Some thoughts on **lighter** and **very light** ions for future LHC runs

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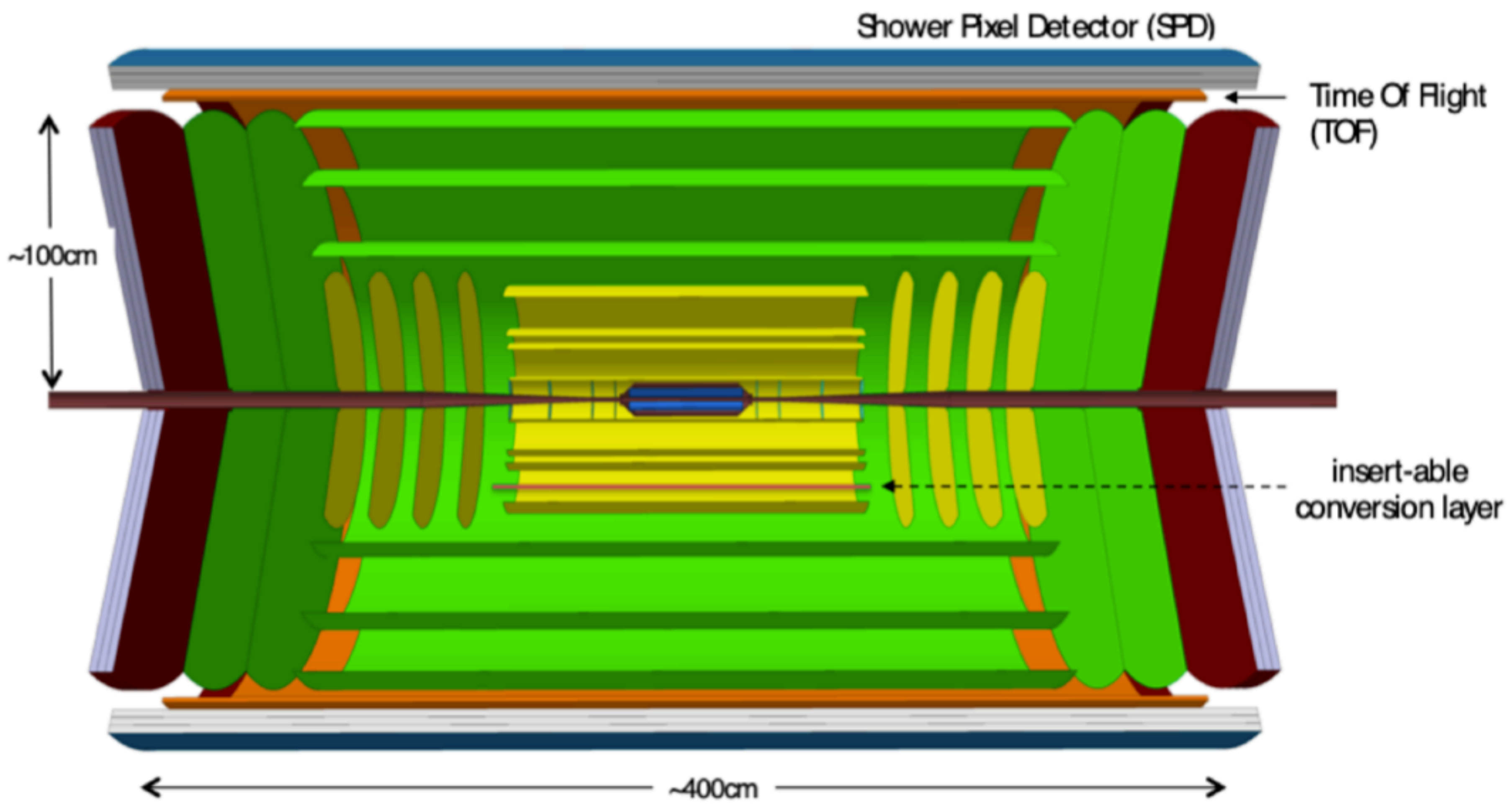
$|\eta|<4$, $p_T \rightarrow 0$



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ALICE3 for Run5 and beyond

arXiv1902.01211

→ In-medium formation and properties of ~pure "coalescence" hadrons (multi-charm, tetraquarks?, ….)
→ "NLO" quenching studies with correlations of light and heavy particles, soft jets and photons, associated HF production, …
→ chiral symmetry restoration, very soft photons, UPC

Lighter ions for "hot" studies at HL-LHC

Lighter (but still heavy) nuclei could guarantee a better compromise between luminosity and medium properties and size

→ **on paper, strong impact on NN luminosity**

	$^{40}Ar^{18+}$	$^{40}Ca^{20+}$	$^{78}Kr^{36+}$	$^{129}Xe^{54+}$	$^{208}Pb^{82+}$
$\sqrt{s_{NN}}$ / TeV	6.3	7	6.46	5.86	5.52
$\langle L^{month}_{NN} \rangle$ pb^{-1}	**5090**	3510	1330	636	**213**

- **Statistics-hungry probes:**
  →multi-quark hadrons, like multi-charm (Ξ_{cc}, Ω_{cc}..) tetraquark, di-jets, DPS, ..
- **smaller background** for HF/exotic at very low p_T and for **low-mid p_T jet / HF physics**
- **reduced number of uncorrelated heavy-quark pairs**
  →easier background subtraction for multiple HF topologies

- **Less charm/beauty density**
  → reduced charmed density and lower enhancement due to recombination effects
- **Lower medium density, less quenching?**
- **probably many other considerations to be addressed..**

→ **theory input is welcome to guide the studies**
→ test run in Run4 with most promising nucleus?

Optimistic scenario from Yellow Report

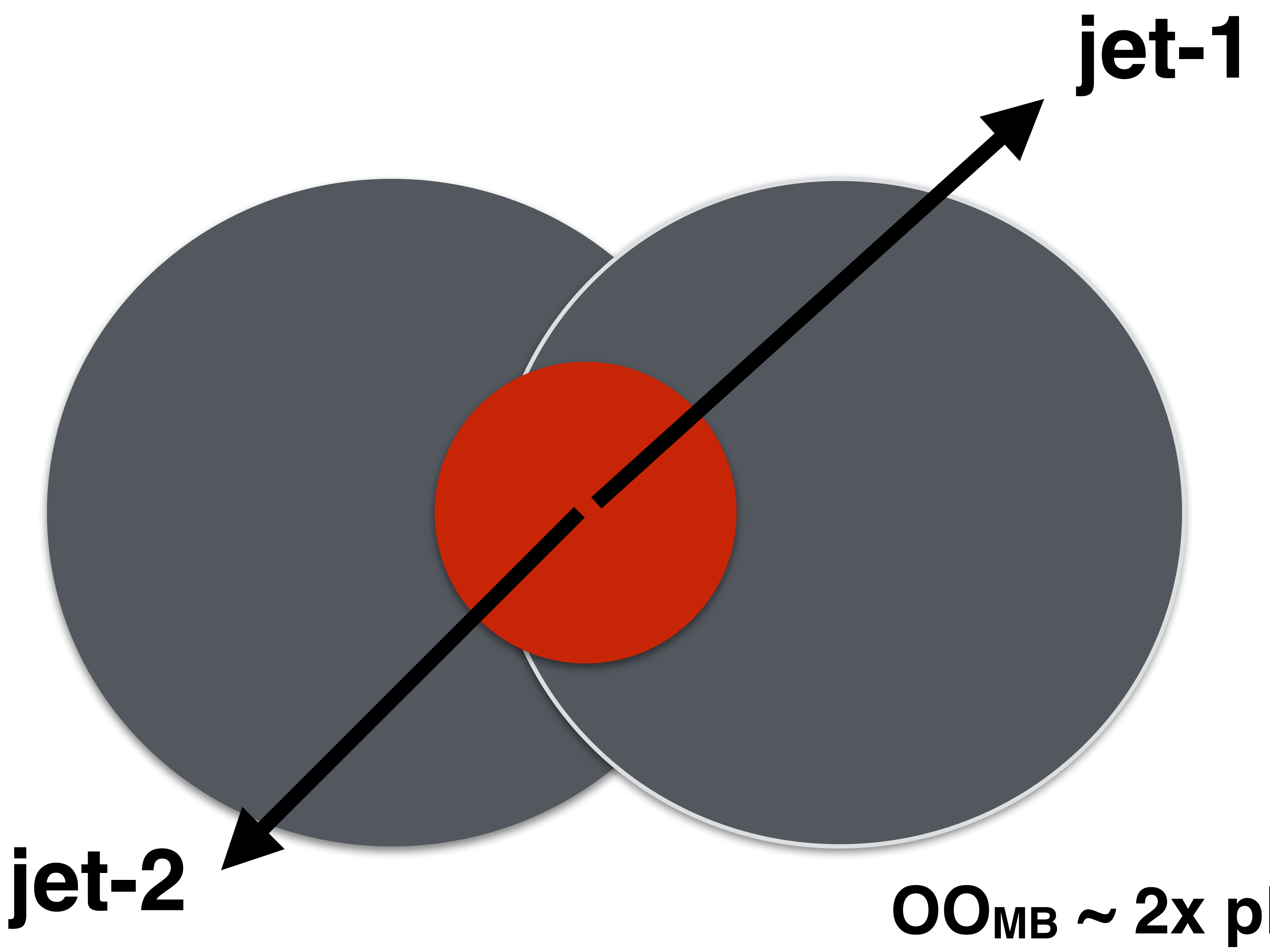
Light ions for initial and final state effects

→ **With ALICE2: The planned short OO/pO run allows for important tests of both initial and final states studies in small systems**

Quenching vs flow in small systems?

→ **observe/characterize final state effects w/o geometric biases**
- R_{OO} → R^{periph}_{PbPb} , R_{pA} at similar multiplicities? Acoplanarity?
- time/length dependence of quenching, …

→ **insights into the origin of flow:**
- relevance of pre-equilibrium, geometry, fluctuations, ..



OO_{MB} ~ 2x pPb_{MB}
OO_{MB} ~ peripheral PbPb

Benchmark to validate our understanding of QGP phenomena:
→ **different medium size, density, geometry (limited biases)**
- J/Ψ **suppression vs regeneration** miraculous cancellation?
- J/Ψ nuclear interaction in small systems?
- Biases in particle production vs multiplicity?
- Relevance for magnetic effects or vorticity (to be explored)?

Evident advantage in "symmetrizing" a complex geometry while preserving similar multiplicities

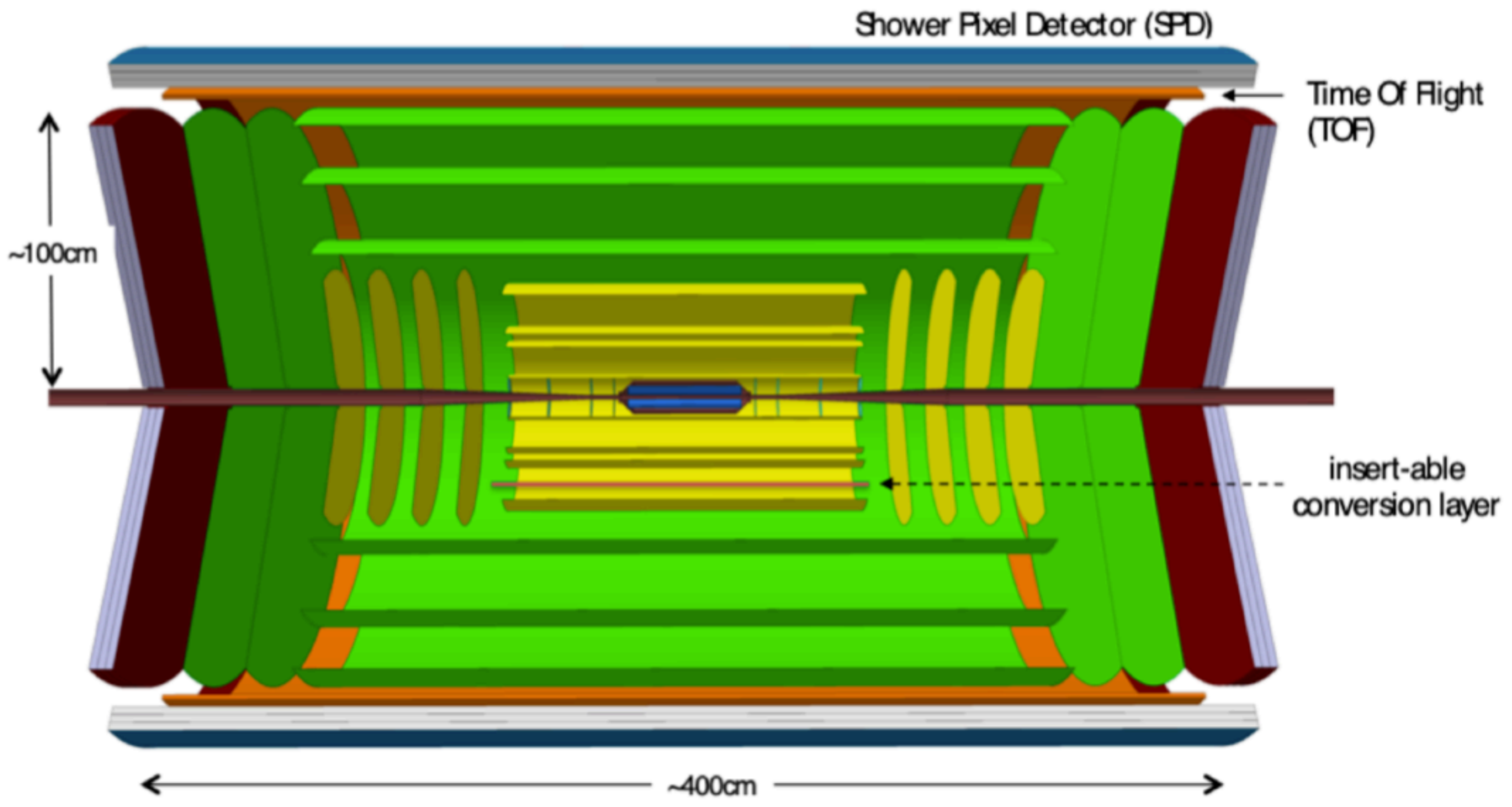
With ALICE3, longer runs with very light ions would allow for:
- quantitative constraints to nuclear PDF at low-A, **saturation scale f(A, x_{LHC}),** heavy quarks in nPDF, search for saturation
- heavier baryons, X in small systems, multi-charm would require very large datasets and/or very strong in-medium enhancements

BACKUP

ALICE3 experiment in Run5

- Excellent tracking/vertexing capabilities down to ~ 0 GeV
- Very large η coverage (|η|<4 is the goal)
- Fast readout and easy calibration

arXiv1902.01211



→ Unique tracking and vertexing resolution
→ low p_T reach for tracks, photons and muons
→ very wide pseudo-rapidity coverage Δη~8,
ideal for correlation studies

4π massless tracker at the core of the new experiment:
→ work on going to optimize its design and complete the ALICE3 layout with other sub-detectors if needed + forward?

Letter of Intent under preparation!

	$^{16}O^{8+}$	$^{40}Ar^{18+}$	$^{40}Ca^{20+}$	$^{78}Kr^{36+}$	$^{129}Xe^{54+}$	$^{208}Pb^{82+}$
$\sqrt{s_{NN}}$ / TeV	7	6.3	7	6.46	5.86	5.52
$\langle L_{AA} \rangle$ cm^{-2}s^{-1}	4.54×10^{31}	2.45×10^{30}	1.69×10^{30}	1.68×10^{29}	2.95×10^{28}	3.8×10^{27}
$\langle L_{NN} \rangle$ cm^{-2}s^{-1}	1.16×10^{34}	3.93×10^{33}	2.71×10^{33}	1.02×10^{33}	4.91×10^{32}	1.64×10^{32}
$\langle L^{month}_{AA} \rangle$ nb^{-1}	5.89×10^{4}	3180	2190	218	38.2	4.92
$\langle L^{month}_{NN} \rangle$ pb^{-1}	1.51×10^{4}	5090	3510	1330	636	213
N_{part}	11.1	24.3	24.2	42.0	71.2	113.7
N_{coll}	14.1	43.3	42.1	-	201.8	385.5
radius (fm)	2.8	3.53	3.766		5.36	6.624

Optimistic scenario from Yellow Report