**Summary**

The ATLAS tracking system will be replaced by the all-silicon inner-tracker (ITk) consisting of pixels and strips in the course of the HL-LHC upgrade until 2026. The readout of the ITk pixel system will be most challenging in terms of data rate. First test of readout concepts are performed with the ITk Pixel Demonstrator, a system composed of several ITk-style modules with in total 120 readout chips. Their readout is realised with data aggregation via GBTx chips transmitting data optically to ATCA-boards acting as off-detector components.

**Outer Barrel Demonstrator**

- Stave with ITk-layout and 120 legacy frontend chips
- Inclined sections with 32 double-chip modules
- Flat sections with 14 quad-chip modules
- Readout with several pixel specific readout systems (RCE, USBpix, Yarr) and off-detector readout prototype (FELIX)

**GBTx and RCE-GBT Readout**

ITk requires 5 Gb/s readout links. By aggregating slower links, similar rates for readout development can be reached (3.2 Gb/s user bandwidth, 4.8 Gb/s total).

- **GBTx**:
  - Aggregation of 20 frontend links into one bidirectional optical link
  - Readout of 120 frontends on Demonstrator requires 6 GBTx
  - Used for RCE-GBT and FELIX systems

- **RCE-GBT**:
  - ATCA-based readout system
  - COB (Cluster on Board) ATCA carrier board
  - DPM (Data Processing Module) performs decoding and analysis of received data
  - RTM (Rear Transition Module) with SFP+ transceivers to GBTx and two links to each DPM
  - One COB with 3 DPMs is sufficient for the full Demonstrator

**Test Setup**

- Tests with smaller stave with 7 quad modules until full Demonstrator is ready
- Generic VHDCI connectors for readout
- Electrical connection to GBTx
- Carrier board with GBTx-mezzanine from DESY and VHDCI connector
- SFP+ transceivers to readout
- Readout with RCE COB over optical link

**Results**

- Analog test: Internal injection into all pixels of the FE
- Threshold tuning: Adjusting pixel discriminator threshold to 3000 e⁻
- Test with Sr⁹⁰ source
- Readout of all working FEs with 2 GBTx in parallel

*Readout of 7 modules fully functional → can be scaled up to full Demonstrator*