First performance results from upgraded LHCb and SMOG2

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on behalf of the LHCb collaboration

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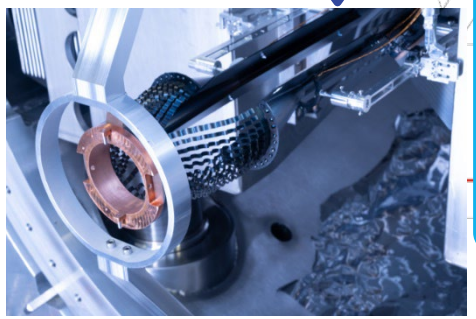
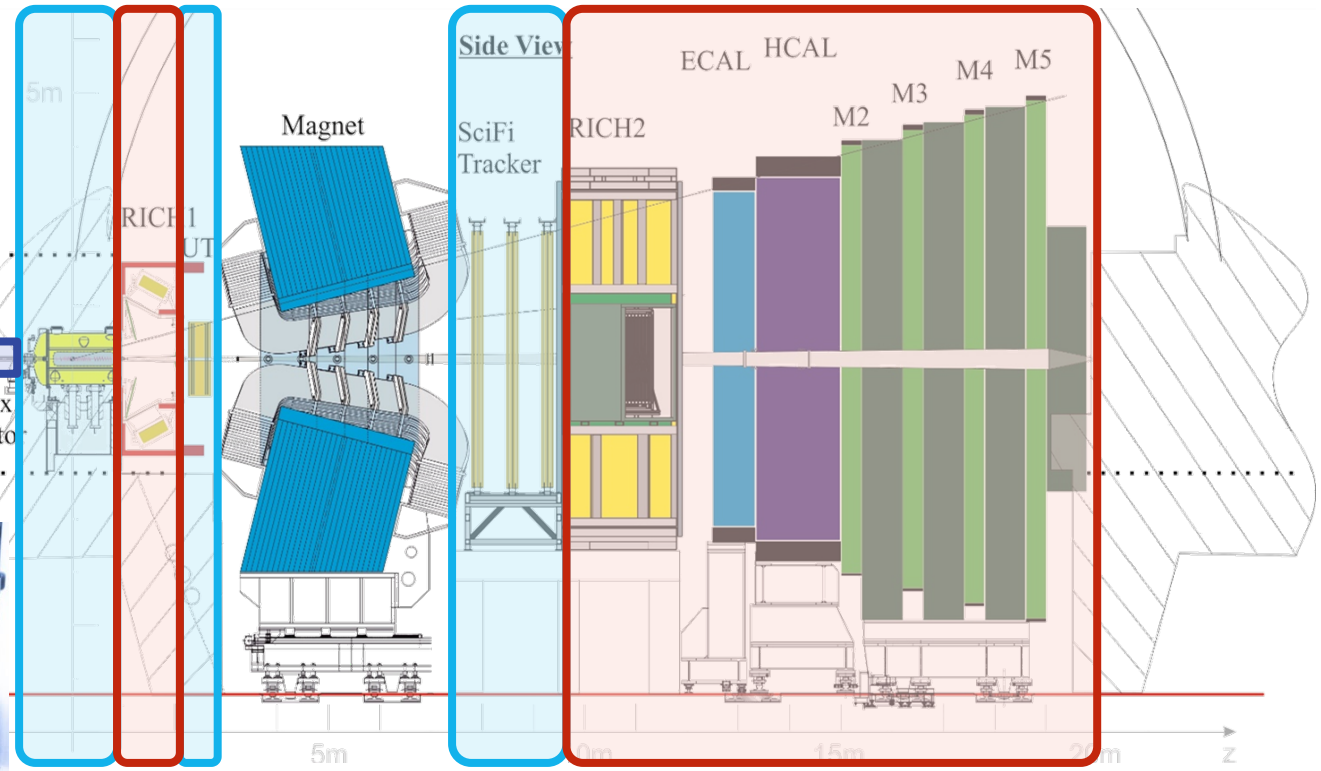
LHCb Run3 Upgrade

For Run3, LHCb upgraded >90% of the experiment:

- New tracking system
- Upgraded PID system
- Full software DAQ chain
- **New storage cell upstream of VELO for fixed target measurement!**
  - 20cm long, 1cm wide
  - z = [-541,-341] mm

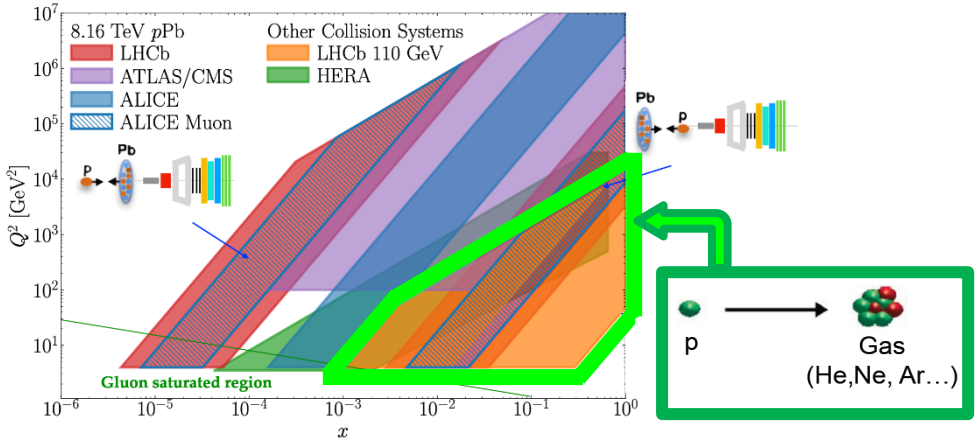




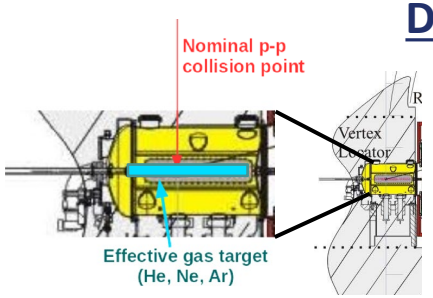
SMOG and SMOG2: LHCb fixed-target program

Pioneering fixed target programme studying collisions between LHC beams and gas targets:

- Unique and complementary Q^2-x coverage
- Highest energy fixed-target experiment: 41-115 GeV
- Access to rapidity in the centre of mass system -3 < y* < 0

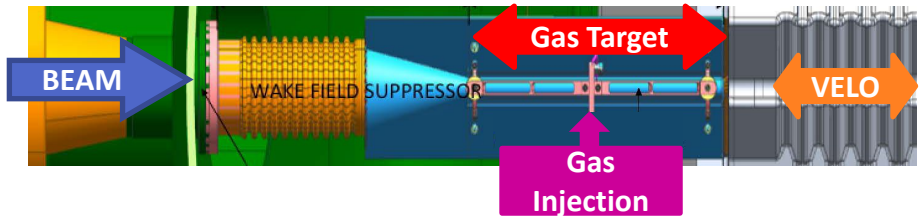


During Run 2: SMOG



- Gas flows in a wide vacuum region: ±20 m around IP in LHC beam pipe
  → **Limited pressure and gas species**
- No direct pressure measurement
  → **Large systematic uncertainty on luminosity**
- Overlapped with *pp* luminous region
  → **Limited data taking time and lower statistic**

Run 3 upgrade storage cell: SMOG2



- Up to **100x gas density** with same gas flow
- Precise and **direct pressure measurement**
- More injectable gases: **H_2, D_2**, He, **N_2, O_2**, Ne, Ar, **Kr, Xe**
- SMOG2 and *pp* **luminous region separated**

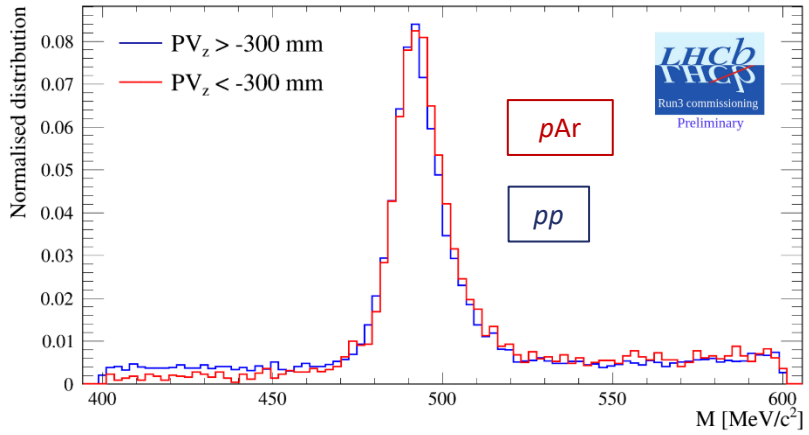
SMOG2 first performance results

First Run 3 data successfully taken in 2022!

- Completely **transparent for LHC** operation
- Commissioning performed with Ar, He and **first injection of H_2**!
- Preliminary data shows **good agreement with previous simulation** studies
- **Data in Pb-Gas configuration** collected during Pb test in 2022!

RECONSTRUCTION AND MASS PEAKS:

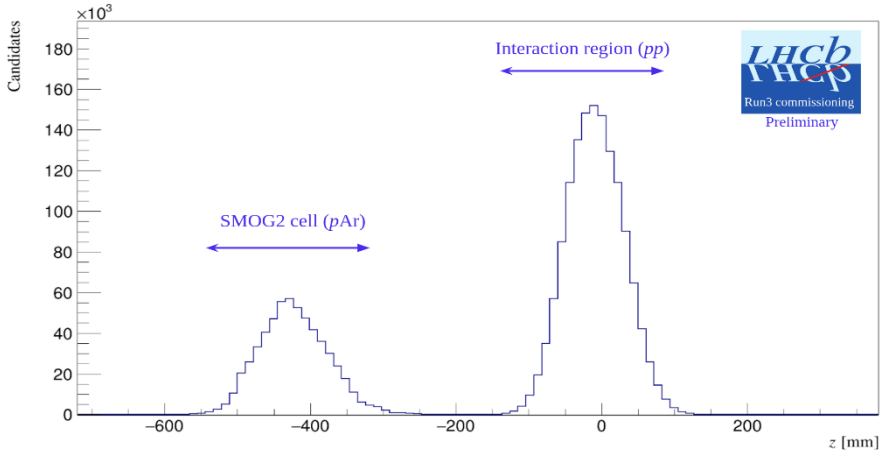
Composite particles produced in beam-gas collisions reconstructed!



Same mass resolution for Ks in *pp* and *p*Ar!

SIMULTANEOUS DATA TAKING:

Highly efficient separation between *pp* and *p*Ar: PVs well separated in z and distributed around z = –441 and z = 0 mm

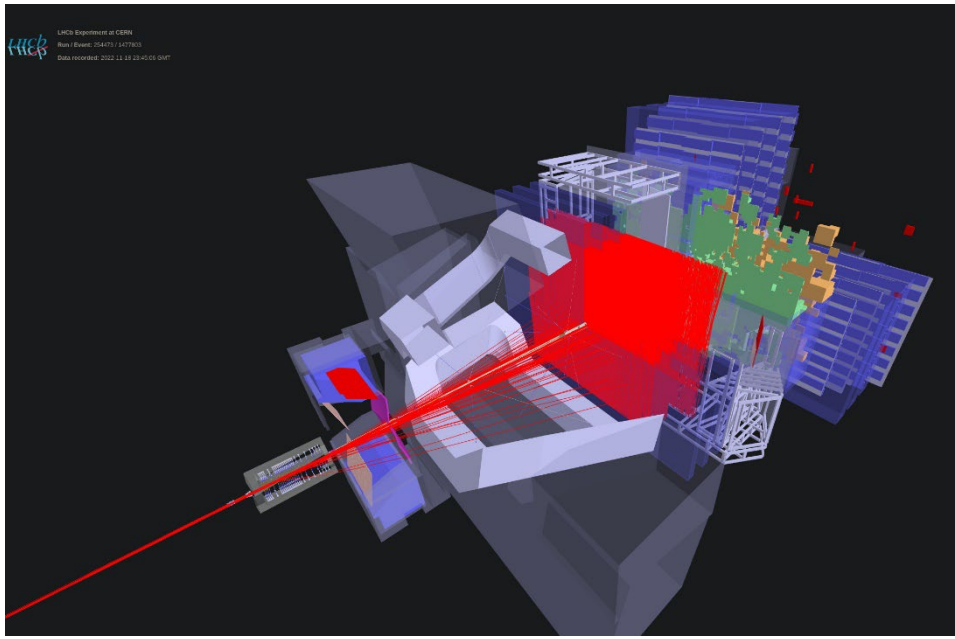


Only experiment operating simultaneously in collider and fixed target mode with two interaction points!

Conclusions

Intense and successful commissioning year of the new upgraded LHCb detector:

- **Validation of the upgraded full detector chain**
- Commissioning and calibration of new **SMOG2** apparatus:
  - **Comparable performances as for *pp* events**!
  - **Operating simultaneously with two interaction points for *pp* and fixed target!**
  - **Running both in p-Gas and Pb-Gas!**



Many new exciting opportunities for LHCb Heavy Ion program ahead!