

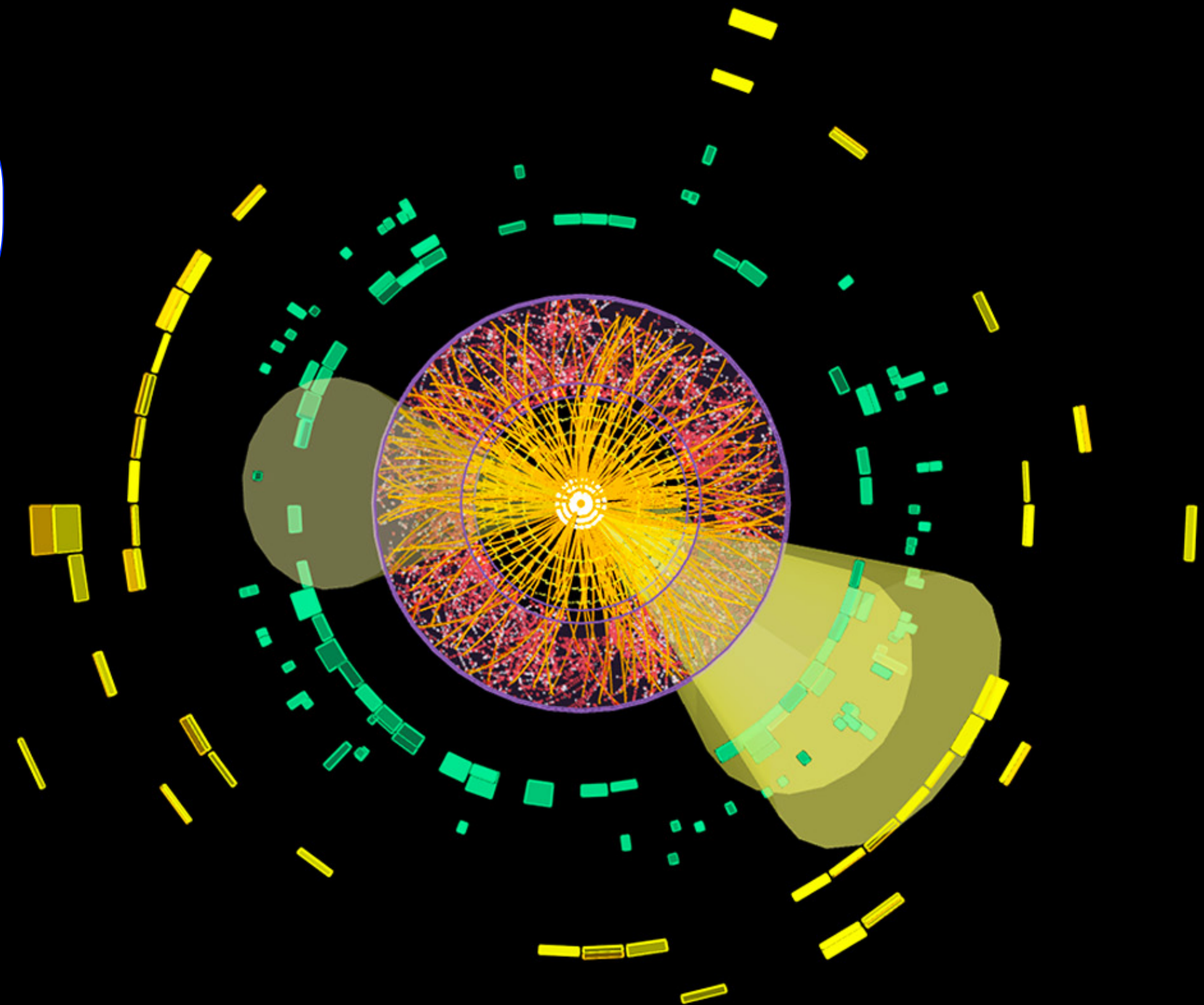
New Ion Collisions @ LHC Run 4 - ATLAS HI Perspective

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For the ATLAS Heavy Ion Group

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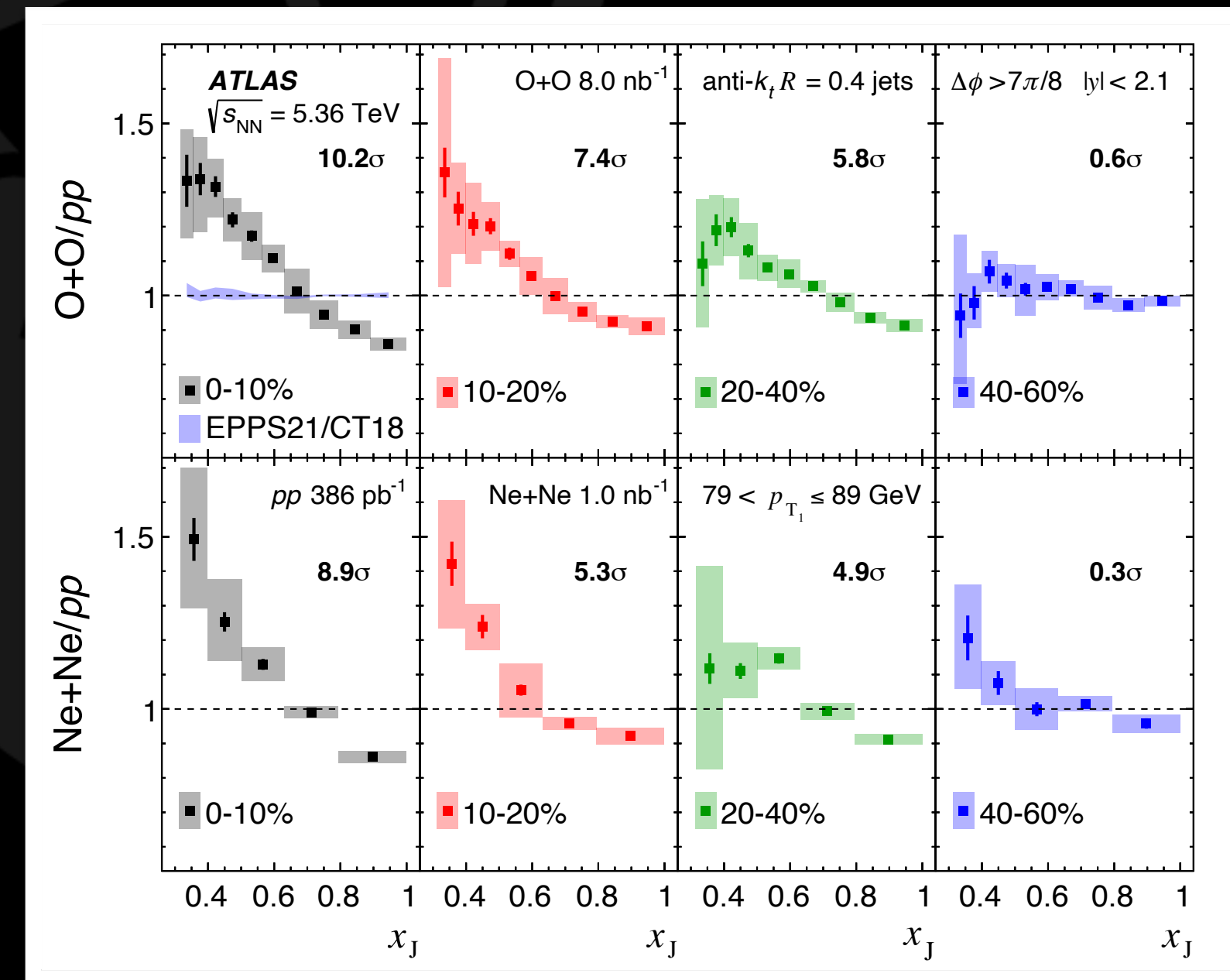
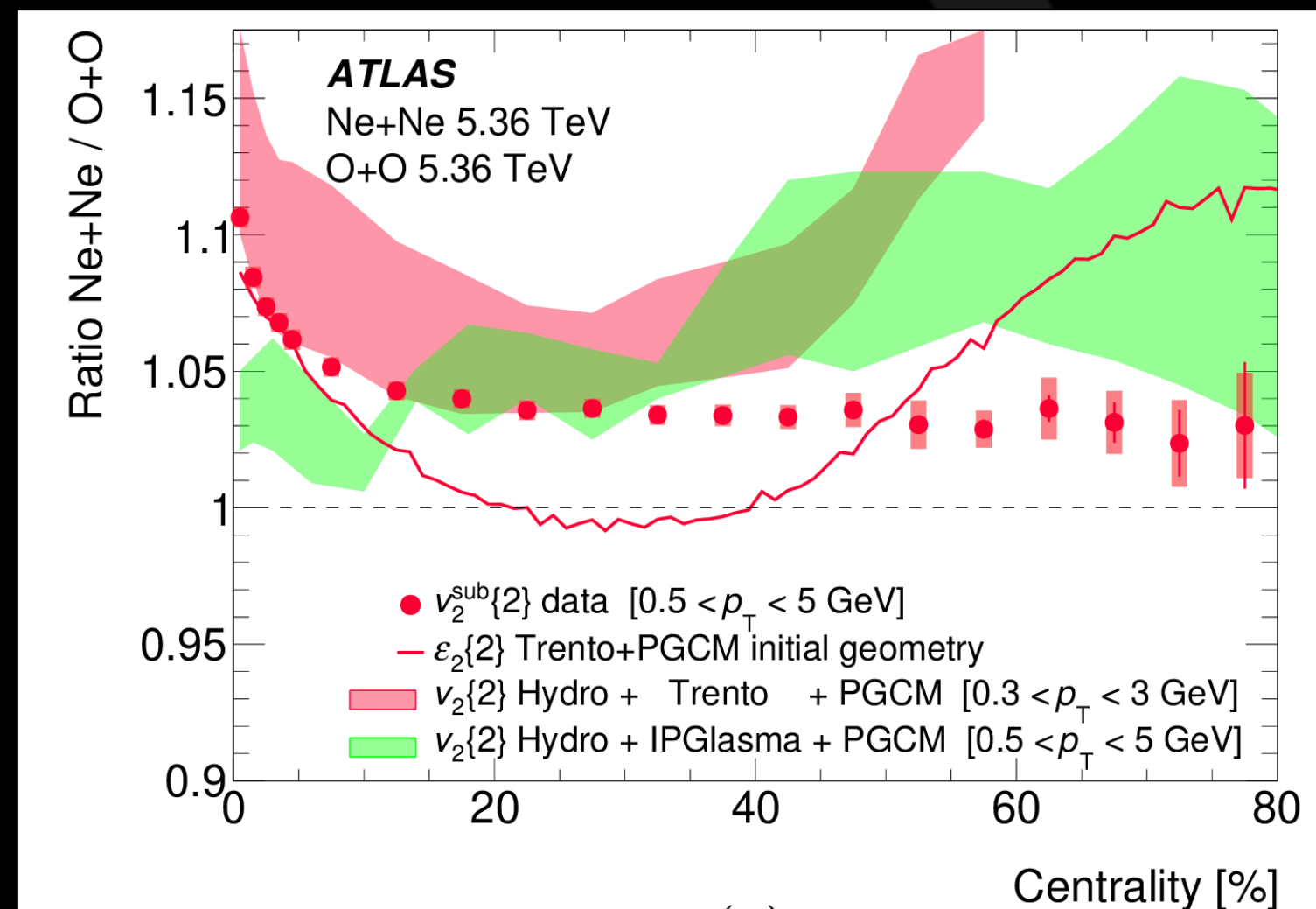
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General observations

- The ATLAS Heavy Ion group strongly values the opportunities offered by the 2025 Light-ion run and thanks the machine for the incredible work to enable this data-taking.
- We recognize that the 2025 LI run greatly sparked *new momentum and interest in the field*
- We have learned a lot...

Soft Probes,
see talk by
S.Mohapatra



Hard Probes,
see talk by
A.Sickles

- ...and we will learn a lot more in the next 2-3 years

More ATLAS results in T.Bold's overview talk

General observations

- The ATLAS Heavy Ion group strongly values the opportunities offered by the 2025 Light-ion run and thanks the machine for the incredible work to enable this data-taking.
 - We recognize that the 2025 LI run greatly sparked *new momentum and interest in the field*
- We understand Run 4 has a budget of about 87 (29x3) days for HI running ([slides from 25' LI workshop](#))
 - Within this time, we believe a high-luminosity ($\gg$ 2016 lumi) p+Pb run that leverages the new capabilities introduced by the upgrades and includes an adequate pp reference at the same CoM energy is a priority.
 - We consider the Run 3 + Run 4 Pb+Pb datasets as a whole and not separately
 - For this reason, we would strongly favor *running at the same energy as Run 3 (5.36 TeV)*
 - We believe ATLAS would support a diverse, physics-driven program while staying within the original HI running-time envelope.

Light-ion running in Run 4

- ***Our physics goals include further light-ion running in Run 4 and beyond***
 - We strongly believe planning is key (see [Monica's talk](#)); we note that ATLAS, as a collaboration, is preparing a high-level PubNote for ion running in Run 4 and 5 (timeline: EoY).
- We understand that, for Run 4, w/o a second injector, further light-ion running time will have to come separately from Pb+Pb (to allow source switch).
 - The same strategy used for the 2025 run (i.e., after TS1, to optimize ZDC installation)
- We would prefer light-ion running *not to be scheduled in the first year of data taking*
 - Commissioning of the upgrades will take time and introduce difficulties → minimize risks for a new unique dataset
- All light-ion running should come at the energy of the Pb+Pb - to leverage the ***same p+p reference***

Light-ion running in Run 4 [Cont'd]

- We are currently not very interested in more O+O or Ne+Ne data in Run 4.
 - We note that further analysis of the O+O and Ne+Ne data could change this opinion later; for example, in Run 5.
- We would always prefer one run period per year, including light ions: detector conditions very similar, sustainable for specialized operation teams, etc. Unfortunately, *this is not possible in Run 4*.
 - For a LI run separate from the Pb one, we value a ***planned period of data taking*** - organized and with a full setup - including ZDC - ***rather than opportunistic fills***.
- We invite the community to *assess a p+Pb run at the same energy as the Pb+Pb*
 - Running p+Pb and Pb+Pb at two different energies will require 2x p+p reference runs.
 - *This time could be used for light-ion running.*
- We *strongly value input from theory* across the borders of different fields (as seen this week), and we believe the experiment/theory engagement should continue to make sure we strengthen the physics case for diverse-ion running as much as possible.

ATLAS contributions to the white paper

- For the physics case, we are very interested in contributing to:
 - ***He+He and mid-system-size energy-loss frontiers:*** predictions and writing for hard-probe measurements to search for the onset of energy loss and characterize the path-length dependence in He+He (track 1) or Ar+Ar/Ca+Ca (synergistic with track 3)
 - **Nuclear shapes:**
 - Predictions and writing for different nuclear structure imaging and heavy-ion initial state in small and large systems. Expanded detector capability will position ATLAS well for reliable and unique flow measurements (even larger η gaps, possibly PID) - maps to tracks 2a and 2c. For instance:
 - Study of optimal choices for structure studies (i.e ^{40}Ar vs ^{40}Ca vs ^{48}Ca , ^{76}Ge and ^{76}Se , ^{136}Xe and ^{136}Ba) & synergy with the above can also be considered but will be less precise experimentally.
- Also interested in providing support for the asymmetric collision system case - within or outside of the white paper effort