Alignment using high Pt tracks

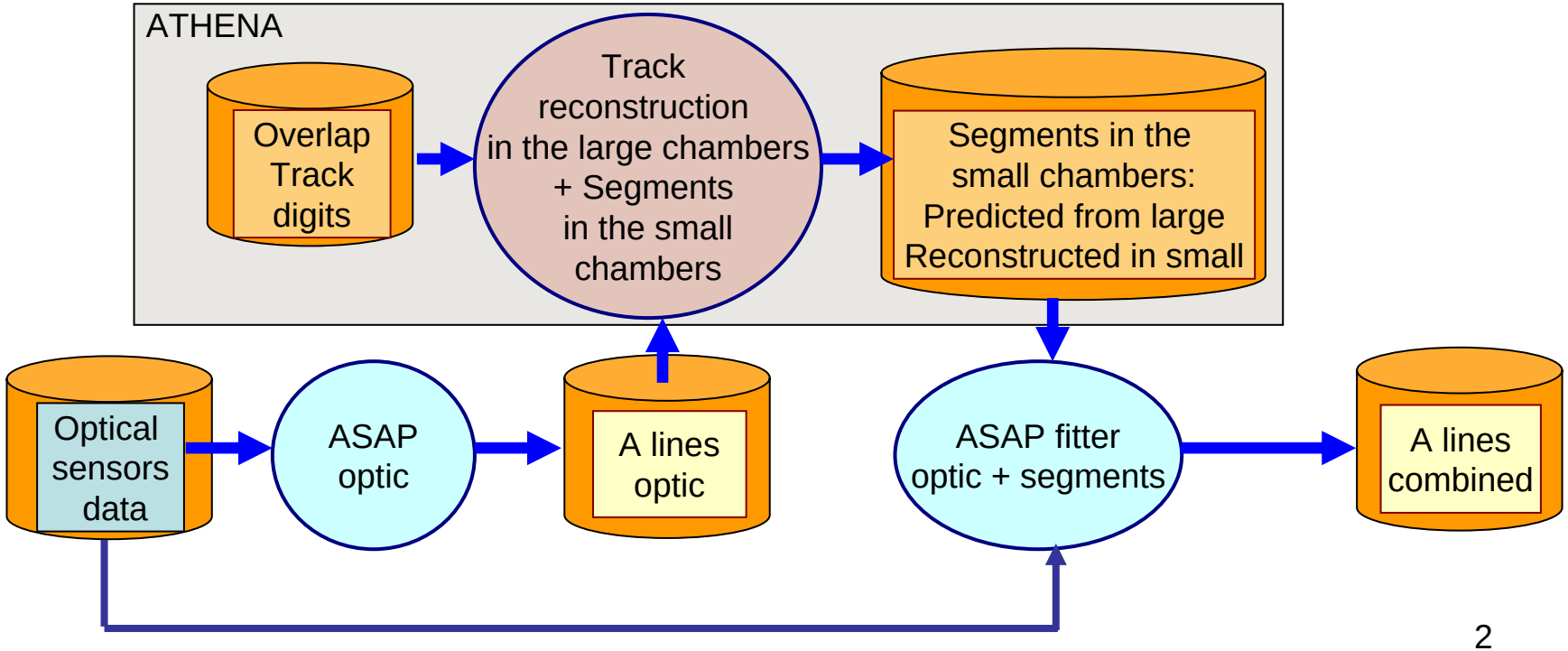
In parallel (or together) with R-T calibration stream, a track alignment stream has to be setup for the following alignment tasks:

1. Small w.r.t. large barrel chambers
2. BEE w.r.t. EC chambers
3. Endcap – Barrel
4. BIS8 w.r.t. BIS7
5. Inner tracker – Muon spectrometer
6. *TGC w.r.t. EC MDT chamber. Not discussed here*

High p_T means: Selected by High p_T Level1 trigger + level2 cut p_T>20GeV
For items 1-4, the target precision transverse to the track direction in the bending plane is of the order 30 μm.
For item 5, a precision of the order 200μm in the toroid bending plane is sufficient.
Not discussed here: alignment with field off (or cosmic) straight tracks (considered as an offline “one time” task)

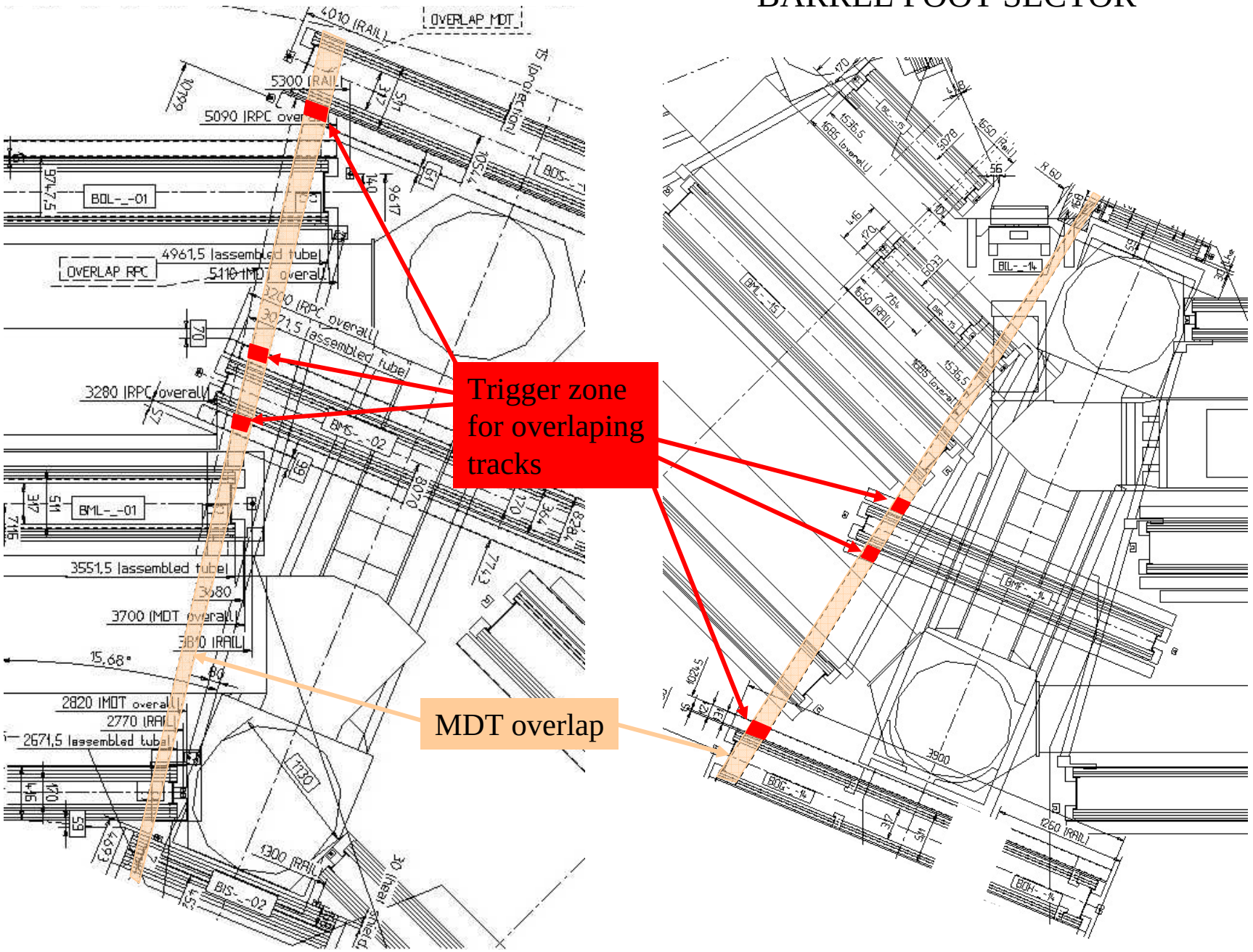
Small-Large barrel chambers

Track selection at level 2: High Pt muon in full overlap (BIS-BIL-BMS-BMLS-BOS-BOL tracks)
Selected tracks rate at L=10^{33}: ~3 Hz (barrel, 200 towers) + ~10 Hz (End caps)
Frequency : every 2 hours (~100 segments per chamber overlap)
CPU requirement: ~ 3-10 PC (~3-10Hz with ~1s per track reconstruction)
Comments : optical alignment and track information are correlated in the final fit
DCS condition database data have to be available



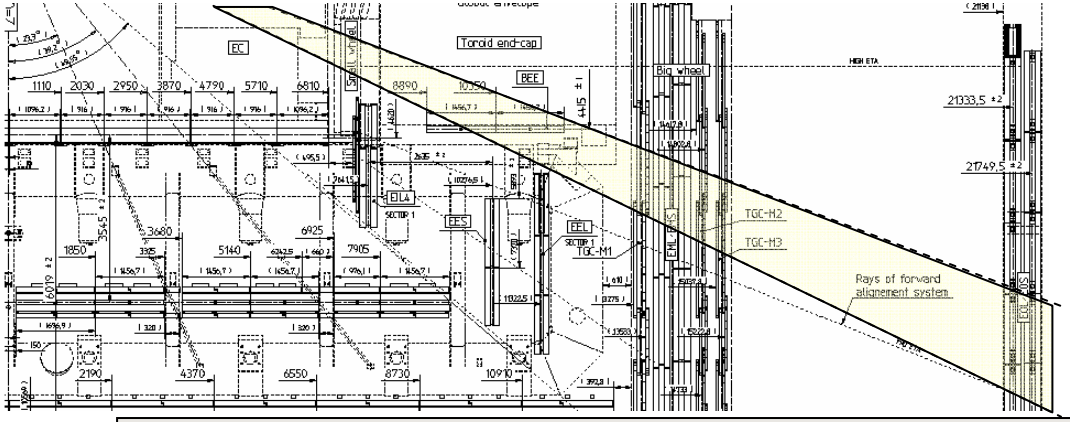
STANDARD BARREL SECTOR

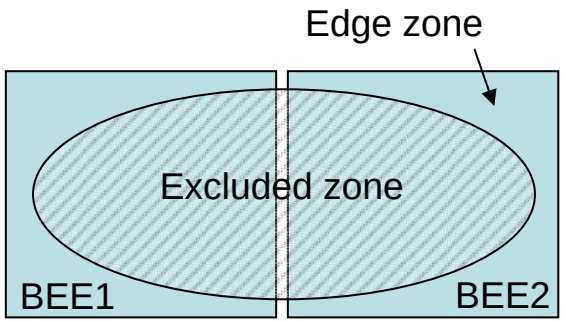
BARREL FOOT SECTOR

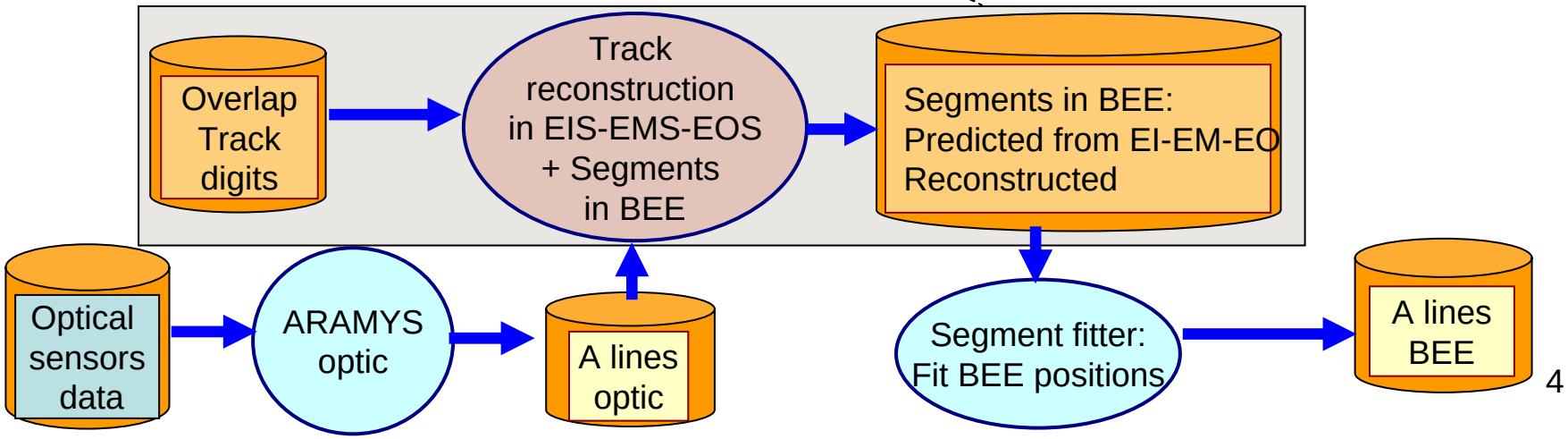


BEE / EC chambers

Track selection at level 2: High Pt muons in the overlap EIS-BEE-EMS-EOS
Selected tracks rate at $L=10^{33}$: ~10Hz ($1.45<|\eta|<1.70$, 30% of 2π)
Frequency : every 2 hours (~1000 segments per BEE in the edge zones)
CPU requirement: ~ 3 PC (~3Hz with ~1s per track reconstruction)
Comments : Only tracks crossing the edges of BEE chambers should be considered

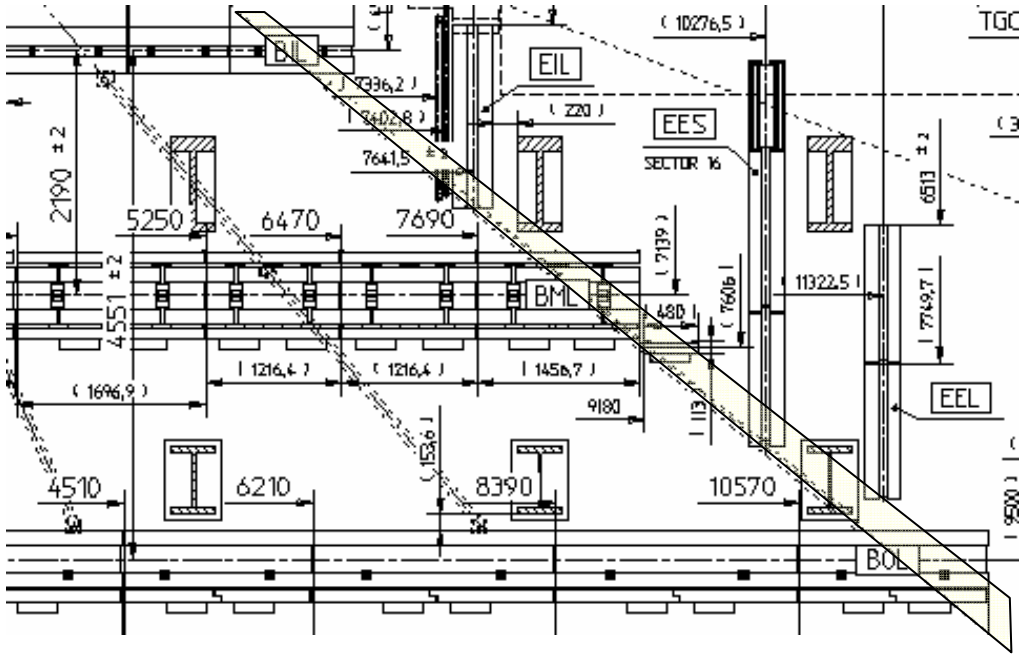




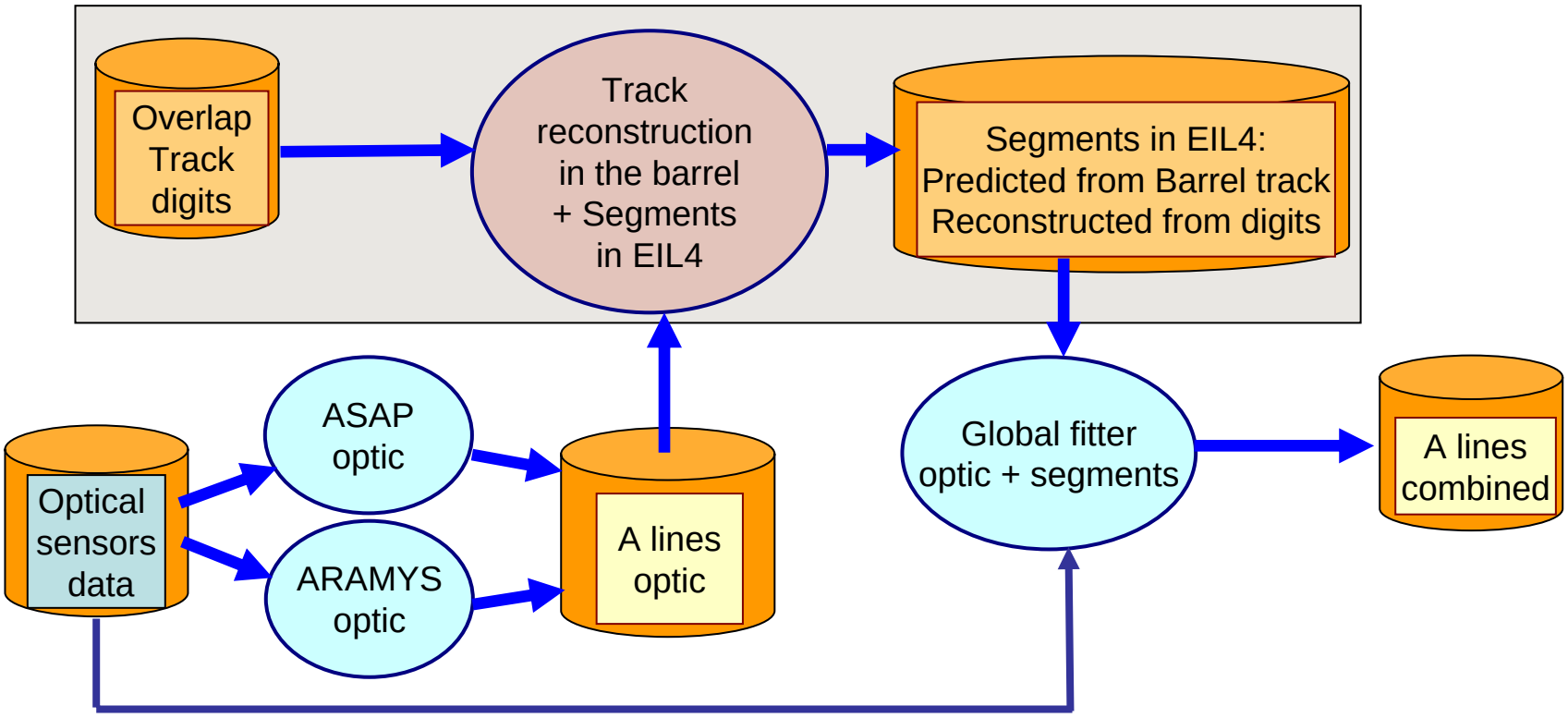


Endcap / Barrel (1)

Track selection at level 2: High Pt muons in the overlap BIL6-EIL4-BML6-BOL6
Selected tracks rate at L=10^{33}: ~4Hz ($\Delta\eta$~0.05, $\Delta\phi$~60% of 2π)
Frequency : every 2 hours (~1000 segments per EIL4)
CPU requirement: ~ 4 PC (~4Hz with ~1s per track reconstruction)
Comments : The final fit involves both barrel and EC optical data in additions to the segments in EIL4. The fitted objects could be barrel layers + EC bars.
With EEL: tracks in the overlap BIL6-EIL4-EEL2-EML5 also possible.

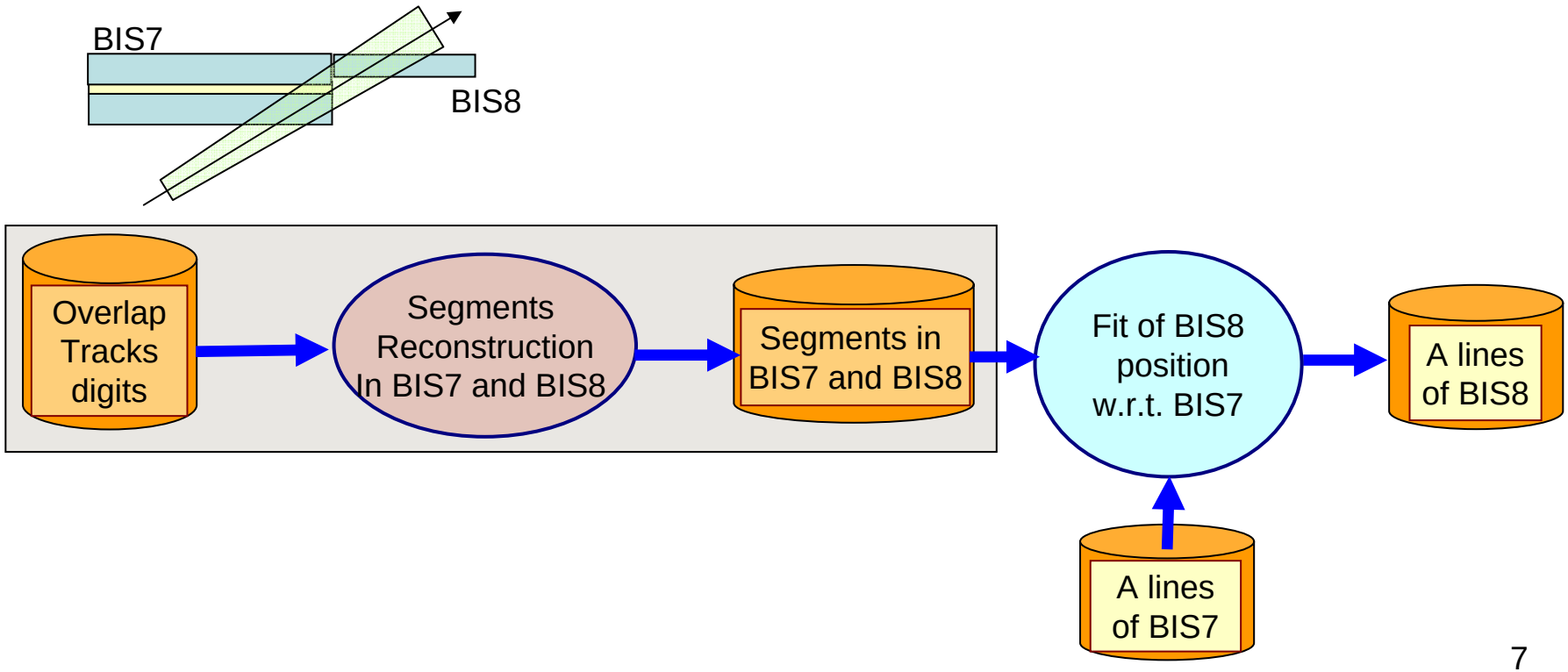


Endcap / Barrel (2)



BIS8 / BIS7

Track selection at level 2: High Pt muons in the overlap BIS7-BIS8
Selected tracks rate at L=10^{33}: ~1Hz ($\Delta\eta$~0.05, $\Delta\phi$~20% of 2π)
Frequency : every 4 hours (~1000 segments per BIS8)
CPU requirement: ~ 1 PC (~1Hz with ~1s per segment reconstruction)
Comments : The segments could the same as those used for R-T calibration



Muon spectrometer w.r.t. inner detector

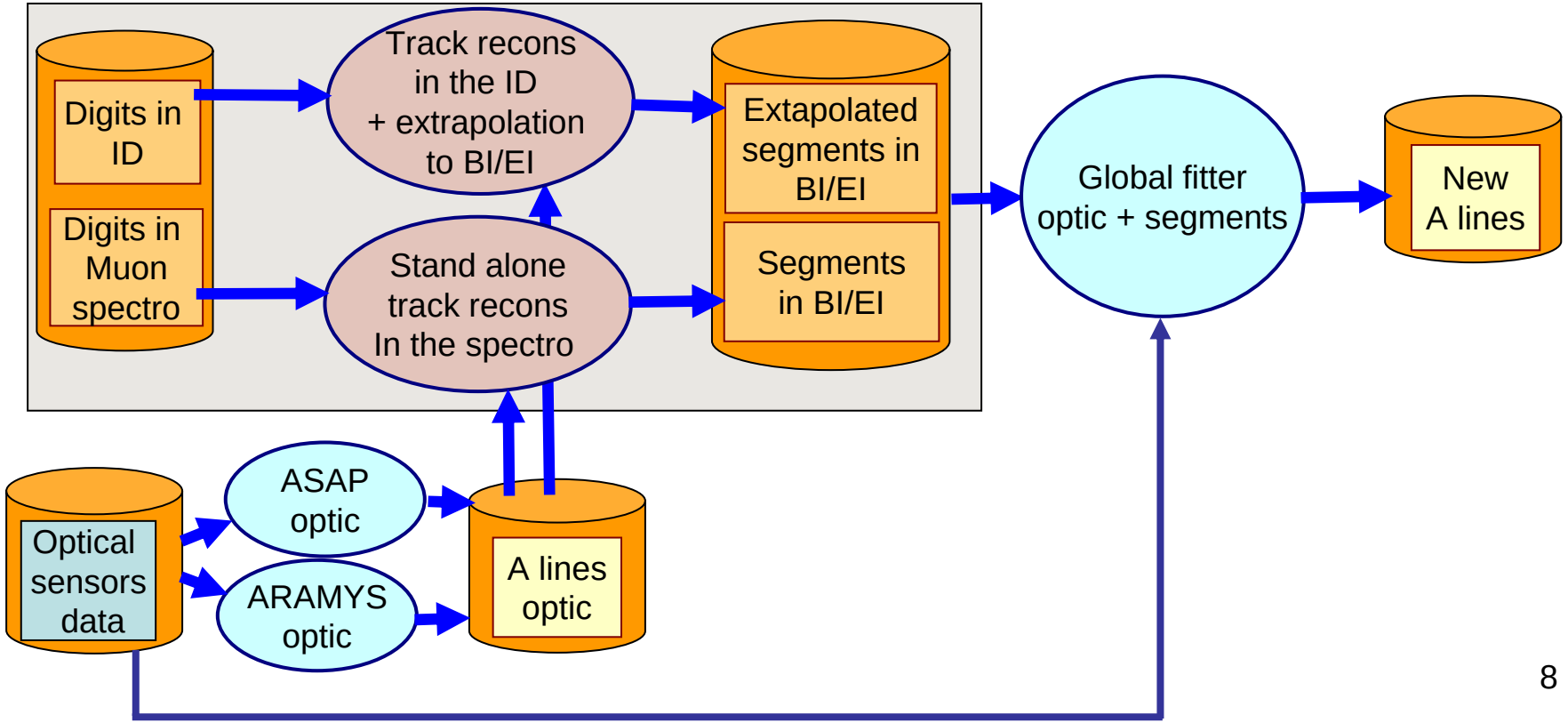
Event selection at level 2: Event with a very high Pt muons (e.g. > 50 GeV) both in ID and muon spectro

Selected event rate at $L=10^{33}$: >10Hz (from W/Z events) + pre-selection

Frequency : every 6 hours (~10000 tracks required to achieve the precision)

CPU requirement: ~ 5 PC (~0.5 Hz with ~1s per track reconstruction)

Comments : The final fit involves both barrel and EC optical data in additions to the segments in BI/EI. The fitted objects could be barrel layers + EC bars.



Conclusions/comments

• At lower luminosity (or if a detailed analysis shows tat the rates are much lower than anticipated), tracks selected at level2 with a lower p_T cut (e.g. >10GeV) can be used.

•Total rate of selected events for alignment with tracks should be ~ 30Hz ($L=10^{33}$)

•CPU time is dominated by the full track reconstruction: ~20-40 PC are required (<10% of calibration load)

• As expressed in the updated LOI, these alignment tasks would be worked out in tier-2 calibration centers.

•The various tasks could be split as follow:

- Optical alignment (ASAP/ARAMYS) : at ATLAS Point1
- Track + segment reconstruction: in Tier2
- Combined fits using segments + optical information : Tier2

• Alignment specific developments will start at MPI Munich tier2.
A collaboration with Saclay has been started to cover the issues of trigger rates in the alignment stream (detailed study with full MC simulations), specific track/segment reconstruction, combined track/optical sensors fits,…

• DC3/CSC simulation data with in a step first ideal detector geometry and later with “as built” detector geometry should be used as a starting point. Realistic rates and efficiencies have to be worked out.

• EDM should be updated to include the notion of extrapolated segment