

Crabs cavities @ IP4? Boundary Conditions

O.Brunner LHC-CC09

Objectives of the “investigation”

- Is there any possibility to install one crab cavity module (assuming same size as one LHC ACS cavity) on each side of IP4? Where?
- Is it possible to connect the crabs to the cryogenic system?
- Where to install crab power stations, the power lines, the control&LLRF systems?

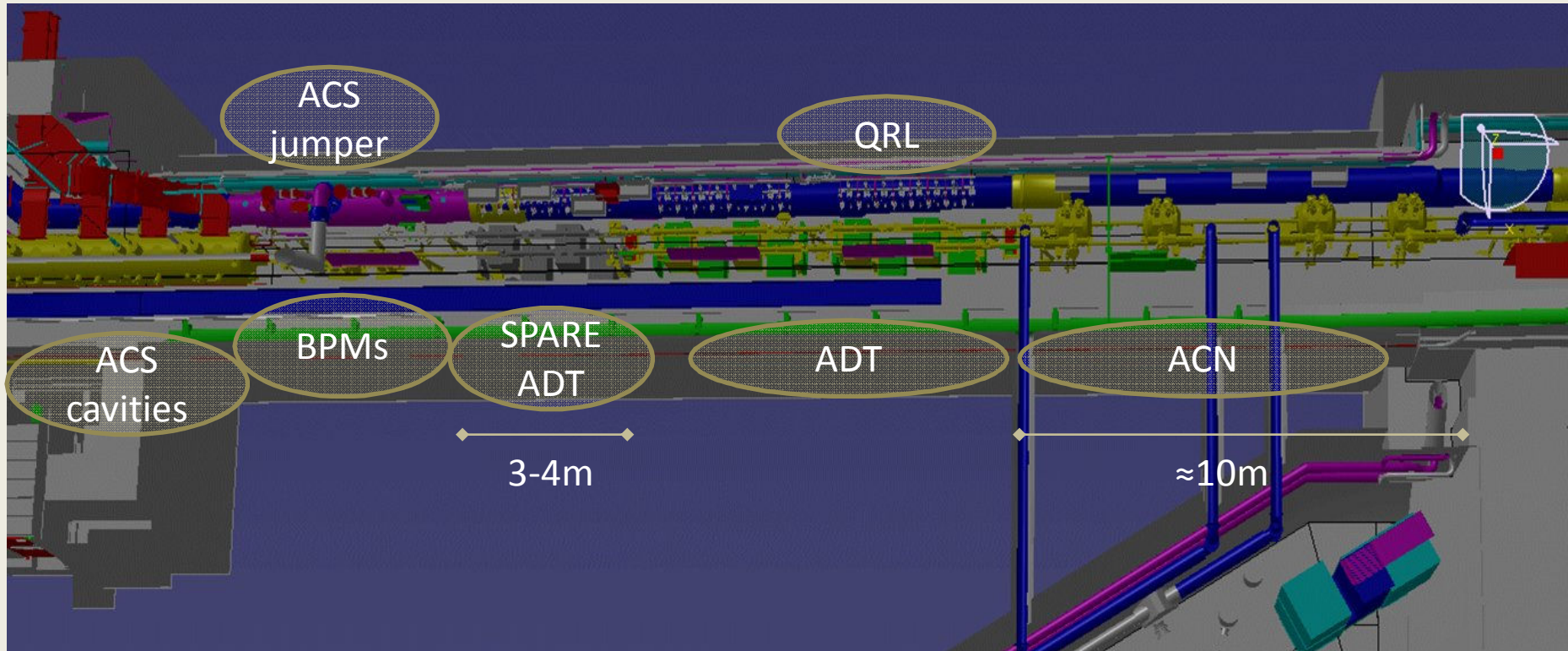
Where Crabs could be installed?

- Only two options to fit the crabs around IP4:
 - ACN cavities region:
 - In case these cavities are not (all?) installed
 - The spare damper position:
 - In case the spare dampers doesn't need to be installed
- If both the ACN and the spare damper need to be installed (only LHC operation will tell us...see next talk), there will be no possibility to install crab cavities at IP4.

IR4 layout

← IP4

Point 5 →



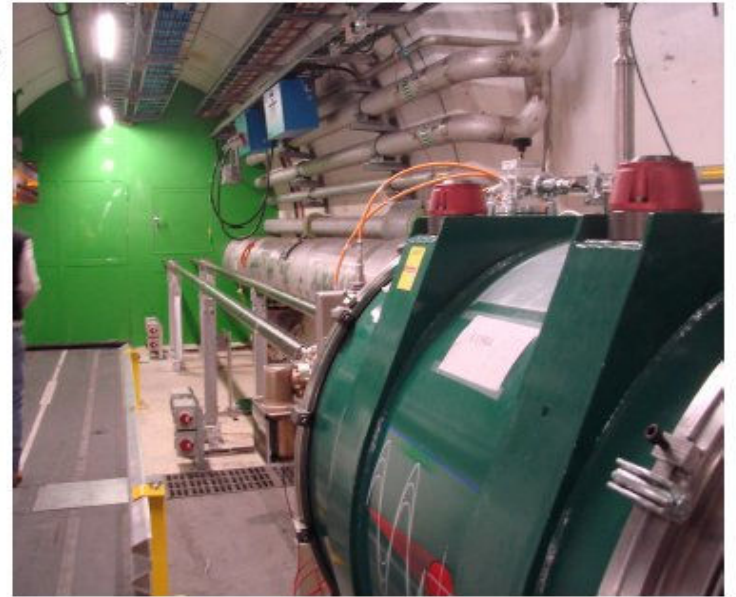
- Symmetric towards point 3
- Not possible to free space in the ACN cavities region (power lines, RF couplers, access behind the ACN)
- Max 3m longitudinally

ACN region

Left of IR4



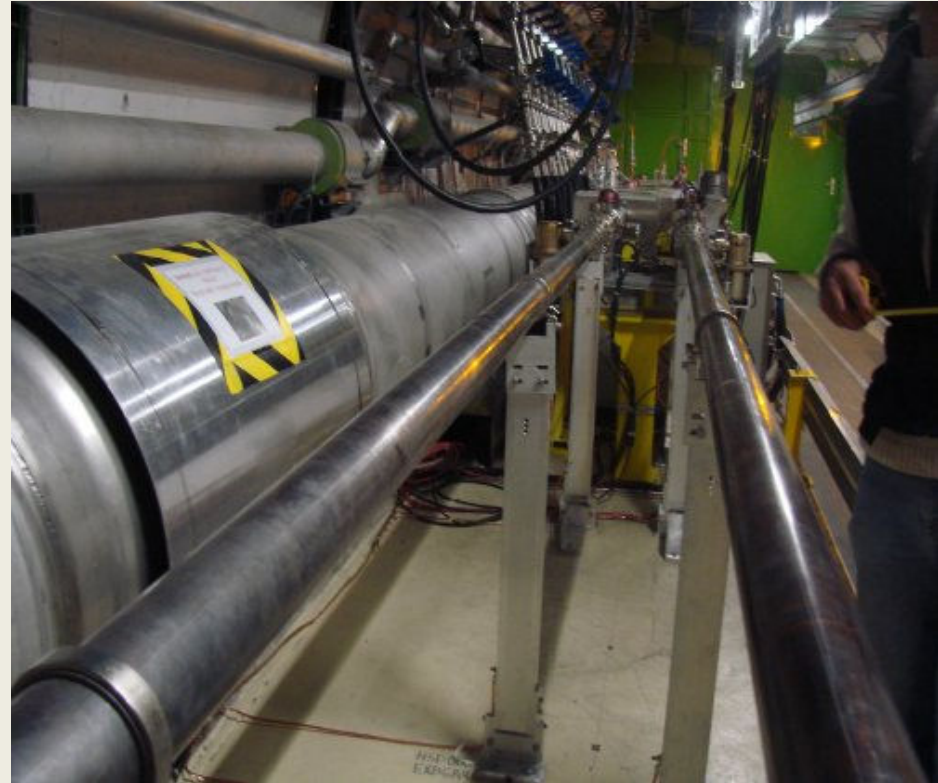
Right of IR4



ADT Reserved Space $\approx 3-4\text{m}$



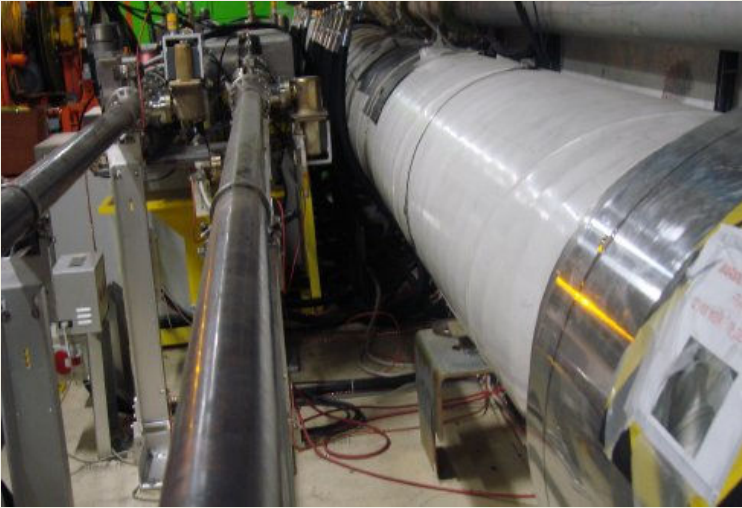
Left of IP4



Right of IP4

Cryostat: max $\approx 3\text{m}$ longitudinally

Lateral constraints



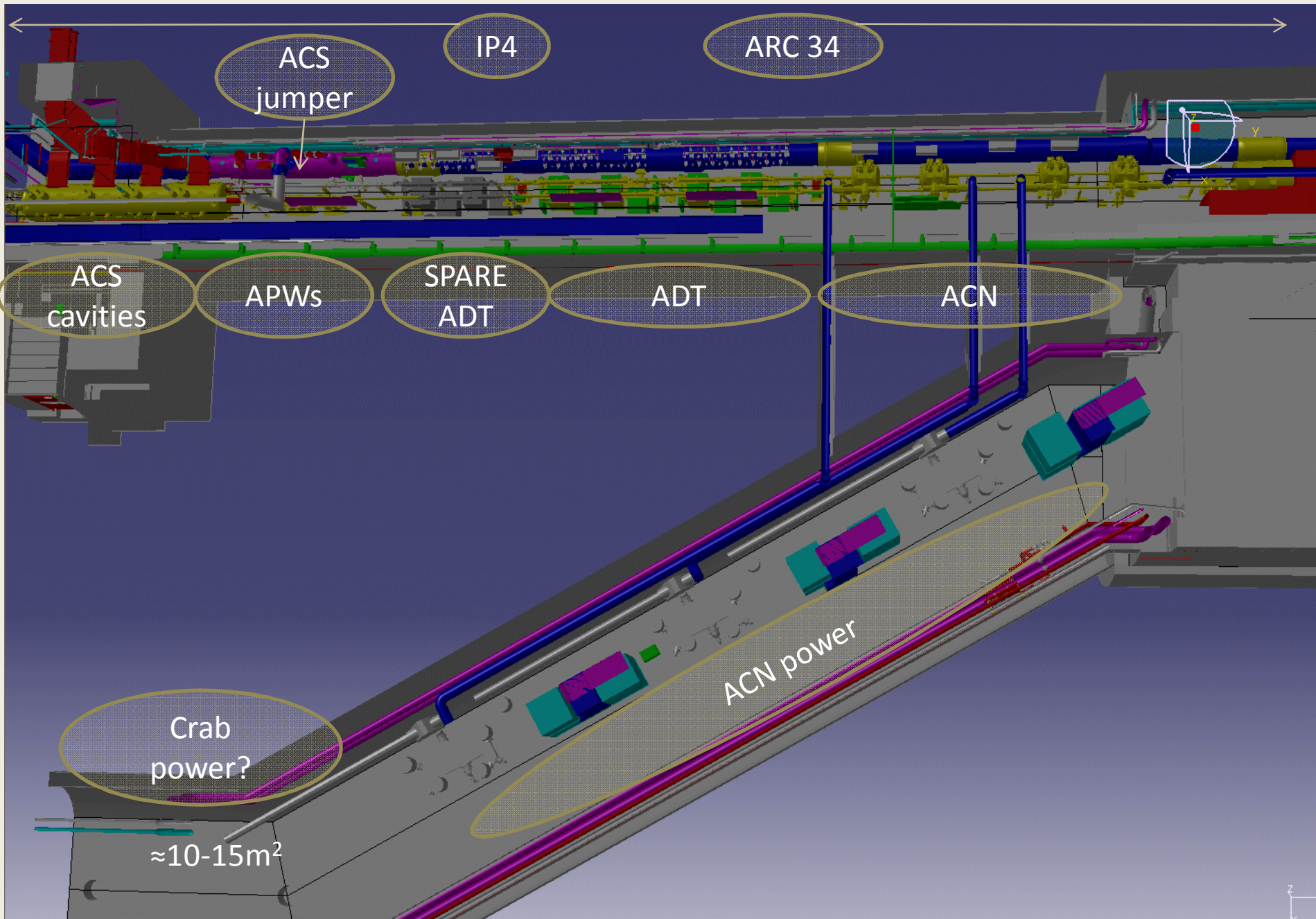
- Space between Beam1 & Beam2: 420mm
- Space between Beam2 & QRL: 380 - 450 mm
(no bellows/bellows/bumps...)

How to feed the crabs with LHe?

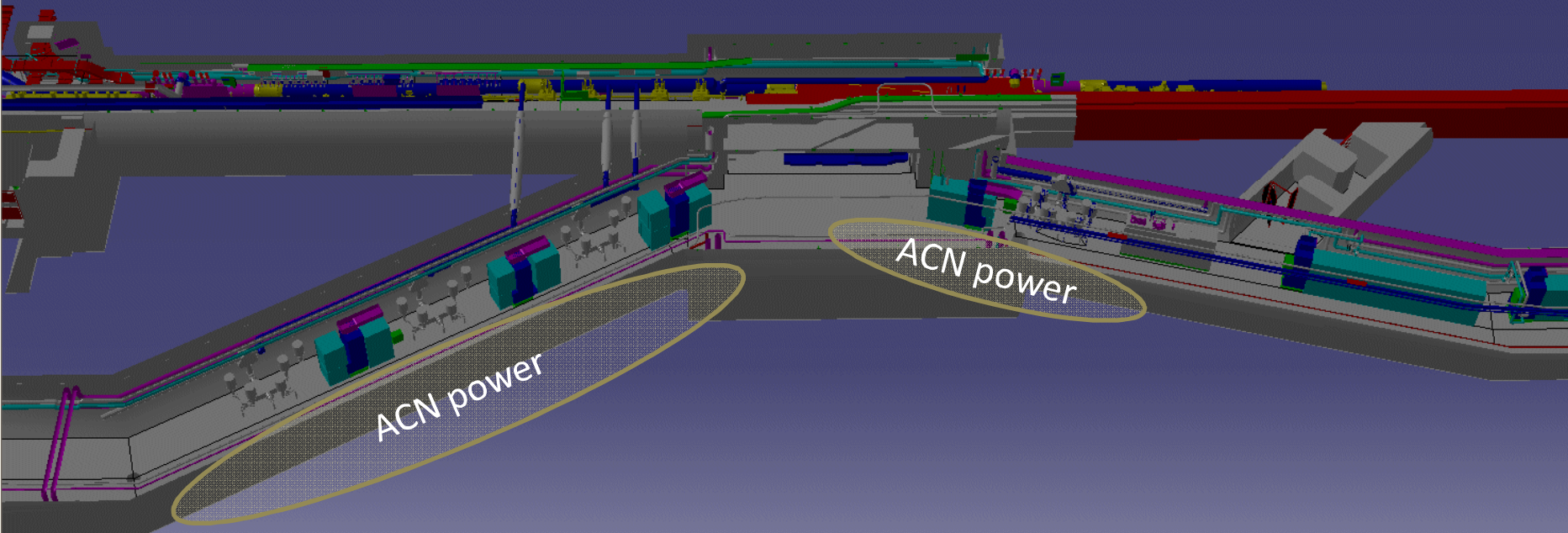
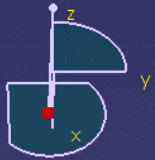
- Two options (see B. Vullierme's talk)
 - Extension of the SC cavity (main RF) LHe lines
 - Is it feasible? And how?
 - Does this require de-installing the SC cavity modules or any other systems?
 - Any impact on main RF operation ?
 - Will this limit the CC operating temperature to 4.5 K?
 - Specific cryogenic lines
 - Detailed integration study and installation of a dedicated jumper must be studied.
 - Any impact on QRL diameter? And therefore on CC cryostat?
 - Requires de-installation of beam lines equipment, cutting off of the QRL..

How to power the crabs?

- CC could be powered by a 60kW RF power station located in the UL's
 - How many square meters required?
 - Restricted space available in the UL's (possible conflict with the ACN power stations)
- ➔ Need detailed integration study (very busy area) of:
 - the power station + control systems
 - LLRF (partially installed in SR4 (surface building))+ RF cabling
 - the power lines
 - services (water cooling, electricity (380V),...)



General view (IP4 left)



Very rough cost estimate (per cavity)

- Civil Engineering: $\approx 10\text{kCHF}$
- Cabling (controls): $\approx 40\text{kCHF}$
- Water cooling: $\approx 30\text{kCHF}$
- RF cabling: $\approx 150\text{kCHF}$
- RF power lines (50m): $\approx 100\text{kCHF}$
- Interlock & Control system: $\approx 80\text{kCHF}$
- Low Level RF $\approx 125\text{kCHF}$
- Installation: $\approx 90\text{kCHF}$

Conclusion

- Very few possibilities to host the crab cavities at IP4.
 - Spare damper
 - ACN cavities
- No way to install the CC at IP4 in case both the spare dampers AND the ACN cavities are needed for future operation
- Feeding the crabs with Lhe at P4 looks possible. More detailed study is required.
- There is a possibility to install dedicated RF power stations in the UL's. Detailed integration study needed.
- LLRF and control systems could be installed either in the UL's or in the SR4 (surface building)