Update on Pileup Mitigation though fast timing R&D

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Our group has been doing R&D on fast timing at high rates, as part of a generic program for HL-LHC and focused on CMS Phase II.

This could serve as input to CMS' Phase II strategy.

2 areas where timing may serve this function:

-timing limitations of calorimetry itself

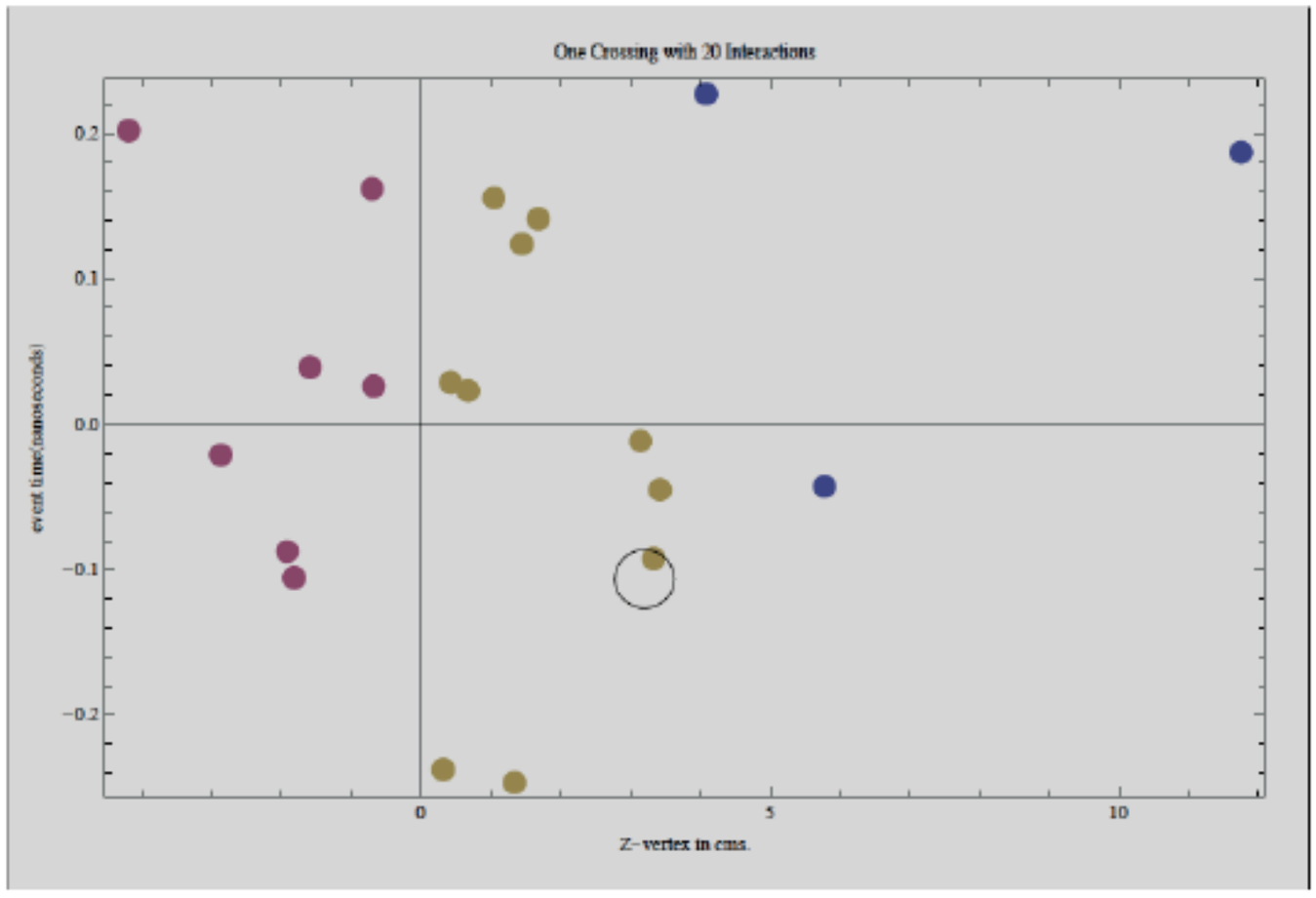
-new technologies for dedicated timing layer

Start from LHC simulation of bunch crossing

2007 paper:**"On the Correlation of Subevents in the ATLAS and CMS/Totem Experiments", S.White, http://arxiv.org/abs/0707.1500**

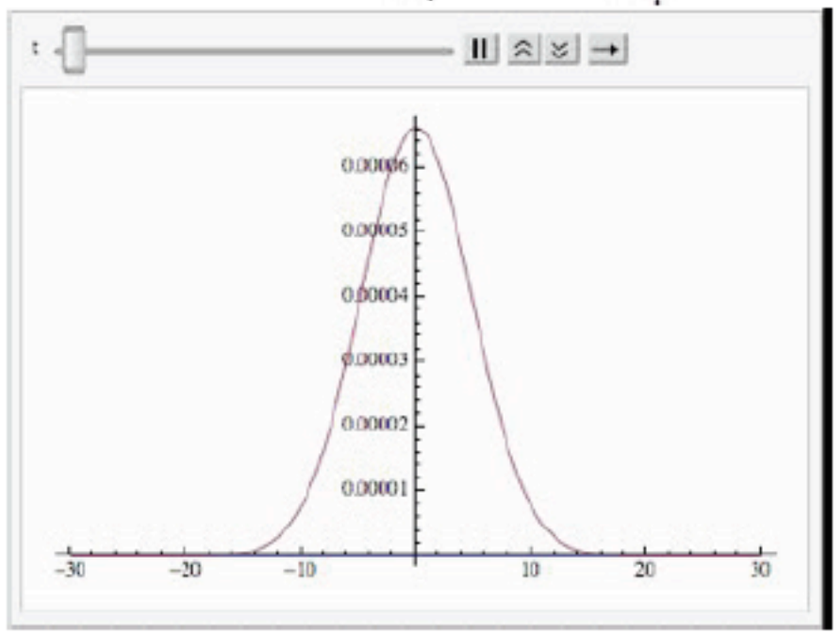
in this example: 20 events/crossing, plotted as vertex(x-axis) vs. event time.

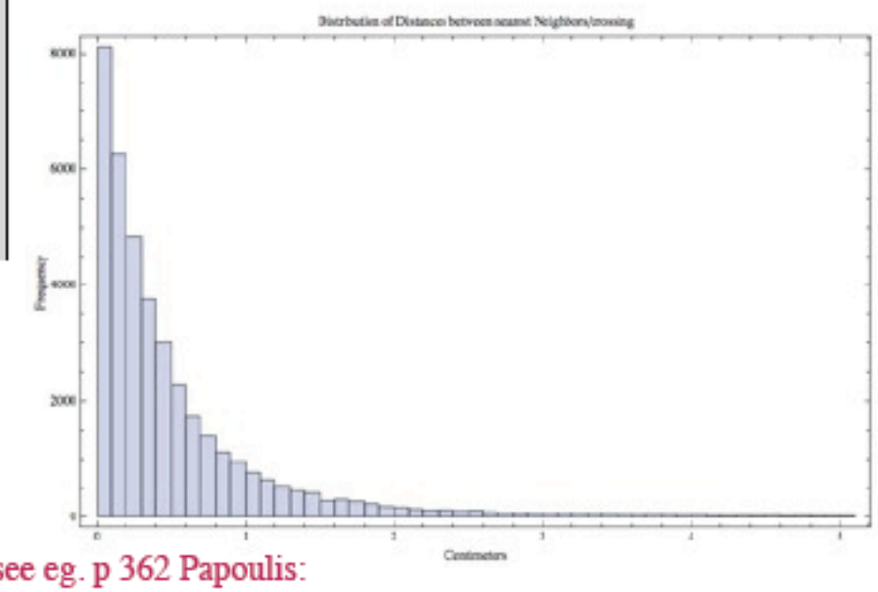
Nb: circled event needs both time and vertex to resolve.



vertex distribution time invariant

$$L(z,t)=l(z,t)*l(z,-t)=\frac{e^{-\frac{(-c\,t+z)^2}{2\sigma_l^2}-\frac{(c\,t+z)^2}{2\sigma_l^2}}}{2\pi\sigma_l^2}=\frac{e^{-\frac{c^2t^2+z^2}{\sigma_l^2}}}{2\pi\sigma_l^2}=L(z)*L(t)$$



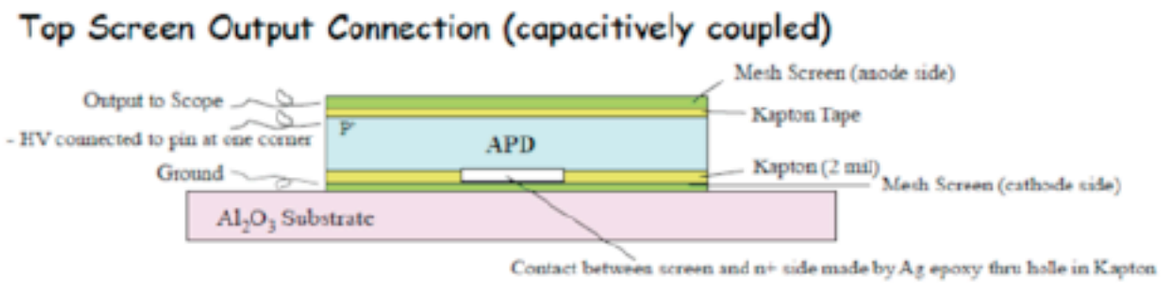


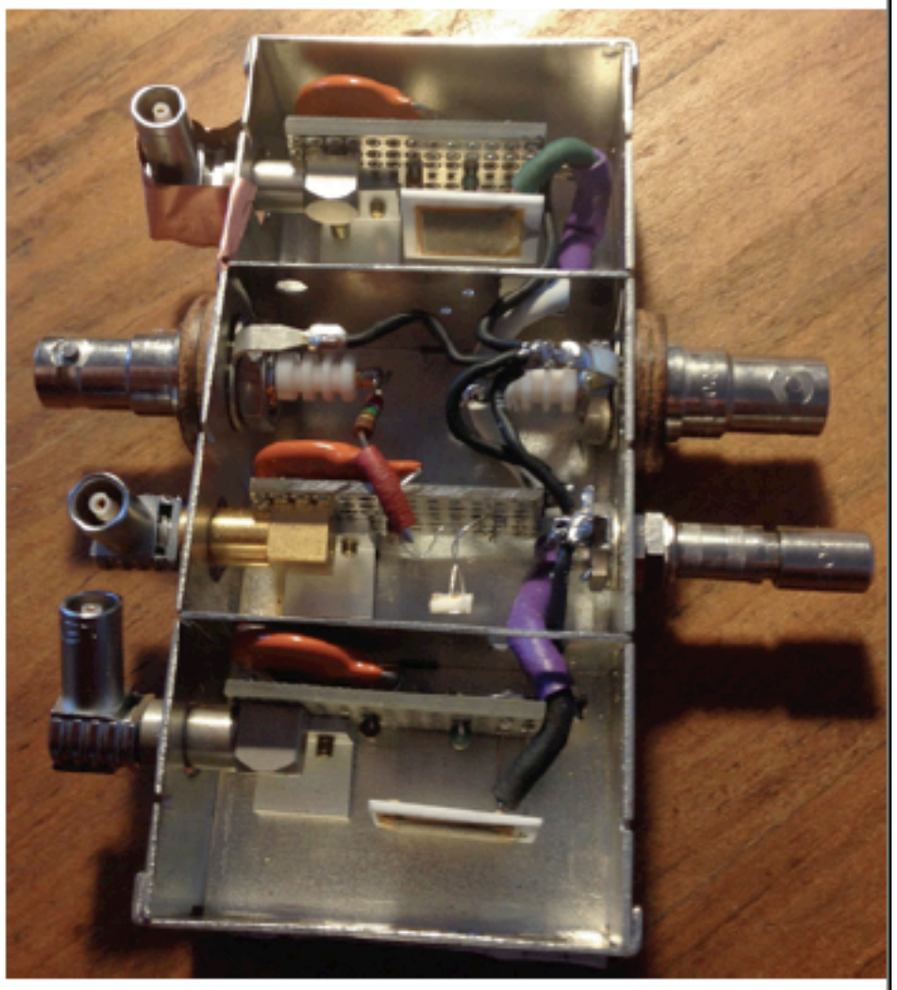
how effectively is PU resolved with n(or Jet) ideal time resolution of 10 picosec? Illustrated by error elipse

dist distribution exponential:see eg. p 362 Papoulis:
Probability, random variables and stochastic processes (1991 ed)

For past year activity mostly on a possible silicon technology. Rapid evolution over last year

Deep Depleted APD with MicroMegas mesh for field shaping





"telescope" for Jan-Feb 2013 beam test at SPS.=>
Since characterization with laser (intensity and wavelength to match MIP charge deposition) now shows good uniformity, initial run planned without need of external tracking device.

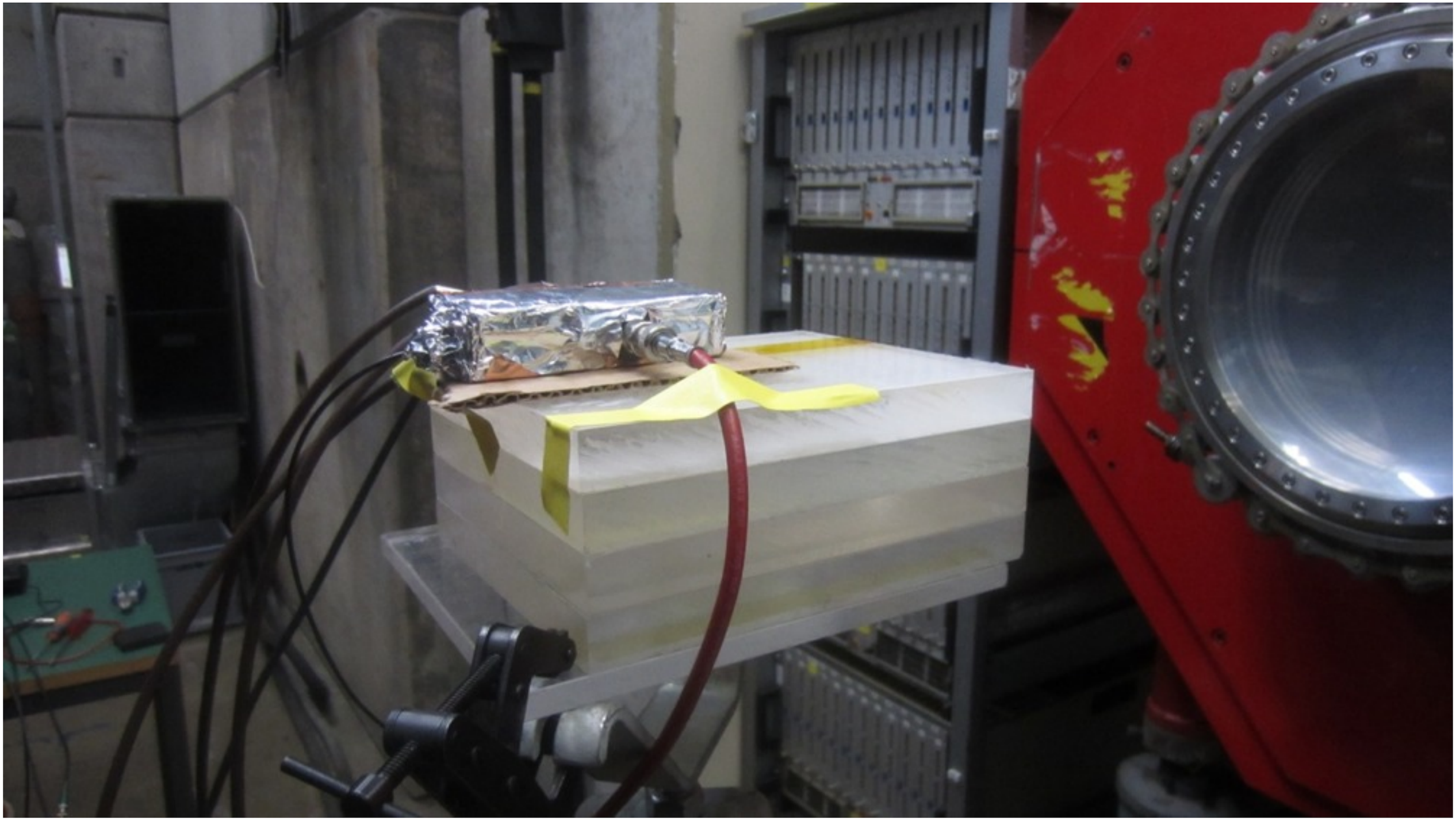
Rad hardness and lifetime:

Initial studies based on CMS APD scaling laws showed several years at 10^7 Hz/cm^2. (http://arxiv.org/abs/0901.2530)
In December 2012 completed initial rad damage tests at PS.
Results soon.

This telescope was being prepared during December '12 run with RD52 (Dual Readout Calorimetry run). New devices with Micromegas mesh not completed before end of run with DREAM.
In February '13 we took initial low statistics data behind the calorimeter of NA61.
PSI beam became available at end of May and, after initial installation (with help from Vladimir Rekovic), our equipment is, more or less, permanently in place a PSI for a series of parasitic runs through the summer.
First opportunity came June 2, running in front of CMS diamond detector group (Hidas et al.).
This initial run, of ~10^5 MIPS (+250 MeV/c pion, muon, electron) has been very significant for us. Very clear signal amplitude vs. detector capacitance=>Voltage amp to be replaced with Transimpedence amp.
Will work also with experts on waveform digitizers in next run (ie Ritt). Generally PSI very supportive.

entrance to beam area

telescope in beam



developing TOF pid using phase relative to accelerator clock

In[30]:=
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 Epilog → Map[Point, Transpose[{time, v2 + .4}]]]
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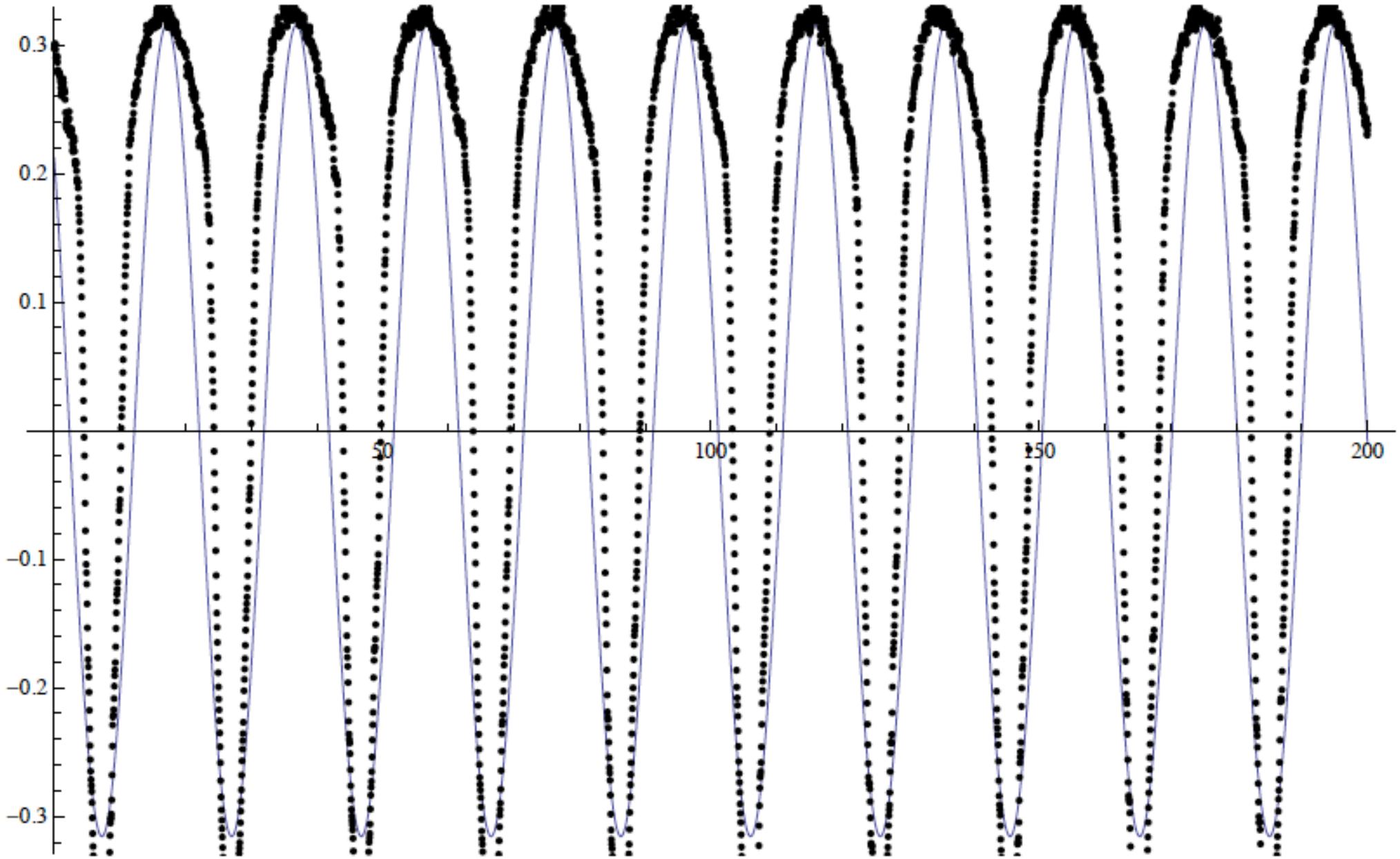
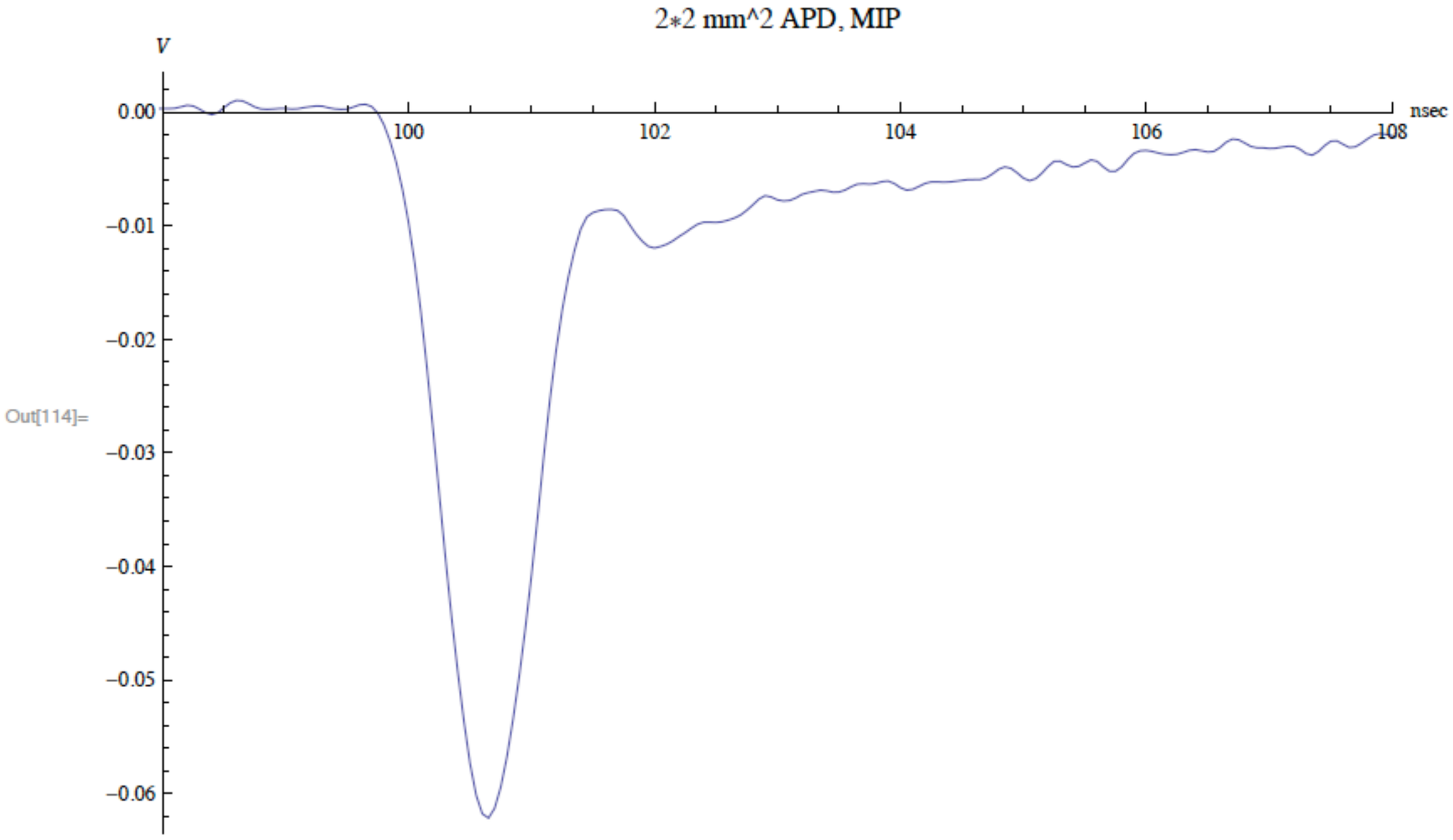
Out[30]=



Nice signal quality for lower capacitance APD in telescope



Out[114]=

Now clear that a better solution to electronics chain for next run