



Overview of the main events related to AT equipment in the LHC injector chain for 2007

P. Strubin, on behalf of AT Department

Thanks to: H. Genoud, E. Mahner, S. Meunier, A. Newborough, E. Page, A. Rey,
D. Smekens, T. Zickler



Outline



- Events in the SPS
 - Vacuum
 - Magnets
- Events in the PS complex
 - Linac2
 - PS
 - ISOLDE
 - AD
- Miscellaneous observations
 - Needs to know status of equipment
 - A fault identified before start-up
 - An example of vacuum affected by losses
- Conclusions



Main Vacuum Faults in SPS



- SPS
 - 19 June 2007
 - Problem with a sector valve controls card
 - Lost time: 2h 10min
 - 7 August 2007
 - Compressed air problem on a sector valve
 - Lost time: 3h 10min
 - 13 August 2007
 - Faulty gauge prevented to open a sector valve
 - Lost time: 40min

There are no systematic or recurrent faults on the SPS vacuum system, but the pneumatic of the sector valves needs attention and some action is taken during the present shut-down.



Main Magnet Faults in SPS

- SPS

- 29 August 2007

- Change of MBA60450, 14h ← Reason: leak on vacuum chamber

- 4 Septembre 2007

- Change of MBB13090, 8h

- 12-13 Septembre

- Change of MBB60290, 20h ← Reason: short in the magnet

- 24-27 Septembre

- Fault on QNLF2405M
- 2 x 4h40, but no beam on T4 for 3 days

- 3-4 November

- Fault on QTAF2308
- Some 50 hours cooldown of TCC2 before repair

Did only
affect
experiments
in the North
area



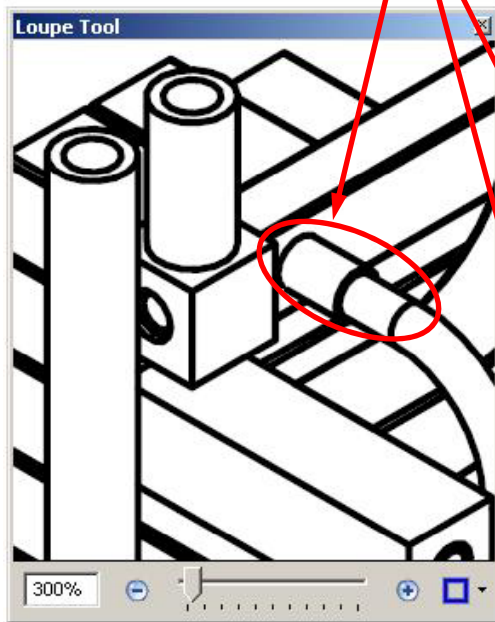
Water leaks in the SPS



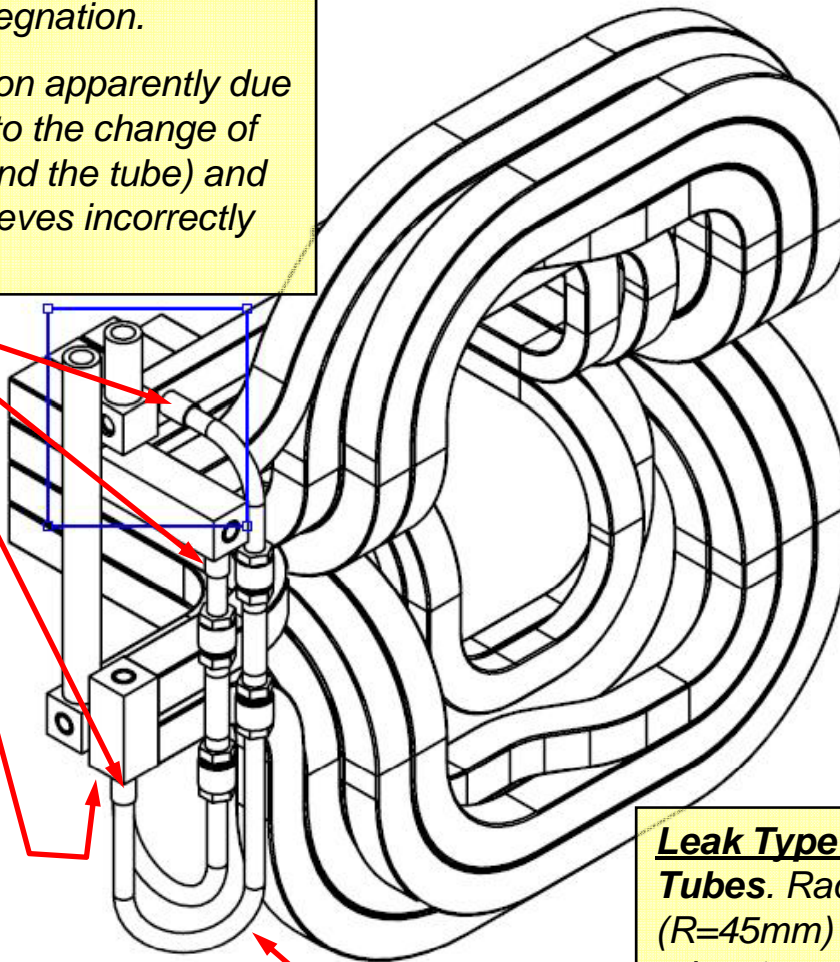
- **Systematic faults**
 - The bulk of this class of fault is understood and the consolidation program is ongoing on the 255 most critical magnets
 - 80 magnets repaired in the 2006-2007 shut-down
 - 80 magnets being repaired this shutdown
 - Remaining magnets to be repaired during 2008-2009 shut down
 - Represent some 70% of all faults related to water leaks
- **Non systematic faults**
 - The 30% remaining faults are more or less random faults
 - Damaged components, twisted water hoses, etc.

LEAK Type 1 On straight copper tube junctions. Copper tubes are brazed on a short thick sleeves. These sleeves are brazed to the coil conductor prior to coil impregnation.

6 cases of leaks in 2004. Erosion apparently due to bad design (turbulence due to the change of diameter between the sleeve and the tube) and also due to bad fabrication (sleeves incorrectly brazed or incorrectly inserted)



21 January 2008



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Courtesy D. Smekens

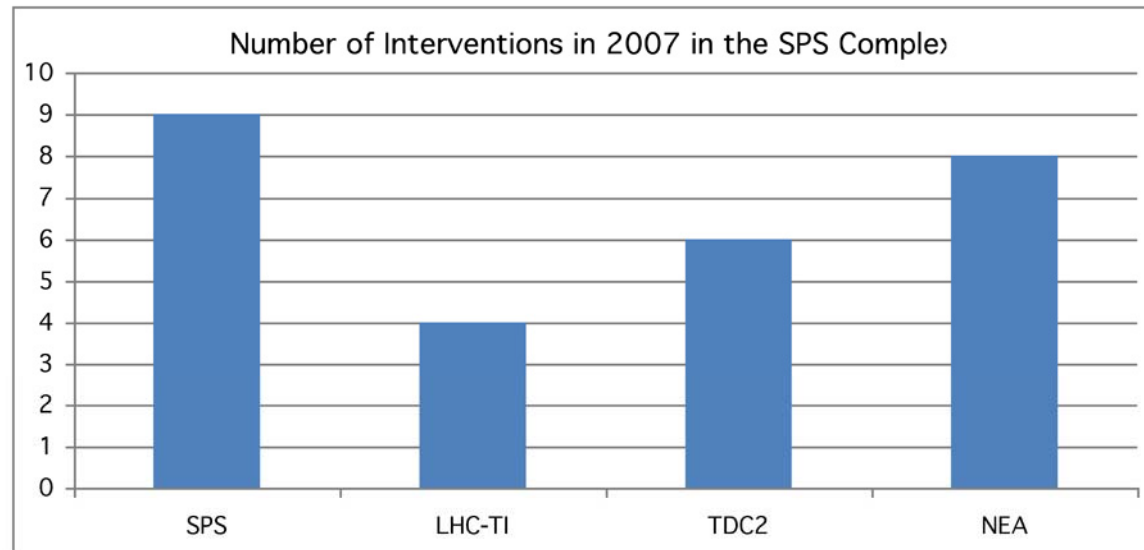
Leak Type 2 on U-shape Copper Tubes. Radius too small ($R=45\text{mm}$) for the diameter of the tube. 1 case of leak in 2004. Erosion apparently due to bad manufacturing (inclusion ?, dent?)



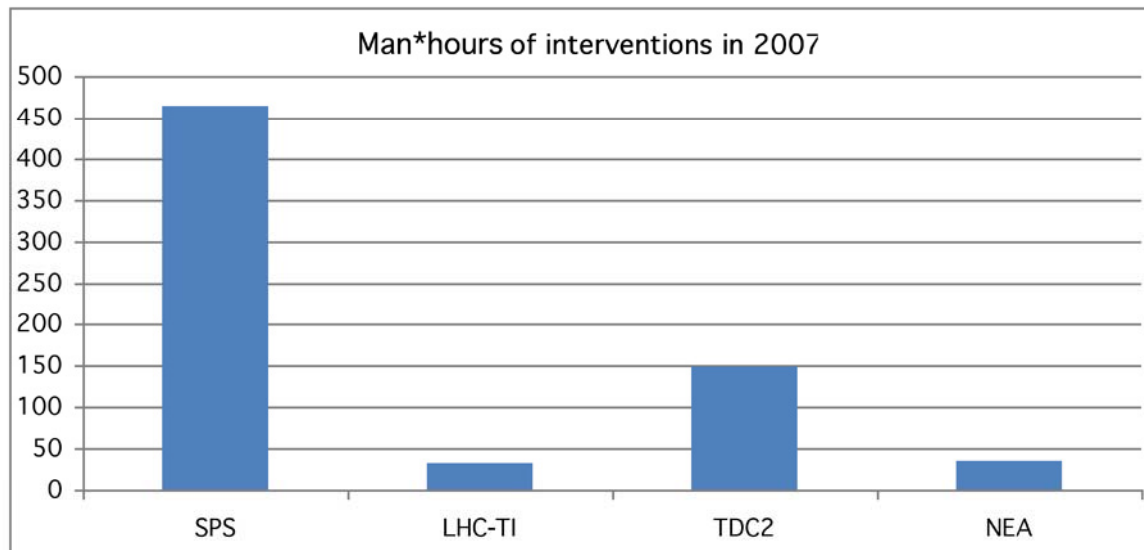
MEL Statistics for SPS



- Interventions



- Resources

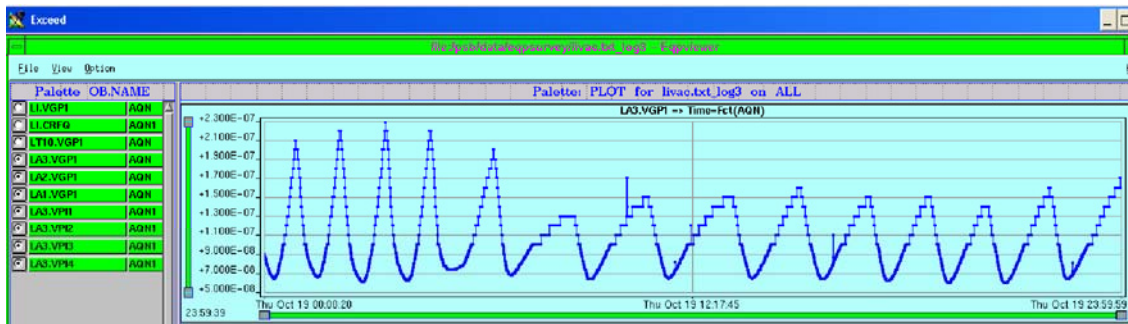


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- Systematic consolidation during 2006-2007 shutdown (1)
 - Pressure instability on the tanks
 - A polymer skin was poured around the flange where the largest leak was located to create a differential vacuum
 - The « sliding » feet were lubricated



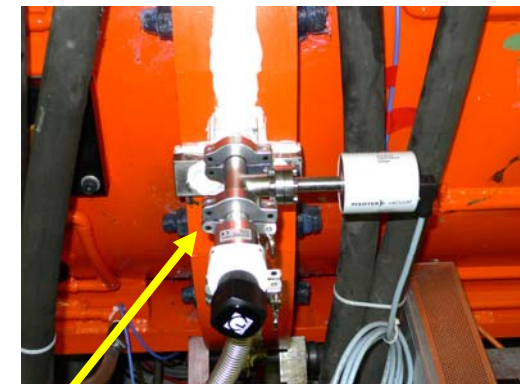
Pressure now stable in the 10^{-8} mbar range, independent from the temperature of cooling water, **no longer any RF trips**



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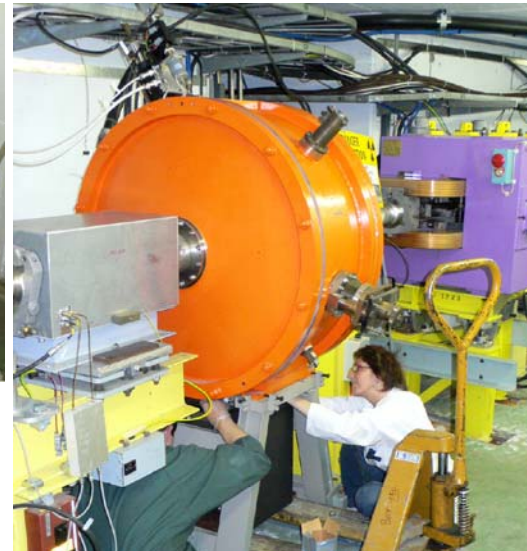


Resin poured and polymerised in situ (TS-MME)



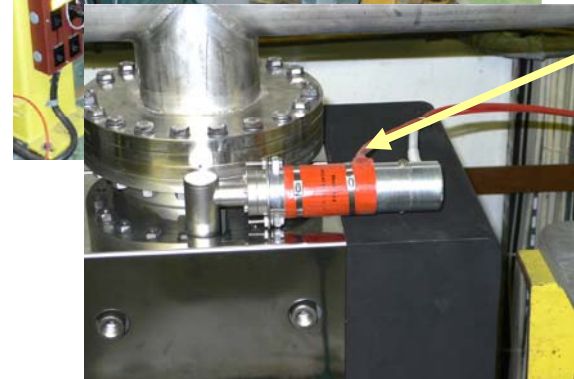
Differential pumping: outside pressure around 2-3 mbar

- Systematic consolidation during 2006-2007 shutdown (2)
 - Various items on the LT10 transfer line
 - Replacement of ion pumps with corroded HV feedthrough



Please note the very appreciated help of an AB-OP operator!

Replacement of leaking vacuum chamber (corrosion)



Heating collars added to avoid moisture

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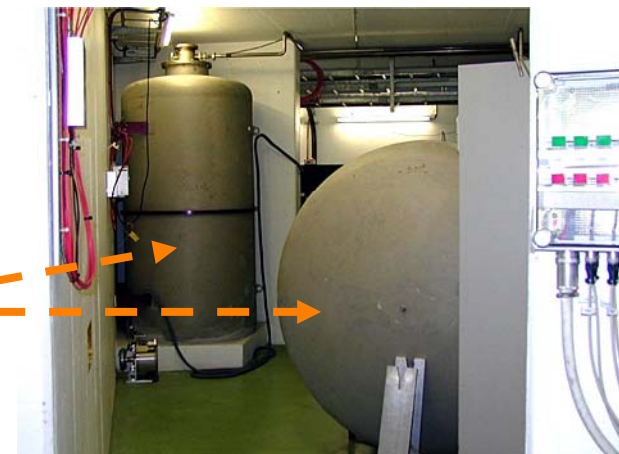
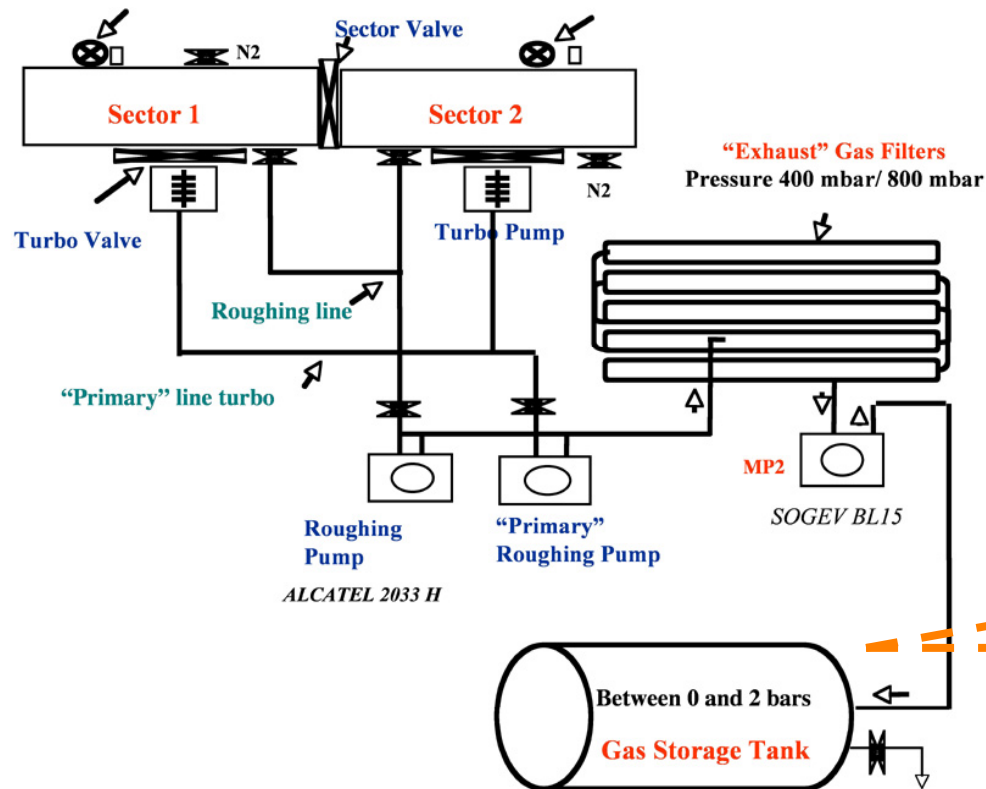
- Corroded ion-pump feedthrough
 - Severe corrosion



- Rapid survey of all PS pumps did not show any other case

Systematic inspection of the feedthrough and connector of every ion-pump in the PS is ongoing during this shutdown

- Most important incident on gas recuperation
 - Was the consequence of an intermediate status of the vacuum system to prepare the installation of the RFQ, which masked a leak on the Faraday cage that developed during this period.
 - Stopped data taking for about 1.5 days

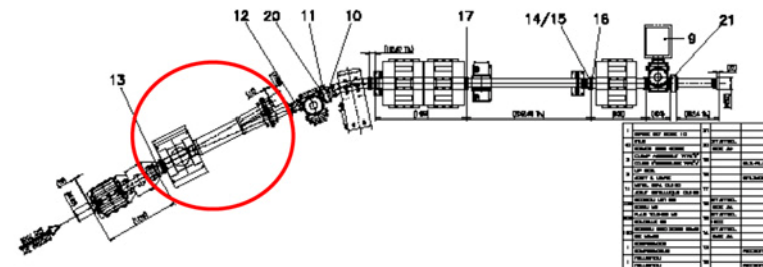
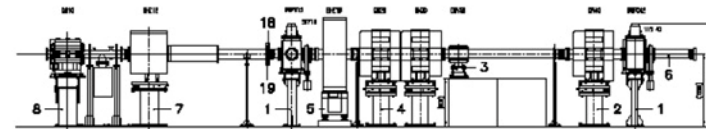




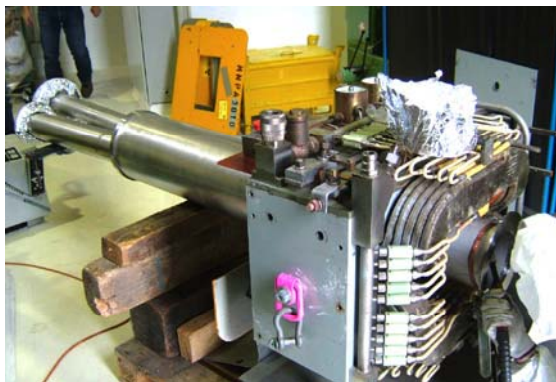
- Problem with a valve on the HRS front-end
 - Faulty switch
 - Valve “closed” status could be assessed
 - Emulate the valve end-switches with a manual switch
 - Could not be repaired because of radiation level
 - -> wait for shutdown
- Fault on a pressure sensor affecting both front-ends
 - Pressure in argon line used to vent the targets could not be measured
 - Required a manual intervention every week when changing the target on HRS

No physics time was lost, but mobilised VAC resources for every change of target

- Magnet BHZ12 had to be replaced in extraction line DE0
 - Ground fault developed as a consequence of coil damage
 - Cut out the "Y" chamber



- Install it in refurbished spare magnet



- Magnet DHZ2908 had to be replaced
 - Required to vent the vacuum sector
 - AT-VAC took the opportunity to replace a faulty ion-pump feedtrough
 - Because of the need for bake-out, the total down-time was around 10 days (10 to 20 September)

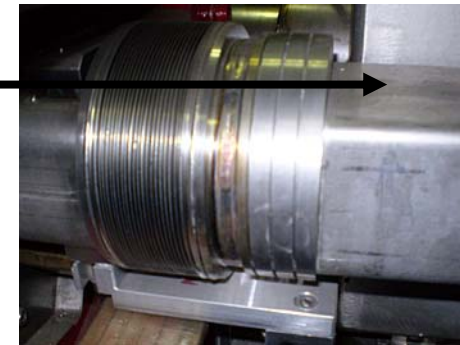
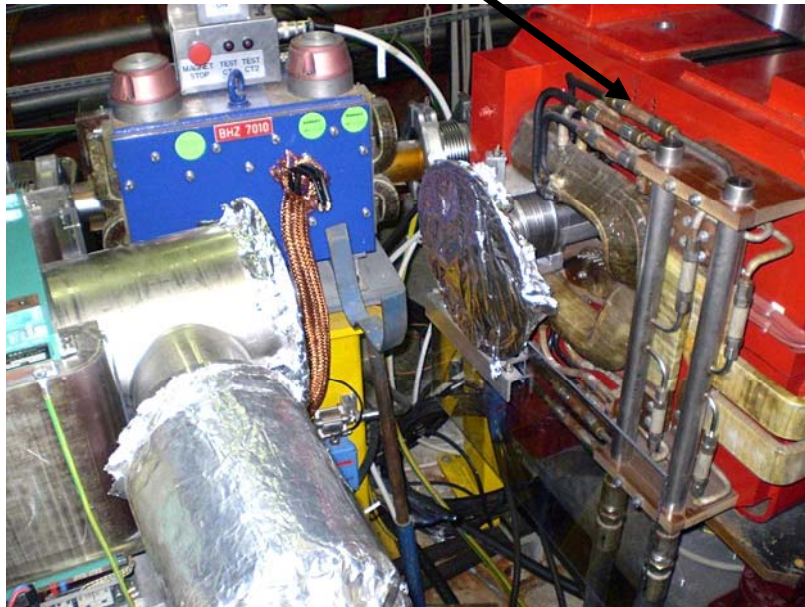


New layout of the magnet installation will avoid to open the vacuum system if a new fault develops on the magnet

Magnet to replace

- Water leak on QFC54
 - Identified during the repair of DHZ2908
 - Repair could wait for the shut-down
 - Implies heavy mechanical work
 - Vacuum chamber is welded to septum 58

Magnet to repair

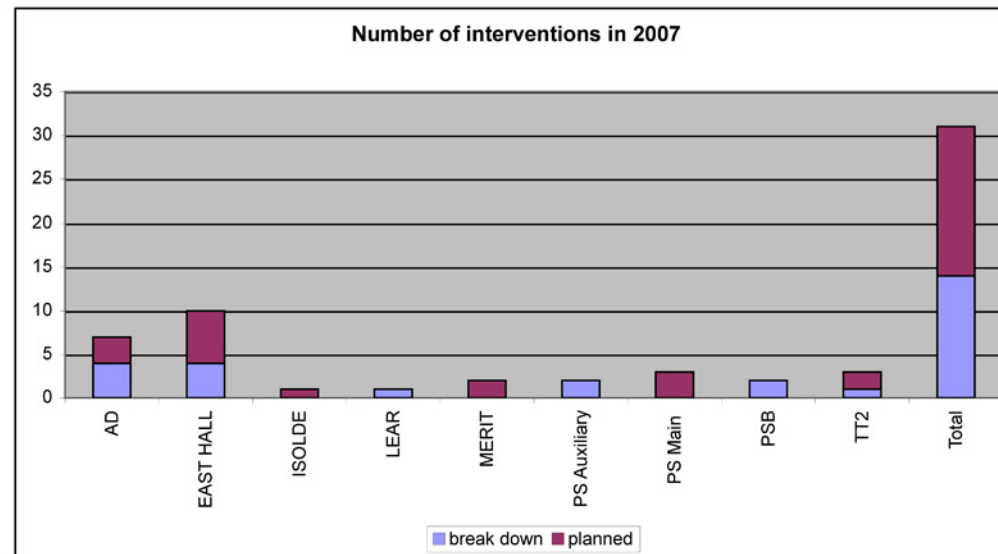


General statement on AD, Booster,
ISOLDE and East Hall:

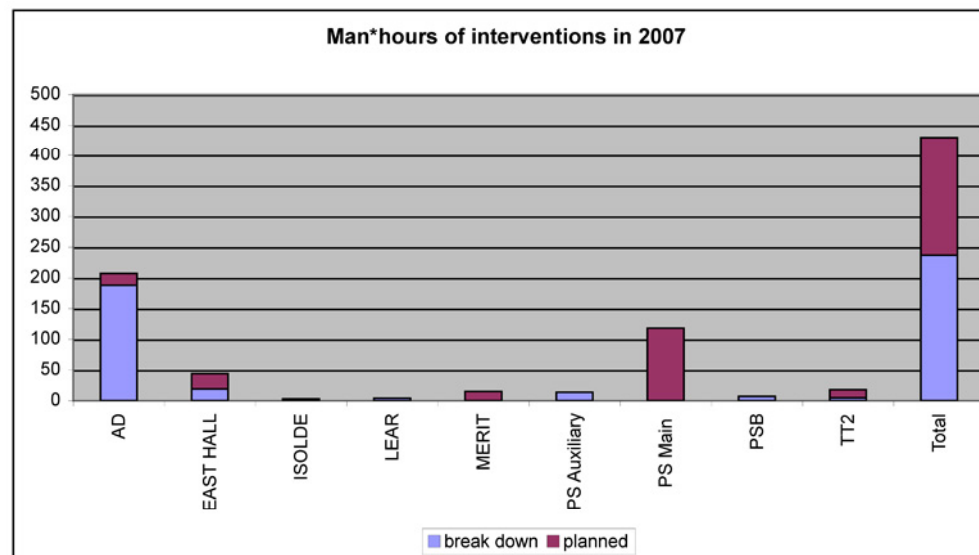
"We don't have a clear status..."



- Interventions



- Resources



Courtesy T. Zickler

- Example of a cooling manifold in ISOLDE
 - Water leak found in ISOLDE on a cooling water manifold



A new manifold was made from stainless steel and installed into the machine. Due to the irregular positions of the connectors the manifold could not be made from a drawing but only by copying the original, which had to be removed from the machine.

We don't know anything on the reliability of the (at least) 4 types of magnets, nor do we know the status of their manifolds.

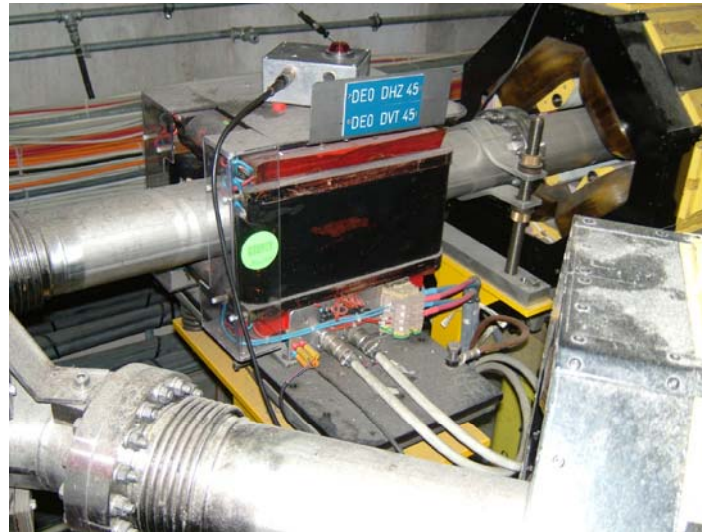
Real status and documentation are badly needed

- Debris in a kicker
 - Found at the end of the 2006-2007 shutdown
 - Could have stopped operation if not detected then



- AT-VAC encountered difficulties when closing a large (330 mm) flange with a non-standard seal
 - Had to use an expensive Helicoflex™ joint

- The equipment is not always the culprit!
 - Example from AD:
 - Interlock on DHZ45 corrector in DE0 line
 - Traced back to an unplugged cable



Additional finding: when getting to DE0 line, the MEL team found the security door wide open. The AD control room was not aware of it, but was looking for reasons why they could not inject in the line...

- A beam loss problem where the pressure was the “probe”
 - Losses on MST & MSE in SPS, extraction of LogBook:

Summary of the work done so far on the extraction:

The interlocks stopping the magnetic septa MST+MSE North were due to vacuum. **This has increased since the increase in intensity on the fixed target cycle** at the beginning of august and provoked the trips of the MS North at the end of last week and yesterday when we increased the extracted intensity to reduce the amount of beam on the beam dump.

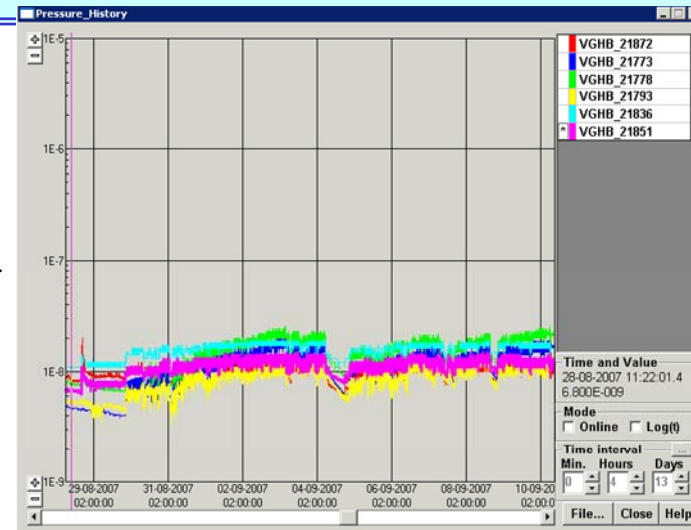
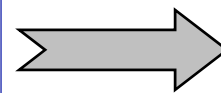
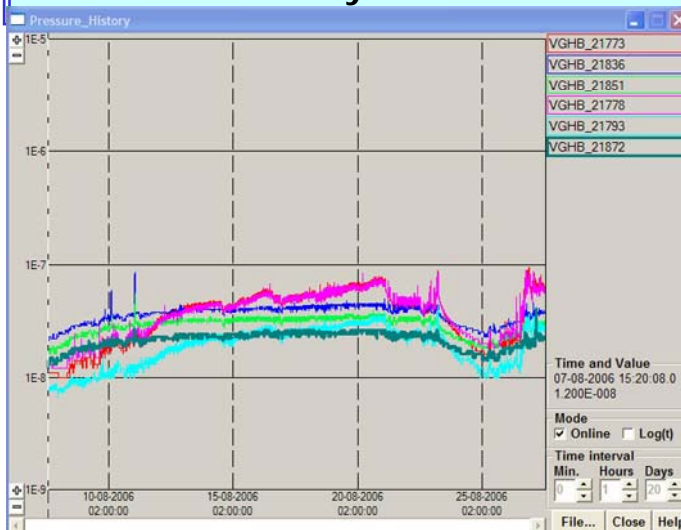
Observed that the losses are particularly high at the TPS and MST1.

These losses could be reduced by reducing the strength of the servo-quadrupole and increasing the tune slope during extraction and by reoptimizing the position of the ZS anodes and girder with the Macro written by Delphine and using the passerelle.

The losses have been at least halved at the MST with no significant increase at the ZS.

A second iteration on the losses by optimizing the position of the girders might be required, but at the moment there is no beam.

Since this morning we did not get any interlock more and we have increased again the extracted intensity.





Some conclusions

- The major systematic problems have been identified
 - Water leaks in the SPS magnets
 - 160 will have been repaired by the end of this shutdown
 - PS magnets
 - 8 more replaced during this shutdown (leads to 42 repaired)
- The equipment is ageing
 - Generate random faults
 - Magnet coils that burn
 - Water leaks on magnet cooling circuits
 - Corrosion on vacuum feedthrough
- Real status of some magnet systems need to be assessed
 - Booster, AD, ISOLDE, East Hall
- Documentation needs to be checked and completed
 - e.g. magnet system in ISOLDE

Vacuum and magnet systems should not develop major problems in 2008, but they will need close follow-up