

# ALCOR development plans



# ALCOR day in Torino

## ALCOR for EIC

Tuesday 7 Mar 2023, 11:00 → 16:00 Europe/Rome

Torino

Description <http://cern.zoom.us/j/67299495767?pwd=TWhpNjJxeC9qNEFWUTBIUVJuMG1hUT09>

  status\_03\_2023.pdf

 There are minutes attached to this event. [Show them.](#)

**11:00** → 11:10 **TDC clock ambiguity [understood]**

🕒 10m 

**11:10** → 11:20 **TOT orphans [understood]**

🕒 10m 

**11:20** → 11:30 **ALCOR test at 390 MHz**

🕒 10m 

**11:30** → 11:40 **Preliminary studies on packaging and AlcorV3 layout**

🕒 10m 

**11:40** → 11:50 **SiPM capacitance and optimal coupling with ALCOR**

🕒 10m 

**11:50** → 12:00 **Time resolution of the SiPM+ALCOR system**

🕒 10m 

**12:00** → 12:10 **Definition of ToT reconstruction algorithm**

🕒 10m 



# ALCOR status

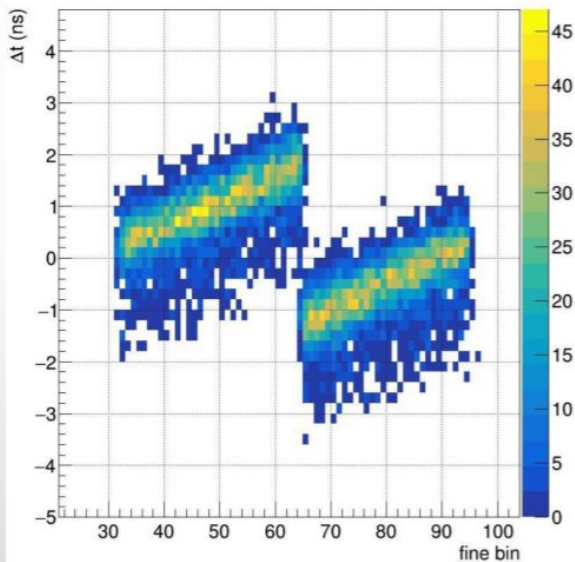
07-03-2023

Giulio Dellacasa – Fabio Cossio



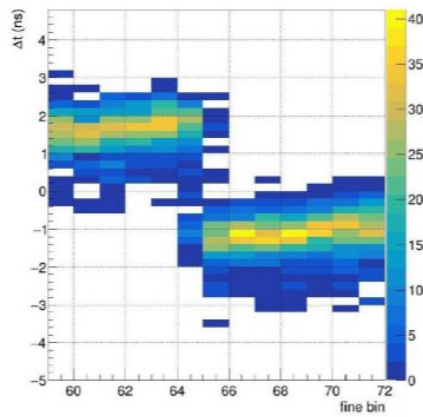
# TDC clock ambiguity

## ALCOR fine TDC measurement



observed ambiguity in ALCOR fine TDC measurement for same TDC bin (two peak structures)

there are worse cases than this, need to look into this together and replicated in lab



Roberto's slides

# TDC clock ambiguity: solution

- The Coarse Counter is latched on the fast ramp signal
- Fast ramp signal: rising edge asynchronous – falling edge synchronous
- Source code digitally simulated with a scan of Test Pulse phase
- Reconstructed time after simulations is now correct



it will be corrected in  
ALCOR-v3

# Works in progress: 400 MHz

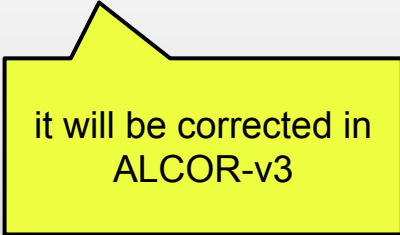
- New firmware with clock frequency 390 MHz: done
- Data transmission at 390 MHz x2 (DDR mode) seems to be correct
- CRC checks: ongoing
- TDC behaviour: some effects to understand in few pixels/TDC
- In any case a new implementation of the serializers is required to have a clean STA

few checks still to be completed, but positive outlook

EIC clock 98.52 MHz → candidate clock for ALCOR: 295.56 MHz (or **394.08 MHz**)

# Works in progress: TOT

- TOT «Orphans effect» reproduced in simulation
  - Due to a bad implementation of the Fake Trigger function
  - Always occurs with the Coarse Counter rollover
  - Always on TDC1 and TDC3 (TOT falling edge)
  - Works in progress to change this part of the code
- TOT mixed events (rising and falling edge are not consecutive in data stream)
  - A different readout mechanism should be implemented for the TOT readout



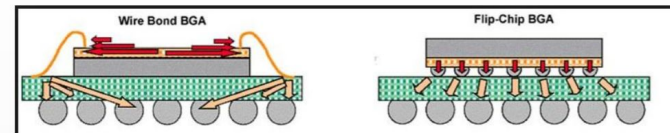
it will be corrected in  
ALCOR-v3

# Packaging: Europractice

- Europractice service does not provide BGA packaging
- Standard packaging is cheap but not suitable for a good implementation of the 64 channels ASIC
- BGA packaging could be done through Europractice as Customized Packaging with one of their partner or outside the Europractice IC Service

<https://europractice-ic.com/services/packaging/asic-packaging/>

## Flip chip or wire bond to BGA



- BGA: Higher costs, best implementation
- A totally new layout for both solutions (BGA vs standard)

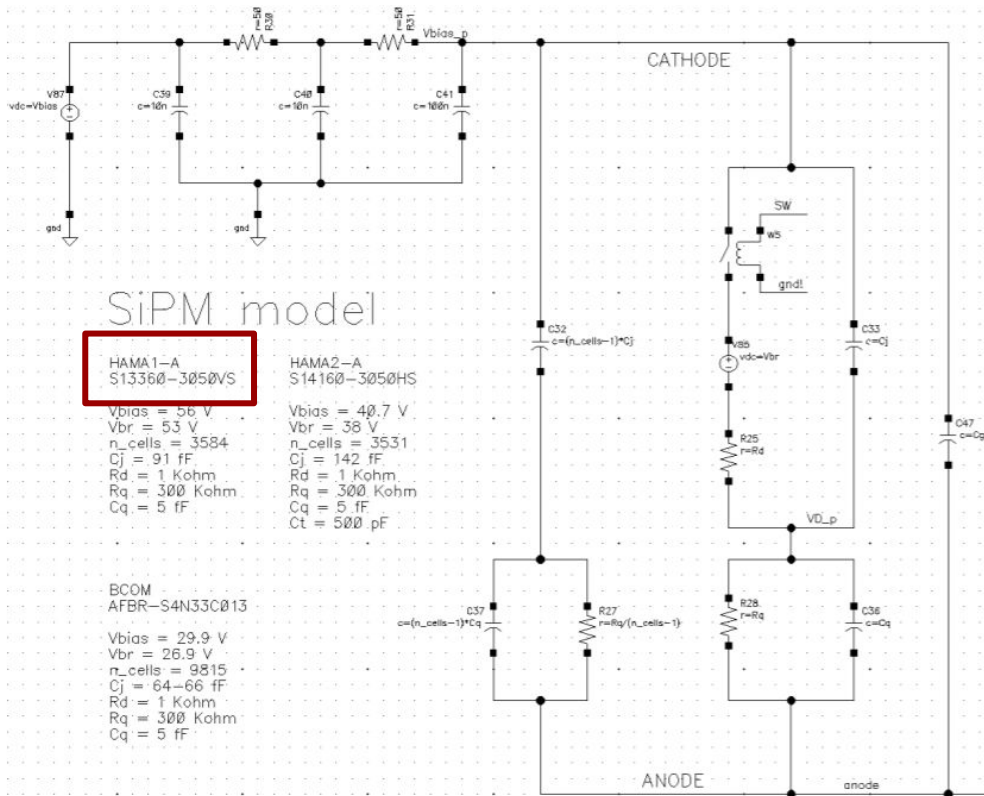


# Timelines

- **ALCOR-v2 is coming this year**
- **possible plan to have packaging and ALCOR-v3 in 2024**
  - might be close to final ALCOR version
  - need to make sure that front-end is “well tuned” on the sensor
  - R&D with FBK is approved, there will be new sensors in 2024
  - what if we eventually decide we are happy with FBK sensors and need to adapt front-end?
- **engineering run, when?**
  - ideas to have it in 2025
  - I personally think this has to be thoroughly discussed
  - see above, chip front-end and matching with sensor

**There is urgency to define timelines, we need to stage discussions and reach the point where we can make decision-making**

SiPM model



# SiPM model

HAMA1-A  
S13360-3050VS

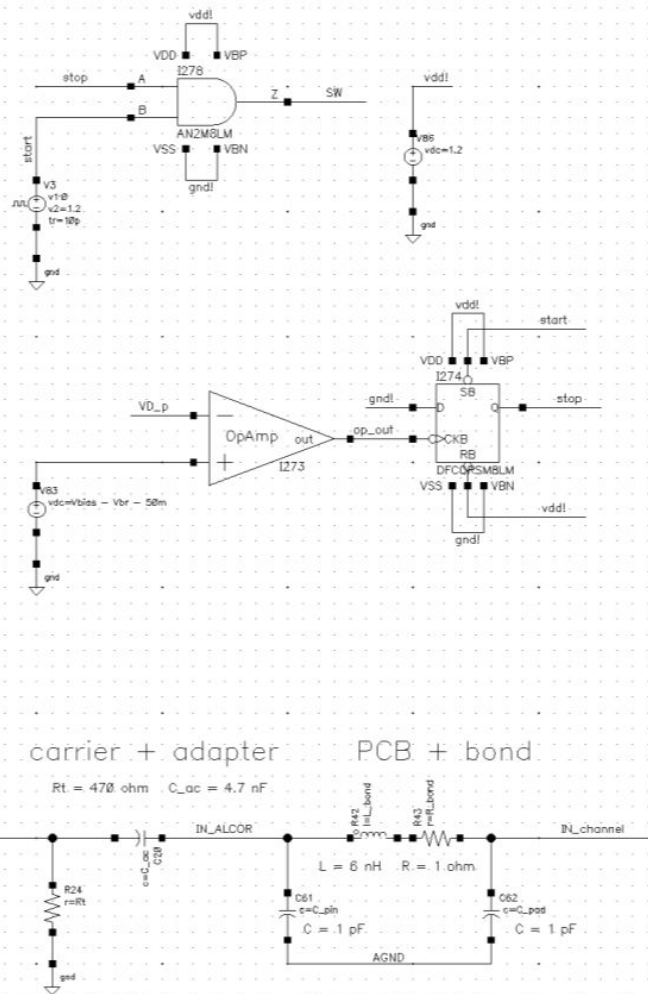
Vbias = 56 V  
Vbr = 53 V  
n\_cells = 3584  
Cj = 91 fF  
Rd = 1 Kohm  
Rq = 300 Kohm  
Cq = 5 fF

HAMA2-A  
S14160-3050HS

Vbias = 40.7 V  
Vbr = 38 V  
n\_cells = 3531  
Cj = 142 fF  
Rd = 1 Kohm  
Rq = 300 Kohm  
Cq = 5 fF  
Ct = 500 pF

BCOM  
AFBR-S4N33C013

Vbias = 29.9 V  
Vbr = 26.9 V  
n\_cells = 9815  
Cj = 64-66 fF  
Rd = 1 Kohm  
Rq = 300 Kohm  
Cq = 5 fF



carrier + adapter

PCB + bond

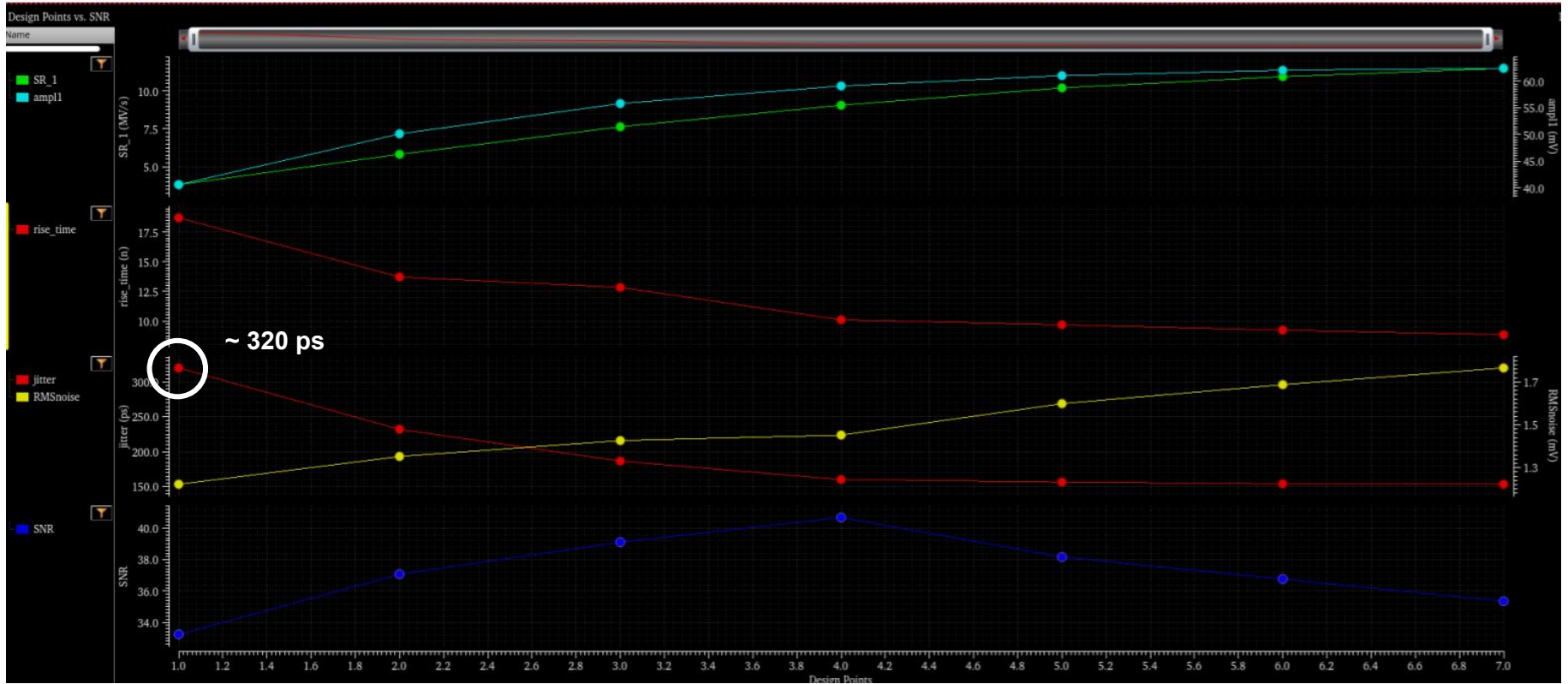
Rt = 470 ohm C\_ac = 4.7 nF

L = 6 nH R = 1 ohm

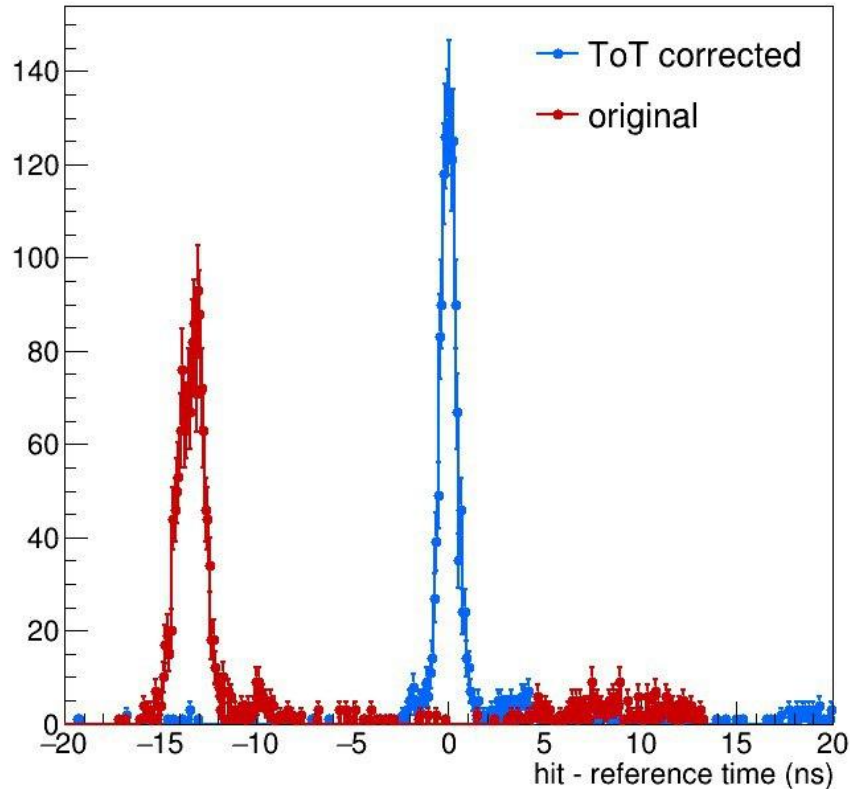
C61 c=C\_ph C = 1 pF

C62 c=C\_pos C = 1 pF

# Common gate scan (0-30)



# ALCOR ToT



ToT feature of ALCOR used for the first time by us in 2022 beam test

ToT is important for improving time resolution we are far from a measurement of it from the beam test, but we have a best result

which is  $\sim 350$  ps for HPK 13360 sensors larger than what I hoped at lowish overvoltage (3 V)

is this close to the limit we can achieve with ALCOR coupled with these SiPM sensors?

if not, we need to understand where in the electronics chain we need to improve for better timing