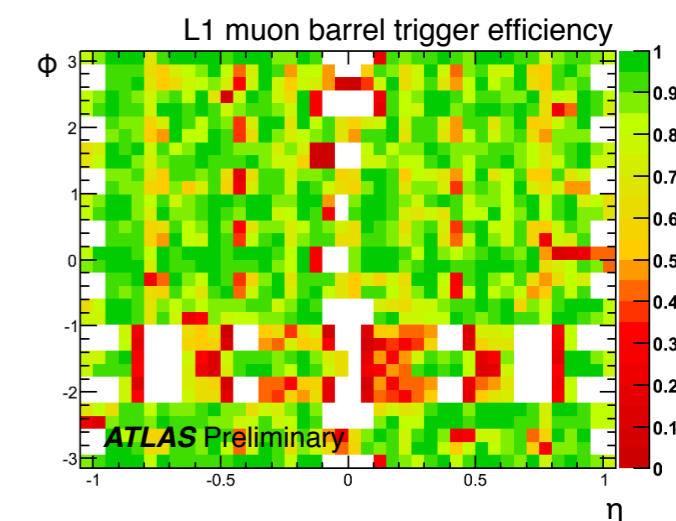
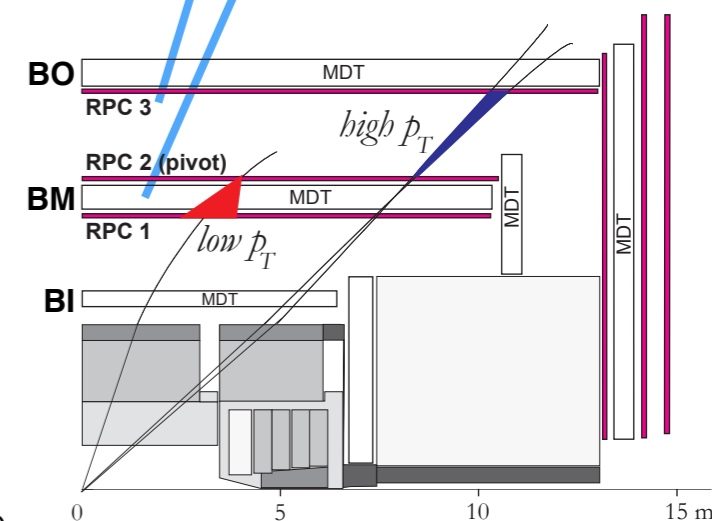
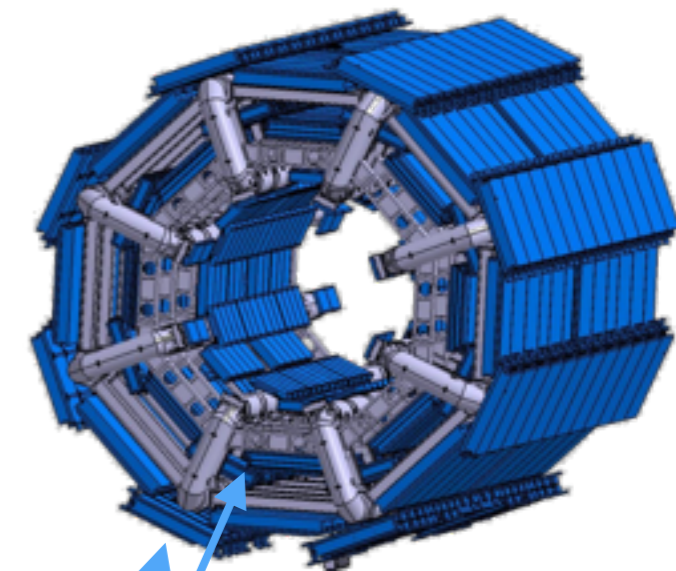


# A proposal to upgrade the ATLAS RPC system for the High Luminosity LHC

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# The current ATLAS RPC Muon Barrel System

- The barrel trigger algorithm is based on **hit coincidence of three concentric RPC stations** (two in the Barrel Middle region and one in the Barrel Outer region).
- The **Low- $p_T$**  trigger ( $< 10$  GeV) makes use of the two BM stations, while the **High- $p_T$**  trigger ( $> 10$  GeV) requires an additional confirmation on the BO station.
- **RPC geometrical coverage:**
  - RPC detector coverage is limited to **73%** because of the **ATLAS mechanical support structures** (toroid ribs in small sectors of BM, toroid feet in the lower part of the barrel);
  - one possibility to increase the current detector coverage is to install additional RPC chambers in the Barrel Inner region, where there are no mechanical structures.
- **RPC rate capability:**
  - current detector was developed to stand 10 years of LHC operations at **nominal luminosity of  $L=10^{34}$  cm<sup>-2</sup> s<sup>-1</sup>**;
  - detector longevity has been certified for a nominal hit rate of **100 Hz/cm<sup>2</sup>** including safety factors (ageing test done in accelerated conditions showed that the design rate limit cannot be exceeded);
  - an **extrapolation** of 2012 data to **Phase-II LHC luminosity ( $7 \cdot 10^{34}$  cm<sup>-2</sup> s<sup>-1</sup>)** foresees a hit rate of  **$\sim 150$  Hz/cm<sup>2</sup>** in average,  **$\sim 300$  Hz/cm<sup>2</sup>** in the **hottest sectors**.
  - RPC HV **working point will have to be lowered** to limit the hit rate and to avoid detector degradation;
  - an additional RPC layer in the BI region could allow to recover the lowered efficiency and to increase the barrel trigger performances.



# New RPC inner layer proposal for HL-LHC

- The insertion of a **new RPC inner layer** (triplet or quadruplet) allows to increase the current **detector coverage up to 96%**.
- **Increased trigger redundancy** and robustness: from 3 to 4 concentric RPC chambers, from 6 to 10 layers.
- The increased redundancy allows to **cope with the HL-LHC foreseen RPC hit rates**:
  - the BM station (RPC1 and RPC2) can be used with a **2/4 majority** instead of the 3/4;
  - this allows to **change the old RPC HV operating point** (reduced gap efficiency) to a safe value, **without affecting the trigger efficiency**.
- The new generation of RPCs can work at hit rates  $> 20 \text{ kHz/cm}^2$ .
- **Pileup insensitive** due to high space-time RPC granularity  $\sim 0.5 \text{ cm}^2 \times 0.5 \text{ ns}$ .
- The increased lever arm allows for a **sharper momentum threshold**.

