

10<sup>th</sup> LHC operation “Evian”  
workshop  
Session 3: Run3

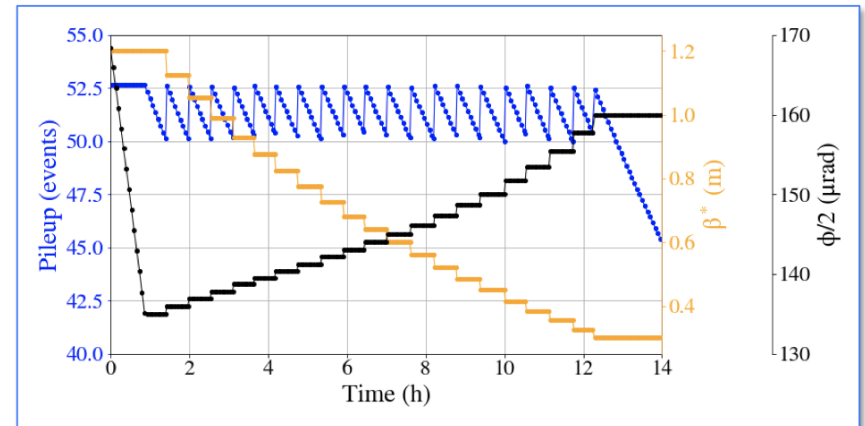
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# Run3 session – Main challenges

With increased injectors performance:

- **Levelling** (separation, beta\* Xing angle,...) will be a challenge:
  - ATLAS/CMS limited to pile-up less than ~60, IT cryogenics
  - LHCb expect to run at  $L=2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$
  - ALICE expects levelling at 0.6 to  $1.3 \times 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$
- **Dynamic aperture** preservation
  - LHCb Xing angle rotation
  - Collisions
- **E-cloud, impedance and stability**
  - High chromaticity recommended
  - Octupole strength to be adjusted
  - Enhanced bandwidth ADT settings key, pickups noise reduction beneficial

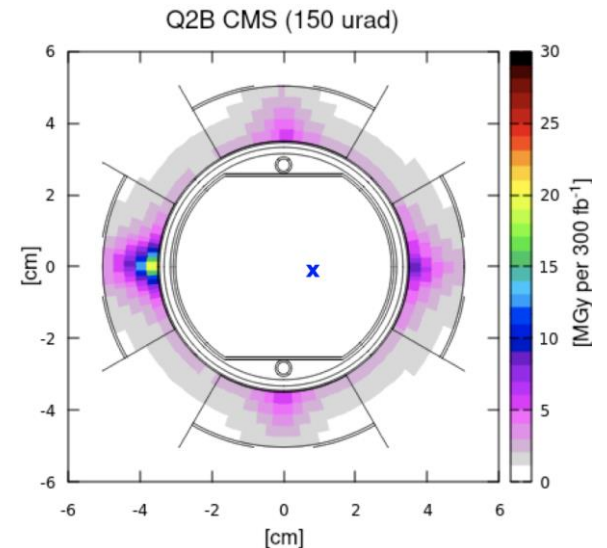
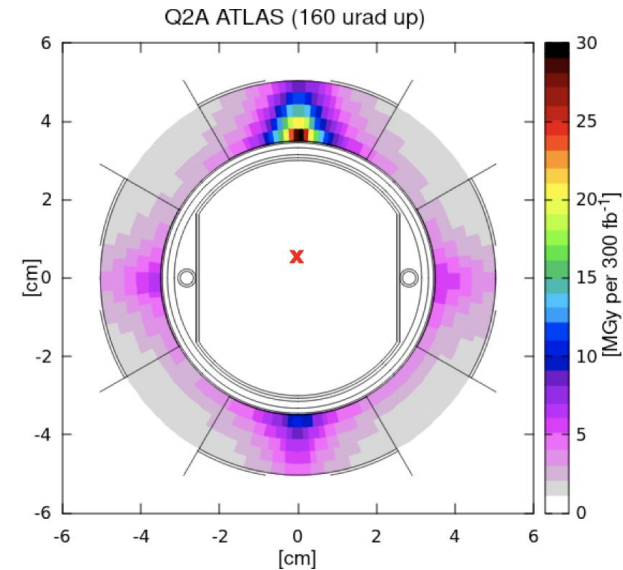
Optics Parameters	2022	2023/2024
ATLAS and CMS		
$\beta^*$ [m] at the start of collision	0.60	1.20
$\beta^*$ [m] at the end of levelling	0.30	0.30
Pre-squeezed $\beta^*$ [m]	0.60	0.60
Telescopic index variations in SB	1.0 → 2.0	0.5 → 2.0
Half-crossing angle [ $\mu\text{rad}$ ] (start of collision)	160	160
Half-crossing angle [ $\mu\text{rad}$ ] (start of $\beta^*$ -levelling)	145	135
Half-crossing angle [ $\mu\text{rad}$ ] (end of $\beta^*$ -levelling)	160	160
Alice		
$\beta^*$ [m]	10.0	10.0
Half-crossing angle [ $\mu\text{rad}$ ]	200 (V)	200 (V)
LHCb		
$\beta^*$ [m]	2.0	2.0
Half-crossing angle [ $\mu\text{rad}$ ]	200 (H)	200 (V)



# Run3 session – Critical points

Uncertainties and possible limitations:

- **Heat load** after LS2 situation to be established
- **Possible failure of IT main magnets and correctors** due to radiation exposure (the longer the run the higher the risk). Some mitigation measures:
  - Change of crossing angle polarity for ATLAS
  - Loss of 1 MCBX per IP side not critical
  - Ongoing studies on risks of IT tilting to compensate for MQSX loss
  - Non-linear correctors were not use in 2016 ( $\beta^*=40\text{cm}$ ), studies to identify mitigation
- **Dense program** with large number of special runs
  - Different ion species`



# Run3 session – IONS

## IONS plan for Run3

- 2022: Pb-Pb, 1 month
- 2023: p-Pb, 1 month
- 2024: Pb-Pb, 2 months
- Plus:
  - pp reference runs
  - Possible O-O and p-O runs



Integrated 1-month luminosity in nb <sup>-1</sup>		IP1/5	IP2	IP8
50 ns 75 ns backup	1240_1200_1240_0	2.5, 3.1	2.7, 3.3	0., 0.
	1144_1144_1144_239	2.4, 3.	2.6, 3.3	0.17, 0.22
	1088_1088_1088_398	2.3, 2.9	2.6, 3.2	0.29, 0.36
	1032_1032_1032_557	2.2, 2.8	2.5, 3.1	0.38, 0.48
	976_976_976_716	2.2, 2.7	2.4, 3.	0.46, 0.57
	733_702_733_468	1.7, 2.1	1.9, 2.3	0.34, 0.42

↑ 50% OP eff.
↑ 62% OP eff.

## Assumptions

- 200 min turnaround time
- Operational efficiency 62%-50% (LIU specification vs Run 3 protons)
- 24 days of physics available after initial commissioning

- Upgrade to **50 ns beams** from injectors (SPS slip-stacking)
- **E = 6.8 Z TeV** (unless serious issues with crystals)
- Assume **offset levelling** at:
  - IP1/2/5:  $6.4 \times 10^{27} \text{ cm}^{-2}\text{s}^{-1}$
  - IP8:  $1.0 \times 10^{27} \text{ cm}^{-2}\text{s}^{-1}$