News from the ALICE solid fixed-target setup design

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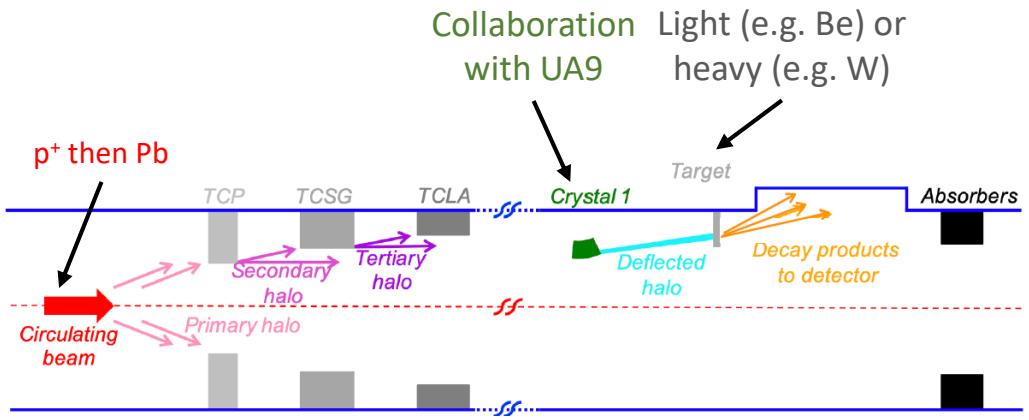
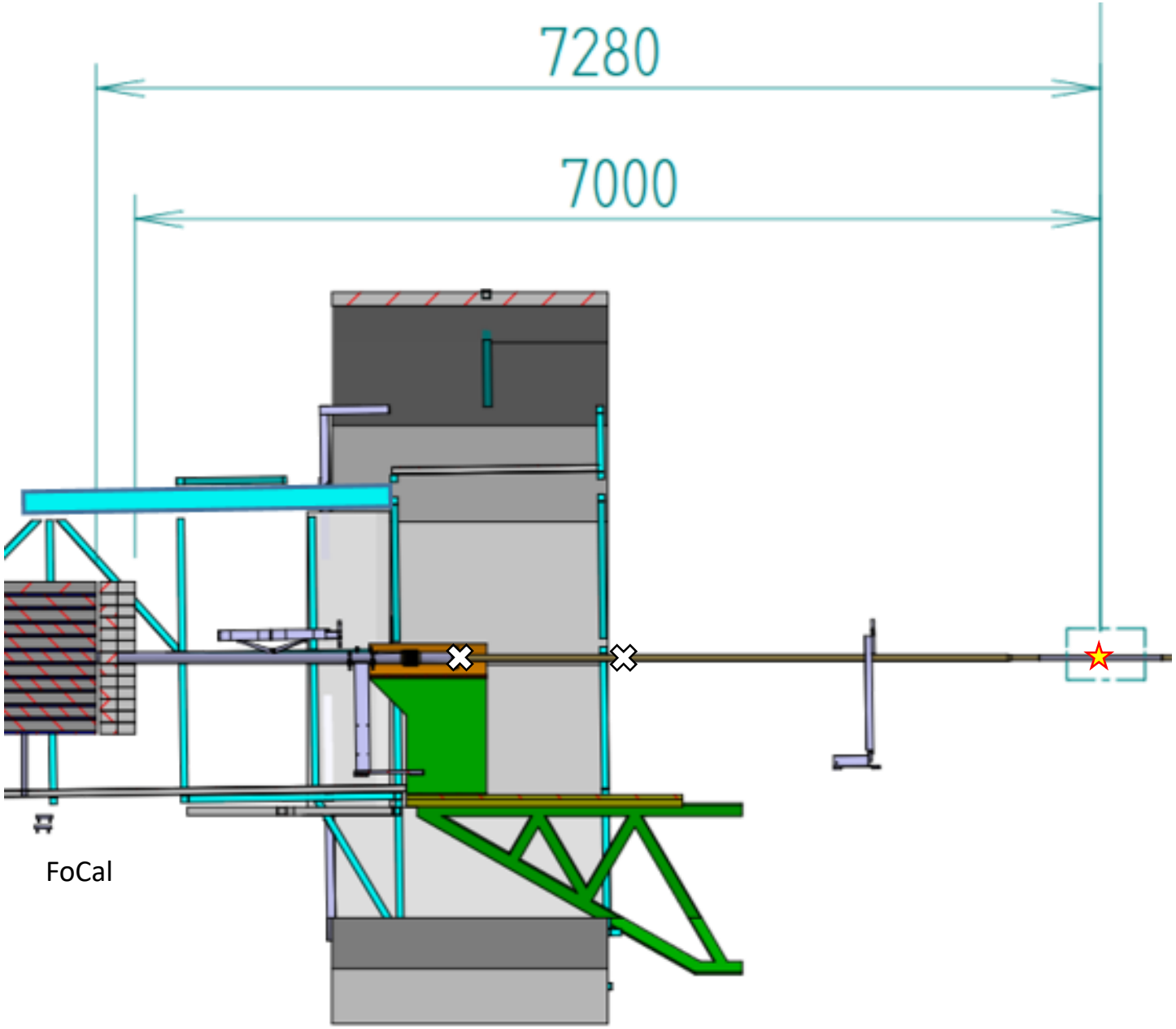
Summary

- Context of the fixed-target experiment @ ALICE
- Expected ALICE environment during run 4
- Progress in the design
  - Two valves-based design
  - Single valve-based design
- Current work and issues
- Next step

Context and reminders

- Retractable target: fine-tuning positioning from parking position (out of the pipe) to active position (4 mm away from the beam axis).
- Parasitic experiment if possible.



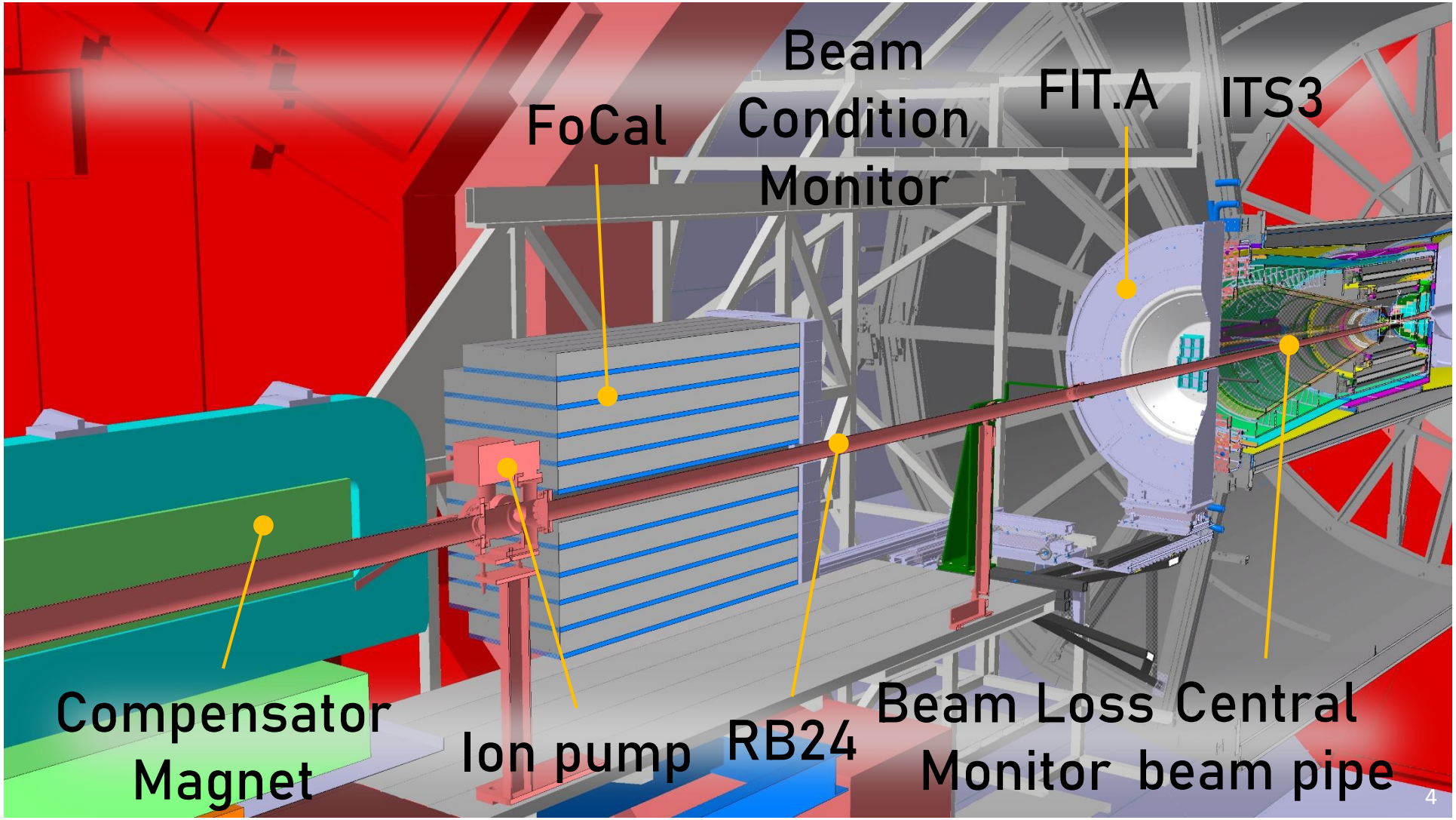


Possible locations of the target (-3,5 m ; -4,7 m)

IP2

Possible ALICE layout Run 4

See September 26, 2019 Corrado's presentation



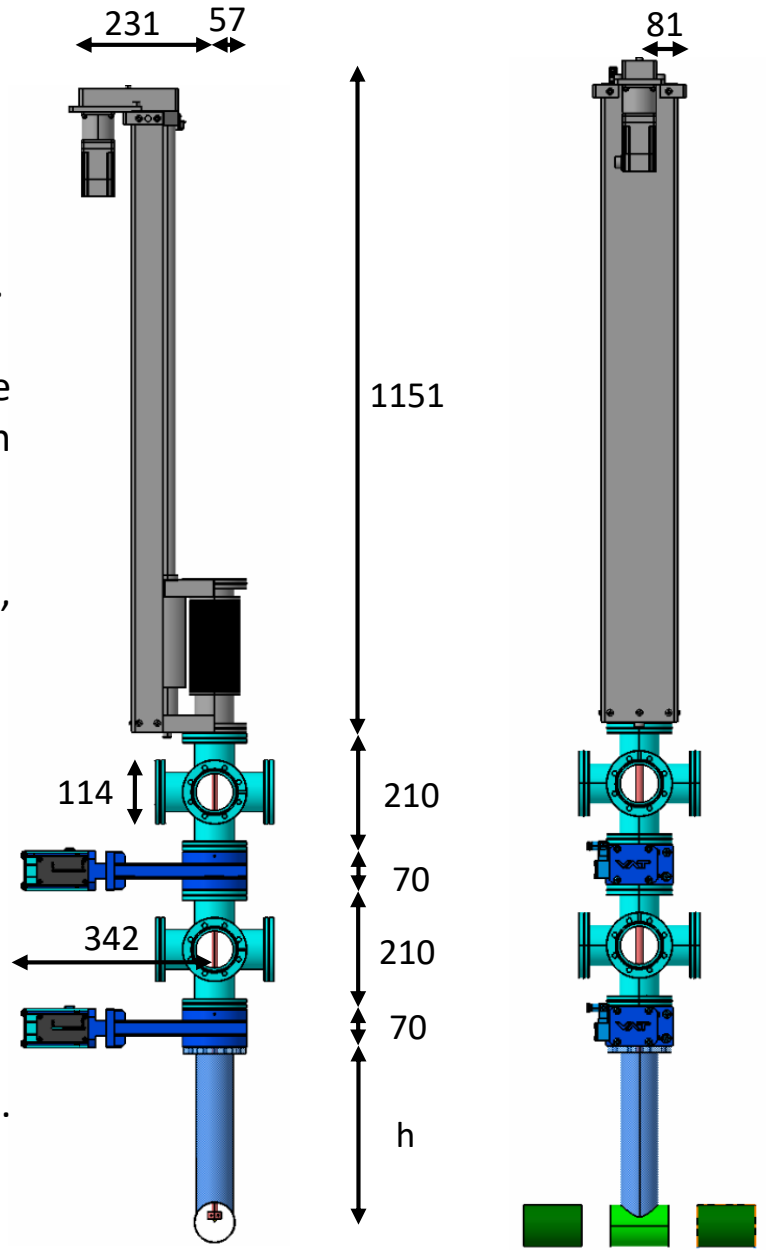
Design progress

No more valve along the beam pipe but in the tapping.

Two valves solution: valve #1 and cross #1 (where pumps and a baking system is connected) remain in the cavern, then:

- Shutting down the valve #1
- Dismounting of the assembly {valve #2, cross #2, motorization-bellow, rod, target}
- Breaking the vacuum of the assembly
- Changing the target
- Pumping and baking the assembly
- Mounting back the assembly on the cross #1
- Opening the valve #1.

Moving speed: 10 mm/s.
Accuracy: 10 µm.
Cost (motorization + bellow, crosses, valves): 25 k€. Pumps, gauges, and the target costs are not included.



UHVDesign {linear motorization + bellow}. Here the bellow is compressed (stroke = 800 mm).

Primary pump, secondary pump, ionic pump and pressure gauge on each of those crosses.

Minimum distance to avoid shadow to FoCal. If z_{target} = -4,7 m from IP2, h = 350 mm. If z_{target} = -3,5 m from IP2, h = 270 mm.

LHC pipe

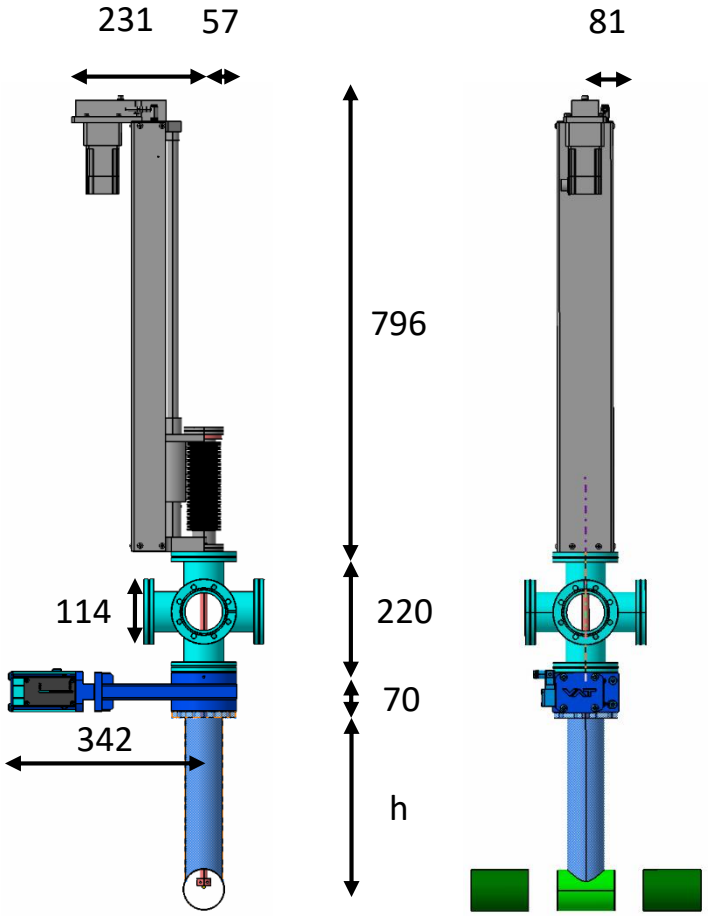
Vertical setup while the target is 4 mm away from the beam. Orientations of the crosses, the valves and the motorization-bellow can be modified. Rounded values to 1 mm.

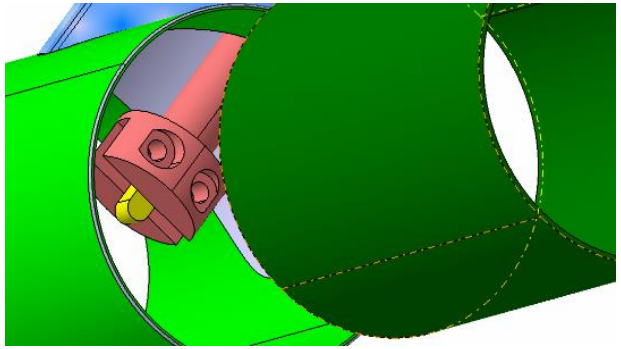
Design progress

No more valve along the beam pipe but in the tapping.

One valve solution: everything remains in the cavern. Every vacuum-related job must be performed in the cavern.
Pumps and a baking system are switched on before opening the valve.

Moving speed: 10 mm/s.
Accuracy: 10 µm.
Cost (motorization + bellow, crosses, valves): 14 k€. Pumps, gauges, and the target costs are not included.





UHVDesign {linear motorization + bellow}. Here the bellow is compressed (stroke = 500 mm).

Primary pump, secondary pump, ionic pump and pressure gauge.

Minimum distance to avoid shadow to FoCal. If z_{target} = -4,7 m from IP2, h = 350 mm. If z_{target} = -3,5 m from IP2, h = 270 mm.

LHC pipe

Vertical setup while the target is 4 mm away from the beam. Orientations of the crosses, the valve and the motorization-bellow can be modified. Rounded values to 1 mm.

Issues under investigation

- Vertical vs. horizontal integration
  - vertical, no bending
  - horizontal, bending $d = \frac{m_{target} g L_{rod}^3}{3E\frac{\pi \emptyset_{rod}^4}{64}} + \frac{m_{rod} g L_{rod}^3}{8E\frac{\pi \emptyset_{rod}^4}{64}}$. If $\begin{cases} m_{target} = 0.02\ kg \\ L_{rod} = 1\ m \\ \emptyset_{rod} = 12\ mm \\ E = 70\ GPa \text{ (aluminum)} \end{cases}$, $m_{rod} = 0.31\ kg$ and $d = 20\ mm$.

    If $\emptyset_{rod} = 20\ mm, m_{rod} = 0.85\ kg$ and $d = 7.1\ mm$

- Budget material optimization: crosses ($m_{cross} = 6\ kg$), valves ($m_{valve} = 9\ kg$), motor-bellows ($m_{bellow} = 13 \dots 33\ kg$)

- See Charlotte's talk for impact on FoCal

- Ultra-high vacuum environment:
  - target holder optimization (geometry, mass) and surface reduction
  - pumps dimensioning

- Alignment and positioning control

- Motor power and control

- ALICE integration: mechanical support around beam pipe and free space vs. z_{target}

Next steps

- Procedure for a target change.
- Impedance (antenna effect).
- Heat on the target to dissipate.
- Light pipe (Be? Al?).
- Aim : installation during LS3.