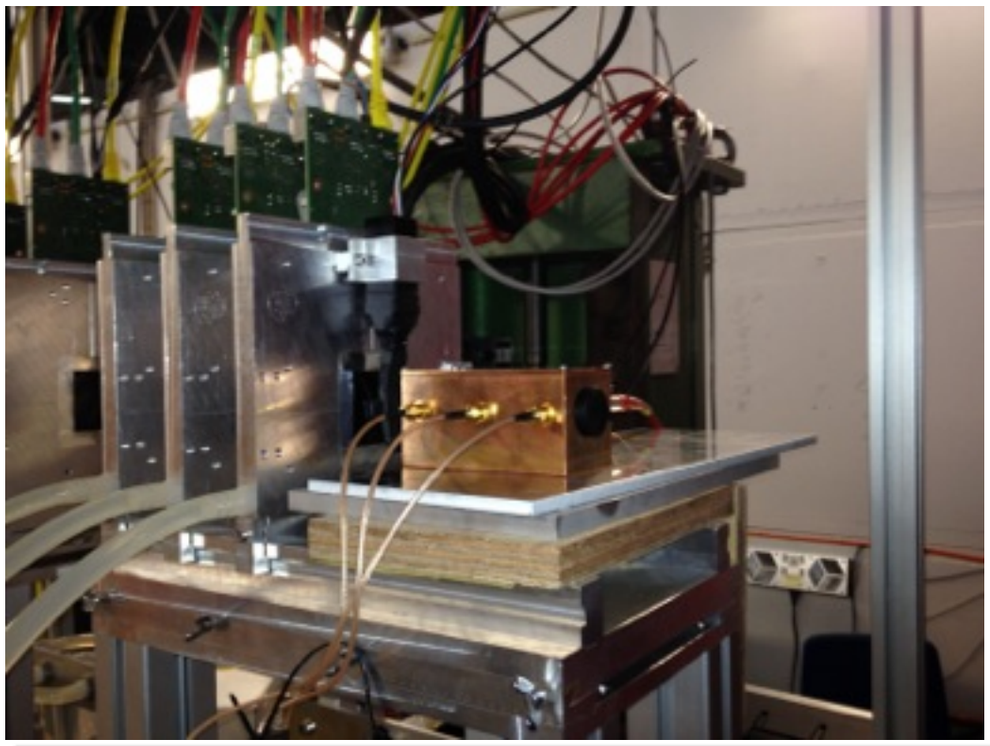
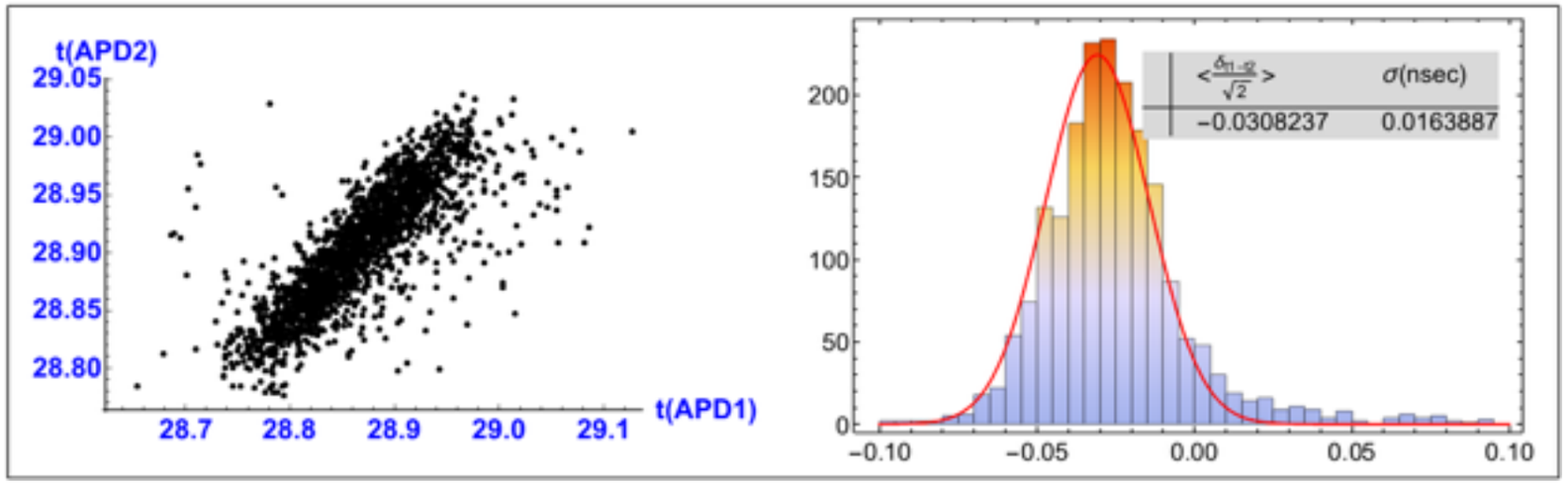
New Results on Micro Pattern Gas Det. Timing

CMS working group CERN, March 18, 2015

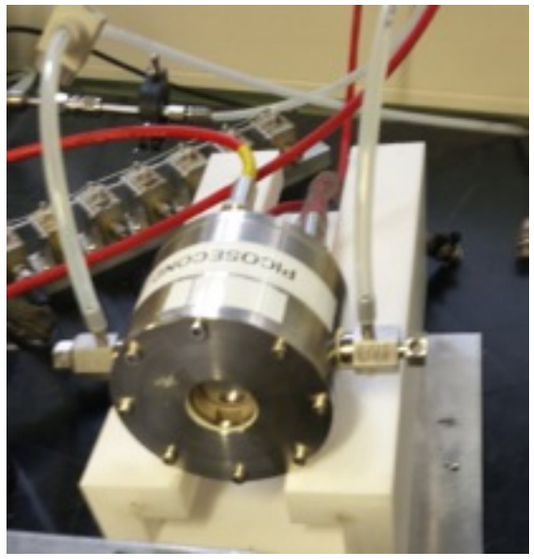
Sebastian White, Princeton University

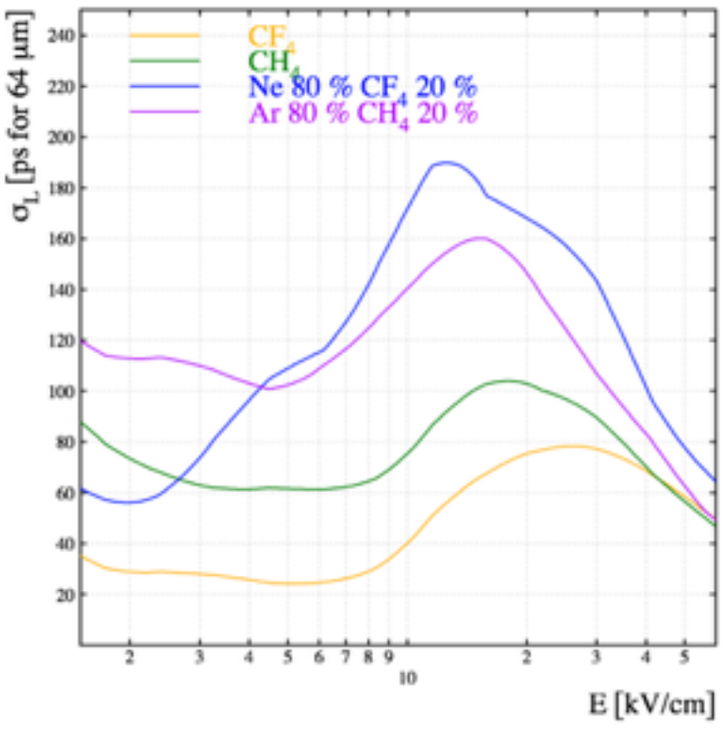
Si technology





MPGD technology





Collaborators:

- new tools for pileup mitigation based on timing: Started 2007 in FP420, 2010 DOE ADR&D and ATF AE55(McDonald and White,co-PIs), in 2014 USCMS&RD51

US-CMS Phasell R&D

Development of Precision Timing Pileup Mitigation Tools within the Context of a Dual Readout Calorimeter for CMS: *Proposal Submitted to US-CMS*

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Hamamatsu Photonics:

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DAQ techniques:

Eric Delagnes, Dominique Breton, Herve Grabas, Stefan Ritt, LRS/Teledyne, Roman Zuyeuski

RD51

Request for Project Funding from the RD51 Common Fund

- Date: *20-05-2014*

Title of project:	Fast Timing for High-Rate Environments: A Micromegas Solution
Contact persons:	*Sebastian White (co-PI),CERN/ Rockefeller* sebastian.white@cern.ch *Ioannis Giomataris (co-PI), Saclay* ioa@hep.saclay.cea.fr
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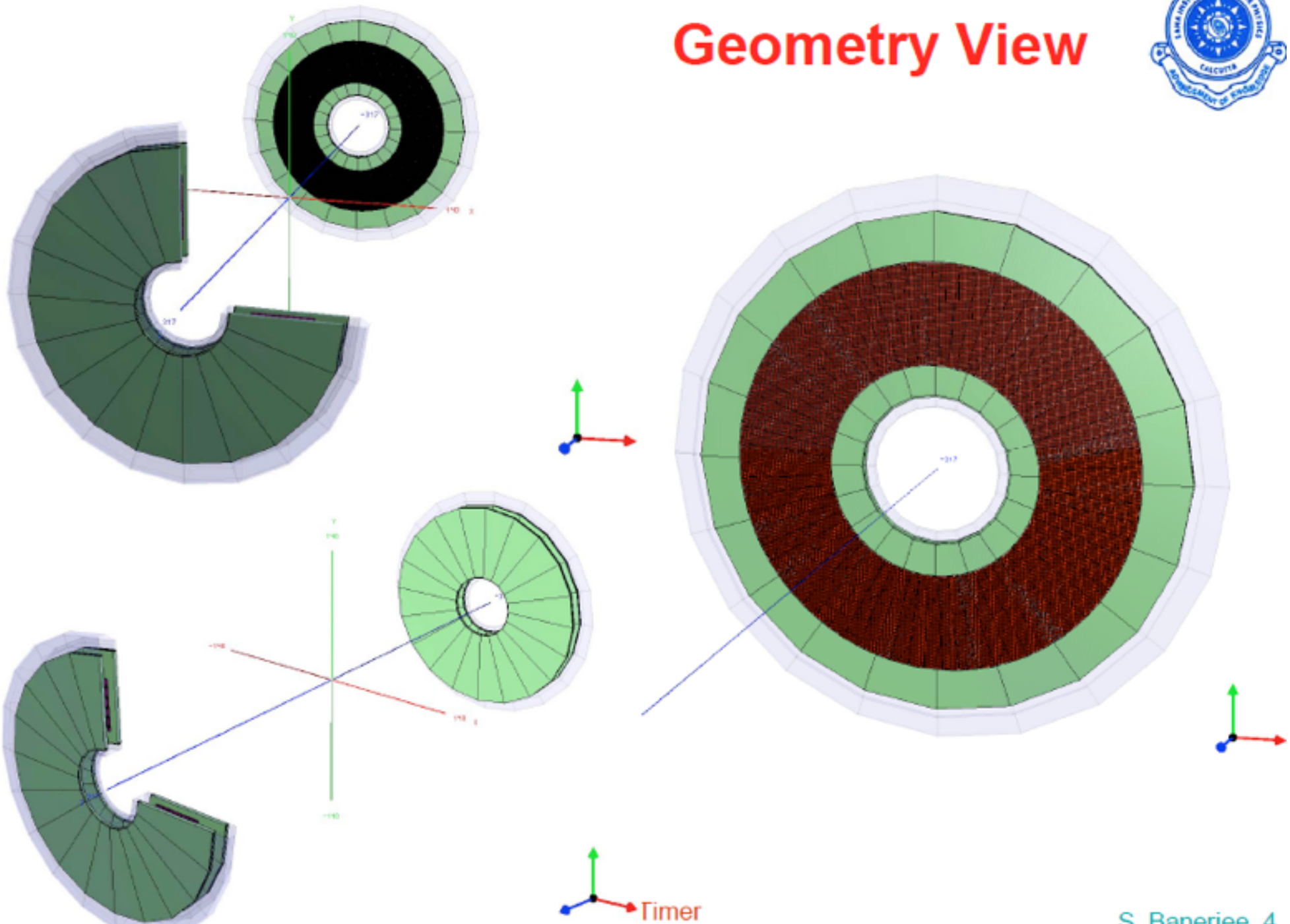
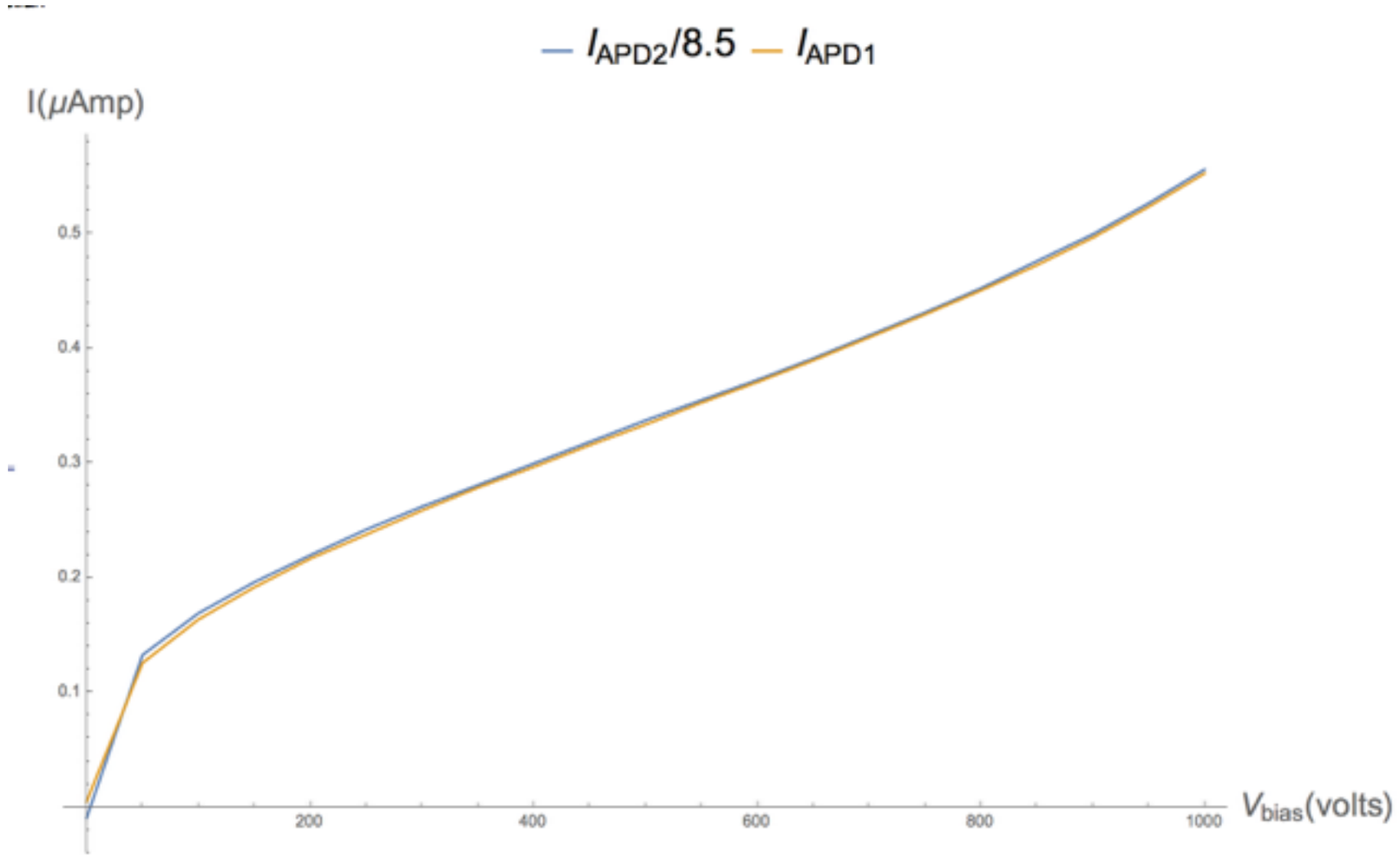
Our group has been developing a dedicated fast timing solution with Si or MPGD options for end cap



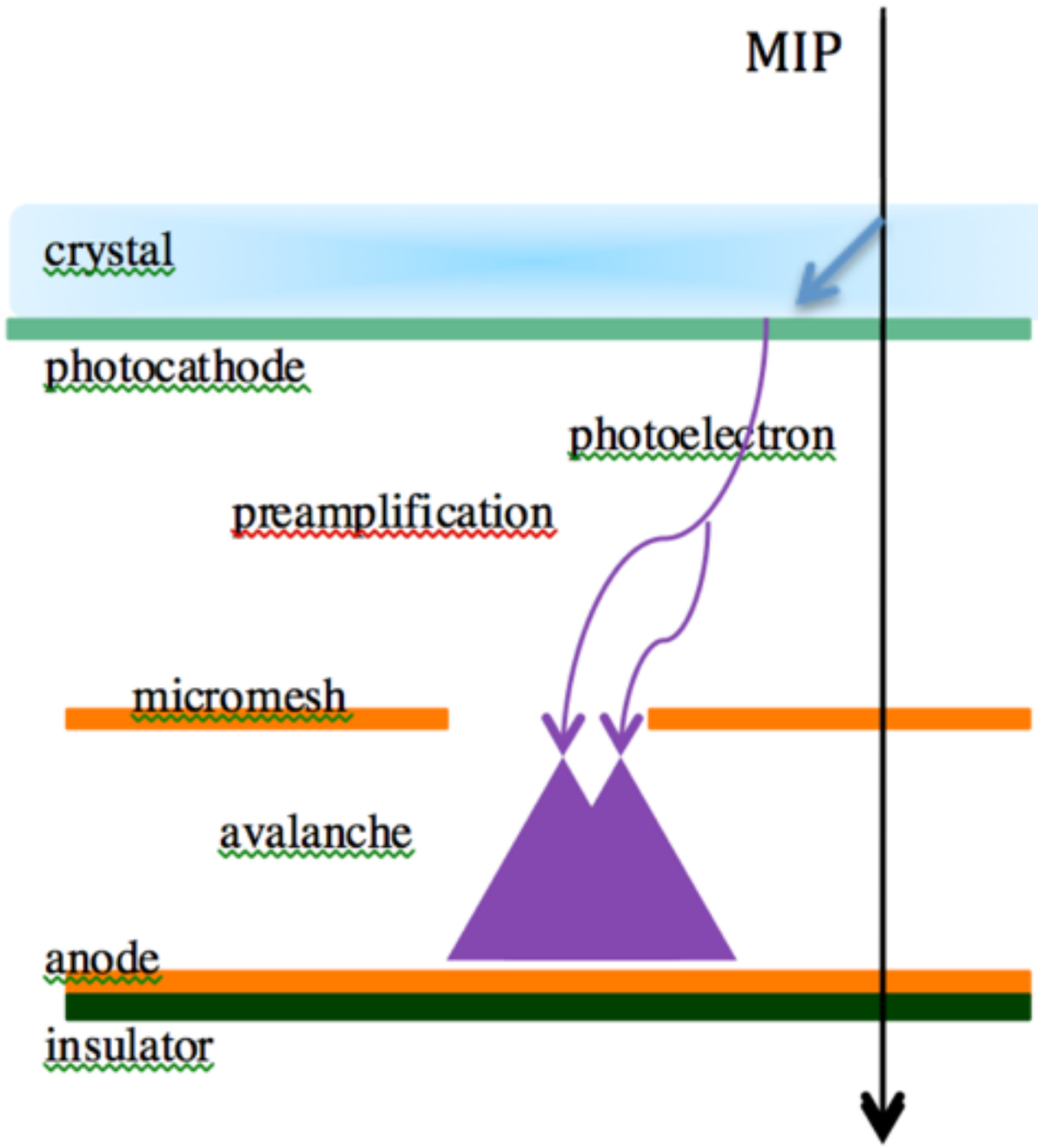
- there have been many CMS presentations by us to FC task force and also to Philippe's meetings
- main focus has been on Si based charged particle timing. Performance-> 16 pico sec rms at 1 MIP equivalent.
- Also electronics/readout development.
- Also work on realistic fab.
- now joined CERN RD50 group-> extend Rad. dam testing and focus on better modeling.
- As hedge against cost and rad hard limitations started 1 year ago on MPGD R&D (based both CERN and Saclay).

recent progress on Si rad dam issues

- big jump in exposure to ~10^14 protons
- perfect scaling of I w. exposure
- no evidence for gain degradation
- updating CERN RD50 capability for higher bias



Progress on MPGD timing



We have been constructing 2 devices to demonstrate the concept:

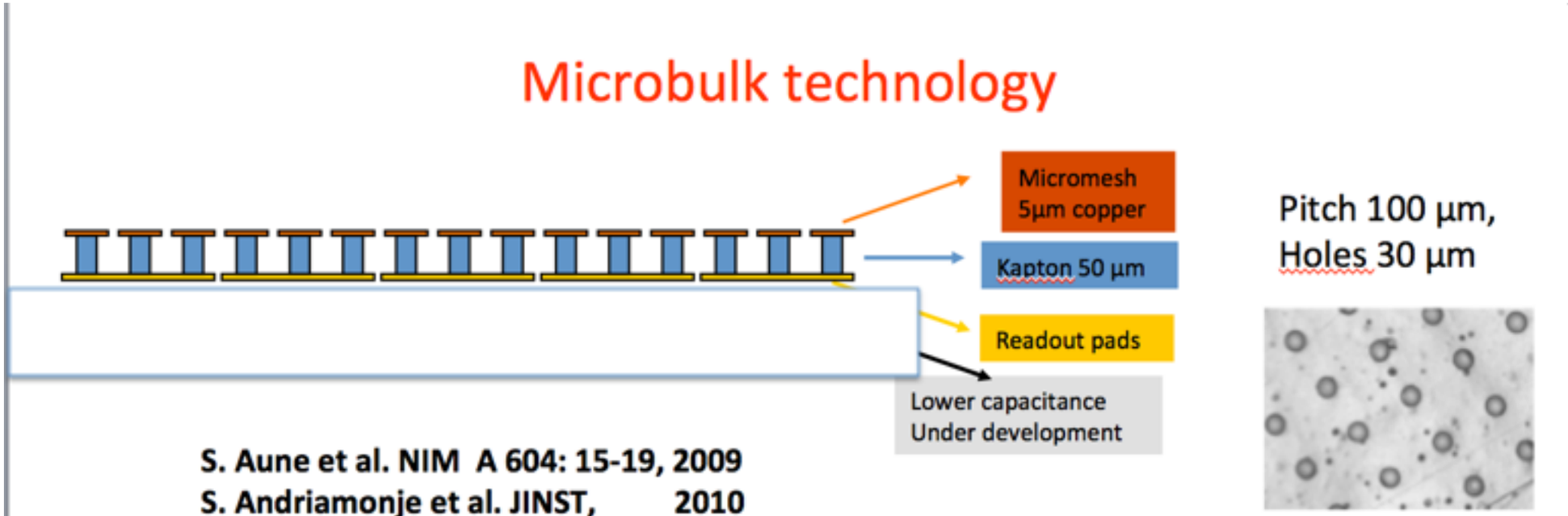
One at CERN, nearing completion.

One at Saclay recently completed and tested with flash lamp

Week of March 9th-> 1st exposure at Saclay Laser-matter Interaction Facility

Group photo

This initial test used Microbulk technology for amplification structure.
Potential time jitter reduction with higher pitch.
Used Ne-Ethane (10%). CF4 nominally will yield lower jitter.
110 V in 200 micron “drift region” led to limited pre amplification gain.
440V across micro bulk in run shown below.
initial test with 10nm Al used as “pc” with very low (~10^-6) qe
n-photon ~ Cerenkov photon yield in final design



S. Aune et al. NIM A 604: 15-19, 2009
S. Andriamonje et al. JINST, 2010

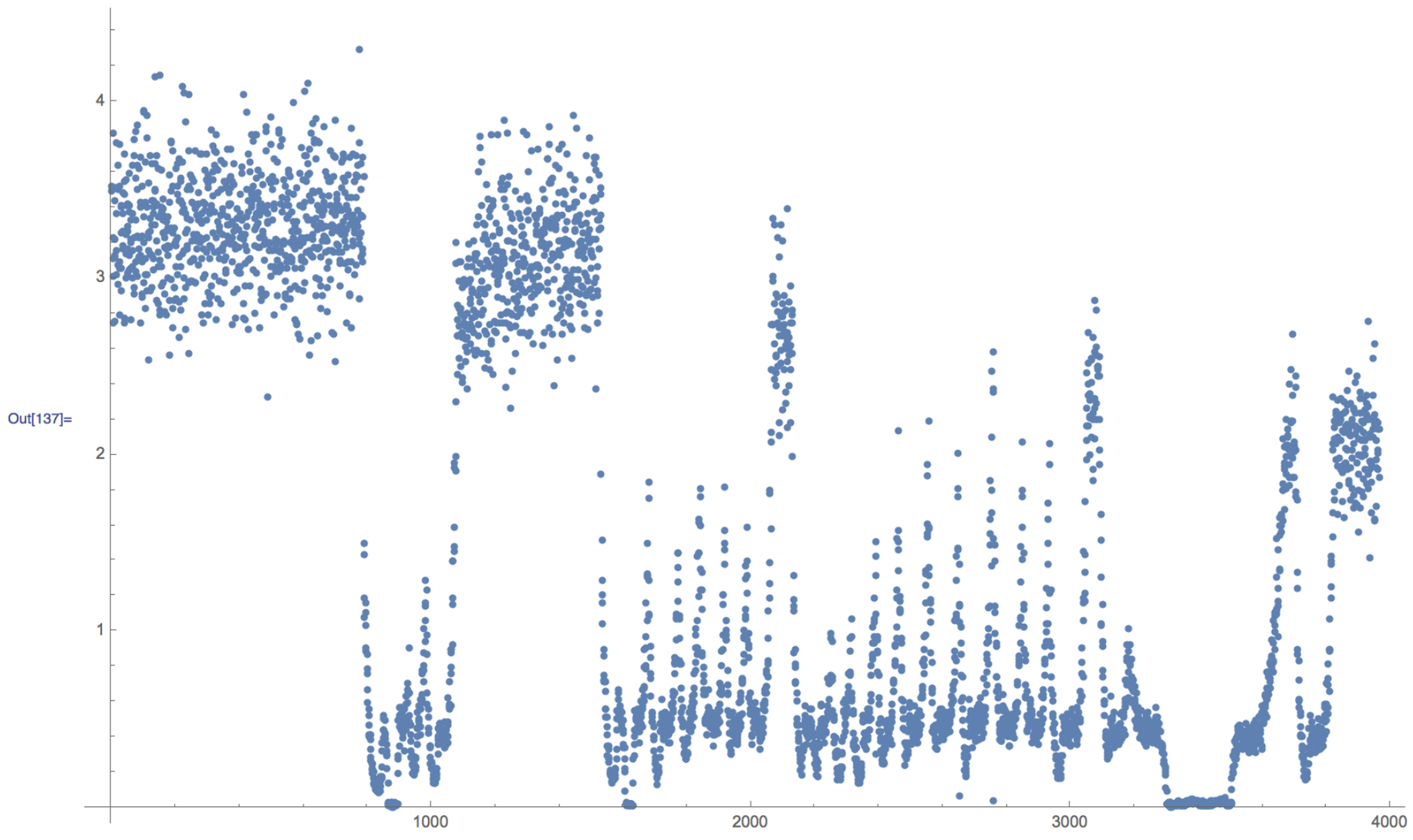
✓Energy resolution (<13% FWHM @ 6 keV)
✓Low intrinsic background & better particle recognition
✓Low mass detector
✓Very flexible structure

×Higher capacity
×Fabrication process still improving
×Fragility / mesh can not be replaced

amplitude vs. event no.

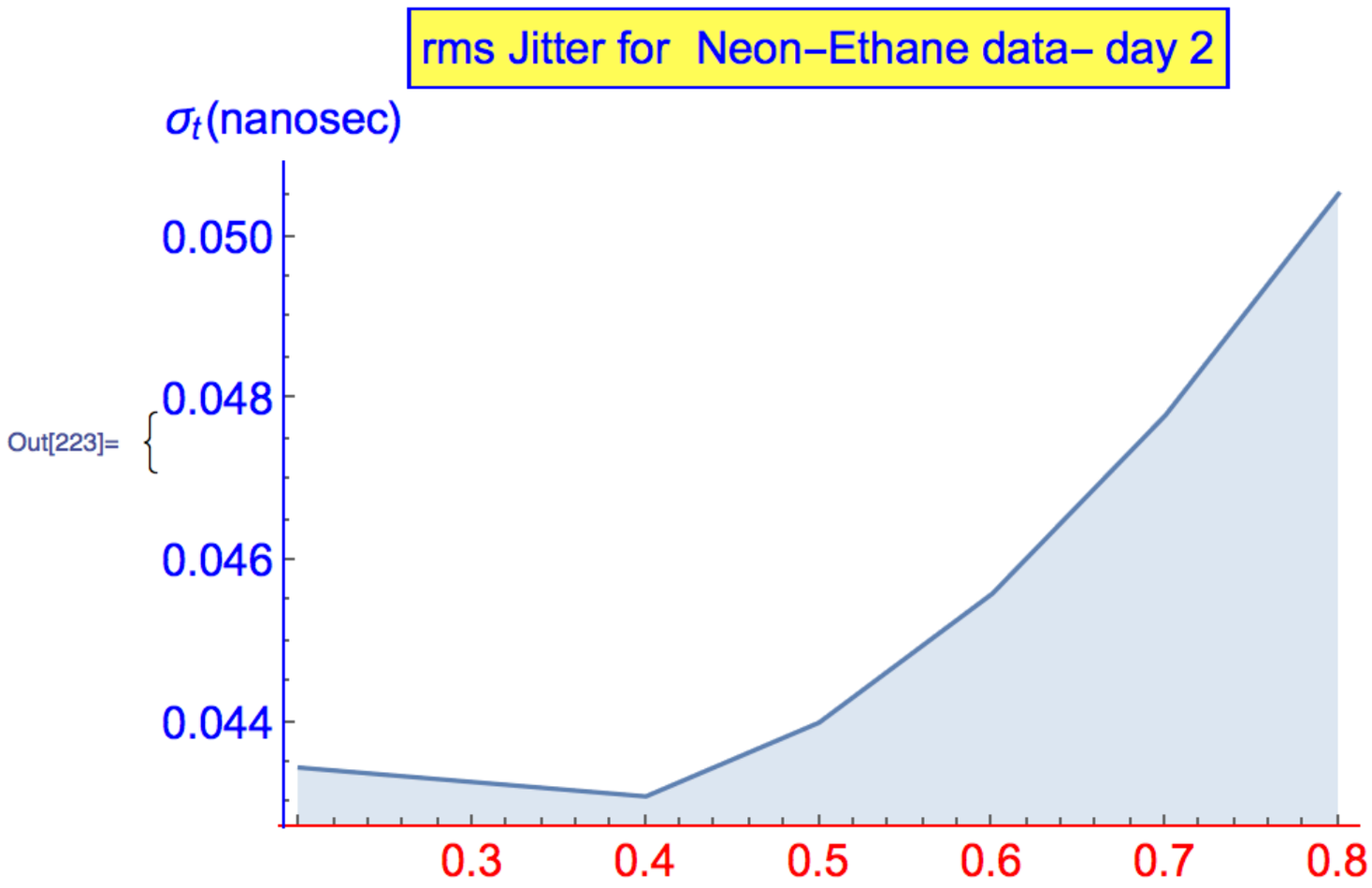
In[137]:= **ListPlot[pk1]**

Out[137]=



Some runs in this initial test had difficulty with sparking. Perhaps aggravated by high laser intensity/rep rate. We look at the first part of the above run.

jitter in 1st 750 events



Out[223]=

0.2	0.0434365
0.4	0.0430806
0.5	0.043993
0.6	0.0455856
0.7	0.0477906
0.8	0.0505277

=>Improved to 36 picosec after correcting for trigger jitter.

Conclusion

- we have been busy since taking these data last week
- much to do on systematically reviewing the full data set collected.
- preparing other tests and enhancements to design
- these data confirm the validity of our concept.
- much promise as a tool with lower cost and radiation damage sensitivity.
- leading to promising collaboration with the Saclay laser facility