

# ADT plans and support

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# LHC transverse feedback (ADT)

- ADT is the only place in LHC, where a bunch-by-bunch, turn-by-turn beam position is available at a full rate with a sub-micron resolution
- ADT acts on the beam transversally
  - Based on what the beam is doing (i.e. the transverse feedback)
  - By arbitrary synthesized signals with finely controlled parameters (e.g. coloured noise, coherent excitation etc.)
- Robust in operation, but very flexible and versatile for MDs
- Interconnected with other instruments via the LHC instability trigger network

# ADTObsBox

- A unique, high performance computer system (ADTObsBox) which is an integral part of the ADT
  - Real time analysis of the bunch position data
  - Position data buffers.
  - “Long time” storage (~24 hours) of the full rate data for offline analysis
- Fixed functionality for operation (instability detection, post-mortem, fixed displays...)
- Very versatile and useful for MDs

# ADT plans for Run III

- New beam position measurement electronics, 4 pickups per beam per plane, lower measurement noise
- A complete rework and clean up of the ADT firmware and software for higher flexibility
- A complete clean up and rework of the high-level control from LSA/CCC

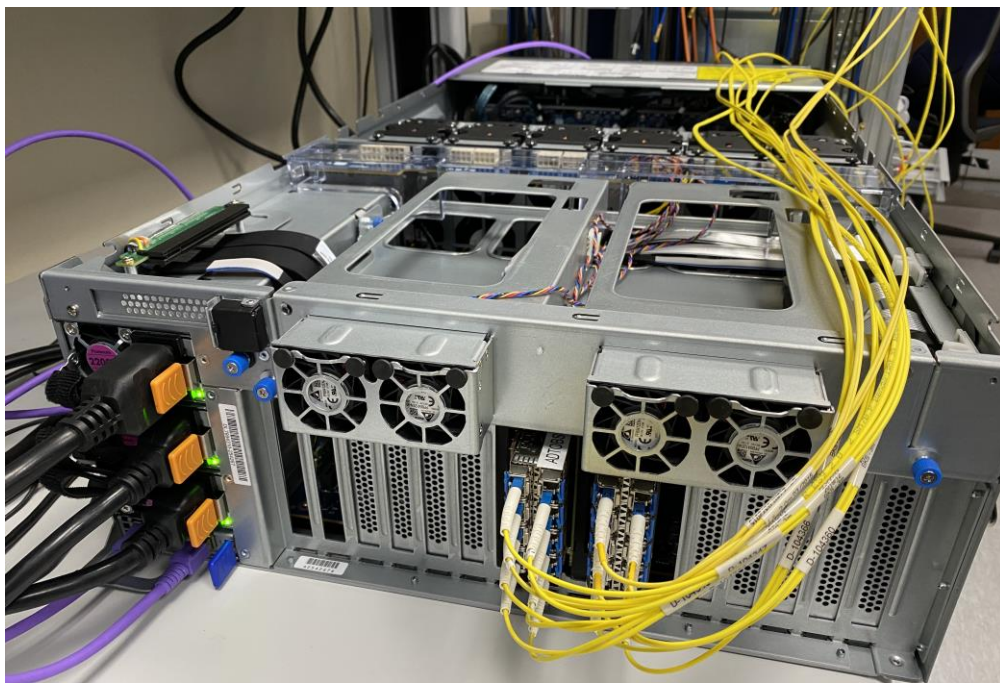
# ADT plans for Run III

- A new generation ADTObsBox – a major upgrade of computing hardware, complete rework of hardware, firmware, software, significant increase of processing power
- All 16 pickups processed by a single machine (synchronization!)
- 24hr local storage at full rate available (144 TB), new links to a long-term storage in CCR
- You can take home a full 8 hour MD data on a 1TB drive (for a typical MD filling scheme)

# ADT plans for Run III

- The new ADTObsBox is capable to feed commands back, directly to the ADT signal processing FPGA. Great potential for all kinds of “active collaboration” and triggering (real time analysis and only few turns latency)
- Now truly real time analysis possible. The delay was cut down to only a few turns (reduced from 4k++ turn delay)
- Users can run their own online analysis on the development server using Python, C, C++ (with some help from Martin)

# ADT plans for Run III – new generation ADTObsBox



**Signals from all pickups (4 per beam, per plane) received by a single machine**



**Disk storage: 24 hr at full rate**



If the energy stored in LHC beam is often compared to...



British aircraft carrier travelling at 21 km/h



or a duck travelling at 21 km/second

...then the noise from the new ObsBox servers can be compared to:



...Airbus A320 taking off 😊



# ADT MD requests and proposals

- In Run 3, we would like to study
  - Methods for real time, bunch by bunch tune measurement, passive and active, using all pickups and ADTObsBox (with BI and OP)
  - Active manipulations of beam involving real time beam parameter analysis and fast feedback from the ADTObsBox (with BI, OP, ABP)
  - Alternative signal processing schemes
  - ADT Hardware studies in view of HL-LHC
- Many specific activities are already part of MDs with other teams (injection, collimation, instabilities, operation...)
- We will certainly continue the close collaboration with ABP on noise studies and potential feedback improvements for the day to day operation

# Support: ADT as an MD tool

- ADT is very versatile and powerful device. It has played an instrumental role in many MDs, and was used as an important tool for many other MDs
- ADT (which normally comes with an “operator”) is regularly highly oversubscribed for the whole duration of the MD periods
- As demonstrated, we can do many interesting and sophisticated things...
- **But proper planning**, well ahead of the MD period and **proper testing** is essential (including end of fill MDs)

# ADT as an MD tool workflow

1. Discuss your preliminary MD ideas with the ADT team well ahead
  - We assess the feasibility, propose what and how it can be done with the current system, or what needs to be implemented to provide the requested service. Resources will be estimated
2. Write down the request in a formal way, ask for approvals
  - E.g. Machine Protection Panel to approve the parameters etc.
3. Implementation starts
  - Depending on complexity this part may take days to weeks...
  - Note, there are always many parallel requests for the same MD period
4. Tests in the lab, but often also validation in the machine
5. MD period: prepare and test with beam, execute the MD
6. Same applies to end-of-fill MDs

# Thank you for your attention



Pre-LS2 ADT Low Level RF system installed in LHC point 4.  
Beam position measurement, digital signal processing, all ADTObsBoxes.