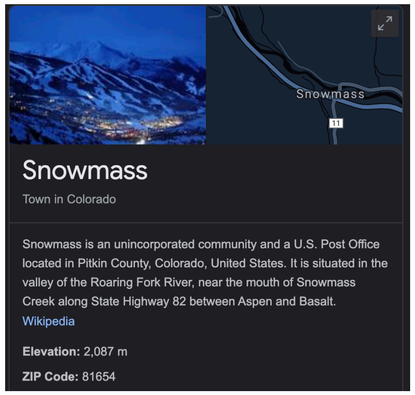
Planning for Snowmass: Instrumentation Frontier 5-White Paper 3

Ciaran O'Hare, Dinesh Loomba

What is Snowmass?



Not entirely sure myself, but paraphrased from https://snowmass21.org/ it is…

The Particle Physics Community Planning Exercise (a.k.a. “Snowmass”) is organized by the Division of Particles and Fields (DPF) of the American Physical Society as an opportunity for the entire particle physics community to come together to identify and document a scientific vision for the future of particle physics.

The **P5, Particle Physics Project Prioritization Panel**, will take the scientific input from Snowmass and develop a strategic plan for U.S. particle physics that can be executed over a 10 year timescale, in the context of a 20-year global vision for the field.

Hierarchies…

Frontiers → Topical groups → White papers

Snowmass Frontiers

- Energy Frontier
- Neutrino Physics Frontier
- Rare Processes and Precision
- Cosmic Frontier
- Theory Frontier
- Accelerator Frontier
- Instrumentation Frontier
- Computational Frontier

Instrumentation Frontier (IF)

- IF1: Quantum Sensors
- IF2: Photon Detectors
- IF3: Solid State Detectors and Tracking
- IF4: Trigger and DAQ
- IF5: Micro Pattern Gas Detectors (MPGDs)
- IF6: Calorimetry
- IF7: Electronics/ASICs
- IF8: Noble Elements
- IF9: Cross Cutting and Systems Integration
- IF10: Radio Detection

WP1	MPGDs: Recent advances and current R&D	Klaus Dehmelt, Andy White
WP2	MPGDs for nuclear physics experiments	Kondo Gnanvo, Matt Posik
WP3	**Recoil imaging for DM, neutrino, and BSM physics**	**Dinesh Loomba, Ciaran O'Hare**
WP4	MPGDs for TPCs at future lepton colliders	Alain Bellerive
WP5	MPGDs for muon detection at future colliders	Anna Colaleo, Kevin Black

We are working on IF5-WP3

Working title:

Recoil imaging for dark matter, neutrinos, and BSM physics

Dinesh Loomba, Ciaran O'Hare + many more authors tbc

Focus:

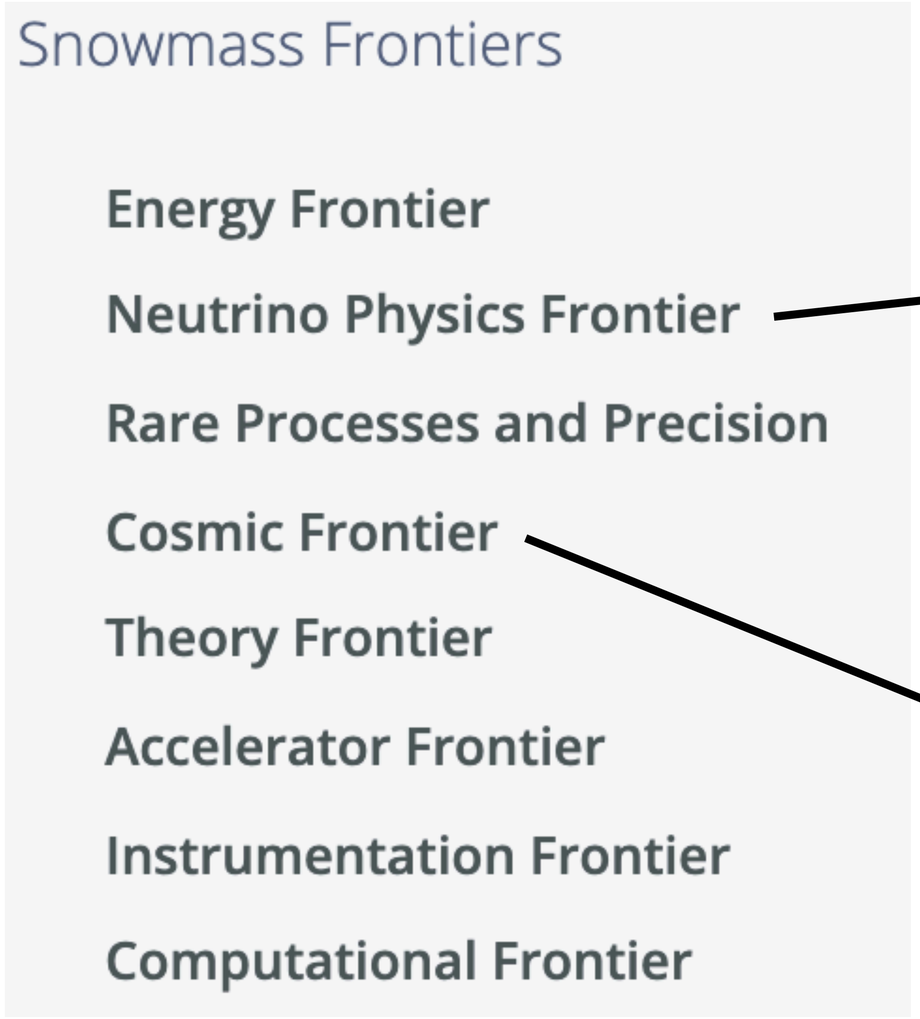
1. What are the physics goals facilitated by recoil imaging (i.e. real-time reconstruction of NR/ER directions)
2. What technology is needed to reach those goals?

Will synthesise the Cygnus feasibility paper, review papers, as well as several other ideas that can be described as recoil imaging. It will not expound the *value* of the physics covered, but instead focus on practical steps forward to achieve those goals.

Aim to be a multi-frontier paper

incorporated into CF1, NF3, NF4 and NF10 via executive summaries.

→ We will spend time crafting the political messages for these, as they are what will eventually inform actual decision-making



Neutrino frontier (Patrick Huber, Kate Scholberg, Elizabeth Worcester)
NF03: BSM
NF04: Neutrinos from natural sources
NF10: Neutrino detectors

Cosmic frontier (CF1): Dark matter: particle like
Topical group 1: *Direct detection to the neutrino floor*, Prisca Cushman, Rick Gaitskell, Cristiano Galbiati, Ben Loer

Our white paper combines several submitted Letters of Interest

(Click on links to see pdf of the original LOI)

- CYGNUS (Vahsen et al.)
- Directionality in gas argon TPCs (Caratelli et al.)
- Scalable readout system (Muller et al.)
- Optical readout (Brunbauer et al.)
- Dual-readout argon TPC (Gramellini et al.)
- MPGDs for IAXO (solar axions) (Ferrer-Ribas et al.)
- CEvNS (vBDX-DRIFT) (Snowden-Ifft et al.)

Mixture of physics applications (DM, neutrinos, BSM, tau-tracking), blue-sky detector R&D (optical, dual-readout), and ongoing work (νBDX-DRIFT, IAXO, SRS)

Outline (preliminary)

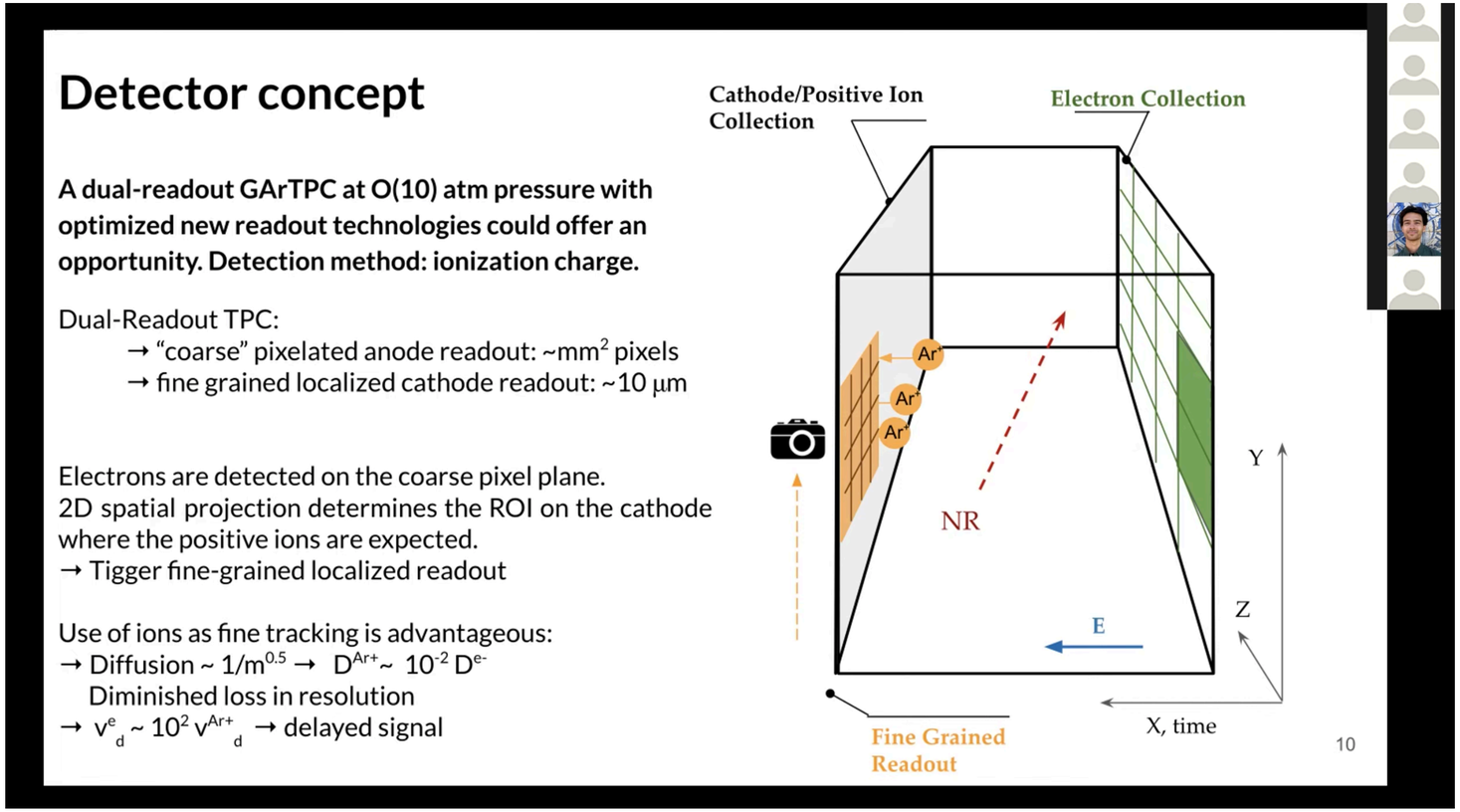
The is room for the scope to be expanded, so if anyone has an idea for something else to include, let me and Dinesh know (we would probably need you to write some short text for it though)

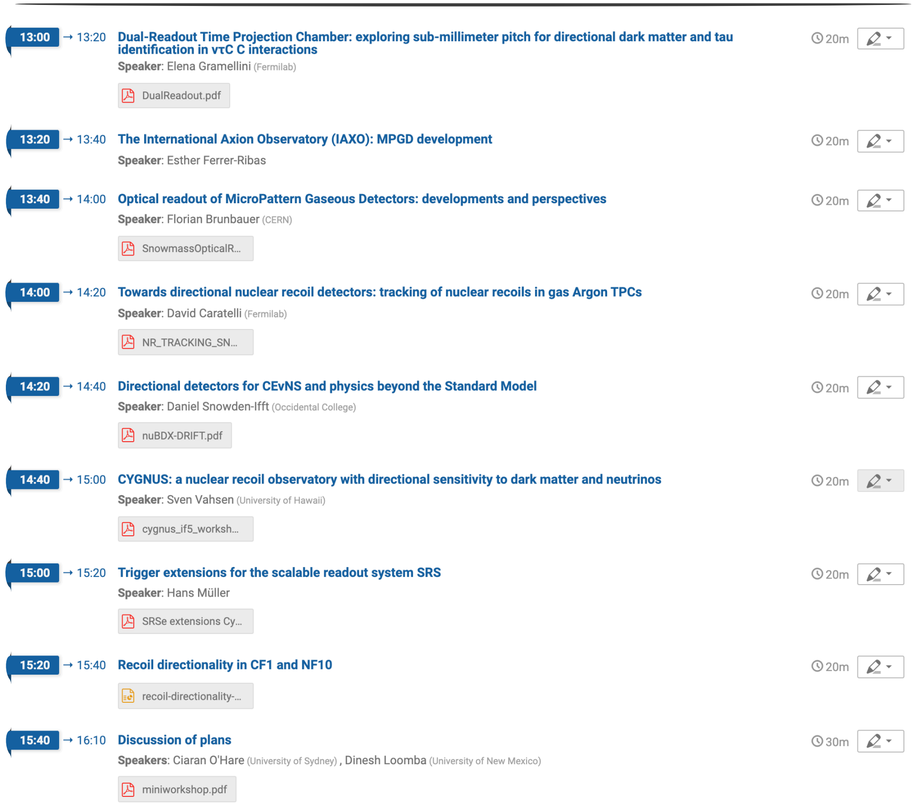
Topics included but without an LOI:
→ DM discovery, neutrino fog (O'Hare)
→ Neutrino-electron scattering (O'Hare)
→ Negative ion drift R&D (Loomba)
→ X-ray polarimetry (Loomba, Baracchini (?))
→ Neutron detection (Loomba)
→ Rare nuclear decays (Loomba)
→ Migdal effect (Loomba)

Still time to get involved!

Late December we had a mini workshop with contributions from each LOI author

See contributions: https://indico.fnal.gov/event/52282/
Watch recording of meeting: https://www.youtube.com/watch?v=eDeR8qOtMdM





Timeline (presented to authors at meeting)

Now—End of the year: Provide comments to me and Dinesh on the preliminary structure. Tell us how much you are willing to contribute, and list the main messages that you want included from your side.

January 10: All contributors to provide initial draft text at least containing the key points you want included in the WP. Either send this to me and Dinesh via email, or place it directly into overleaf in the relevant section.

January 15: A draft should be ready with text in all sections including executive summaries

January—February: Focus on refining text, formulating the political message, and writing three executive summaries to be sent up the ladder to IF, NF and CF.

March 1: 3 x Executive summaries submitted
March 1—15: Final edits + internal refereeing process
March 15: White paper should be on the arXiv no later than this

Please get in touch if you want to be involved and/or kept in the loop via email

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