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# Welcome to the LHCb Alignment Web Page

## Alignment Subtasks

- Former conveners: Lucia Grillo, Agnieszka Dziurda, Francesco Polci, Giulio Dujany
- Alignment software: Wouter Hulsbergen, Maurizio Martinelli
- VELO alignment [↗](#): Silvia Borghi, Giulio Dujany
- Tracker alignment: Francesca Dordei, Lucia Grillo and Maurizio Martinelli
  - ◆ TT alignment: Elena Graverini and Maurizio Martinelli
  - ◆ IT alignment: Zhirui Xu, Maxime Schubiger and Maurizio Martinelli
  - ◆ OT alignment, OTMonoLayerAlignment: Wouter Hulsbergen
- Muon alignment: Stefania Vecchi
- RICH Mirror Alignment: Paras Naik, Claire Prouve, Anatoly Solomin
- AlignmentMonitoring
- Open Alignment Tasks
- Alignment problems database [↗](#)

## Tools for Alignment

- Introduction to running the Alignment
- Alignment DB Monitoring Tools
- Manual for alignment framework ('Kalman')
- Geometry Framework
- Protocol for uploading new calibration and alignment constants from CAF jobs

## How To:

- How to run the online alignment (2015+)
- **Alignment piquet's reference:** how to solve most common problems with automatic VELO and tracker alignment
- Check consistency between conditions used online and offline.
  
- Test the online alignment procedure.
- Time table for using of the HLT farm in 2017 Winter Shutdown
  
- How to develop Alignment software
  
- Various How To's with the Conditions Database
- HowToCreateCondDB: How to Create a local copy of the Conditions Database
- HowToBrowseCondDB: How to Browse the Conditions Database (LHCBCOND.db)
- How to create a misaligned Conditions DB
- Access bookkeeping DB (fast)
  
- How to access the energy deposit in the calorimeters (e.g. to get a momentum estimate for magnet-off runs)
- Solve warning and errors from the nightlies
- Check QMTests
- Add histograms to the online monitoring presenter

## Alignment versions

- CondDB and Alignment version used in the HLT.
- List of 2010 alignment versions: [link](#).
- List of 2011 alignment versions: [link](#). List and time range of the fill: [link](#)
- List of 2012 alignment versions: [link](#). List and time range of the fill: [link](#)
- List of 2015 alignment versions: [link](#). List and time range of the fill: [link](#)
- Late 2015 and 2016 on: The automatic update of the constants was switched on the 23/10/2015 for the VELO and the 3/11/2015 for the Tracker, more information and monitoring plots can be found in the [logbook](#) . List and time range of the fill: [link](#)

## Data sets for tests

Here are a few data sets available for testing:

- **Data 2011:** \$ESCHEROPTS/COLLISION11.py
- **Data 2012:** \$ESCHEROPTS/COLLISION12.py
- **Data 2015:** /afs/cern.ch/user/m/mamartin/public/forWouter/r166277\_Calibration.py

## Activities

See [link](#) to the Activities List.

## Open tasks

See [link](#) to the Open tracking and alignment tasks.

## Useful Detector Information

- [Tracker Turicensis](#)
- [Inner Tracker](#)
- [Outer Tracker](#)

## Hardware Alignment Systems

- **RASNIK system:**
  - ◆ [RASNIK System for Outer Tracker, June 2007 \(LHCb password required\)](#)
  - ◆ [CDS Notes](#)
- **RICH Laser Alignment System**
  - ◆ [Ph.D. Thesis by Andres Macgregor](#)
- **IT BCAM:**
  - ◆ [IT monitoring using BCAM intersections](#)
  - ◆ [BCAM results with both polarity](#)

## LHCb Tracking & Alignment Workshops and Other Relevant Meetings

- All the meetings can be found at this page [↗](#)
- Jun 3-4 2010: Tracking and Alignment Workshop @ CERN
- Jan 28-29 2010: Tracking and Alignment Workshop @ CERN
- Jul 10 2009: Tracking and Alignment Workshop @ CERN
- Feb 16-18 2009: Tracking and Alignment Workshop @ Heidelberg
- Jun 10-12 2008: Tracking and Alignment Workshop @ CERN
- April 7-11, 2008: Alignment working week 3 @ CERN
- Feb 27-29, 2008: Tracking & Alignment Workshop @ Ferrara
- Feb 11-15, 2008: Alignment Working Week 2 @ CERN
- Jan 7-11, 2008: Alignment Working Week 1 @ CERN
- Aug 29-31, 2007: Tracking & Alignment Workshop @ Amsterdam
- Aug 3, 2007: Alignment Meeting @ CERN
- Feb 22-23, 2007: Tracking & Alignment Workshop @ Heidelberg
- Nov 8-9, 2006: Tracking & Alignment Workshop @ Lausanne
- July 13-14, 2006: Tracking Workshop @ Zurich
- Jan 12-13, 2006: @ Alignment Workshop @ Cambridge
- Oct 31-Nov 1, 2005: Tracking & Alignment Workshop @ Glasgow

## LHC Detector Alignment Workshops

- LHC Detector Alignment Workshop - 3, Sept 15-16 2009
- LHC Detector Alignment Workshop - 2, June 25-26, 2007
- LHC Detector Alignment Workshop - 1, Sept 4-6 2006

## Presentations and Proceedings

- Survey Task Force Reports, May 2007 Software Week slides
- J. Palacios Local-to-global transformations, and Marco Clemencic, on implementation of Survey data into Geom DB or Cond DB, presented at T-REC Meeting slides
- W. Hulsbergen on alignment with Kalman filter tracks in the LHC alignment workshop slides
- L. Nicolas, Tracking stations alignment with Kalman tracks at LHCb, presented at : 2008 IEEE, 2008 slides
- M. Gersabeck, Alignment of the LHCb VERTex LOcator, presented at : 10th International Conference on Instrumentation for Colliding Beam Physics, 2008slides slides
- E. Rodrigues, Impact of misalignment on beauty physics at LHCb, presented at 3rd LHC Detector Alignment Workshop 2009 slides
- J. Blouw, The LHCb alignment and alignment monitoring framework, presented at 3rd LHC Detector Alignment Workshop 2009 slides
- C. Salzmann, LHCb silicon detector alignment with first LHC beam induced track, presented at 3rd LHC Detector Alignment Workshop 2009 slides
- M. Deissenroth, LHCb T-station detectors alignment with cosmics, presented at 3rd LHC Detector Alignment Workshop 2009 slides
- S. Pozzi, LHCb Muon detector alignment with cosmics, presented at 3rd LHC Detector Alignment Workshop 2009 slides
- F. Maciuc, Tracking and Alignment in LHCb, presented at Physics at the LHC2010, 2010 slides
- S. Borghi, Tracking and alignment performance of LHCb silicon detectors, presented at International Workshop on Vertex Detectors, 2011 slides proceeding [↗](#)
- F. Dupertuis, A Novel Alignment Procedure and Results for the LHCb Silicon Tracker Detector, presented at 2011 IEEE Nuclear Science Symposium and Medical Imaging Conference, 2011 slides

proceeding

- R. Märki, Alignment of the LHCb tracking system presented at 13th ICATPP Conference on Astroparticle, Particle, Space Physics and Detectors for Physics Applications, 2011 slides proceeding

More recent talks and proceedings are at [link](#)

## Publications, public notes

- J. Amoraal et al., "Application of vertex and mass constraints in track-based alignment", Nuclear Inst. and Methods in Physics Research, A 712 (2013), pp. 48-55 [↗](#), doi:10.1016/j.nima.2012.11.192 [↗](#) arXiv:1207.4756 [↗](#)
- S. Borghi et al., "First spatial alignment of the LHCb VELO and analysis of beam absorber collision data", Nucl. Instrum. Methods Phys. Res., A 618 (2010) 108-120, PDF [↗](#)
- M. Needham, "First alignment of the Inner Tracker using data from the TI-8 sector test", LHCb-2009-030 ; CERN-LHCb-2009-030 ; LPHE-Note-2009-02 [↗](#)
- L. Nicolas et al, "Alignment of LHCb tracking stations with tracks fitted with a Kalman filter", LHCb-2008-066 ; CERN-LHCb-2008-066 [↗](#)
- L. Nicolas et al, "First studies of T-station alignment with simulated data", LHCb-2008-065 ; CERN-LHCb-2008-065 [↗](#)
- J. Amoraal, "Alignment of the LHCb detector with Kalman filter fitted tracks." LHCb-CONF-2009-026; CERN-LHCb-CONF-2009-026
- M. Deissenroth, "Experience with LHCb alignment software on first data" LHCb-CONF-2009-009; CERN-LHCb-CONF-2009-009
- A. Hicheur, M. Needham, L. Nicolas, , J. Amoraal, W. Hulsbergen, G. Raven, , "First studies of T-station alignment with simulated data.", CERN-LHCB-2008-065, Mar 2009. 35pp.
- L. Nicolas, A. Hicheur, M. Needham, J. Amoraal, W. Hulsbergen, G. Raven, "Alignment of LHCb tracking stations with tracks fitted with a Kalman filter", CERN-LHCB-2008-066, LPHE-2008-14, Dec 2008. 6pp.
- W. Hulsbergen, "The Global covariance matrix of tracks fitted with a Kalman filter and an application in detector alignment.", Nucl.Instrum.Meth.A600:471-477,2009 [↗](#). doi:10.1016/j.nima.2008.11.094, arXiv:0810.2241 [↗](#) [physics.ins-det]
- S. Viret, C. Parkes, M. Gersabeck, "Alignment procedure of the LHCb Vertex Detector", Nucl. Instr. and Meth. A596 (2008) 157-163 [↗](#), doi:10.1016/j.nima.2008.07.153 arXiv:0807.5067 [↗](#)
- M. Gersabeck et al., "Performance of the LHCb Vertex Detector Alignment Algorithm determined with Beam Test Data", Nucl. Instr. and Meth. A596 (2008) 164-171 [↗](#), doi:10.1016/j.nima.2008.07.154 arXiv:0807.5069 [↗](#)

## Subset of relevant non-lhcb references

- V. Blobel, "Software alignment for tracking detectors" (2006) [↗](#). Publication for millepede
- V. Blobel, "Alignment algorithms" (2007): Overview of different alignment algorithms for the LHC alignment workshop
- P. Bruckman, A. Hicheur and S.J. Haywood, "Global chi2 approach to the alignment of the ATLAS silicon tracking detectors" [↗](#) : another formulation of the closed form alignment approach
- A. Bocci and W. Hulsbergen, "TRT Alignment For SR1 Cosmics and Beyond" (2007) [↗](#): alternative (short) formulation of the closed-form alignment approach.

## Tracking and Alignment Plots for Conference

<https://twiki.cern.ch/twiki/bin/view/LHCb/ConferencePlots>

## Old stuff

- 2010 AlignmentOpenIssues
- Old Data sets
  - ◆ Alignment Samples
  - ◆ Special Data Sets for Alignment
  - ◆ Bookkeeping Database
  - ◆ Alignment databases
- How to use the GUI for the Offline Alignment Monitoring

-- StevenBlusk - 13 Nov 2006

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