

Fermilab June 2022 LAPPD beam test second meeting

Alexander Kiselev (BNL)

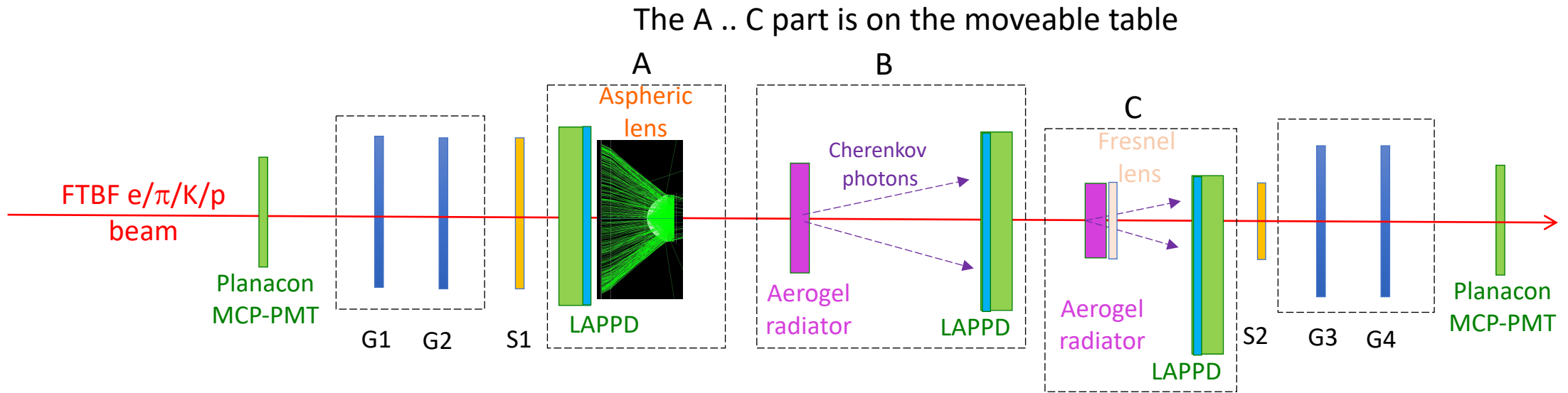
eRD110 meeting

May 19, 2022

Dates, participants, contacts

- Dates: June 13-26, 2022; day shift, main users
- Installation starts on Monday June 13th
 - Martin: June 11 (Sa) – 16 (Th)
 - Bob: coming on June 13th for the first week + for June 25-27
 - AK: June 11 – 28 (Tu)
 - Craig: second week
 - Junqi: will be present for two weeks (?)
 - Sanghwa & Alibordi: two weeks
 - Deb: two weeks, either at Fermilab or (24/7 😊) from Trieste
 - Mark Popecki (Incom): starting from June 14-15, for 7-10 days
 - Murad: ?
- Points of contact: Mandy (rominsky@fnal.gov) and Evan (edniner@fnal.gov)
 - ALL: fill the google doc form & arrange your travel NOW
- https://docs.google.com/spreadsheets/d/1MpT8MzPG02ae0jojpN0lcxNROjUcGsUL_oZKnAulRNI/edit - gid=0

Experimental setup in MT6.2C



- G1 .. G4 – COMPASS GEM reference tracker
- S1 .. S2 – trigger scintillator counters
- Either mRICH or pRICH configurations require
 - Replacing aspheric lens by aerogel container (and a Fresnel lens in case of mRICH)
 - a 180-degree rotation of the LAPPD / HRPPD assembly

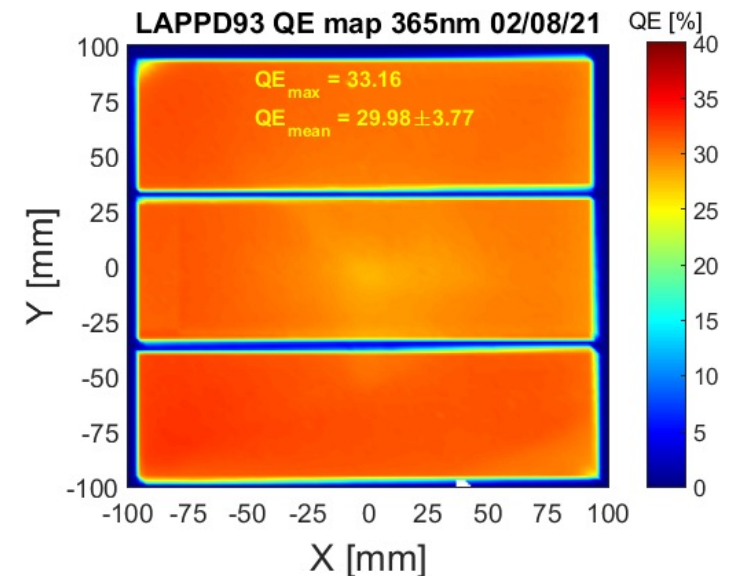
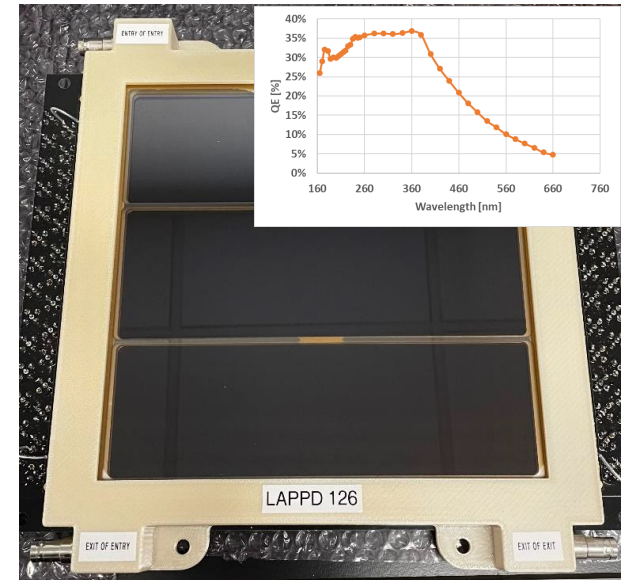
Incom tiles

- 20cm Gen II LAPPD will be rented for May-August on eRD110 budget
 - New spacer configuration ☹️
 - 10 μm pore MCPs
 - Hopefully: 2 mm thin ceramic base plate and short ceramic walls
 - Na_2KSb photocathode
 - Window material -> UV grade quartz (see Sanghwa's slides)

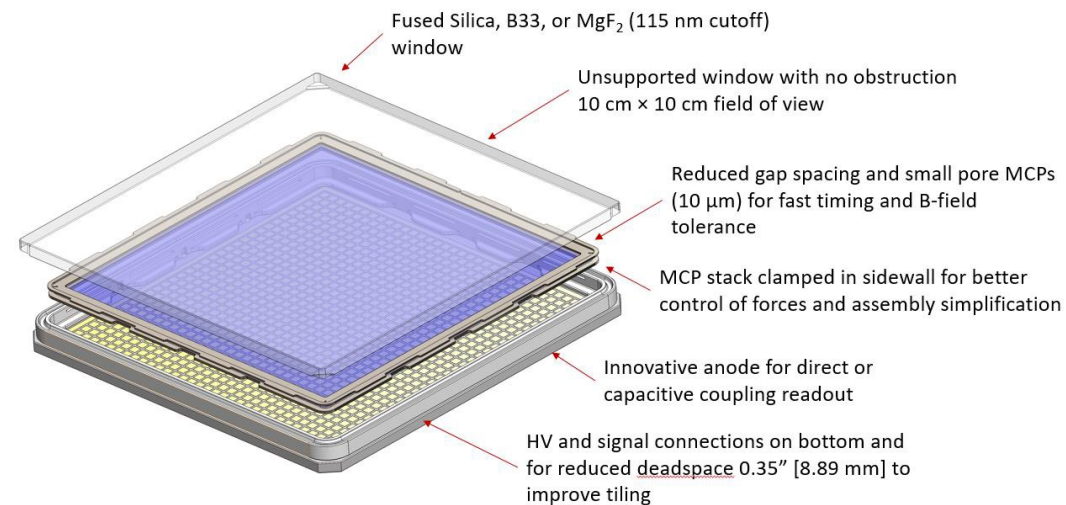
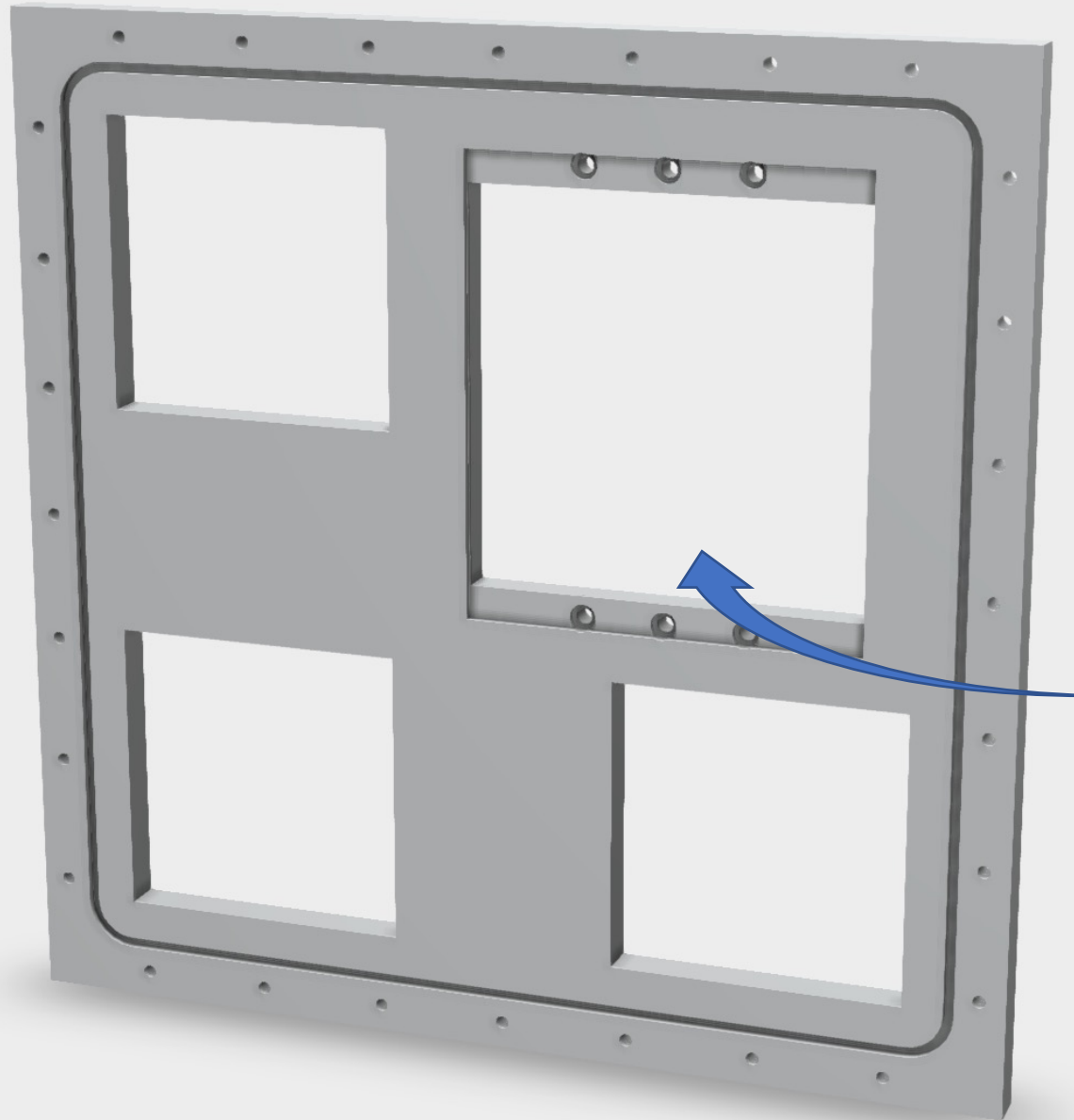
→ Being sealed now; expected at BNL by the end of May

- 10cm Gen II HRPPD of a similar build
 - Chances are high it is sealed and passes the QA at Incom by mid June

→ If this happens, Mark will bring the tile in his suitcase

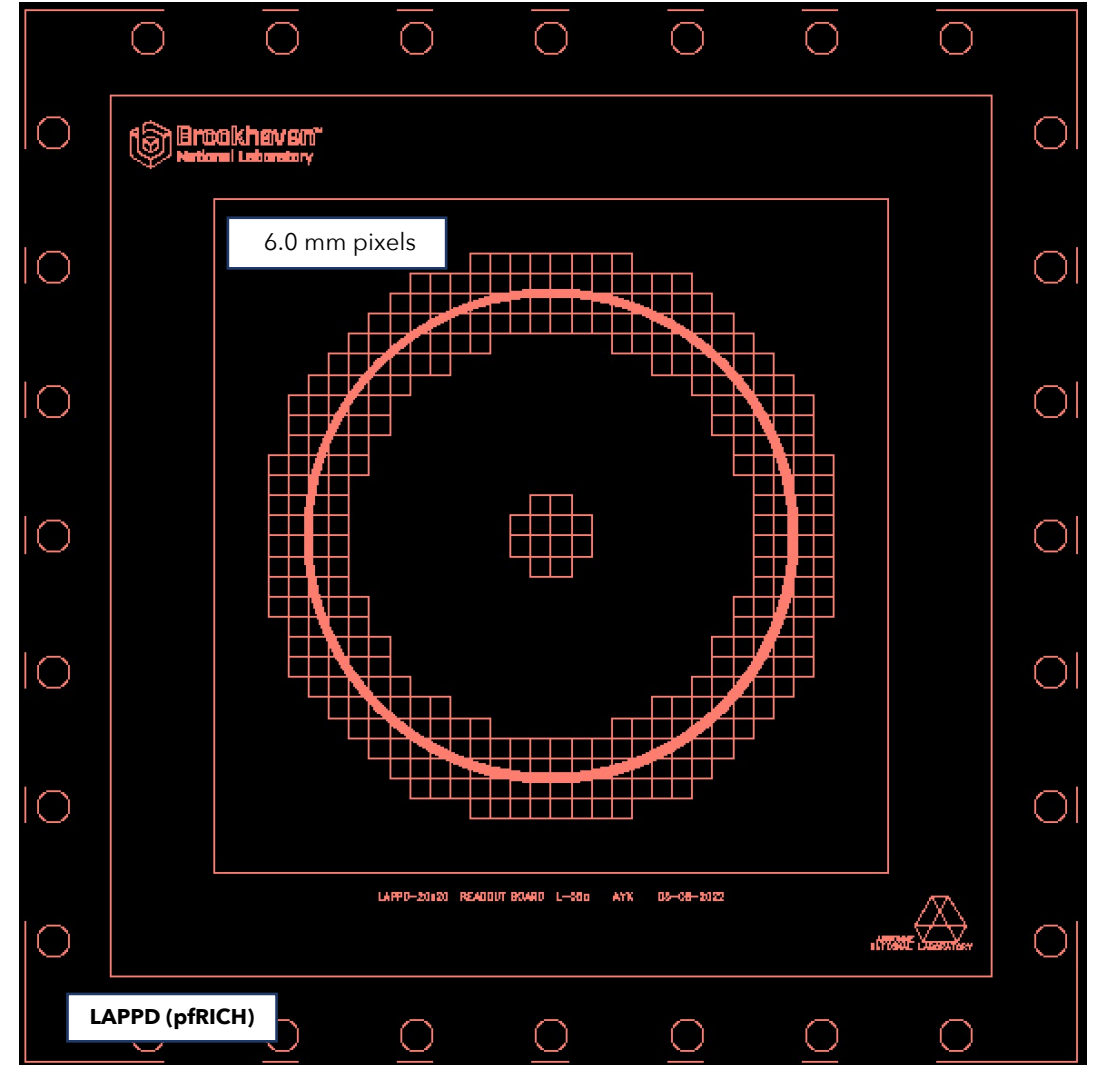
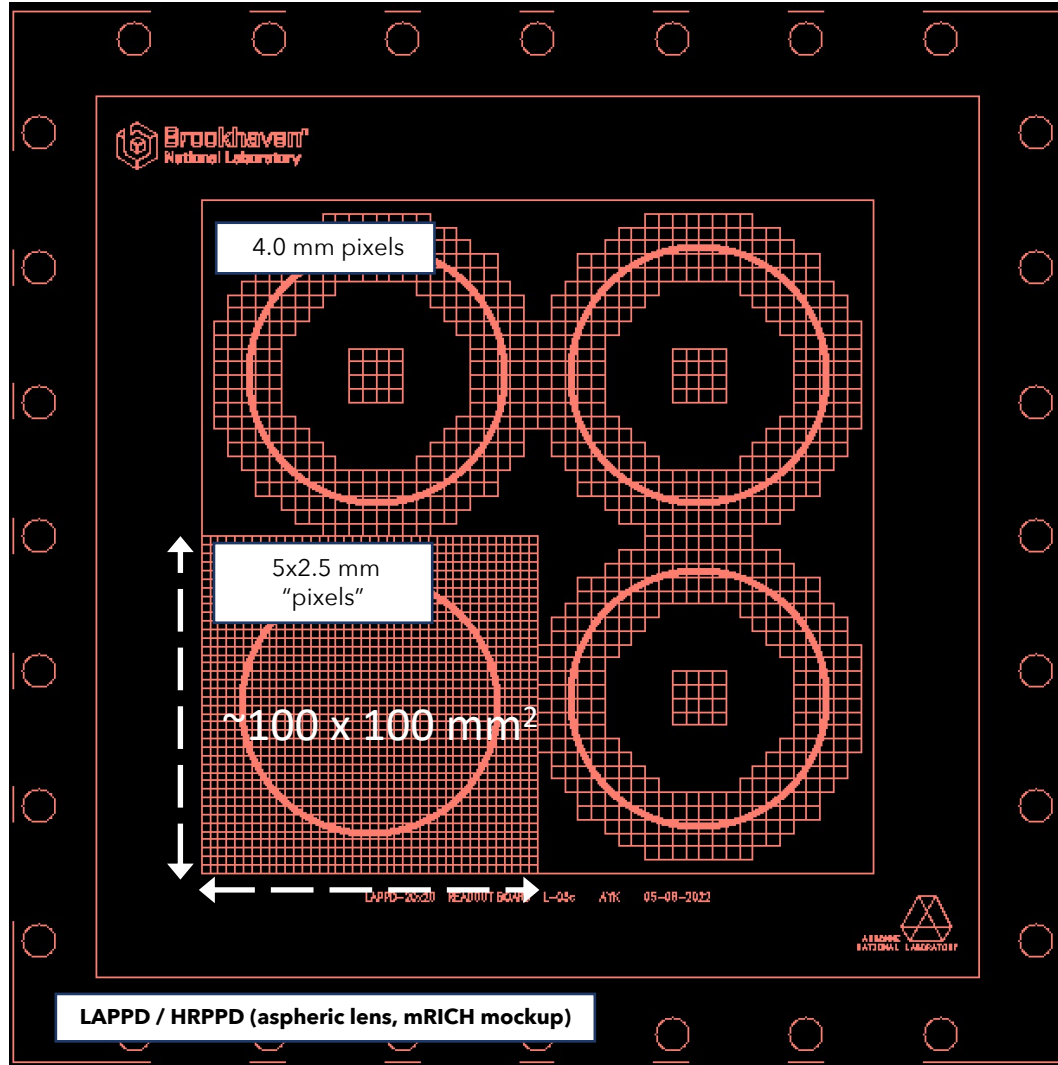


HRPPD holding structure



- Design is trivial & is pretty much finished
- Need to agree on the HV connection scheme
- To be 3D printed at BNL by the end of May ...
- ... together with the other parts for a 2-d assembly

Readout boards



Bare boards: ordered, will be shipped to BNL around May 25
Assembly (+ additional pair of MCX adapters): order is being placed

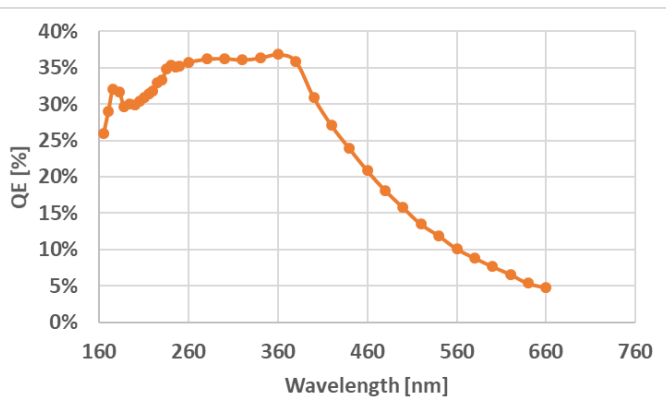
Other equipment

- First Planacon (Argonne) – available
- Second Planacon (INFN) – will be at BNL June 2^d (may require some work)
- GEM tracker – still in boxes after the June 2021 beam test
- Aerogel with $n \sim 1.030$ and mRICH mockups – shipped from GSU last week

- DRS4 electronics (including a separate box for the beam line Cherenkov counters), VME crate, readout PC, trigger scintillators, NIM logic, light tight enclosure, aspheric lens(es), still useable 2020-2021 readout boards – all available
- A “spare” DREAM readout card from Saclay arrived this week
- Gas for the GEM tracker is being ordered
- CAEN V1742 cross-module synchronization cables – ordered, will be at BNL by end of May
- Trigger module (or other related hardware) – will be provided

The case for a second Planacon

- It is always good to have some redundancy in the system ...
- ... but it can also happen that the LAPPD / HRPPD timing resolution will be way *better* than of the reference Planacon, in our configuration:
 - Given the QE plot below, a relativistic charged particle will nominally (if PDE was equal 1) produce a ~1cm diameter blob of ~150 p.e.'s in a 5mm thick UV grade quartz window [see also Sanghwa's talk today]
 - We know that a single p.e. signal in a central 4mm pad of a cluster has MPV amplitude of ~10-15mV ...
 - ... so, we will be seeing signals >500mV, without any pre-amplification
 - V1742 DRS4 implementation by CAEN has only 500 MHz bandwidth (+ traces and cables add a lot, see below)
 - A couple of mV noise level per sample and rise time ~1ns (or so) is what we see in the data
 - Therefore, a “theoretical” limit for us is perhaps ~333 MHz bandwidth, closer to case (b) than case (a) in the below table, just given the expected S/N ratio, see <https://arxiv.org/ftp/arxiv/papers/1405/1405.4975.pdf>



$$\Delta t = \frac{\Delta u}{U} \cdot \frac{\sqrt{t_r}}{\sqrt{f_s}} = \frac{\Delta u}{U} \cdot \frac{1}{\sqrt{3f_s f_{3dB}}} \quad (4)$$

Case	U (mV)	Δu (mV)	t _r (ns)	f _{3dB} (MHz)	f _s (GSPS)	Δt (ps)
a)	10	1	1	333	5	45
b)	450	1	1	333	5	1
c)	100	1	0.35	950	5	2.6
d)	500	0.35	1.6	-	5	0.5
e)	63	0.35	0.2	-	5	1.1

Table 1: Theoretical limit of the achievable time resolution Δt for certain signal and sampling parameters.

- Complementary information on signal losses:
 - 6' long RG-174 cable: ~1.8 dB @ 1 GHz
 - Traces in the PCB stack are several inches long, with an estimated loss ~0.25 dB/inch @ 1 GHz

Software

- DREAM driver debugging – June
- DRS4 timing calibration database – should be ready (software-wise) by end of May
- Online monitoring and near online data analysis – time to start revamping the codes