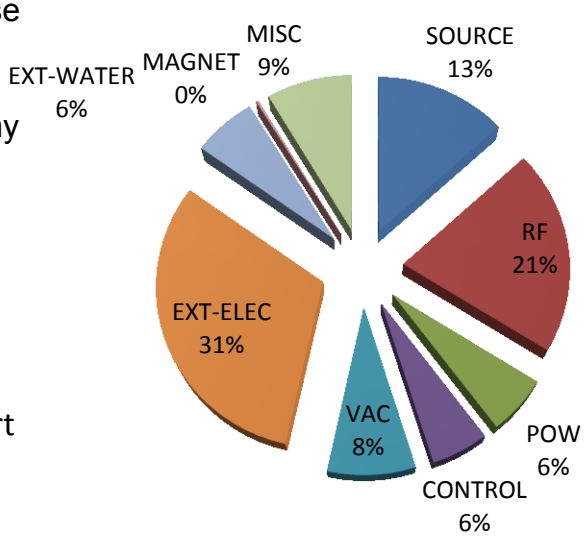
Linac2 Review

- 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

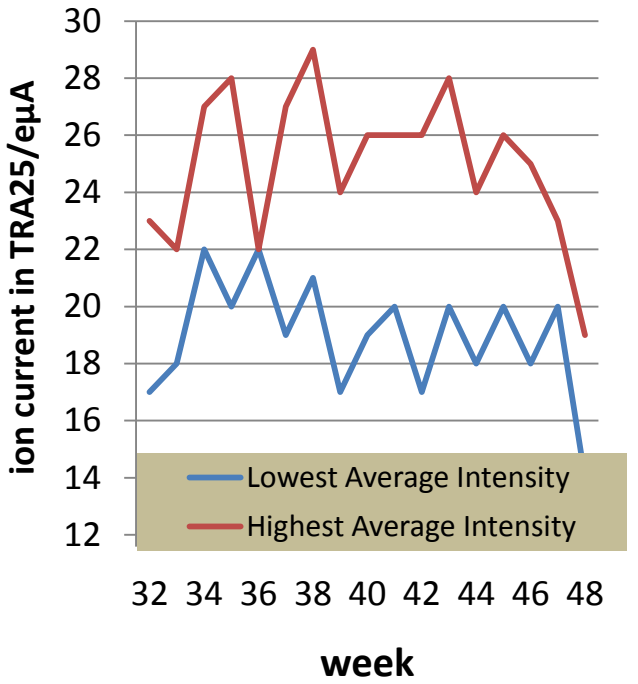


Total downtime= ~964 hrs
Total op. time = 59994 hrs avg. availability = 98.4%

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)