

# CMS GEM : Plans for 2014 SPS/H2-H4 Test beam

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On Behalf of the CMS GEM collaboration

**Content :**

- **Initial plans for H2 test beam**
- **Summary & comments (H2)**
- **Plans for H4 test beam**
- **Installation & Requirements**

**See Sunanda's talk (Thursday, WG1)**

→ 1 week test beam preparation & training (≈15 collaborators)

### Plans for SPS/H2 :

#### *Detectors under test :*

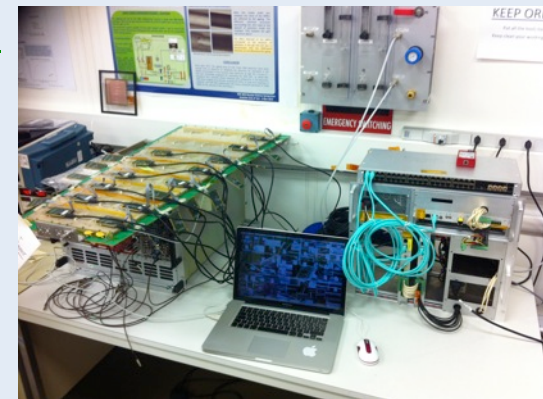
- GE1/1-IV irradiated at GIF (1year ≈ 11mC/cm<sup>2</sup> - no aging effects -)
- GE1/1-IV not irradiated (for reference → will be irradiated at GIF++)
- GE1/1-V (last generation)
- + RD51 tracker (triple-GEM + scintillators)
- + new CMS GEM tracker (check good operation)

#### *Interested in : (with VFAT+TURBO)*

- Detection efficiency vs HV
- Time resolution (time efficiency) vs HV
- Space resolution vs HV (vs readout strip pitch)

#### *Testing conditions :*

- **Magnetic field (up to 3T) → were informed 2 weeks before the test that magnet not operational due to critical issues with cryogenic system**
- Gas mixtures: Ar/CO<sub>2</sub> (70:30%) (& Ar/CO<sub>2</sub>/CF<sub>4</sub> (45:15:40%) if extra time
- Detectors gain ≈ 200 to 5x10<sup>4</sup>
- Muon beam (≈ 150GeV)



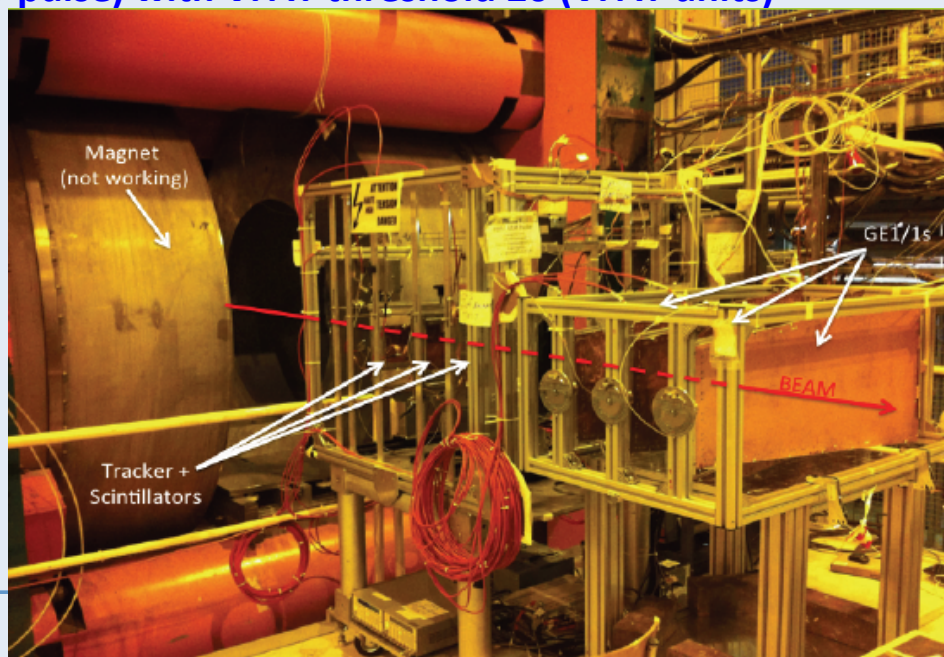
## Different sets of measurements : with VFAT+TURBO readout system in Ar/CO2 70:30%

Async. mode

- High Voltage scans :
  - MSPL = 1,2,4 (length of the output VFAT pulse) with VFAT threshold 20 (VFAT units)
  - MSPL = 1,4 with threshold 15,10
  - + with latency scan for each HV value
- Time resolution measurement :
  - MSPL = 1 with threshold 20,15,10 (with HV scan)

Sync. mode

- High Voltage Scan :
  - MSPL = 1 with threshold 20,15,10
- Time efficiency @ constant HV
  - signal delay = 20 to 50 ns (step of 1ns)
- Time efficiency @ constant delay 40ns



### Very difficult conditions :

- Main user only the first week then “parasitic” user downstream CMS calorimeters (HCAL)
- Very unstable beam from SPS/PS, unstable rate and beam profile
- Major issues (main power cut, storms ...) → not more than 40% efficiency the first week

→ Nevertheless successful campaign : preliminary results will be shown\* at CMS General Muon meeting (10<sup>th</sup> November)

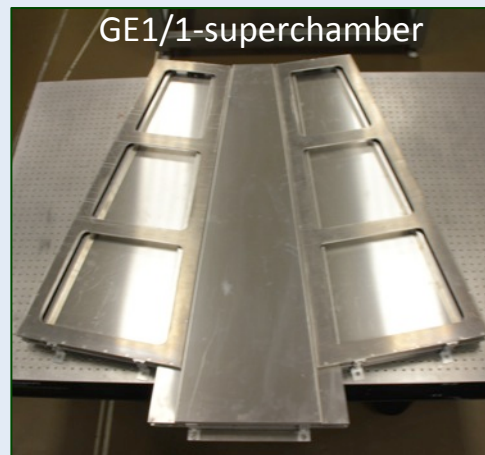
\*if ready and approved



## Plans for SPS/H4 :

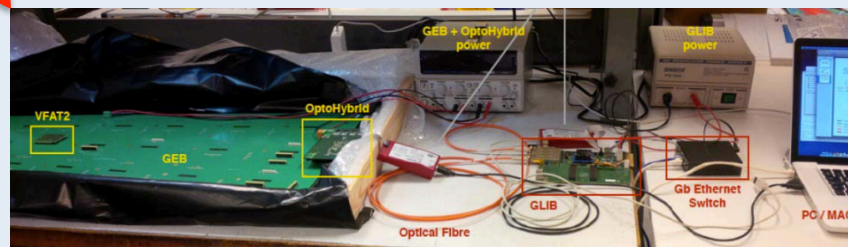
### Detectors under test :

- GE1/1-IV irradiated at GIF
  - GE1/1-IV not irradiated
  - GE1/1-V x2 → **superchamber\***
  - **GE1/1-III with multi-channel power supply\***
  - GE1/1 with CMS VFATs and GEB (new electronics)
- + RD51 tracker (TOTEM VFATs + TURBO)  
 + new CMS GEM tracker (APVs + SRS + SRU)



### Interested in : (with VFAT+TURBO & APV+SRS)

- Detection efficiency vs HV
- Time resolution (time efficiency) vs HV
- Space resolution vs HV (vs readout strip pitch)
- Performances of CMS GEM Super-Chambers



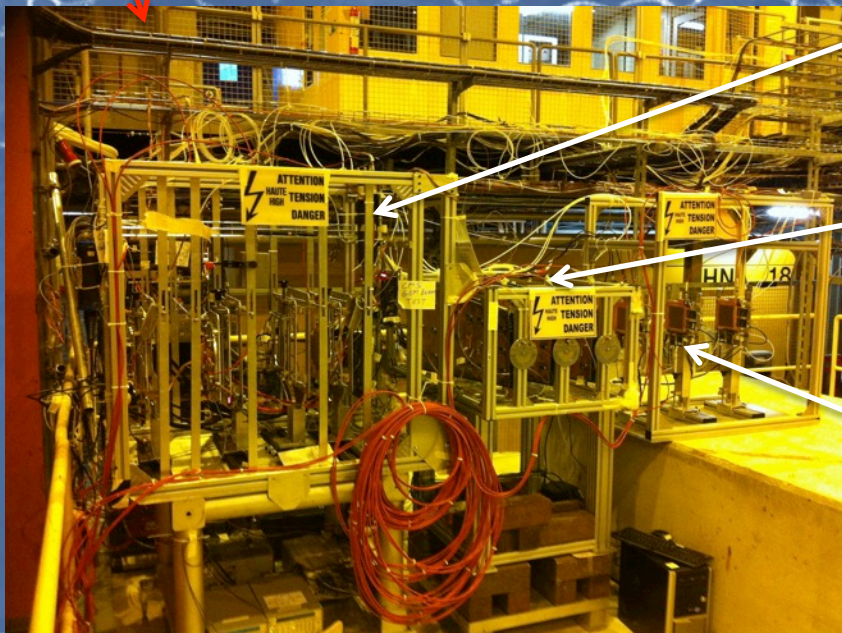
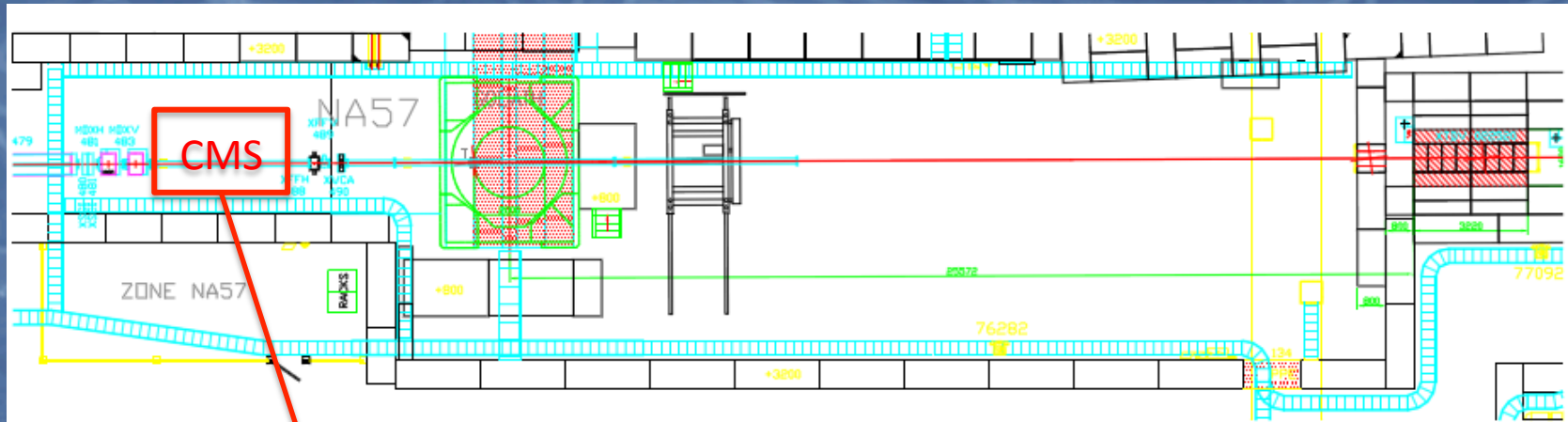
### Testing conditions :

- Gas mixtures: Ar/CO<sub>2</sub>/CF<sub>4</sub> (45:15:40%)
- Detectors gain ≈ 200 to 5x10<sup>4</sup>
- Muon beam (≈ 150GeV)

\*if ready



# CMS GEM H4 test beam campaign



RD51 tracker with  
 VFAT+TURBO

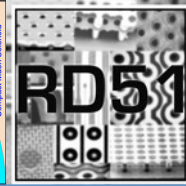
CMS support for  
 GE1/1's

CMS GEM tracker  
 with APV+SRS

### Requirements for H4 :

- Space : > 2.6m
- Gas : 1 line Ar/CO<sub>2</sub>/CF<sub>4</sub> (copper) + 2 lines Ar/CO<sub>2</sub> (from re-mixed bottles)
- Trigger and tracking : RD51 telescope with trigger logic rack
- HV : long cables + space in the mainframe (2 boards)
- Network : 2 outlets in control room (1 not DHCP)  
Long Ethernet from beam area (> cat5)
  
- most of the equipment already in our hands (from H2)
  - supports for detectors
  - safety shoes and helmets for the team
  - gas supply + flow meters
  - electronics (except VFAT)
  
- Beam ... preferably with rate > Hz

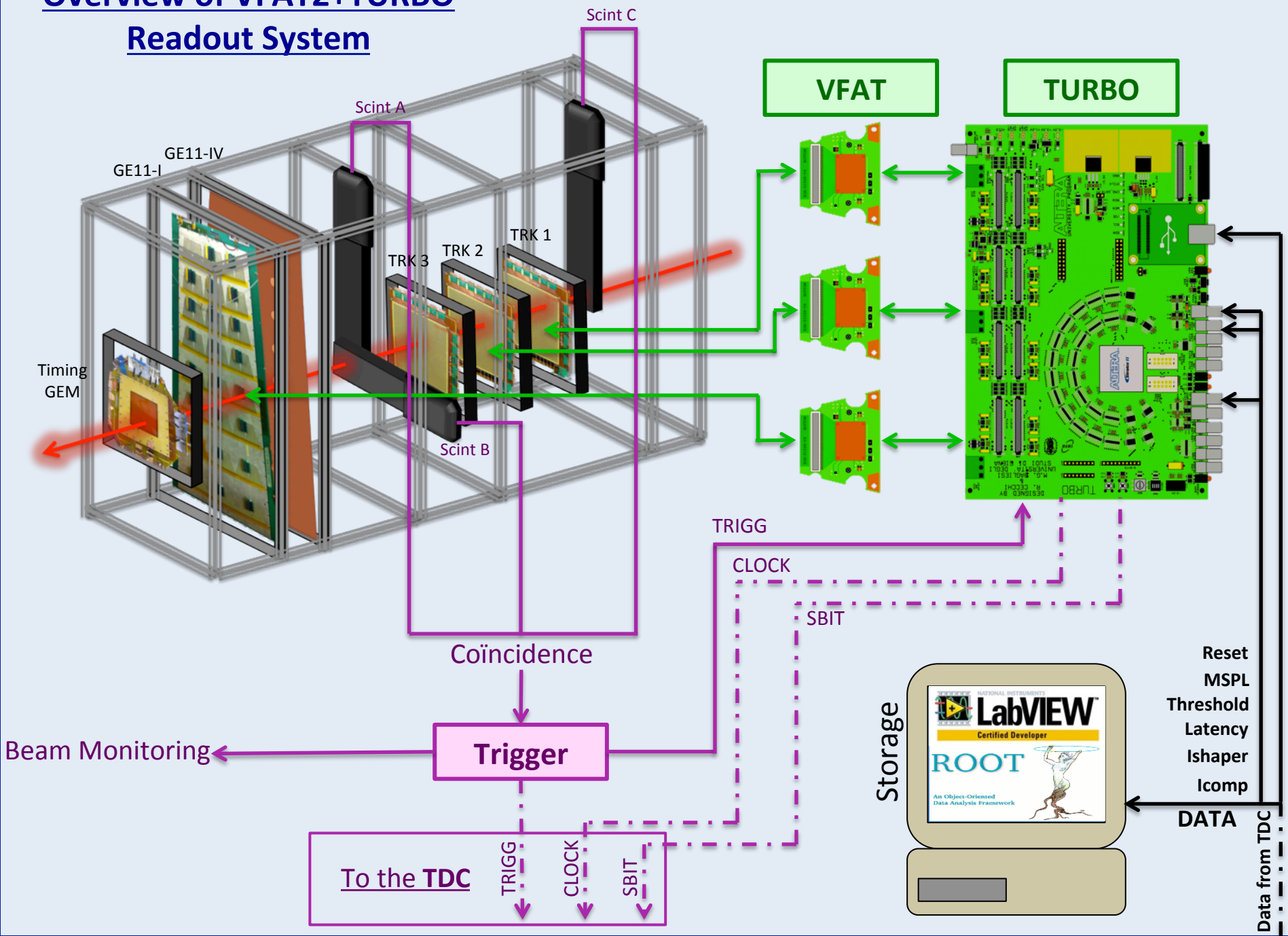
**Thank you**





# Overview of VFAT2+TURBO

## Readout System



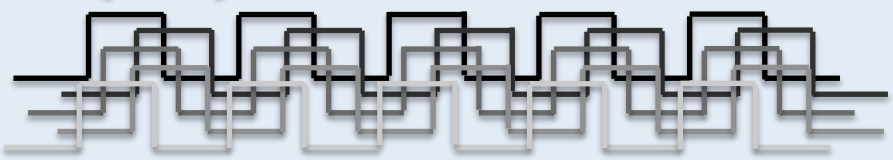
From **TURBO & SCINT**  
TRIGG  
CLOCK  
SBIT

# Time Measurement in Asynchronous Mode

trigger

25 ns

SBIT



random position of the trigger with respect to the clock

## TDC

TDC Common Stop      TDC INPUT      TDC OUTPUT

Stop

Few us window

Time

Time

Time Distribution

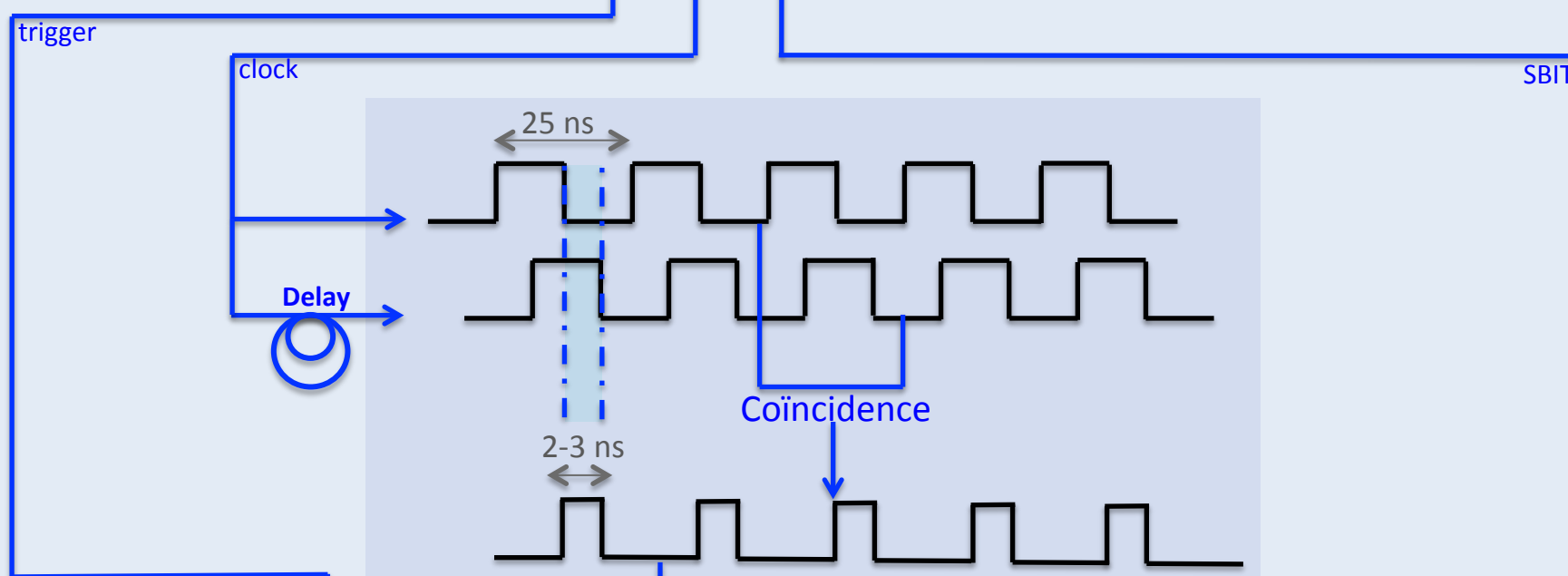
Time

Data from TDC ↑

From **TURBO & SCINT**  
TRIGG  
CLOCK  
SBIT

# Time Measurement in Synchronous Mode

Data from TDC ↑



Select only the events in a thin window

