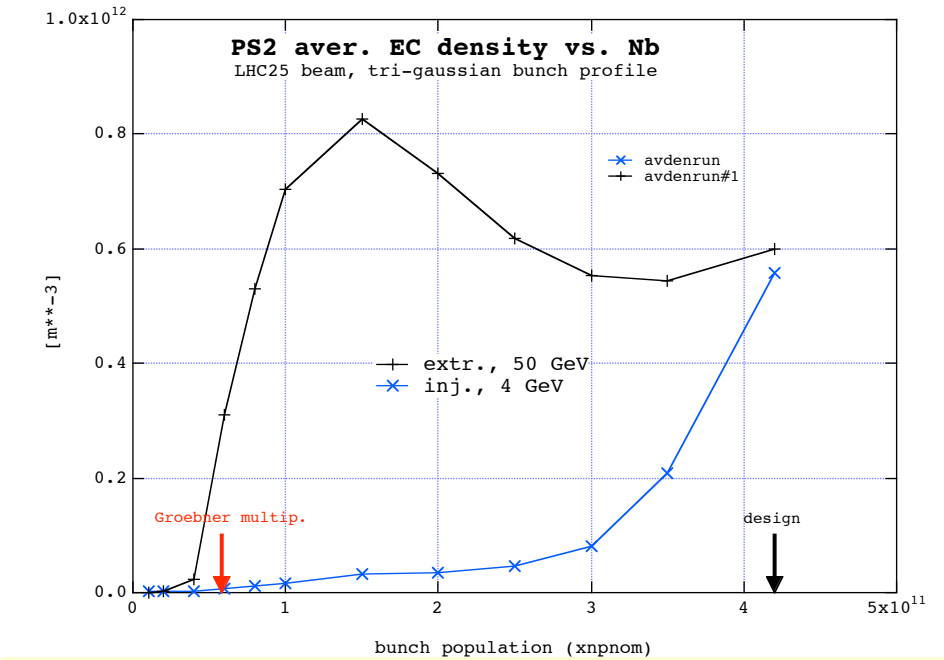
M. Furman

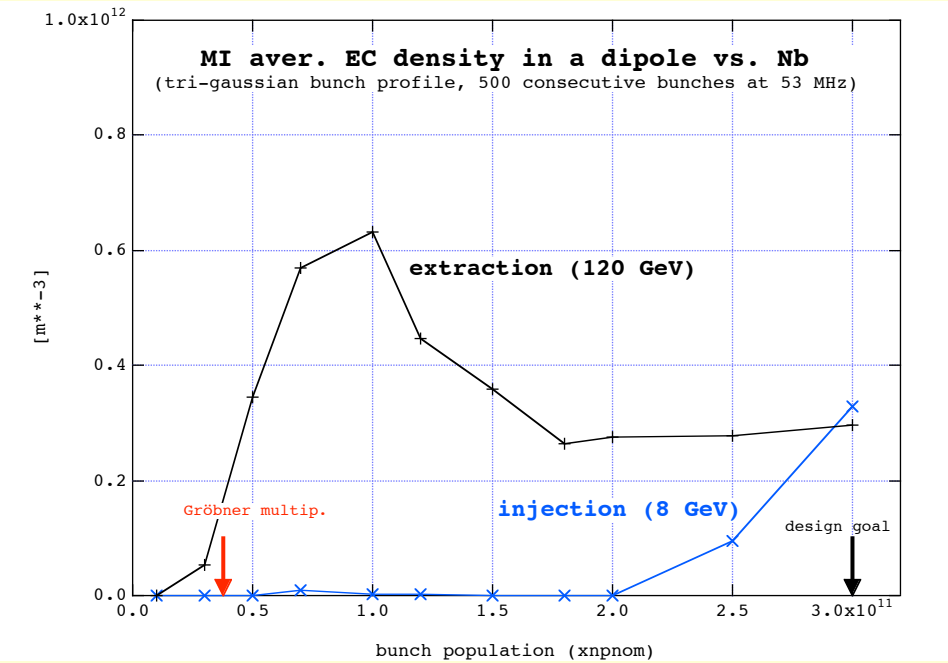
- Comparison PS2 to FNAL MI (for Project X)

PS2

preliminary!

MI





Goals

- 1st Goal: Write sections of PS2 Design Report
  - Report to be done by beginning 2012 (CERN goal)
  - Well defined focus for LARP PS2 task
  - Clearly identifiable contribution by LARP
    - CERN has publicly acknowledged LARP contribution (PAC09)
- 2nd Goal: Follow-on studies; Possibility of getting into hardware design.
  - There is interest in doing this
  - needs close coordination with CERN & buy-in by LARP

Possible PS2 Design Report Outline

(Machine physics part)

Source:
Memo by
M. Benedikt
& Y.
Papaphilippou

CERN

LARP!

- Coordination and basic lattice design
- Linear correction systems
- Non-linear dynamics and correction systems
- Collective effects and feedback systems
  - Space charge studies
  - Impedance estimates and instabilities
  - e- cloud effects and vacuum system requirements
  - Damping system specifications
- Collimation aspects
- Machine protection
- Instrumentation specifications and commissioning strategy

The LARP PS2 Subtasks

- ~~Laser Stripping of H^- (R. Wilcox, LBNL)~~
- Space-Charge Simulations (Ryne, Qiang (LBNL); Spentzouris (FNAL))
  - setup & verify model in codes (ML/I, SYNERGIA), simulate op. scenarios, halo development, beam collimation
- *e*-Cloud build-up & instabilities (Furman, Venturini (LBNL); Pivi, Wang (SLAC))
  - simulate build-up (POSINST, CLOUDLAND), study instabilities(WARP), emittance growth, mitigation strategies (coating)
- Collective Instabilities (Bane, Stupakov (SLAC))
  - analytic, possibly e-m & beam simulations, growth rates, impedance budget.
- Multibunch instabilities & feedback (Rivetta (SLAC))
  - analytic & simulations (PEP-II codes), growth rates, conceptual design of f/b systems.
- IPM (de Maria, Brown (BNL); Fisher (SLAC))
  - Define requirements, conceptual design

Effort Distribution

			Summary FY09...FY14						
Project	**Lead**	**Lead lab**	**PersonYear tot**	**SLAC**	**LBNL**	**FNAL**	**BNL**	**Travel & M&S**	
~~**H- laser stripping**~~	~~R. Wilcox~~	~~LBNL~~	0.0	0	0	0	0	$	-
Space-charge tracking, collim	J. Qiang/Spentzouris	LBNL/FNAL	10.0	0	5	5	0	$	180.00
Instability	K. Bane	SLAC	5.5	3.5	2	0	0	$	30.00
e-cloud	M. Furman	LBNL	4.3	1.5	2.817	0	0	$	180.00
Feedbacks	C. Rivetta	SLAC	1.0	1	0	0	0	$	30.00
IPM & Phase-space diagnostic	R. de Maria/K. Brown	BNL	1.3	0.25	0	0	1	$	90.00
Total			**22.1**	**6.25**	**9.8**	**5**	**1**	**$**	**510**
			FY10						
Project			**PersonYear tot**	**SLAC**	**LBNL**	**FNAL**	**BNL**	**Travel & M&S**	
	~~**H- laser stripping**~~		0.0		0.0				
	Space-charge tracking, collim		1.5	0	0.75	0.75		$	30
	Instability		1.0	1	0.0	0		$	10
	e-cloud		1.3	0.5	0.8			$	30
	Feedbacks		0.5	0.5	0.0			$	10
	IPM & Phase-space diagnostic		0.5	0			0.5	$	30
	Total FY10		**4.8**	**2**	**1.6**	**0.75**	**0.5**	**$**	**110**
			FY11						
Project			**PersonYear tot**	**SLAC**	**LBNL**	**FNAL**	**BNL**	**Travel & M&S**	
	~~**H- laser stripping**~~		0.0		0.0				
	Space-charge tracking, collim		1.5	0.0	0.75	0.75		$	30
	Instability		1.0	0.5	0.5	0.0		$	10
	e-cloud		1.3	0.5	0.8			$	30
	Feedbacks		0.5	0.5				$	10
	IPM & Phase-space diagnostic		0.8	0.3			0.5	$	55
	Total FY11		**5.1**	**1.75**	**2.1**	**0.75**	**0.5**	**$**	**135**

Effort Distribution (cont'd)

		FY12						
Project		PersonYear tot	SLAC	LBNL	FNAL	BNL	Travel & M&S	
	~~H- laser stripping~~	0.0		0.0				
	Space-charge tracking, collim	2.0	0	1.0	1		$	30
	Instability	1.0	0.5	0.5	0			
	e-cloud	0.3	0	0.3			$	30
	Feedbacks	0.0	0	0.0				
	IPM & Phase-space diagnostic	0.0				0	$	-
	Total FY12	3.3	0.5	1.8	1	0	$	60
		FY13						
Project		PersonYear tot	SLAC	LBNL	FNAL	BNL	Travel & M&S	
	~~H- laser stripping~~	0.0		0.0				
	Space-charge tracking, collim	2.0	0	1.0	1		$	30
	Instability	1.0	0.5	0.5	0			
	e-cloud	0.3	0	0.3			$	30
	Feedbacks	0.0	0	0.0				
	IPM & Phase-space diagnostic	0.0				0	$	-
	Total FY13	3.3	0.5	1.8	1	0	$	60
		FY14						
Project		PersonYear tot	SLAC	LBNL	FNAL	BNL	Travel & M&S	
	~~H- laser stripping~~	0.0		0.0			$	-
	Space-charge tracking, collim	2.0	0	1.0	1		$	30
	Instability	1.0	0.5	0.5	0			
	e-cloud	0.0	0	0.0			$	30
	Feedbacks	0.0	0	0.0				
	IPM & Phase-space diagnostic	0.0				0	$	-
	Total FY14	3.0	0.5	1.5	1	0	$	60

Project	Lead	Lead lab	FY09	FY10	FY11	FY12
Space-charge Tracking & Collimation	**R. Ryne/P. Spentzouris**	**LBNL/FNAL**	Implement PS2 model in ML/I, Impact, and Synergia. Validate model, perform first space-charge simulations at injection (no ramp), investigate solver parameters and establish numerical stability of space-charge model, compare results from different codes:	Perform long term simulations with ML/I, Impact, and Synergia to characterize space-charge effects on beam shape. Comparisons and checks between codes, update/iterate lattice parameters, especially rf as they become available, interface with PS2 design team. Begin investigation of space-charge mitigation options (as per our proposal, begin development for incorporating ramp	Continue to iterate with PS2 design team on design parameters. Finalize & document findings on beam-shape (halo) generation	Finalize & document findings of space-charge mitigation investigation. Write Design Report. Begin development of necessary infrastructure for interface with collimator design codes; model tests; comparison between codes; deliver prototype with interface to at least one collimator design code
Impedances & Instabilities	**K. Bane**	**SLAC**	First estimates of single bunch instabilities, microwave, transverse mode coupling instabilities, evaluate space charge impedance, intrabeam scattering growth rates, Resistive wall, multi-bunch transverse instability	Build impedance model using best available data or from components of existing machines, numerical calculation of impedance components, e.g. rf bellows, kickers, BPM's, transitions, estimate single bunch growth rates and characteristics of instabilities	Refine and iterate with PS2 design group	Write impedance and instabilities section in the PS2 conceptual design report. Begin vacuum system hardware design investigations (if possible/desired by SLAC & CERN).
e-Cloud Simulations	**M. Furman/M. Pivi**	**LBNL/SLAC**	Refine assessments of electron-cloud build-up, Compare electron-cloud build-up at the PS2 against MI upgrade. Initiate assessment of e-cloud effect on beam (dipoles only at first). Assess need to combine space charge with ecloud simulations	Continue assessment of ecloud impact on beam for full ring with uniform-focusing lattice model. Estimate threshold of e-cloud density. Explore parameter space, Secondary emission model, PS2 design parameters are changing. Assess ecloud mitigation mechanisms. Initial assessment ready by June 2010,	Refine assessment of impact of e-cloud on beam by incorporating a realistic lattice description. Ongoing re-assessments to continue as needed, incl. assessment of mitigation strategies.	Incorporate details of the vacuum hardware into e-cloud assessments. Write Design Report
Bunch-by-Bunch Feedbacks	**C. Rivetta**	**SLAC**	Acquire parameters (rf cavities), initial estimates of growth rates	Couple-Bunch stability studies - Conceptual design of feedback systems.	Conceptual design of feedback systems and kickers. Write Design Report.	
Ionization Profile Monitor	**R. de Maria**	**BNL/SLAC**		Analyze specs. Estimate performance for state-of-the-art designs	Select subsystems, conceptual designs	Write Design Report

Work Plan Details (cont'd)

		FY13	FY14
Space-charge Tracking & Collimation	**R. Ryne/P. Spentzouris**	Long term tracking including ramp, realistic rf, space-charge mitigation to provide input to collimator codes. Begin characterization of overall effectiveness of collimation procedure	Finalize and document FY13 findings of studies described in FY13 task
Impedances & Instabilities	**K. Bane**	Investigate impedance of vacuum components. Iterate on designs with PS2 design group.	Investigate impedance of vacuum components. Iterate on designs with PS2 design group.
e-Cloud Simulations	**M. Furman/M. Pivi**	Incorporate e-cloud into long-term space-charge tracking. Quantify effects on beam-collimation design.	

Funding

- Parts of the work are being done on non-LARP funds
  - justifiable because of the synergy with other projects being pursued by the labs
  - details have been worked out between LARP & the relevant managers at the 4 labs.
- The desire to write parts of the Design Report, however, does imply a commitment until FY12.
  - understood by LARP and by the laboratories.
- Will review outyear plans yearly & adjust as necessary
  - based on case for continuation based on funding available.

Conclusion

- LARP PS2 Collaboration established
  - work has started
- A Plan exists, fits with CERN plans/schedule
- Collaborative effort of all 4 LARP laboratories
  - matches each lab's strength and interest
  - helps to avoid atrophy of strengths due to lack of projects
- Close communication with CERN ensures we stay "in sync"
- Will provide a visible piece of LARP work.