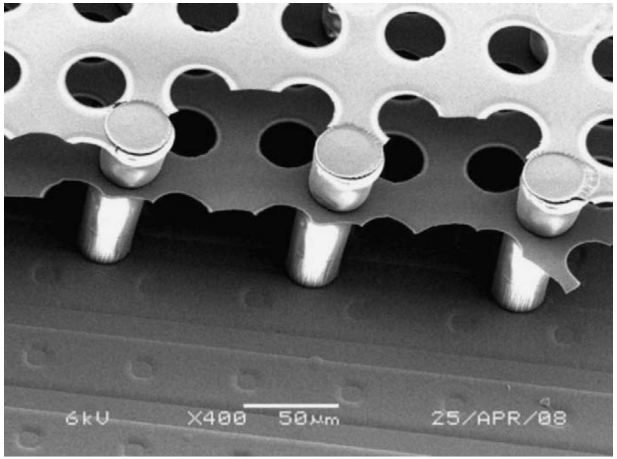
FIMS meeting

23 Sept 2024

Peter Lewis



Kickoff

“FIMS”

I needed an acronym and ended up with “**F**lexible, **I**deal **M**PGD **S**ystem”

I hate it too but that’s what it’s called now

Overview of objectives

Two parallel paths:

MPGD development

Readout development

The funding is for **four years** and these two paths could take up to three of those (experimental validation comes next).

partnership between PI Lewis at UH and Sorensen and Grace at Berkeley Lab to develop FIMS: a Flexible, Ideal MPGD System. An *ideal* detector has performance that is limited by the physics of ionization and charge transport rather than detection technology, with the following **criteria**:

1. Detection of individual charges with efficiency of 0.95 or better.
2. Three-dimensional spatial resolution of less than 20 microns.
3. Ion backflow below 0.5 ions per primary electron.

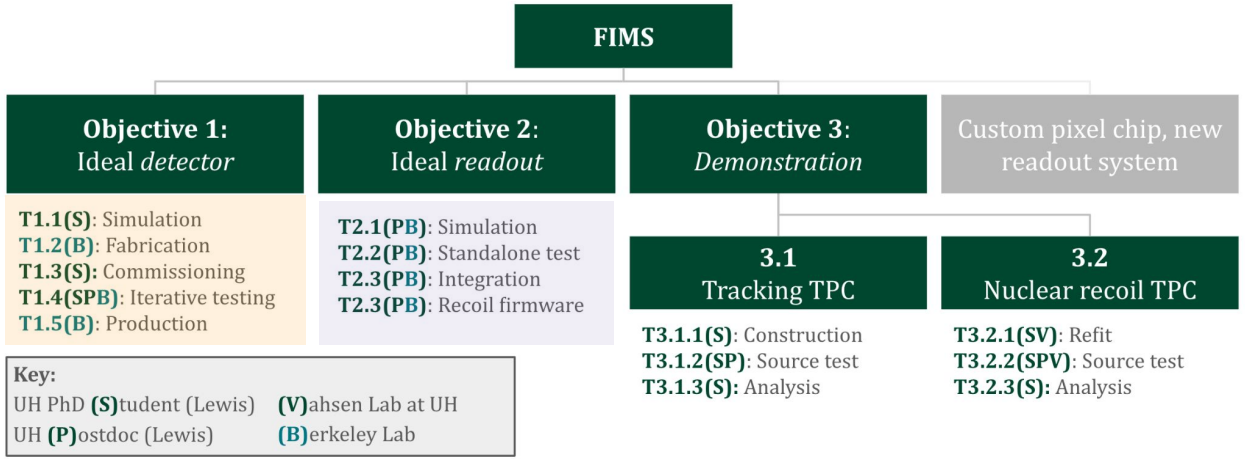
The first objective is to satisfy these criteria by developing an InGrid device with a novel amplification structure. An ideal detector *system* adds two further criteria:

4. Capable of continuous readout at rates of 10Mhits/s or higher.
5. Has flexible, integrated machine-learning capabilities for real-time event processing and decision-making.

The second objective is therefore to satisfy these criteria by adapting existing readout systems with new ML capabilities.

The third and final objective is to demonstrate these capabilities in two diametrically opposed **applications** and show that all five criteria are met. The first application is particle tracking detectors. The second application will be low-energy nuclear recoil detectors optimized for directional Dark Matter searches.

Overview of objectives



Personnel and roles

At UH:

- ptr
- James Harrison (PhD Student, semester research credits)
  - Develop MPGD simulation pipeline
  - (see talk later)
- Yubo Han (incoming postdoc, 0.5 FTE)
  - Arrives Jan 1 (if visa is ready)
  - Readout and FE ML/AI
- Tanner Polischuk (incoming postdoc, 0.5 FTE)
  - Arrives Jan 1
  - MPGD development
- Sven Vahsen
  - Mostly observer/consultant for now
  - Resource sharing at UH

At Berkeley Lab:

- Peter Sorensen
  - Microstructure fabrication
  - (chip?)
- Carl Grace
  - Readout
  - FE ML/AI

In practice, I don't expect these distinctions to be this rigid.

What the funding covers

$906K for four years:

- (salaries, stipends)
- Travel (**$89K**):
  - Regular short-term travel for UH people to go to Berkeley Lab (six trips a year)
  - Conferences
- Equipment (**$68K**):
  - $45K in first year, for a new vessel, TimePix3, and SRS, plus accessories*
  - The rest for lab supplies
  - (This isn't a lot! Some creative solutions with Vahsen+Berkeley Labs might be necessary)
- Other (**$5K**):
  - Shipping costs, etc.

$900K sounds like a lot, but we don't have much to play with

Some major questions

Microstructure

What are the **fabrication constraints** placed on the amplification structure design?

(Peter, can we get a document/talk from you on this?)

Readout

What will we use? (directly coupled to chip question)

(SRSe isn't ready yet, and it might be more efficient to use a system already in use at Berkeley Lab)

(Some possible synergies with Sven to consider)

Chip

Do we push ahead with an existing chip, or couple our development to this magic 3*e*-noise chip?

(We **don't** need to decide now, but this is a *very* high-leverage decision we will have to make within the first ~six months)

Other matters

I’ll give a talk on FIMS at CPAD in November… I’ll circulate slides when ready

Let’s meet every other week, but next in three weeks (Oct 14)