Feasibility of installation in the LHC and SPS

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Many thanks to G. Stancari, Y. Muttoni, G. Bregliozzi, P. Chiggiato, S. Claudet, B. Salvant, O. Aberle ….

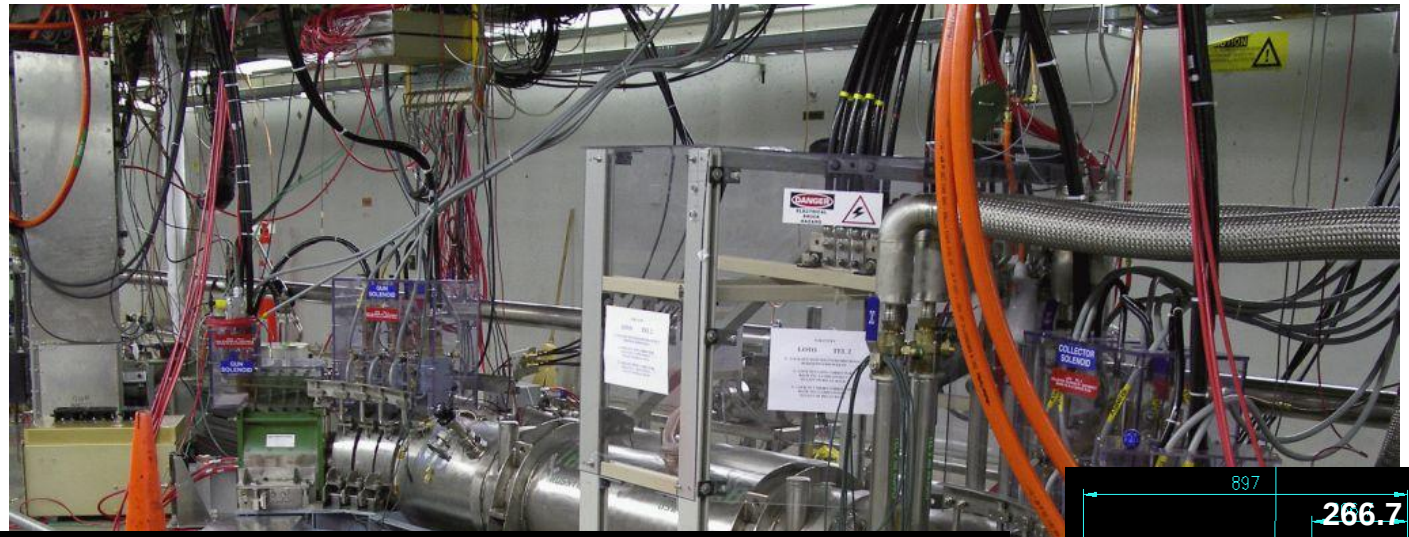
Integration issues

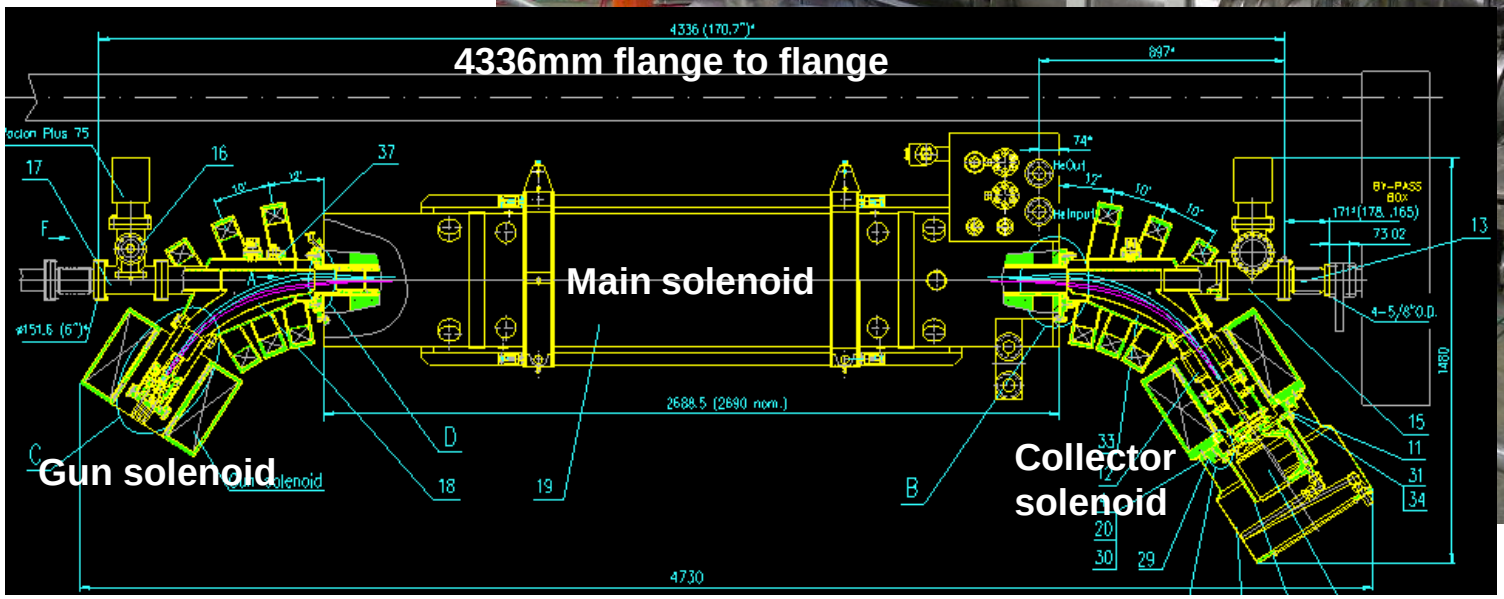
- Space available in SPS and LHC
- Cryogenics
- Vacuum
- Impedance
- Overlapping with other devices
- Summary

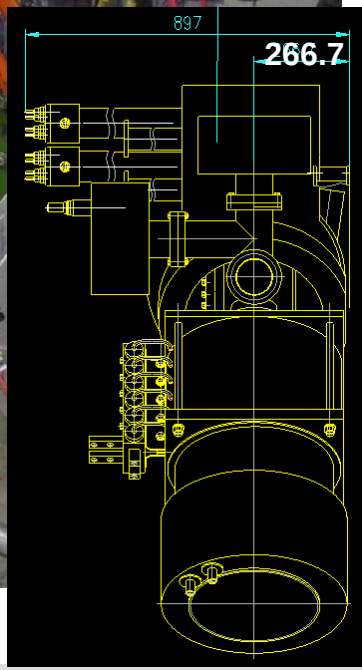
E-Lens TEL2

Operating temperature
- **Solenoid 4K**
- **Vacuum RT**

Vacuum ~ 10^{-8} mbar





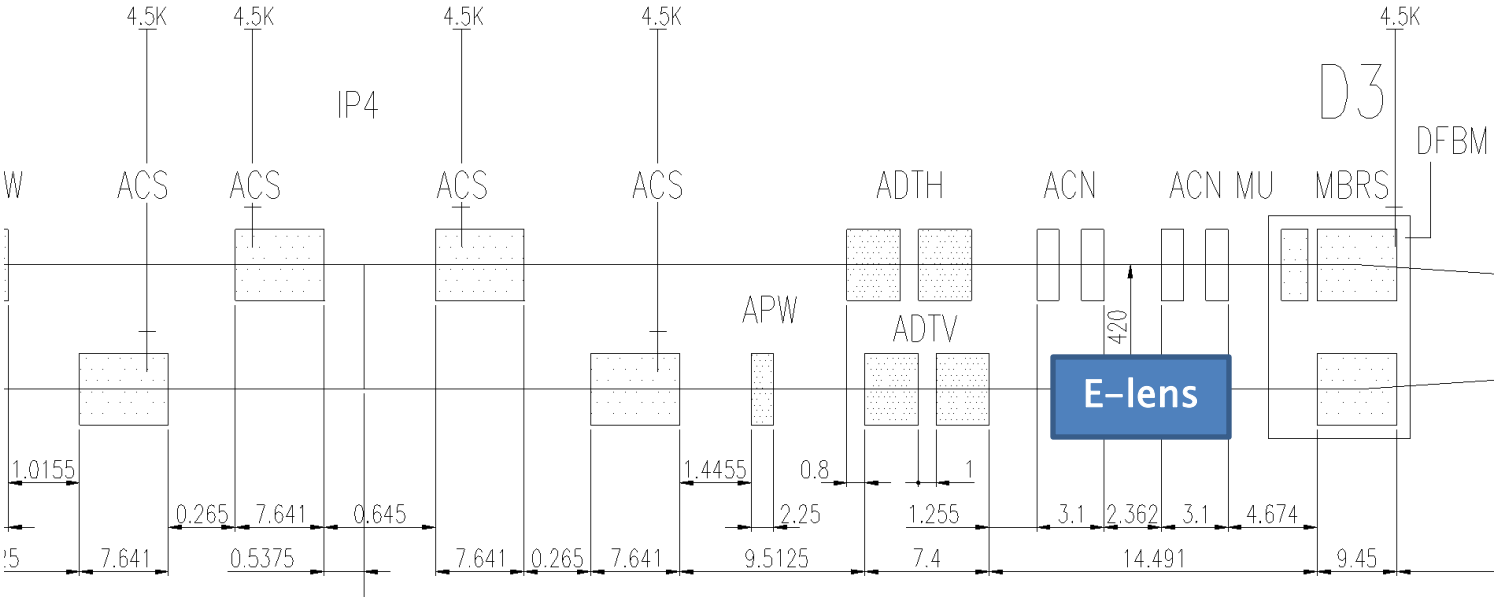


LHC IR4 RB46 or RB44

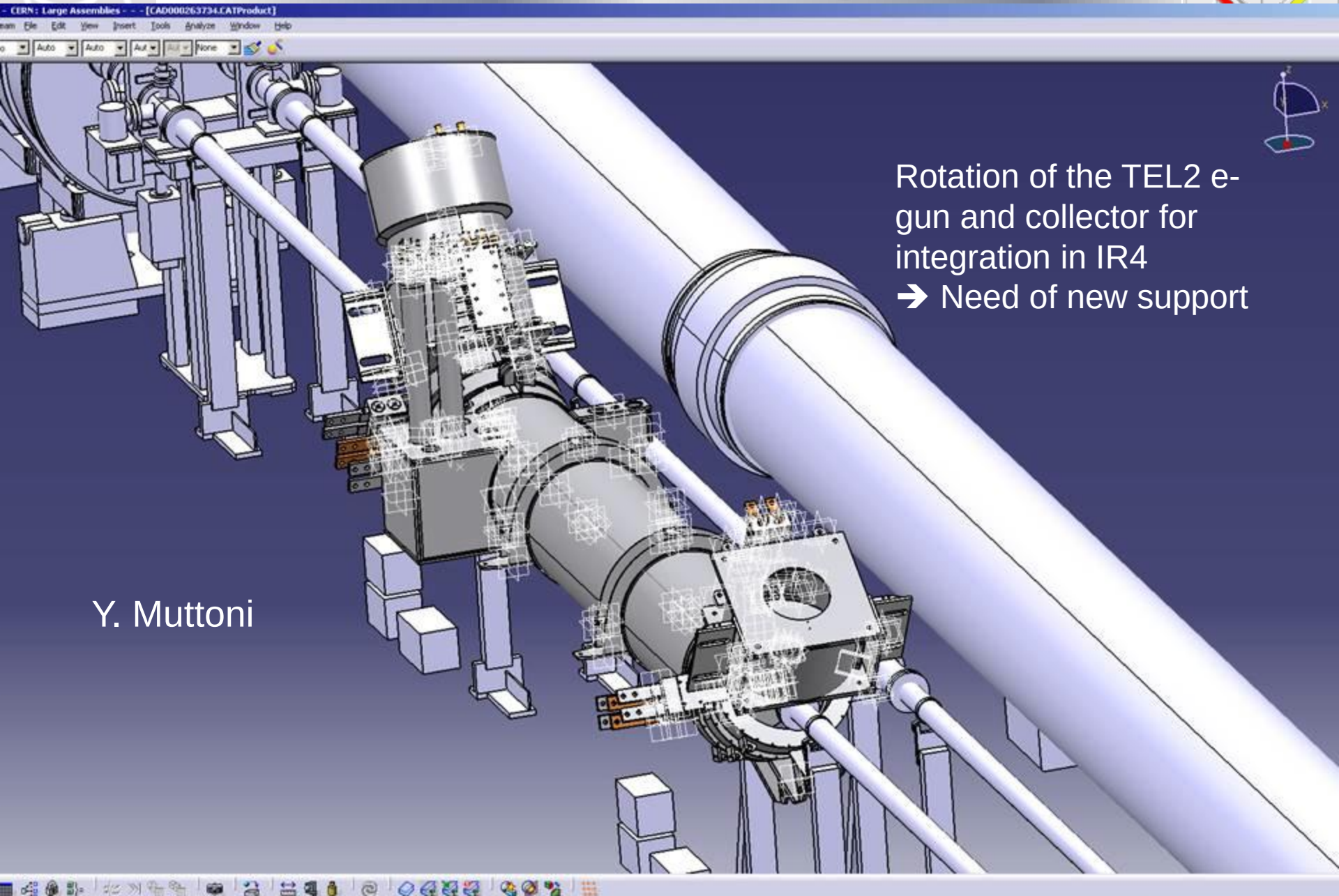
RF INSERTION

Intrabeam space 420 mm

RB46 preferred because rounder beam and

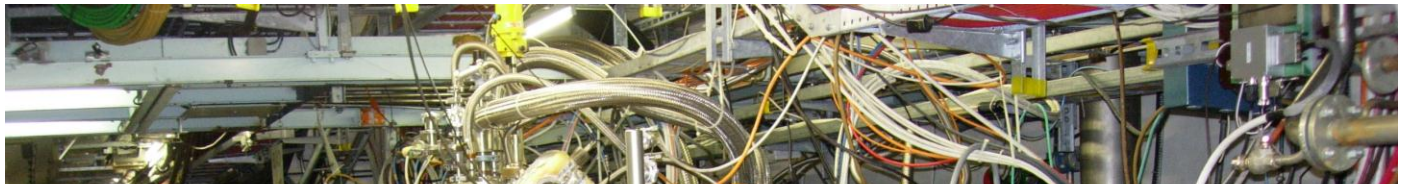


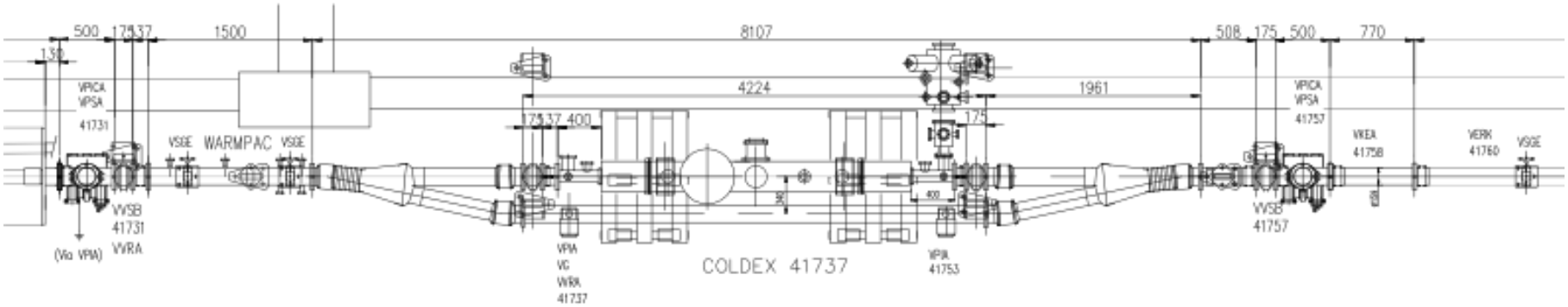
LHC IR4 RB44 integration



SPS BA4 (~ Coldex location)

SPS BA4





- If is series to crab cavities no room for a second Y chamber? TBC
- Collimation scheme to be checked. Existing collimators in SPS:
  - 51899-BRCV (vertical)
  - 51902-BRCH (horizontal)
  - 52102-BRCZV (vertical)

Integration issues

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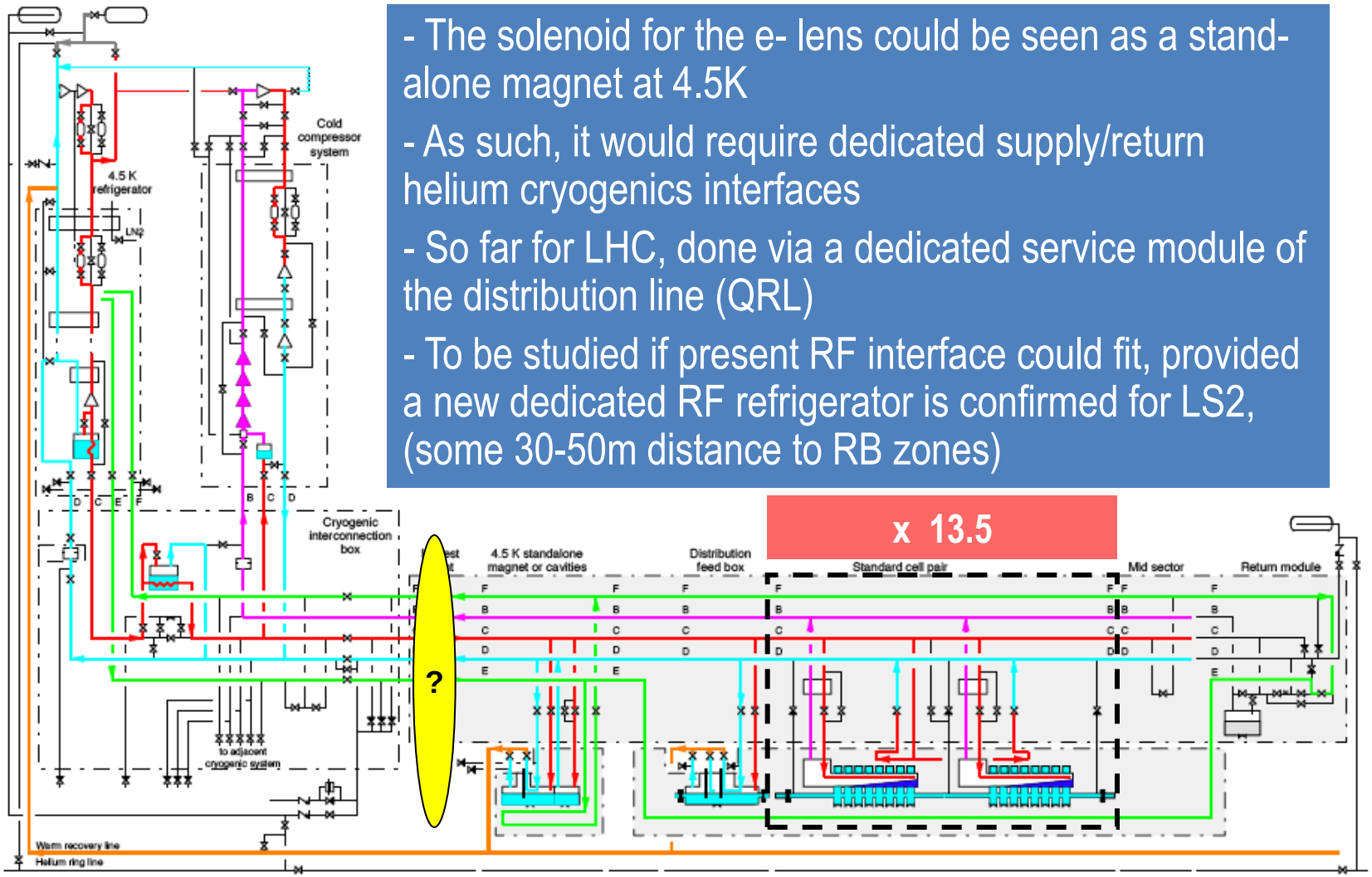
Typical flow scheme of a LHC sector for cryogenics

- The solenoid for the e- lens could be seen as a stand-alone magnet at 4.5K
- As such, it would require dedicated supply/return helium cryogenics interfaces
- So far for LHC, done via a dedicated service module of the distribution line (QRL)
- To be studied if present RF interface could fit, provided a new dedicated RF refrigerator is confirmed for LS2, (some 30-50m distance to RB zones)



Courtesy of S. Claudet

Interfaces to be considered

- Mechanical:
  - Operati 1-2 bar ure, stability required, maximum allowed pressure (safety device), test p 17 bar
  - Number and type of interfaces for supply/return piping
- Thermal:
  - Heat loads at different temperatures (4K, 12W He vessel, 25W N_2 shield
  - Particular constraints for cool-down & warm-up
- Electrical (power):
  - How to power and protect the leads and magnet (QPS?)
- Instrumentation/Controls:
  - Input signals (pressure, temperature, level)
  - Output signals (Cryo start/maintain for powering)

Courtesy of S. Claudet

Sequence to be considered

Preliminary integration study for final layout
Formal validation required after each step

- Gathering of information, clarification of interfaces
- Qualification of HW at surface (SM18 or equivalent) to check technological aspects
- (Possible qualification with SPS beam if appropriate, as done for crab cavities as LHC was not considered as a test bench). Does this apply for e- lens ? Could be installed in BA4 but not working at the same time as Crab Cavities.
- Final installation in LHC

Courtesy of S. Claudet

Integration issues

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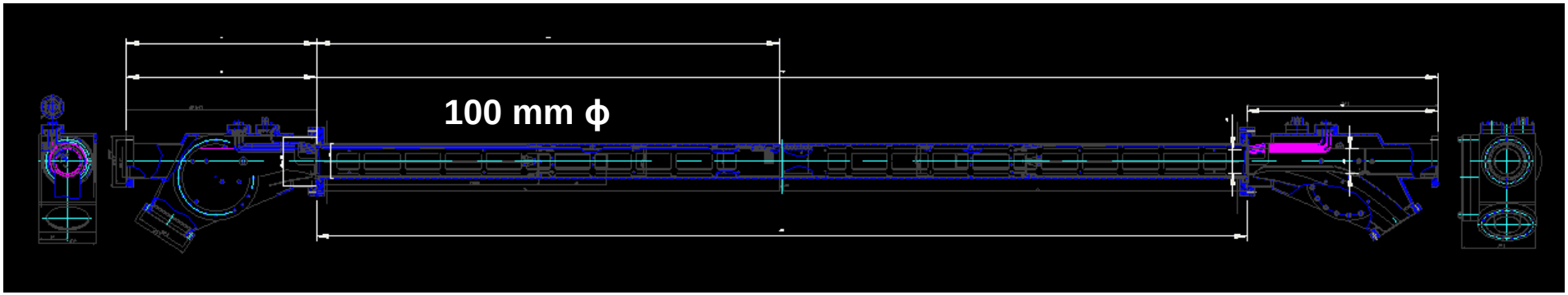
TEL-2 vacuum



- **Tevatron specifications**

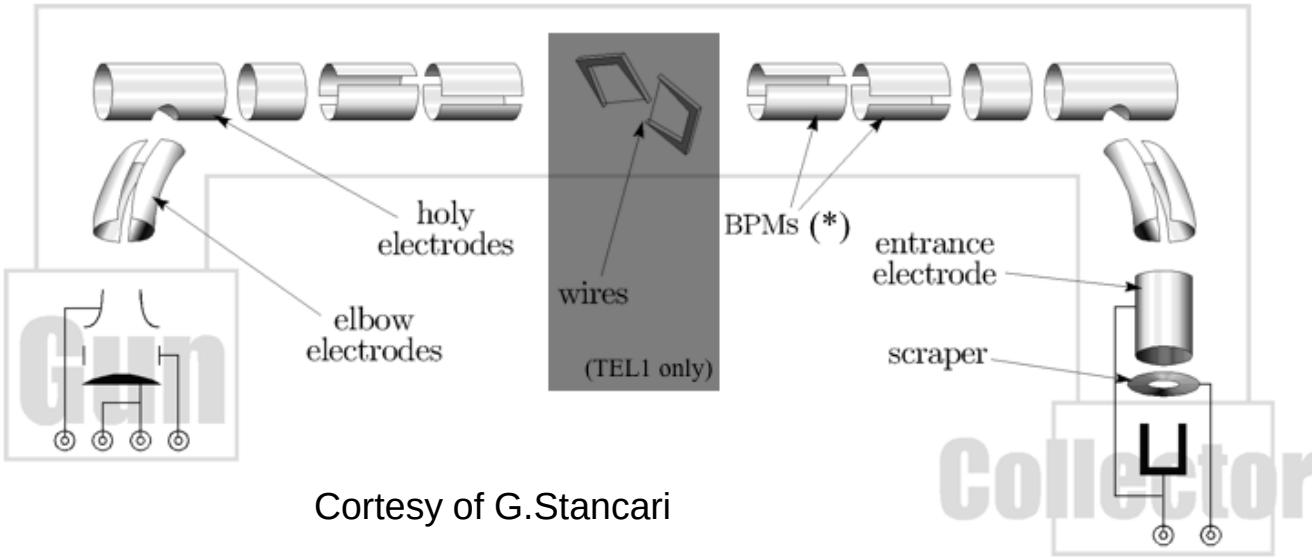
Devices to be installed must meet the following criteria:

1. The device must be able to be baked to a temperature of at least 100 degrees Centigrade.
2. The device must reach 1 x 10-8 Torr in a 3 day period, using the same ion pumps as it would use in the Tevatron, and blanked off in a manner which represents conditions in the Tevatron.

G. Stancari: @ Tevatron the beam-pipe vacuum is provided by 4 ion pumps (255 l/s nominal, total) and includes valves upstream and downstream; since installation in 2006, pressure has been in the 1E-9 to 1E-8 torr also during warm-ups of the Tevatron or during scraping experiments

Tel-2 vacuum

- Electrodes are basically unbaked

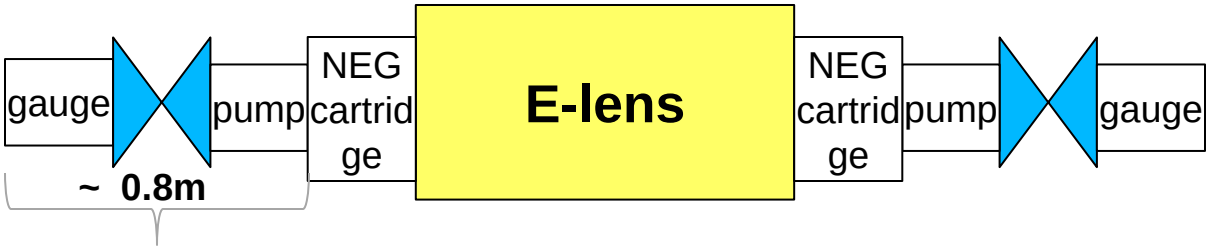


Cortesy of G.Stancari

- If pressure measured at ion pump location central pressure higher

Vacuum requirements for LHC

- E-lens enclosed between valves provided with NEG cartridge, pump and gauge. TO BE INTEGRATED



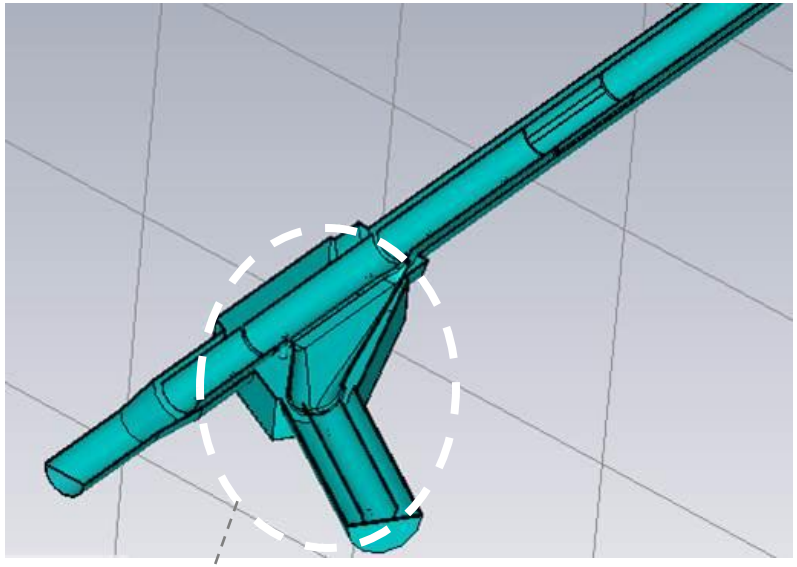
- Possible instabilities (pressure and e-cloud) TO BE VERIFIED (e-cloud should be suppressed by solenoid field when e-lens working)
- Possibility of baking at higher temperature TO BE INVESTIGATED
- Surface tests required

Integration issues

- Space available:
- Cryogenics
- Vacuum
- Impedance
- Overlapping with other devices
- Summary

Impedance

- Impedance issues at Tevatron very different from CERN since Tevatron bunches much longer (1-2 m)
- Preliminary studies with a layout similar to the Tevatron set up show:
  - Very large longitudinal impedance (both low frequency contribution and resonant modes)
  - Smaller transverse impedance contribution
  - The current model is quite unfavourable as it assumes that all inserts are floating



✸ Some modifications are likely be required in this region, to be confirmed.

Integration issues

- Space available:
- Cryogenics
- Vacuum
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Overlapping with other devices

SPS – BA4

- Interference with COLDEX up to end of 2015 (TBC)
- Competing with Crab Cavities (same or different Y chambers?)

LHC – IR4

- Space for both Crab Cavities and E-lens if installed at opposite sides of IP4.

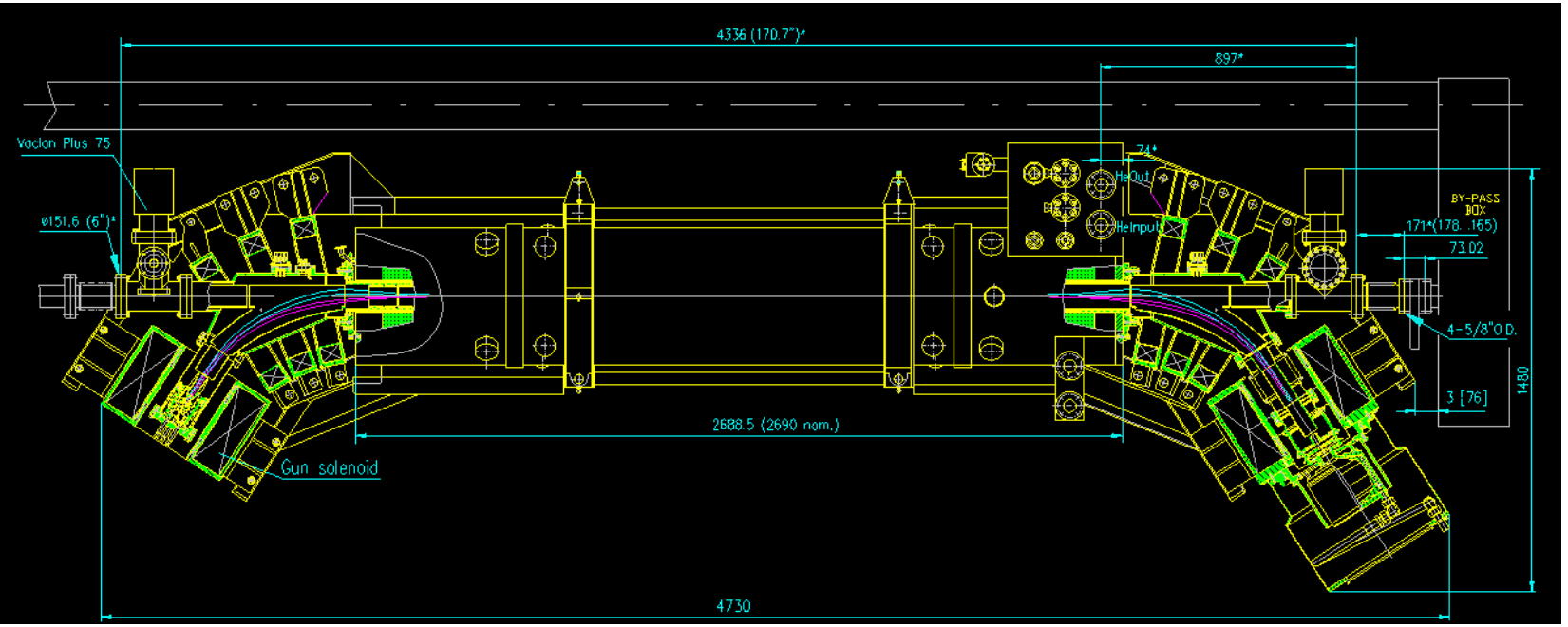
Integration issues summary

- Space available and overlapping with other devices:
  - Does TEL2 physically fit in SPS if Crab Cavities installed at the same time (Y chamber?) If in parallel to be operated separately because cryo cannot supply both devices at the same time.
  - LHC: turning of gun and collector solenoid necessary. Consequences?
  - Space for cables? Water cooling for collector?
  - Can we use the same power supply? Where to install them? Will they work at 50 Hz?
- Cryogenics
  - Interfaces
  - Quench protection system?

Integration issues summary

- Vacuum
  - E-cloud and pressure instabilities to be checked
  - Can we bake the beam pipe at higher temperature?
- Impedance
  - Longitudinal both low and high frequencies too high. Modification likely to be required.
- LS2 or earlier shut down periods?
- What can be prepared before final installation?
- What else?

Backup


4336 (170.7")*
897*
Vaclon Plus 75
ø151.6 (6")*
74*
HeOut
HeInput
BY-PASS BOX
171*(178..165)
73.02
4-5/8"O.D.
3 [76]
1480
2688.5 (2690 nom.)
Gun solenoid
4730

Backup