

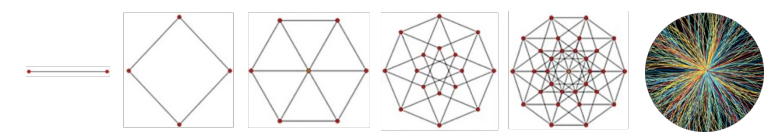
7.3.b Timing measurements and distribution

7.3.b-1 Strategies for characterizing and calibrating sources impacting time measurements

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On behalf of the 7.3.b-1 contributors

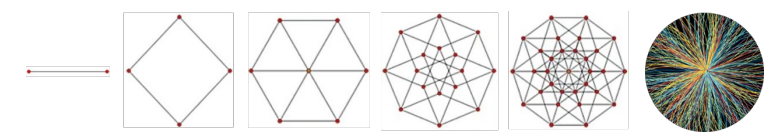
Proto Project ID Card



Timing measurements and distribution	
DRD7 Working Group	7.3: 4D & 5D techniques
Proto Project Reference	7.3.b: Timing measurements and distribution
Sub Project Title	7.3.b.1: Strategies for characterizing and calibrating sources impacting time measurements
Subtitle	Simulation of DAQ and DCS systems
Description	
Innovative/strategic vision	
Target., deliverables and timeline	
Multi-disciplinary, transversal content	
Contributors and areas of expertise	
Available material and human resources	
Existing R&D framework and available funding	
Additional resources to be requested	

- Represents a first «project Intention»
- Written by the conveners & initial contributors of the initiative: both originating from ATLAS and CMS groups.
- Summarises ongoing discussions: will evolve with the needs and additional contributions from incoming institutes, collaboration needs.

Project Description



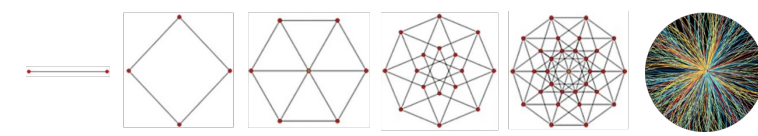
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- Increasing need of timing detectors with very high resolution
- Very high precision and stability ($O(\text{ps})$) of clock signal distribution, along with the fastest signal development.
- How to assess the different biases on this measurement ?



- Characterise the different sources of jitter
- Develop a realistic and fast simulation of the effects.
- Investigate strategies to cope with them





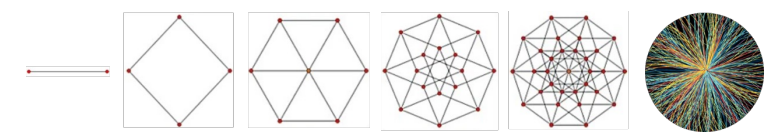
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- The issues and strategies are already needed for the LHC experiments (ATLAS and CMS) in their phase 2 upgrades (HGTD and HGCAL/ETL).
- This project will serve as a tool to define common strategies, as well as paving the way for future experiments.



- Develop and compare implementations on different procedures to model and test the time shifts.
- Study and implement generic solutions to calibrate the detectors.

Performance Target



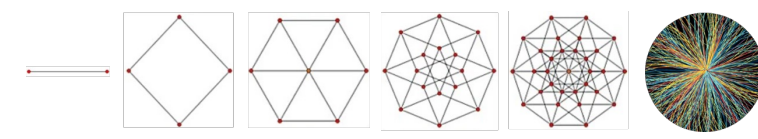
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Several parallel and sometime synchronous developments are needed :

- Design of a protocol of measurement.
- Development of simulation tools in the different experiments.
- Definition of common figure of merits and estimation of their impact on detector's performance.
- Measurement of the properties in test facilities to compare with the predictions.
- Design of calibration chain inside the different experiments.

Even if this is based on the phase-2 LHC upgrade (time scale of 2/3 years) it has a potential for the next generation of accelerators, and even during the operation of the HL-LHC.

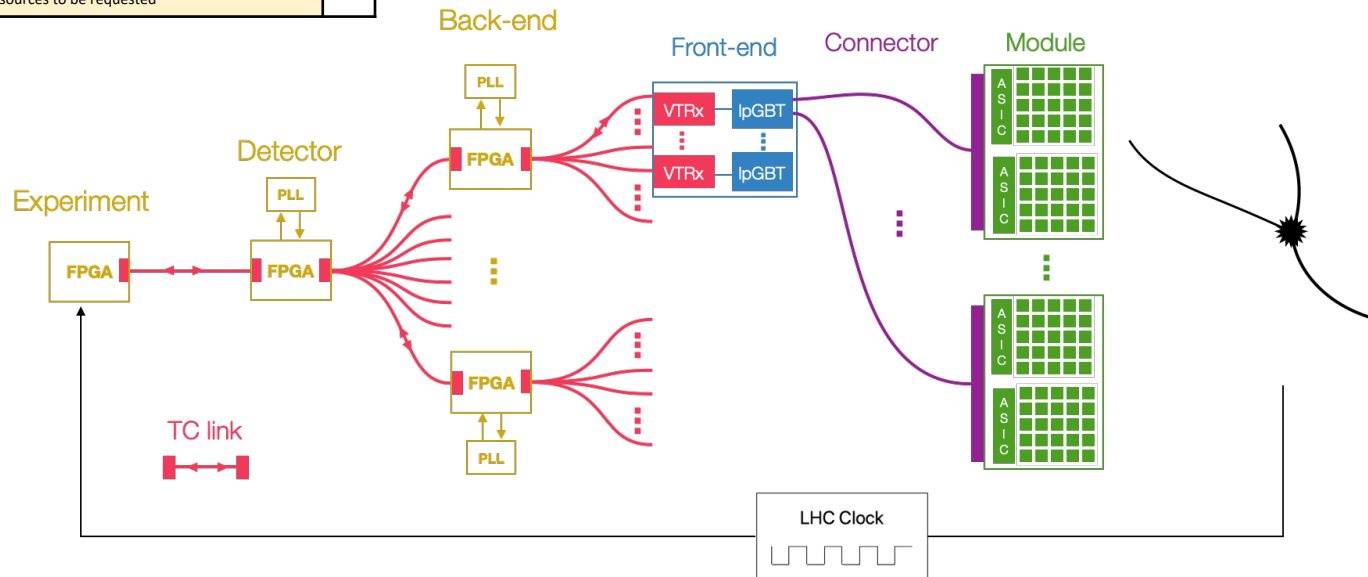
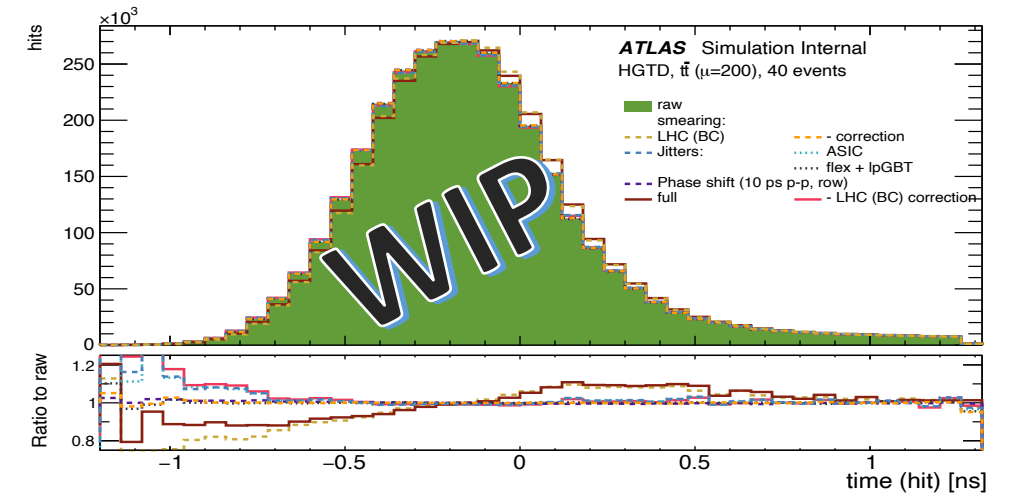
An Example: studies for HGTD



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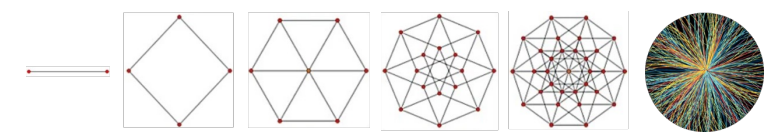
First attempt to categorise and model the clock jitters, in both experiments, for a future detectors.

Already identified some clear milestones to solve:



- The definition of the relevant figure of merit is not straight forward.
- Mapping of the effects requires discussions with various experts of the project.

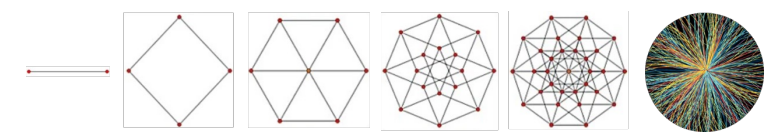
Deliverables & Timeline



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- Q4 2023-Q4 2024: Regular discussions each quarter or twice a year.
- 2024: Define common metrics and description of the effects for simulation.
- 2025: Implementation of measurements on realistic DAQ chain.
- Q4 2025: Drafting a report summarising the items (hardware or software) to be improved for the next generation of experiments.

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HGTD (ATLAS)

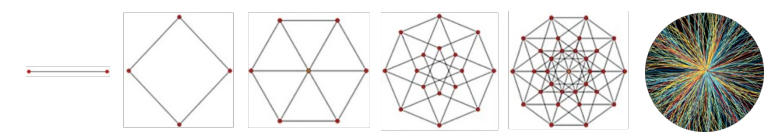


HGCAL & ETL (CMS)



*Some other institutes communicated their interest to contribute via the survey and are being contacted for consolidation

Resources and Organization



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- Resources:
 - The main needs are personpower and technical expertise;
 - Some already established forces in the two collaborations;
 - Additional contribution proposal are welcomed.
- Organized as:
 - A Forum;
 - Co-Chaired.
- Strong link with:
 - WG 7.3.b.2 (Timing distribution);
 - HPTD interest Group.