

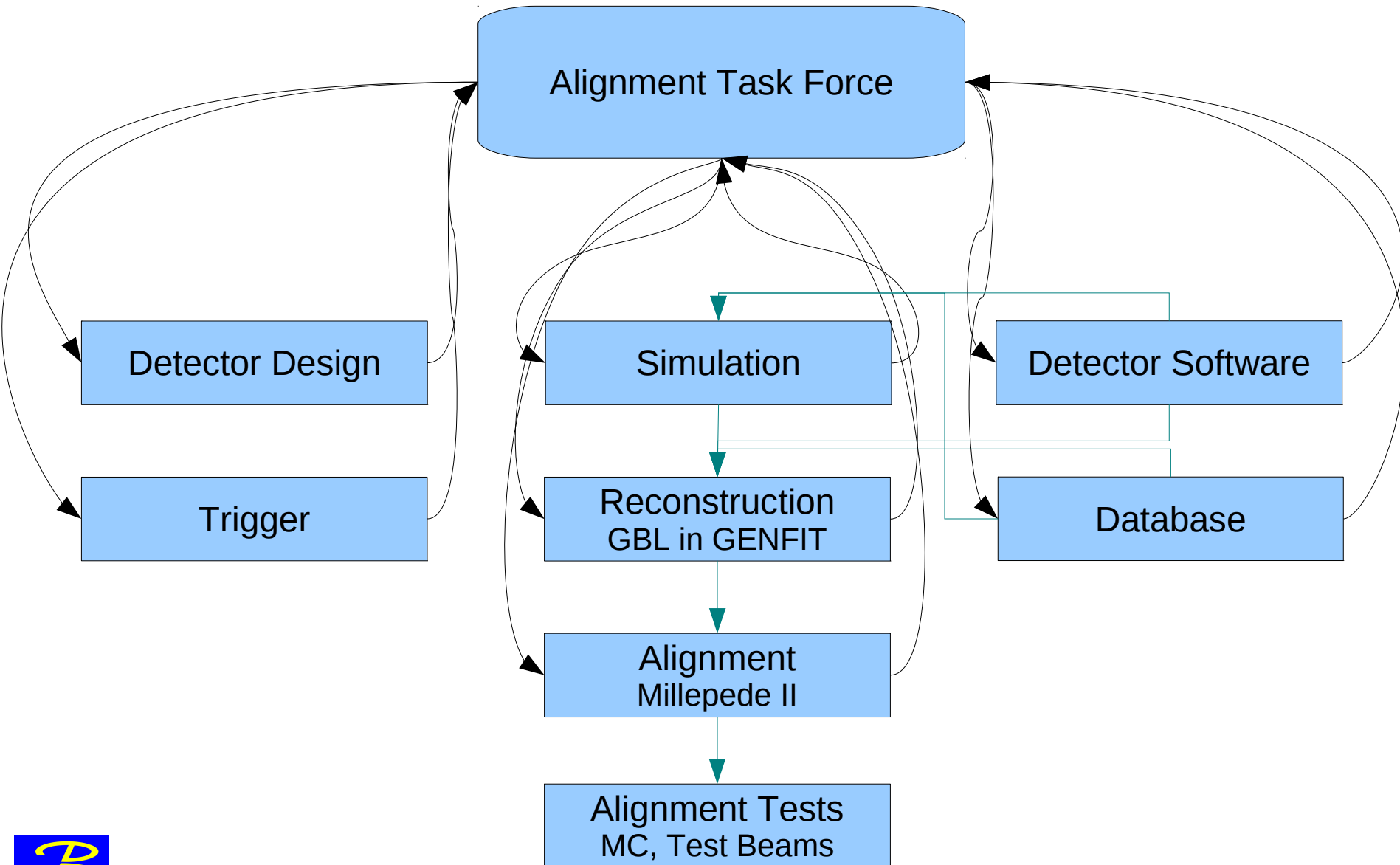
# Alignment

## Short overview

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The 4th Belle II PXD/SVD  
Workshop, DESY, Hamburg,  
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# Alignment Task Force Scheme



# Alignment Task Force Priorities

- > Finalize the full alignment chain as soon as possible. Very important for feedback to the trigger and detector design
  - Simulation and reconstruction in BASF2
  - Alignment with Millepede II (other methods are not excluded)
- > In parallel develop necessary infrastructure
  - Conditions database, geometry model, event data model, dedicated alignment streams
- > Be prepared for the test beam at DESY in January 2014
- > Try to use Belle data for alignment tests
- > Manpower: clearly identify tasks and persons assigned to the tasks in order to avoid unnecessary duplication of activity

# Generators

## > Generators for alignment tests

- Muon pairs
- Cosmic rays

## > Muon pairs from kkmc generator

- kkmc generator included [in basf2 in April 2013](#) (Kiyoshi Hayasaka)

## > Cosmic generator

- Planned for and [included to the current release](#) (Sergey Yashchenko)

## > First alignment tests used a simple ParticleGun generator

## > Will use kkmc and cosmic generators for more realistic tests



## Millepede II

- > Linearization of the track model to calculate corrections to initial values of global alignment and calibration parameters
  - With block matrix algebra can be reduced to a system of the size of the number of global parameters
  - Obtain all global parameters keeping the correlations due to all the tracks, complete covariance matrix from all local track fits is required
  - Details: *V. Blobel, NIM A, 566 (2006), 5-13*



## General Broken Lines

- > Fast global track refit taking multiple scattering into account
  - Determine the complete covariance matrix of all track parameters
  - Additional local or global parameters can be added
  - Details: *C. Kleinwort, NIM A 673 (2012) 107*

# Reconstruction

- > Software focused review recommendation: integration of GBL to GENFIT2 and basf2
- > GENFIT2 is in the development stage (Johannes Rauch and Tobias Schlüter), to be finished in November 2013
  - Development versions of GENFIT2 and basf2 provided by Tobias and Johannes
- > Implementations and first tests done (Tadeáš Bilka and Sergey Yashchenko with input from Claus Kleinwort)
- > Output from GBL to Millepede II prepared and tested
- > Tests with PXD and SVD and material successful
- > Input for Millepede II provided, first tests done
- > Tadeáš will present today studies for the DESY test beam

# Misalignment Simulation

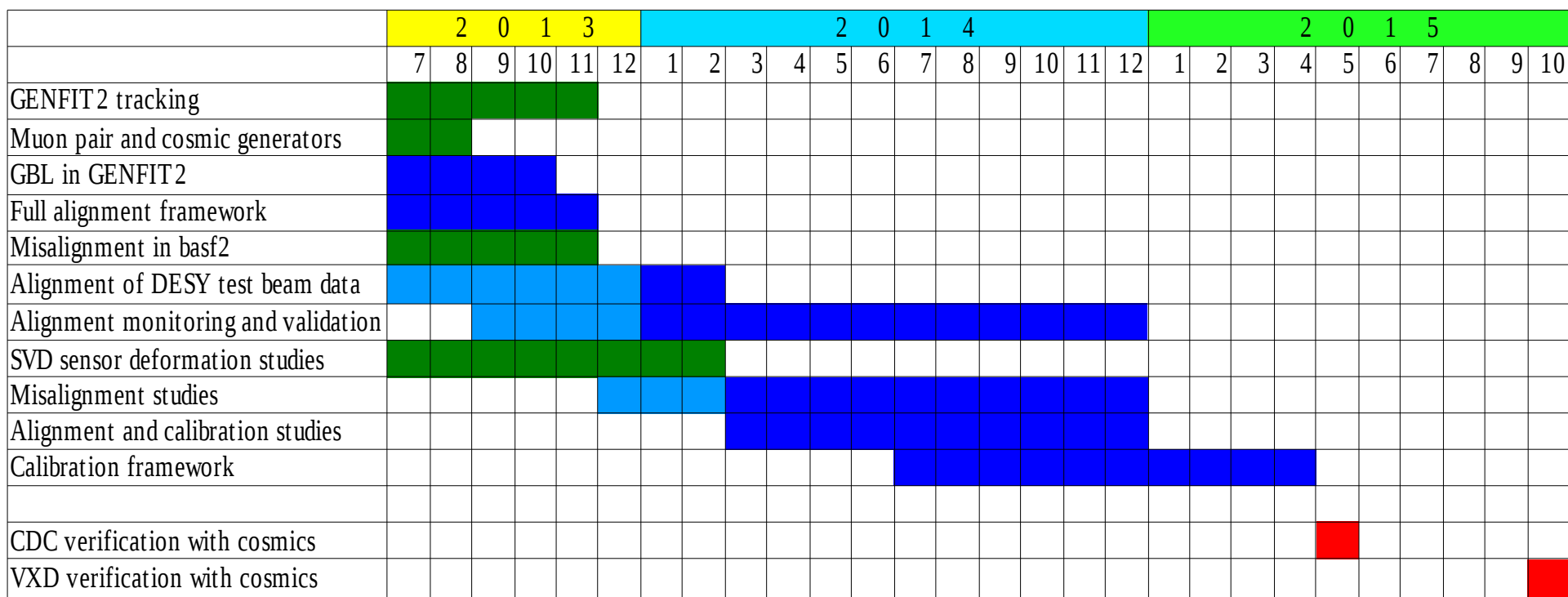
- > Misalignment simulation on digitization/reconstruction level
- > Misalignment for CDC (Hitoshi Ozaki)
  - Gravitational sag of sense wire in CDC full simulation
  - One can assume misaligned wires and sags in reconstruction, i.e. assume different geometry from that in simulation
  - [Implemented in basf2](#)
- > Misalignment for VXD (Peter Kvasnička)
  - Use of xml files that contain some configuration/calibration data for sensors also for alignment
  - Deformations of VXD sensors to be implemented virtually through position corrections via GeoCache and the RecoHit SensorPlane
  - Planned to be implemented [in basf2 by November 2013](#)

# Alignment Quality Monitoring and Validation

- > Demonstration that determined alignment is reasonable
- > Define validation alignment plots (residuals, vertices, physics distributions, ...)
- > Monitor alignment quality during running
- > Development started (Simon Wehle)
- > **First version** to be ready by the **end of 2013**
- > **Final version** by the **end of 2014**
- > Final alignment validation: during cosmic and beam running



# Alignment Task Force Roadmap: First Version



- > Alignment Task Force tasks (blue, light blue for first versions)
- > Related tasks of other software and detector groups (green)
- > Important milestones from the detector schedule:
  - Alignment for CDC: **May 2015**
  - Alignment for VXD: **October 2015**

# Report from the Belle II Focused Review

- > Alignment strategy must be developed and tested to make sure the detector design and construction plans will support the needs of the alignment group. For those works, software for detailed detector simulation, event reconstruction and alignment algorithm should be prepared well in advance. Early versions of reconstruction and alignment are already needed for the late-stage test beams now being planned. Debugged and well tested algorithms will be needed for detector commissioning in 2015 and 2016. One recommendation from the June review which was considered but not followed was to choose one track algorithm for both reconstruction and alignment. Currently reconstruction plans to use a Kalman filter, while alignment plans to use General Broken Lines (GBL). The tracking software group presented a strong case why having two algorithms is beneficial. Importantly, both algorithms have now been integrated inside GenFit2, such that the same infrastructure (material and magnetic field descriptions) is used by both. Results of tests using both algorithms on the same simulated track data showed compatible results. These responses address the fundamental concerns behind the recommendation, and so can be considered to have satisfied that recommendation.
- > Recommendation: Prove the assumption that an alignment based on GBL will produce good Kalman filter track fits, with the simulated data and the forthcoming DESY test beam data.

# Summary

- > Progress with alignment framework
  - Muon pair and cosmic generators available
  - Integration of GBL to GENFIT2 in parallel with GENFIT2 development
  - CDC misalignment already in basf2, VXD implementation in progress
  - Alignment quality monitoring and validation: activity started
- > Preparation for test of the alignment framework during the VXD test beam at DESY in 2014 in progress
- > Alignment Task Force roadmap discussed with other groups
- > Internal Note for documentation