Summary of the IEFC Workshop

21-24 March 2011

P. Collier

All Presentations Available at:

http://indico.cern.ch/conferenceDisplay.py?confId=123526

The Session Summary Slides and This one will also be added

Sessions

- **Safety :**

  R. Trant & G. Roy

- **MTE and High Intensity Operation :**

  V. Mertens & T. Zickler

- **Experimental Areas :**

  I. Efthymiopoulos & C. Maglioni

- **Controls in the Injectors :**

  E. Hatziangeli & B. Mikulec

- **Linacs :**

  O. Bruning & F. Roncarolo

- **Consolidation and Upgrade Plans in the Injector Complex :**

  R. Garoby & M. Meddahi

Session 1: Safety

R. Trant & G. Roy

- Early safety management of projects and experiments *(Isabel Bejar-Alonso)*
- ALARA Experience and lessons learnt *(Heinz Vincke)*
- Safety consolidation in and around the accelerator chain *(Simon Baird)*
- Evolution and Future of access safety and control systems *(Rende Steerenberg)*
- Evolution of Radiation Monitoring *(Gustavo Segura)*
- Safety management of shutdowns *(David McFarlane)*

Safety Management

Early safety management of projects and experiments

- Everybody is expected to contribute by announcing new projects, experiments, activities well in advance.
- Proper documentation serving the full life cycle is a must, and supporting guidelines are available.
- Adequate resources must be provided on both sides: project – safety experts (DSO's, HSE, etc.)
- Action:
  - Extend the training foreseen for GLIMOSes of small and medium sized experiments to Project Safety Officers in project. HSE

Safety management of shutdowns

- Actions:
  - Extend the LHC and SPS method and tools to all other beam facilities. EN-MEF
  - Train shutdown coordinators on Safety. HSE

ALARA experience and lessons learnt

- ALARA principles and corresponding methods are well accepted and progressively extended to all facilities. Tune-up of the process must now take place based on lessons learnt over the last few years. DGS/RP, RSOC

- Remote handling and monitoring is important for ALARA. Needs top management support, and creation of a dedicated center of competence, e.g. in EN-HE.

- Documentation of equipment installed and tasks to be performed in particularly radioactive environment is essential.
  Examples : taking video footage on site for difficult operations, training with mockups or spare parts before actual intervention.

Safety Consolidation

Safety consolidation in and around the accelerator chain

- The results of a PS safety review spotting today's status quo were presented
- Safety consolidation proposals will be based on proper risk management techniques, including risk evaluation and scoring to establish priorities and highest effectiveness of measures.
- Such review should also be done for the PSB and the SPS.
- The conclusions of a review of the radiological impact of the PS was presented: Radiation (stray radiation and activation) and Emissions (ventilation).
- One should specify the maximum allowed beam losses as part of key parameters of projects of beam facilities and new installations. Could be used as a key parameter for design of the facility and its equipment but also the required shielding and other protective measures.

Present to ED

Access & Ramses

Evolution and Future of access safety and control systems

Action:

- Deploy the new access system during LS1 to be operational for the 2014 physics run (incl. L2 and L4), and provide training (users, OP…) GS-ASE
- Pursue SPS study for similar upgrade BE-OP, BE-ASR-SU
- Parallel upgrade for exp. areas to be extended to exp. Halls EN-MEF, GS-ASE

Evolution of Radiation Monitoring

Issues have been solved and there is now a clear transition path from ArCon to RAMSES II that minimizes the risks to beam operation of the injector complex

Action:

- Report “regularly” to IEFC HSE (RP & SEE)

Session 2: “MTE and High Intensity Operation”

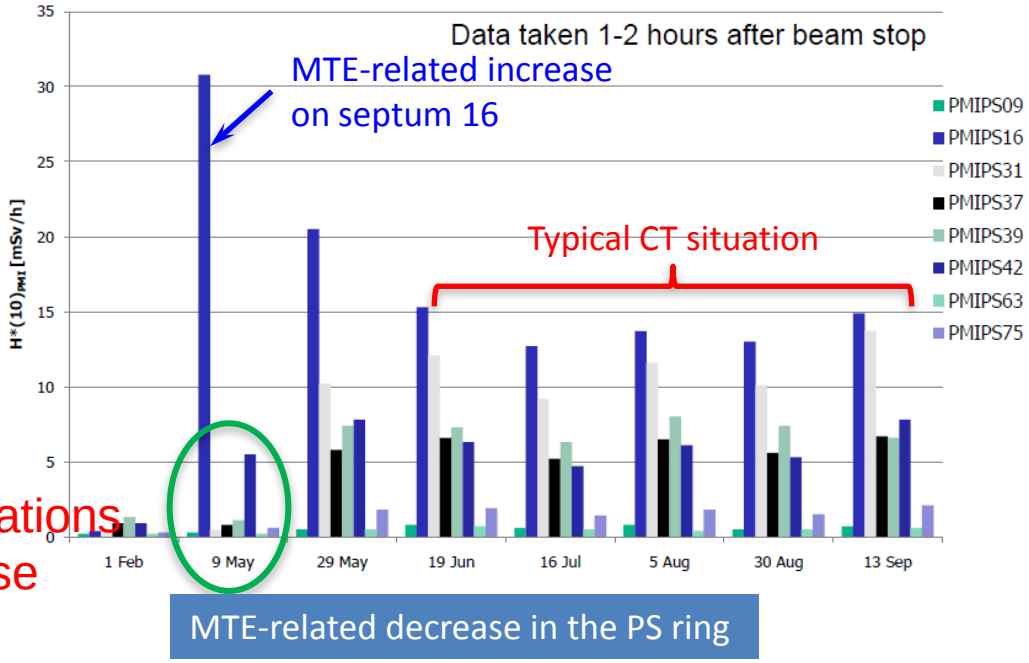
V.Mertens / T.Zickler

Presentations:

M.Giovannozzi	MTE Roadmap - Beam Physics Aspects
R.Steerenberg	MTE Roadmap seen from OP
J.Borburgh	Requirements and Constraints for ABT Equipment
J.-J.Gras	BI Improvements across the Complex
K.Cornelis	High Intensity Beams and their Performance
B.Puccio	Machine Interlocks

MTE Roadmap – Beam Physics Aspects

MTE used in operation in early 2010
2.2-2.3e13 p in 1 PS extraction to CNGS
Extraction efficiency 97-98 % (CT 93-94)
SPS transmission of MTE beam ≤ 94 %
(inj. optics not matched for islands)



Losses concentrated on SMH16 (2-3 x)
Fluctuating PS trapping efficiency
Reason not known yet – no clear correlations
Lots of data analysed, and still to analyse
Fluctuations longer than one cycle
Most losses occur and injection/start of ramp
Fluctuating SPS injection trajectories

Mitigation + tests (ongoing/to come):

Conclude on by mid 2011

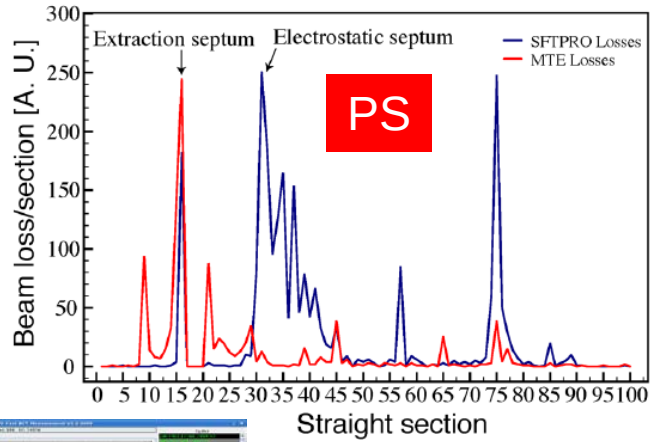
Dummy septum in SS15 (LS1) to concentrate losses on a low-maintenance device (??)
Testing new extraction (using SEH31) – feasibility not clear yet (w/o dummy septum ??)
Check correlations with B-field fluctuations (first attempt fooled by ADC prb), POPS
Cycle setting-up with INCA slow, noisy tune measurement, instruments precision ?
Manpower barely sufficient for studies – rely heavily on OP to drive + CO, BI, … support
Gaps in beam not acceptable (SPS RF limitation) – final word ?

CT likely to be needed beyond LS1

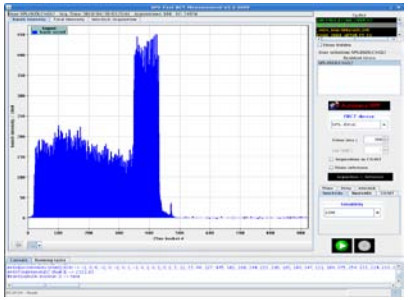
MTE Roadmap seen from OP

PS benefits – less irradiation (equipment (except SS16 …) + environment)
Removes intensity bottleneck, and opens way to further optimisation
If not done, Linac4 and PSB/PS upgrade possibilities cannot be fully exploited
SPS short term benefit – (just) less spiky spill structure
Longer term prospects for
neutrino physics etc.

SPS



MTE uses equipment (e.g. BI) in different ways
(usually more demanding)
Developments for MTE benefit OP in general



Problems of measurement precision (BCT, …)
"Shooting on a moving target" (fluctuations) with a spreading gun (instruments precision)
OP favours dummy septum (over potential hybrid MTE/CT system)
Main focus on understanding the fluctuations

Matter of priority (cycles, time + manpower to prepare/carry out/analyse MDs)
How to follow up issues and to get improvements rapidly implemented ?

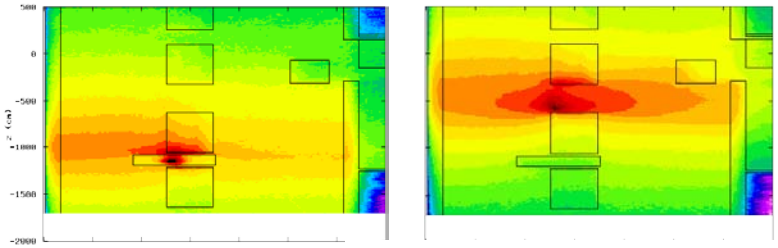
Requirements and Constraints for ABT Equipment

Need to overhaul (broken) SEH31.3 in 2011 as oper. spare (SEH31.2 too hot for now)
Lots of CT equipment "obsolete" (no investment in past years in view of MTE operation)
(controls, electrical distribution, interlocks, PVC HV cables, other safety concerns, …)
can only be done in LS1

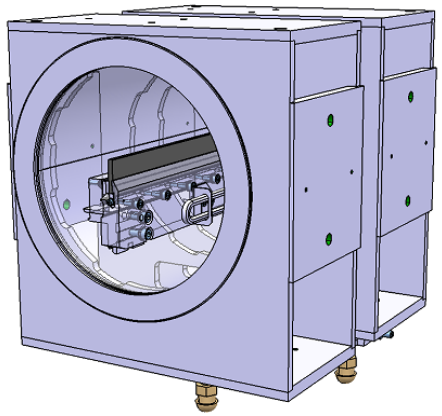
Consolidation for MTE infrastructure (not done due to lack of time and to keep cost low)

Need to exchange operational SEH16 in TS2011/12, and start building additional spare

"Spoiler" (in SS16) not useful
Dummy septum (in SS15) will have good effect
(10-40 x in SS16, 3-5 x for local stray radiation)



	Cost (MCHF)	Resources (MY)
CT	1.6	5
MTE	1.6	6
MTE- CT hybrid	2.4	9



Cost estimate for new generators (3 times faster kicker rise time ?) to be re-made
(new building needed (MCHF !) – B367 re-affected to POPS)

BI Improvements across the Complex

Presentation not focused on MTE only, but intended to cover also LIU, consolidation, …

Ongoing consolidation, concentrated mainly on modern acquisition chain
(electronics, SW, preserving existing monitor (yet trying to get best poss. performance)

New requirements (MTE, LIU, …) can be partly incorporated, some others require different approaches (and level of effort)

Went through list of instruments: SEM, wire scanners, BLM, BCT, orbit, tune/chroma, ….
Lots of questions after presentation …

Clear, consistent and agreed specifications needed (not just “as good as possible”)
Reaction: What is the present performance ?? Not so clear, and not easy to say
(at least time consuming)

Specifications will define funding (LIU), time scales, priorities, …

Problems of rapid drift (resp frequent loss) of calibration (TT2 BPM) – specialists needed

“BI supervisor” should be beneficial – role to be defined.

High Intensity Beams and their Performance

$N_p = N_{days}$ * Intensity * Duty cycle * Availability

Beams looked at: CNGS, FT (COMPASS + NA62), nTOF, future v facilities, LHC25

CNGS:

Losses in PS raise strongly with intensity (not linearly)

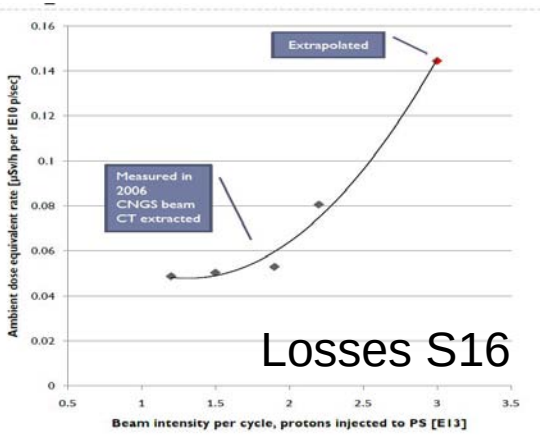
Direct limitations (Route Goward, SMH16),

but also higher wear on equipment (also SPS)

Better to run with lower intensity and higher duty cycle

MTE needed to overcome PS bottleneck

SPS limitations: RF power, vertical aperture



Losses S16

FT:

Reduced duty cycle (concurrency of LHC, CNGS) led to request higher intensities/cycle

Limitations (other than above): ZS losses/spark rate, splitter losses → max 4e13

I_{rms} of MPS (SPS-FT can not be used alone …)

Perturbations from unscheduled cycle changes (LHC setting up/filling)

Technical stops re-scheduling on short notice

LHC25:

Beam dynamics (RF, e-cloud, TMCI → adressed by LIU)

Kicker performance (ripple) → demanding for SPS damper (high power, high gain)

Stress on SPS dump from prolonged setting up (step-wise) and MD

Kicker heating (addressed by LIU)

Duty cycle optimisation as important as record intensities.

Machine Interlocks

Presentation focused on

BIS = Beam Interlock System (VME based), also SIS (Software Int'lk System)

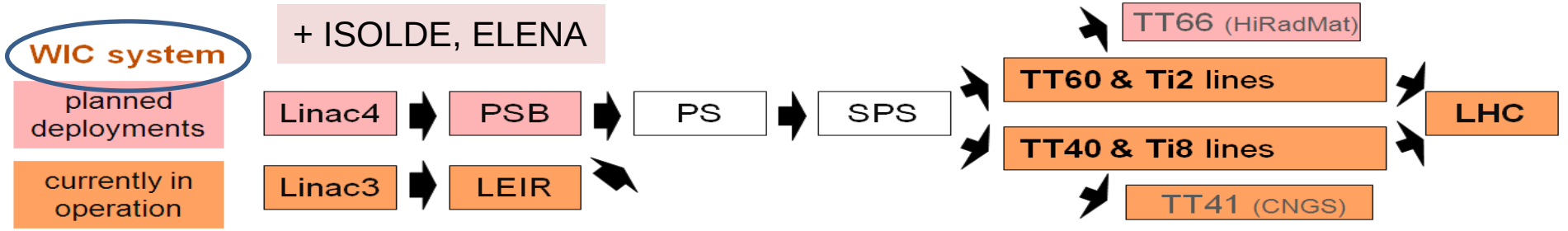
WIC = Warm magnet Interlock Controllers (PLC based)

Highly reliable (available) systems, generic, well integrated, good software tools

Rely on continued good collaboration with EN-ICE (WIC)

Clear plans for coming years (pink below = ready for after LS1, resp. before)

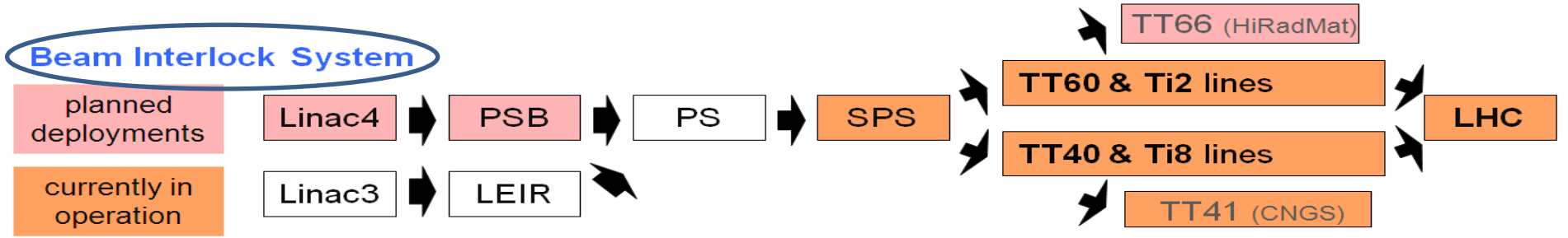
Manpower barely sufficient (planned deployments and maintenance), tight planning



PS (100 main + 50 aux magnets) →15 crates (only study for time being)

SPS (900 magnets) → 24 crates (presently no resources to tackle such a big inst.)

Spare situation for present SPS "WIC system" (TE-MSC) – a concern ??



No decision yet for PS deployment

Session 3: Experimental Areas

I. EFTHYMIOPOULOS & C. MAGLIONI

- What future for PS EA and nTOF : L.Gatignon
- How to ensure a bright future to the AD machine : T.Eriksson
- ISOLDE in 2011 and beyond: Y.Kadi
- SPS experimental areas & CNGS, there to stay? E.Gschwendtner
- Experimenters' dreams for future facilities: I.Efthymiopoulos
- HiRadMat knocking at the door: A.Pardons

PS East Hall (1)

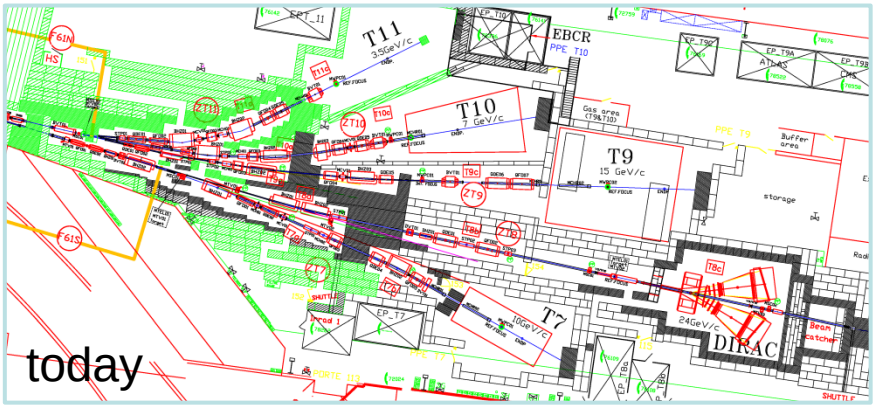
- The area has **lots of users** and have run nicely in 2010
- There is a need for test beams at energies below the NA
- **Consolidation needed**. Also **AIDA** project started in ’11 and expects compensation by CERN. Requests for experiments have been already made. → **new layout**

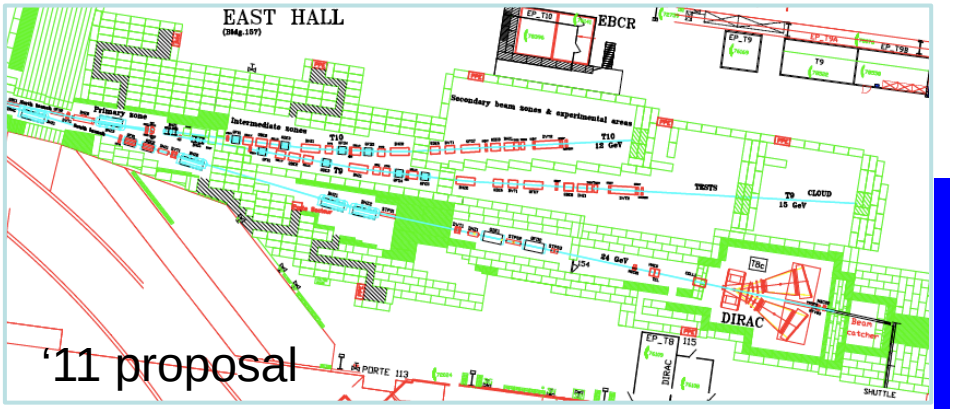
		kchf	**FTE**
1	p^+ facility	450	0.5
2	Mixed field facility	1500	
3	Layout transformation	1555	
4	consolidation	8755	13.5
5	Civil + access + various	3200	1.5
	TOTAL	**13500**	**~15**

- DIRAC is expected to stop before the LHC LS1, then move → Who will pay for **DIRAC dismantling** ?

PS East Hall (2)

- Today's layout → 5 beam lines, 2exper, **3test areas**
- New layout → 3 lines, 2exper, but **test areas** = **1 +0.5**
  - (1 + 1 shared with CLOUD – 50% available)





- It is a good starting point but **need review** of layout design to go ahead. Also infrastructure required for IRRAD.
- nTOF runs well, EAR2 proposal → wait for submission

AD

- Several project are on paper / on mind :
- Is there any **conflict** between them?

  AEGIS physics foreseen 2014-16

  but ELENA install ‘13-’14 (physics ’15)

  and PAX? And others?
- For the future AD seems to remain a **EU key facility** for antiproton physics.
- **Consolidation** : 40 items list, to be revised
  - planning in respect to ELENA and others...
  - maximize physics, minimize resources and conflicts with LHC LS1 (see General Remarks at the end)

Isolde

- → launch a review for the implementation of **ALARA** processes:
  - Distinction should be made between standard maintenance and urgent interventions
  - Distinction should be made between new and recurrent activities
- **Control Room** : the access through experimental area should be avoided → planning/modification ?
- ‘12-’13 EN & TE activities / LHC LS1 (see General Remarks)

SPS NA and CNGS (1)

- The North Area has **lots of users** and ran nicely in 2010
  (Still increasing – always overbooked!)
- **Consolidation**: it involves major investments :
  - Power converters – not yet approved (20MCHF, 30FTE,LS2?)
  - Magnets – partially ongoing
  - Targets & Obstacles control – ongoing (750kchf, 5yrs)
  - Access system – ongoing
  - CV & EL ?
- The whole plan and budget have to be reviewed → add to consolidation program

SPS NA and CNGS (2)

- COMPASS & COMPASS-II → till ‘21 (to be approved)
  will need **consolidation** too (2-3Mchf)
- NA62 physics in ‘14 → new beam line, dismantling NA60, NA48 completed. New beam dump
- NA61, NA63, UA9 → ion program in ‘11 and ’12
- CALICE (ILC & CLIC) → 20w test beam in ’11 (**space?**)
- CNGS → should reach wanted total pot in ’15
  → and **after** ? Cannot switch off so easily
  future proposal?
  → **water issue**

Future Facilities (1)

- **A large variety of projects in the pipeline**
  - Operation and maintenance of Secondary Beams and EAs must be assured for the far future
- **Projects “around the corner”:**
  - H4IRRAD : required by R2E/LHC
  - GIF++ : LHC experiments
  - PS-neutrino beam : waiting SPSC evaluation
  - AIDA : Very-Very-Low-Energy (VVLE) beam design
- **H4IRRAD (North Area):**
  - Ready for beam in May/June’11 → **tight schedule**
  - Beam intensity vs RP safety (Ok for 10^9 ppp in 2011)
  - First stage towards a new facility in PS East Area
  - Should be already considered in the East Area layout? Cost implications?

Future Facilities (2)

- **GIF++**
  - Design Completed – Ready for construction
  - Part of AIDA Project – Funds to External Teams to use it!!
  - Need to Clarify missing Funding (~600kCHF)
  - Schedule to define as well – Source delivery ~1 year.
- **PS n-beam : proposal to SPSC under evaluation.**
  - Design study to follow if requested.
  - Beam delivery seems feasible
  - Possiblly large impact on site (Magnet rescue factory)
- **Others**
  - **Neutrino physics** : LAGUNA_LBNO
  - **Plasma Wakefield Acceleration** : EuroNNAc Network activity, new Area
  - **Medical physics Applications:** LEIR, PS East Area (part of new layout?
- **HiRadMat**
  - Good progress, getting ready for first beam in 2011
  - Operational procedures & docs to be defined
  - Aim for three experiments in 2011

EA: Conclusions & General Remarks

- **Lots to come for all EAs :**
  - new projects **AND** consolidation
- **LHC LS1 :**
  - CERN resources are **only** 100%, not everything can be done in // for experimental areas
  - Need for a general, common LS planning **including** the experimental areas
- **ISOLDE**
  - lesson on **safety** management to learn for everyone.

Session 4: Controls

E. Hatziangeli & B. Mikulec

INCA – The point of view of the main users	S. Pasinelli
ACCOR – What will change for operation and equipment groups?	A. Radeva
Industrial controls in the injectors – 'You (will) know that they are here'	H. Milcent
Databases for operations of the injectors – overview, dependencies and strategy for smooth upgrades of the data-driven controls system	Z. Zaharieva
PS & PSB cycle management review	S. Deghaye
Samplers in a 3-tier control system: plans and first experience	R. Steerenberg
Application development for operations in the coming years	M. Lamont

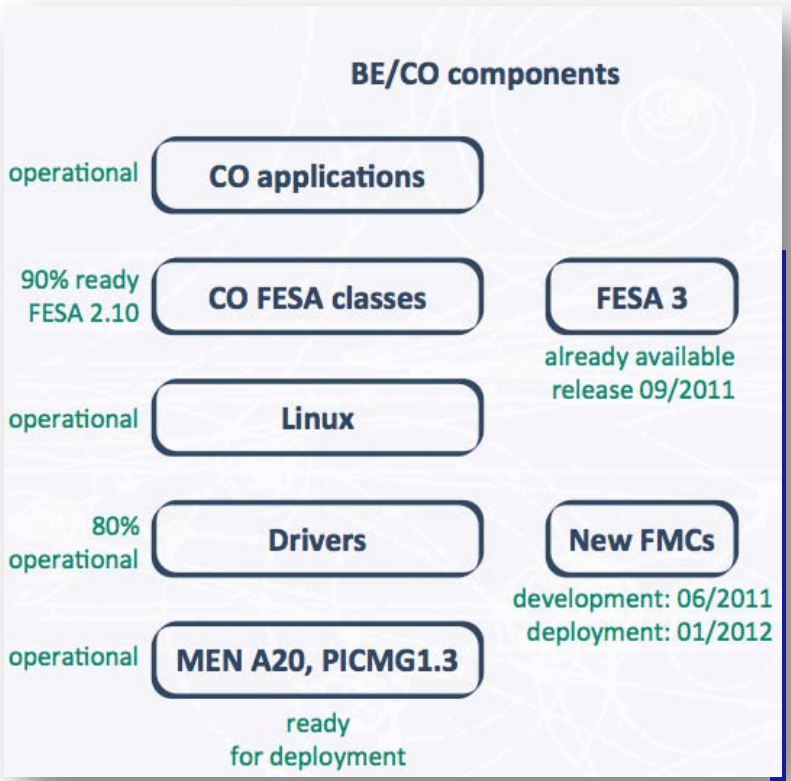
InCA Summary

- Improved functionality and very good support of InCA team
  - ✓ Well planned releases without perturbation
  - ✓ Close follow up of issues
- Need to solve some outstanding issues
  - Cycle creation, LKTIM,…
- Reduce InCA complexity for users and simplify DB configuration processes
- Release AcqCore before InCA deployment in PSB plus stable archiving and ppm-copy
- Improve documentation and provide continued training
- New functionality on the SW side can only be provided through serious and well-planned **HW controls renovation**
- Accelerate the migration from GM to FESA and renovate X-Motif applications

ACCOR: What will change for Operation and Equipment Groups?

- Controls Renovation has high priority for CO as the Injectors control system has reach end of life and it is impossible to add any new functionality
- Critical systems to be renovated:
  - No hybrid transceivers for PSB (TE/EPC) (30 yo)
  - RIO spares down to 60 – total installed 640
- ACCOR project should be extended beyond 2012
  Already done till 2014 with original budget stretched
- Limited critical system renovation in 2012
  - Controls renovation should be put at an appropriately high level by Equipment groups
- Controls renovation work (P+M) should be planned and visible in APT by Equipment groups
- Agree to a formal EDMS approval procedure for every renovated systems
  - Signed and approved by CO, OP and corresponding Equipment group

Project Status



ACCOR: Summary & Actions

- **Combined coordination of priorities, planning and upgrades between ACCOR, LIU, 25 years Consolidation under one body**
- **The shared responsibility of the new renovated FE systems should become formally accepted**
  - Equipment groups become the 1st line support for their front ends
  - CO is called if problem is related to CO supported infrastructure by Equipment groups
  - Put a coherent support scheme amongst all parties involved
  - Exploitation tools for 1st line support
- **OP requests clearly a coherent solution across all groups towards exploitation**
- **Provide operations with improved diagnostics tools to be able to diagnose problems.**
  - These tools are necessary for the diagnostics of the new samplers, for the new Controls responsibility model and for the timing renovation, but also to diagnose problems in general for CO systems composed of multi-layers.

Industrial Controls in the Injectors

Summary

- ICE involvement is according to the needs
  - EN/ICE: responsible for the control infrastructure
  - Expert/equipment groups: responsible for the controlled process
  - All request should go via the application expert or equipment group
- EN-ICE provides a Standby Service, to cope with hardware and software failures
  - Stock of critical equipment spare is maintained
  - The input of equipment groups is indispensible to maintain the stock of missing spares
    - Clear reminder to the equipment groups is needed

Databases for Injector Operation (1)

- **Continuous effort is being put into rationalizing, improving, federating and developing new functionality in the existing databases and their interfaces**
  - High priority: describe the complete accelerator complex in the layout database => demanding in terms of manpower
- **Data management requires the involvement of the data owners and data users**
  - OP & Equipment experts should maintain the data in the configuration database
- **OP & Equipment experts must verify the list of link people, responsible for the different applications and systems each year**
  - Automatic sanity checks to be implemented by DM team

Databases for Injector Operation (2)

- **Very important to ensure smooth data upgrades, as it has direct impact on operational systems and operations**
- **Must ensure a coherent set of data throughout all distributed databases**
- **Interdependencies of the data and impact of data changes should be easily available to the users**
  - DM to provide tools to expose the interdependencies
- **Push to deploy FESA 3.0 as soon as possible**
  - Will allow to recognise and deal with changes to front-ends and interdependencies.
  - But also push to eradicate X-Motif applications …
- **Non-backward compatible changes allowed with formal coordination and follow-up**
  - Enforce the use of ECR for layout DB changes in all machines
- **Move away from ORACLE - feasible?**
  - Evaluate other databases in terms of performance and cost of migration

PS & PSB Cycle Management

- **More that 24 USERS are requested by Operations since a few years but "old" control system cannot provide this functionality**
- **More than 24 beams available even though never played at the same time**
  - Will get worse this year with double batch
- **Hardware solution not possible before LS1 due to size of the upgrade and complexity of the new channel cabling.**
- **Push the software solution based on LSA context mapping**
  - ⇛ But …. InCA should be deployed in the PSB
- **New solution is based on the notion of cycle, not user**
  - ⇛ Adapt all Java applications to work with the cycle selector
  - ⇛ High priority to eradicate the implied X-Motif applications
- ⇛ **Push for the Open CBCM renovation project to high priority**
  - ⇛ Will allow the sequence manager to work with cycles
  - ⇛ Will allow for a real beam structure throughout all accelerators in LSA
    - ⇛ beneficial for derivation of statistics
- **Strong request from OP to replace all GFAs during LS1 due to reliability issues**
- **Proposed solution for the LHC fast PSB-ring switching using makerules and virtual devices implies**
  - ⇛ appropriate tools for OP to have full transparency

Samplers

3695 instances of sampler classes currently used across the majority of the facilities

- **Samplers with permanent settings are indispensable for OP**
- **The new sampler solution in CTF3 works well for the 1.2 second repetition rate**
  - BUT: ensure the performance is adequate for 5 Hz operation
  - Guarantee correct time stamping for signal sychronization
  - Provide improved tools for efficient multi-tier system diagnostics
- **OP and CO are currently defining functional specifications**
- **The new strategy for samplers cannot be applied blindly to all renovated sampler installation or for the new systems**
  - Case by case study is needed and special solutions might still be required

Application Development for Operations in the Coming Years

- **Applications development: replacement of X-Motif applications should be pushed**
- **Support of CO for LSA should be kept high, even though the high development phase for LHC is over, there are still improvements needed**
- **The renovations and new applications will be planned for LS1**
  - there us enough resources from OP to do serious work not counting the temporary resources and collaboration with LAFS
  - Take into account the upgrade of resource-hungry BI applications
- **Concerns about support levels in CO and a stretched OP**
- **Significant Manpower to be made available through collaborations (LAFS) and temporary resources (TS,PJAS,Fellows) in LS1 to cover foreseen requirements**

Controls Session : Overall Summary

- InCA should be deployed in PSB this year – functionality requests are well understood and implementation is underway
- **GM classes and Xmotif application should be eradicated** asap
- Request to **increase the priority of controls renovation** – coherent planning amongst all main projects (consolidation, LIU, ACCOR+equipment groups)
- As we move to a more complex control system and to **a shared responsibility** model, a **coherent and complete set of diagnostic tools** is a necessity
- Important to **ensure coherency and smooth data upgrades**, which has a direct impact on operations
- Interdependencies of the data & impact of changes must be available to the users
- A new solution is based on LSA context mapping and the notion of cycles provides a software-based solution to the cycle management issue which is problematic with double batch beams
- The new samplers solution based on MEN A20, OASIS FESA and virtual samplers works well in CTF3 and its deployment should now continue - watch for the 5Hz operations and the correct time stamping!
- The eradication and implementation of new applications will be planned for LS1; there are enough resources from OP to do this work; complemented by temporary resources and collaboration effort

Session 5: Linacs

O. Bruning & F. Roncarolo

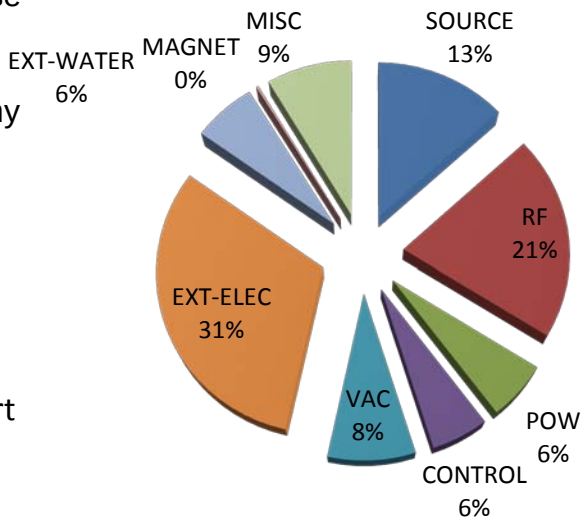
- Linac2 Performance and Hardware Review: G. Bellodi
- Linac3 Source Status R. Scrivens
- Mid-Long Term Needs for Ion Beams S. Maury
- Linac4 Source J. Lettry
- Linac4 Connection Possibilities as a backup to Linac2 A.Lombardi

Linac2 Review

- L2 operated with 99 % uptime in 2010 and 98% in the last 10 years
- Systems review: all under control even for L2 till LS2 if 'nightmare' scenarios (e.g. DTL quad failure, inter-tank vacuum leak) don't happen
  - DTL vacuum sector conditions are delicate and must be kept under close surveillance/control
  - The first series of consolidation measures for intervention in case of quadrupole faults in Tank 2 are in place and have been tested on dummy loads
- Present operational performances:
  - 165mA average at DTL exit
  - L2-PSB transmission 70%-100% depending on users
- Requested current increase to 180mA (Chamonix '11):
  - possible but risky (RFQ sparks, RF tubes lifetime). Can be tested for short periods → MD requested, Replacement of 3 RF tubes during April TS approved
- In 2010 radiation levels increased
  - source of losses not fully understood
  - new optics shifted downstream the hot spot
  - for 2011 new BLMs + new optics should help

In general: optics retuning to improve transmission not unusual

2000- 2010 faults – integrated



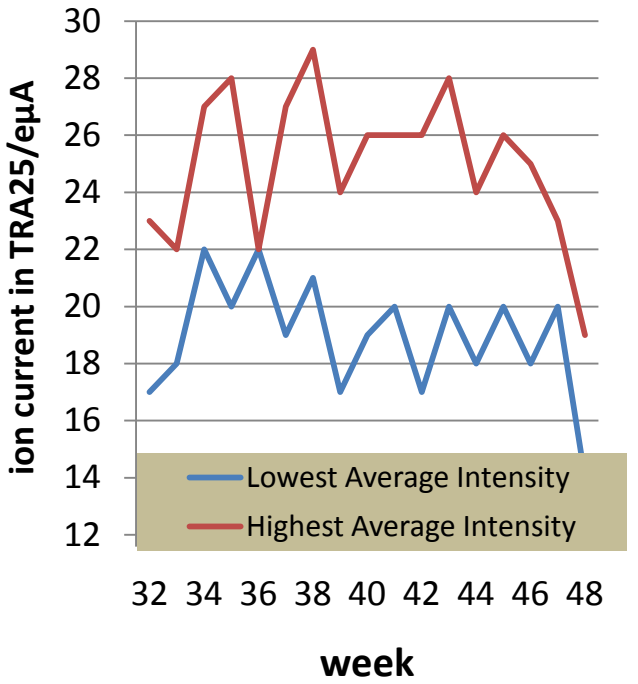
Total downtime= ~964 hrs
Total op. time = 59994 hrs avg. availability = 98.4%

General messages:

- as long as we need to rely on L2, risk mitigation must be prepared as much as possible
- Long shutdown in 2013-2014 requires continuous running of the infrastructure (cooling and ventilation) and monitoring of the Linac temperature and vacuum.
- The replacement for LINAC2 faces a tough challenge in terms machine reliability and uptime
- Commissioning time for LINAC4 must be sufficiently long to assure a similar performance in term of reliability

Linac 3 Source Review

- Nominal beam parameters just within reach for LEIR with the present performance of the source and Linac3.
- ECR source proved to be reliable (96% uptime 2010 to be corrected for low performance periods)
- Oven1 typically runs for 2 weeks, so the second oven was used as a backup in 2010 (and used several times).
  - Trying to refill one oven while keeping the other one in operation is not possible, as the oven movement leads to a long retuning time 28hr, so the highest uptime is found by running, and then refilling both ovens
- oven length or diameter could in principle be increased, but not clear if in any case can reach 4 weeks without re-fill. For the moment: foresee 1 stop (1-2 days) per LHC ion run
- Stripper mechanism is orphan, needs 250kCHF to change it
- Only NA61 + LHC would occupy all L3 time. Any other ion species (apart from Ar and Xe) must be after 2017, unless a dedicated test stand can be found
  - Request for ion operation for NA61 with Argon and Xenon can be satisfied with current hardware (iThembaLABS will make development and provide a starting point for CERN's studies).
- **Second ECR source?**
  - if to have spare: for fast switching, it needs to run in parallel with 1st source
  - if for other ions: needs its own RFQ
- **New EBIS source?**
  - Choice of future ion source and RFQ needs to be based on desired ion type and beam characteristics.



in both cases L3 modif needed, L3 little space

General messages:
- Need to define if and for what a second source would be needed
- If new source tests are needed, money and resources must be assigned
- Need to identify an adequate space for testing a source for new ion species

Medium- Long Term Needs for Ion Beams (S. Maury)

- Simultaneous ion and proton operation not compatible for the NA.
- The new LHC schedule implies the following planning:
  - Pb-Pb collisions in the LHC from now to 2017:
    - only Pb beams for the experimental areas during the period of Pb operation in the LHC.
  - p-Pb beam in the LHC in 2012, 2016 and 2019:
    - request for 2019 only valid if no d-Pb run is planned for 2019 and no p-Pb in 2016.
  - d-Pb collisions in the LHC as of 2019:
    - not yet clear how d-beams can be generated in the LHC injector complex. It also requires new RFQ and source commissioning during 2017 shutdown and therefore a decision on this scenario needed by next year (preparation time).
  - Ar-Ar collisions as of 2014 or 2015:
    - implies Ar operation in the injector complex as of 2013 (LINAC3 and source and RFQ) and several weeks of Ar beam commissioning in LEIR, PS and SPS
    - seems to be a very ambitious planning and is not compatible with NOT operating the injector complex in LS1.
  - Xe-Xe collisions 1 year after Ar-Ar collisions. Same commissioning requirements in LEIR, PS and SPS as for Ar-Ar (source and RFQ already done in 2013).
  - Ar and Xe source is prepared by ITHEMBA collaboration (but they will not deliver a source to CERN). Dedicated commissioning periods will be required for LEIR, PS and SPS before the beams can be used for physics.
  - Studies for a Medical program can not start before 2017 (machine time up to 2017 required for above ion commissioning) but decision on ion species should be taken 5 years in advance -> by 2012.

General messages:

- Need a review of the various scenarios in order to establish the accelerator complex planning
- One needs to identify any ion choices other than Pb for the LHC in due time to allow sufficient time for the ion beam preparation (we do not even know yet how to generate Deuterons)

LINAC4 Source Review

Present Situation

- Present source (based on DESY design)
  - commissioned to operation at 35keV
  - operation at 45 KeV not possible due to electron dump design.
    - Nominal performance not within reach of this source design.
- A crash program was launched in August 2010 for investigating the option of using a Cesiated H- source and address the e-dump issue.
- Review of options in February 2011:
  - None of the ion sources matches the required L4 emittance/current/extr.-voltage figure of merit.
  - Identified 2 options:
    - modification to the existing sLHC plasma Generator (implement Cesium inlet)
    - upgrade of the BNL magnetron source to 45 keV
  - the Linac4 and test stand design must be compatible with both options.

Next

- Prototype source (20-40 mA) needs to be ready by mid 2012 (plus new extraction system and pulsed power supplies) and commissioned by end 2012 to be ready in time for deciding on a LINAC4 connection to the PSB in LS1
  - very ambitious schedule, but is the current baseline.
- Final source after stepwise improvement and test of successive prototypes until 2015
- Operational spare and quick ion source exchange mandatory.
- Review of the H- source work package planned for June 2011.

LINAC4 Connection as Possible Backup to LINAC2

At the PSB distributor

	E [MeV]	I [mA]	Pulse length [us] (4rings)	$\varepsilon_{x,y}$ (rms)[mm mrad]	ΔE/E (rms) [KeV]
LINAC 4	50	40 mA	400µs	0.3	250 , 100 (CCDTL mod4)
LINAC 4	160	40 mA	400µs	0.3	120
LINAC 2	50	160mA	100µs	1	160 (measured 3/2011)

- 50 MeV and 160 MeV proton production possible with LINAC4.
  - 50 MeV: switch off CCDTLs and PIMs
  - 160 MeV: re-match from DTL to PIMS ok
- Multi-turn injection into PSB only compatible with 50 MeV:
  - Assuming a rough performance scaling for the attainable brightness for PSB and LINAC4 operation with 50 MeV protons this might perhaps be useful for LHC operation with
    - nominal bunch intensities
    - 75ns bunch spacing (factor 3 loss in performance as compared to nominal LHC performance)
  - However, this performance can not yet be guaranteed and more precise estimates require detailed simulations.
- Intervention time estimated to 2 to 3 month
- The discussions questioned if this could not be significantly reduced provided that preparatory measures are already implemented during LS1 (e.g. new distributor).

General Messages:
- more detailed simulation studies are needed for estimating what proton beam types could be generated in this setup (but definitely NOT nominal LHC beams)
- the use of the present distributor is limited to 100us pulse length, new distributor (able to inject 400us and compatible with both L2 and L4) could improve L4 with protons (more studies needed)
- The peak current in LINAC4 is limited by the klystron (beam loading)

Session 6: Consolidation and Upgrade Plans for the Injector Complex

R. Garoby & M. Meddahi

Infrastructure	EL Consolidation and Upgrade of Infrastructure	F. Duval
	CV Consolidation and Upgrade of Infrastructure	M. Nonis
Accelerators		
	LIU Baseline Beam Parameters and Planning	R. Garoby
	Possibility to Connect Linac4 during LS1	M. Vretenar
	Plans for the PS Injector	K. Hanke
	Plans for the PS	H. Damerau (repl. S. Gilardoni)
	Plans for the SPS	B. Goddard

Consolidation & Upgrade: EL & CV Infrastructure

- Plans for coherent upgrades during the period 2011-2025: request for project leaders to communicate any change in the assumptions.
- Important EL goal: provide the capacity to power the full Meyrin site from EDF.
- CV planning is based on risk analysis. Meyrin site will be treated first, Prevessin (SPS) last.
- Remarks:
  - Time interval between long enough shutdowns is increasing => Intense work shutdowns
  - Long term activity which will require continuity and support at adequate level during 15 years. Some additional staff is urgently needed to fulfill the objectives of LS1.
  - Shutdown work on infrastructure will create interruption of services: need for careful advanced planning with users to minimize interference. **Crucial need to minimize thermal stress on linac2!**

LIU Beam Parameters & Planning

- Issues to address **in the proton injectors** are identified (the needs of heavy ions have not yet been analyzed). A number of actions deserve more study before being launched (e.g. against e-clouds).
- A significant amount of work related to upgrade and consolidation is planned during LS1 (details in the following talks).
- The RCS study will conclude in the summer 2011.
- Baseline and stretched estimates of beam characteristics after LIU (~2020):
  - With all the foreseen actions, the SPS injectors can saturate the SPS and allow for tests beyond baseline performance (« stretched »).
  - Baseline beam characteristics for 25 ns bunch trains cover part of the scenarios envisaged in HL-LHC.
  - Baseline as well as stretched beam characteristics for 50 ns bunch trains are insufficient for HL-LHC.
  - **Request for including present beam characteristics, as well as the difference between 1.4 and 2 GeV injection energy in the PS.**
  - **Need for iteration with HL-LHC…**
- No gain is expected for LHC before LS2 if Linac4 is connected to the PSB during LS1, but time would be gained adjusting PSB / PS, and work during LS2 would be eased.

Linac4 connection During LS1 & Plans for the PS Injector

- Linac4 connection during LS1 is feasible as a minor change to the present planning under the following conditions:
  - LHC shutdown duration is ~19 months for protons. **Possibility of recommissioning with Lead ions?**
  - Decision of (irreversible) modification of PSB has to be taken after Linac4 has successfully accelerated to 100 MeV.
  - H- source will probably not be nominal, but sufficient for getting the usual beam characteristics from the PSB for all users.
  - Resources: no obvious interference identified with the needs of the LHC during LS1…
- Baseline solution for the PS injector is the PSB at 2 GeV:
  - Main subjects: H- injection at 160 MeV and energy upgrade to 2 GeV
  - Report published with detailed hardware analysis, cost estimate (55 MCHF) and planning.
- RCS option under study (conclusion during the summer):
  - Locations: inside PS ring (difficult passage of transfer lines) or outside (longer lines and lack of space on the surface)
  - **The schedule of construction is an essential information.**

Plans for the PS

- PS is less advanced than PSB and SPS (late start)
- Baseline solution is with injection at 2 GeV:
  - Upgrade of the injection system (redesign of bumper, new septum and additional kicker in SS53). **In case of RCS, it should be capable to pulse at 10 Hz.**
  - Low energy corrector magnets may need replacement (under study).
- Main magnets systematically monitored. Bus bars replacement under study. Spare PFWs ordered.
- RF: need for improving RF feedbacks to reduce beam loading effects during gymnastics and displace instability thresholds. LLRF development and MD required to implement new gymnastics.
- Beam dynamics: transverse damper to be made operational and upgraded; longitudinal instability damper to design and build.
- On-going study of the e-clouds effects at 26 GeV and potential solutions.
- **Because of the cluttered cable trays, unused cables should be removed when equipments are replaced.**

Plans for the SPS

- Baseline goal(?) for beam characteristics at SPS ejection result from the SPS WG, in line with the presentation in Chamonix2011 (1.8E11 p/b within 2.5 mm.mrad at 25 ns spacing, 2.5E11 p/b within 3.5 mm.mrad at 50 ns spacing): **(Coherency with HL-LHC ?)**
  - Based on preliminary results with low gamma-t lattice in 2010.
  - Assumes perfect cure of e-cloud effects, extensive upgrade of 200 MHz RF, improved damper, upgraded beam instrumentation, Kickers impedance reduction, etc.
- Need for MDs (204 h requested out of 336!) to precisely define :
  - Beam instrumentation
  - Cures/mitigation of e-cloud effects and outgassing of components,
  - Beam dump…
- Planning:
  - Some work in LS1 [aC coating of one sextant **(some conflict with LHC),** preparation for 200 MHz RF upgrade, improvement of beam instrumentation,…]
  - Most installation in LS2 (aC coating of full ring, finalization of 200 MHz RF upgrade,…)
- Resources: ~69 MCHF + 183 FTEs

Overall Summary

Excellent Workshop

- ☑ High level of attendance (~100 participants)
- ☑ Lively interaction
- ☑ Clearly filling a need for general communication of activities/ideas

Many Actions Identified

- ☑ Comprehensive list will be generated and farmed out to the various working groups/committees

The needs of the injectors in the coming years is becoming clearer

- ☑ Clear need for combined planning for ALL activities during LS1
- ☑ Many obligatory activities must go ahead (eg CV, EL, controls renovation)
- ☑ Others will have to be carefully analyzed

Safety is an important part of all our activities

- ☑ Very happy to see the level of interest and interaction during this session

Thanks to Everyone, Chairmen, Secretaries, Speakers and Participants!