

**UF Intro – Breakout #7 – Zoom 7**

# Underground Facilities and Infrastructure

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# Underground Facilities and Infrastructure Frontier



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John Orrell (PNNL)

Topical Group		Topical Group co-Conveners and Liaisons			
		Co-conveners			Liaisons
UF01	Underground Facilities for Neutrinos	<u>Accelerator Neutrinos</u> Tim Bolton	<u>0νββ</u> Patrick Decowski Danielle Speller		<u>Neutrinos</u> Albert de Roeck <u>Astronomical v</u> Gabriel Orebi Gann
UF02	Underground Facilities for Cosmic Frontier	<u>LXe DM</u> Kaixuan Ni  <u>Low Mass</u> Scott Hertel	<u>LAr DM</u> Emilija Pantic		<u>Particle DM</u> Hugh Lippincott Jodi Cooley <u>Instrumentation</u> Eric Dahl
UF03	Underground Detectors	<u>Gravity Waves</u> Laura Cadonati			<u>Instrumentation Frontier</u> Maurice Garcia-Sciveres
UF04	Supporting Capabilities	<u>Radon</u> Richard Schnee	<u>Cleanliness</u> Alvine Kamaha	<u>Low Background Assay</u> Brianna Mount	
UF05	Synergistic Research	<u>Nuclear Astrophysics</u> Daniel Robertson	<u>Geo-microbiology</u> TBD	<u>Geo-engineering</u> TBD	<u>QIS, QC</u> Maurice Garcia-Sciveres
UF06	An Integrated Strategy for Underground Facilities and Infrastructure	Laura Baudis Kevin Lesko	Jeter Hall John Orrell		<u>Early Career</u> Pietro Giampa William Thompson

# UF Topical Areas

- UF1 – Neutrinos
  - Accelerator-based Neutrinos
    - e.g., LBNF/DUNE, Hyper-K
  - Non-accelerator Neutrinos
    - e.g., Supernova, solar, atmospheric, background  $\nu$ 's
  - Neutrinoless Double-Beta Decay
    - Nuclear Physics in US, but large HEP & UG overlap
- UF2 – Cosmic Frontier
  - Direct detection of dark matter in underground locations
- UF3 – General Underground Detectors
  - e.g., New technologies, R&D/small-scale exp., QIS, gravity

# UF Topical Areas

- UF4 – Supporting Capabilities
  - Low-background methods, cryogenics, other supporting... not necessarily UG, but needed for UG experiments
- UF5 – Synergistic Research
  - Non-HEP UG science: Geo., Bio., Eng., Nuc. Astro.
- UF6 – Integrated Strategy for UF&I
  - Working group for a vision going beyond a gap analysis

# Focus of Underground Facilities Group

- Understand current and planned underground facilities, underground space for experiments, and supporting capabilities
- Develop requirements and wishes for the future experiments and in particular new frontiers (e.g. QIS)
- Develop synergistic relationships among experiments (shared space, parallel use, partnerships, shared technology)
- R&D space and growth of new technologies
- Understand underground space requirements in closely related fields (nuclear astrophysics,  $0\nu\beta\beta$ , ...)
- Create a vision for underground facilities in the coming decades

# 2013 Underground Facility Report and Recommendations: [1401.6115](#)

15 pages

2 page summary

Short bulleted list of physics goals

Specific section for large detectors

Specific section on low background assay

Simple timeline of facilities & experiments

Specific table for *large* experiments

Summary of assay needs

Summary of existing infrastructure

## Recommendations/Conclusions

1. Locate LBNE underground to realize its full science potential. This step would also provide a natural base for additional domestic underground capabilities at SURF in the future.
2. The U.S. has leading roles in many of the future dark matter, neutrinoless double beta decay and neutrino experiments.
3. More coordination and planning of underground facilities (overseas and domestic) is required to maintain this leading role, including use of existing U.S. infrastructure and closer coordination with SNOLAB as the deepest North American Lab.
4. Maintaining an underground facility that can be expanded to house the largest dark matter and neutrinoless double beta decay experiments would guarantee the ability of the U.S. to continue its strong role in the worldwide program of underground physics.

# 2021 Underground Facilities Report

The Underground World has progressed markedly since 2013. Much of the exciting physics opportunities in the coming decades will be underground. A number of physics topics have made progress since 2013: LBNE/DUNE, G2 Dark Matter, Nuclear Astrophysics, Low Background Assay, ...

**We should assemble a more comprehensive report for Snowmass 2021.**

Each topic should include at least (suggested lengths):

1 - 3 pages: progress since 2013, current experimental situation and status worldwide and within the US and/or with US participation.

2 - 5 pages: forward looking goals, what will the next 10 - 20 years offer US HEP Physics

2 - 5 pages: what will these goals **require from u/g and supporting facilities**. If firm plans exist for hosting experiments - indicate this.

0 - 5 pages: explore opportunities for cooperation and synergistic approaches

Provide a high level technically-limited estimate of the schedule

Indicate alignment with 2013 P5 & Snowmass recommendations

# 2021 Underground Facilities Report

With these inputs, we will assemble:

Executive Summary

Physics goals for the coming 10 - 20 years

Recommendations

Gap analysis for infrastructure

What exists (worldwide)

What will be needed for this program

Plans or proposals to provide the infrastructure

Discussion on the US program in particular

*A visionary plan* for US Underground Physics Program

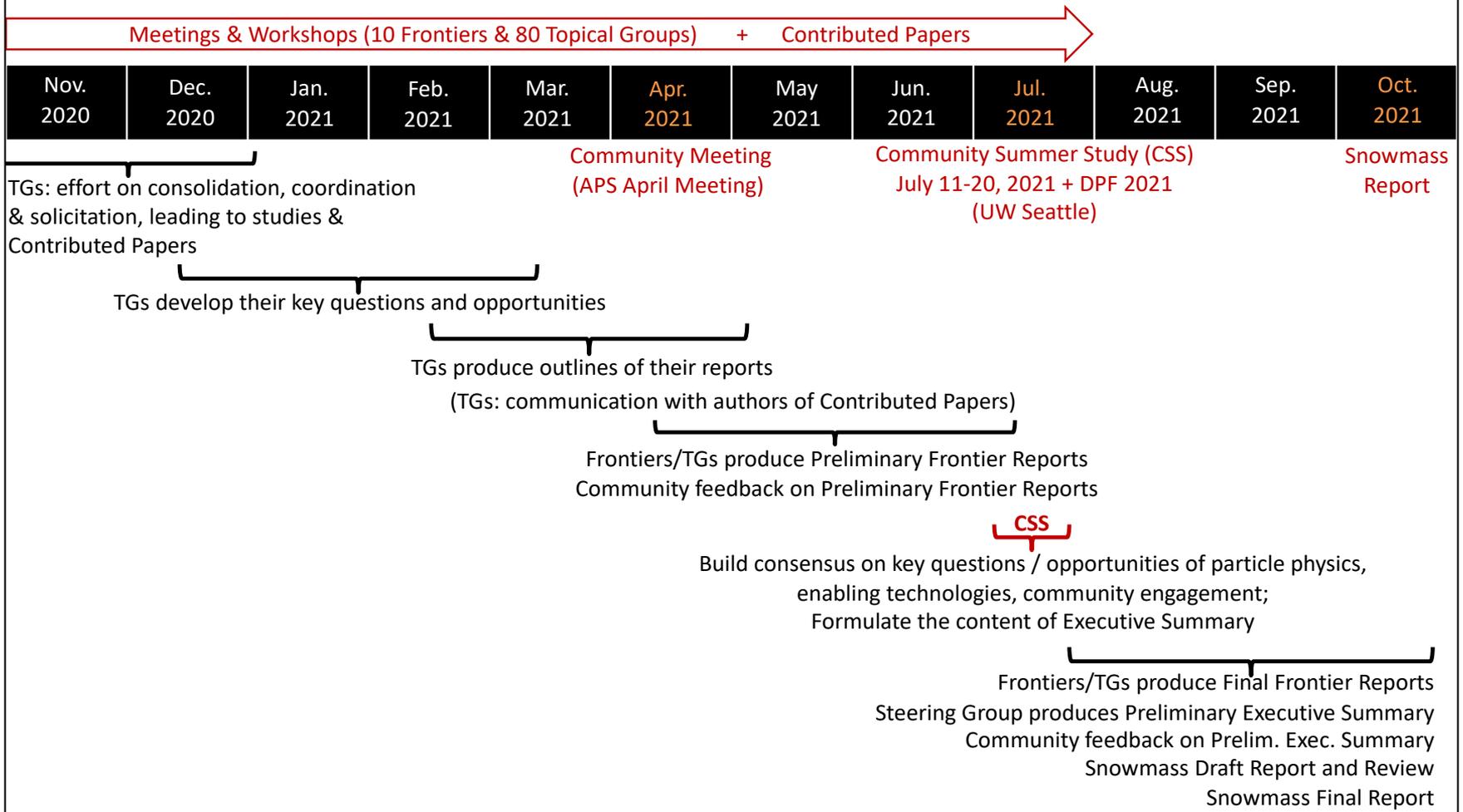
# A Community Planning Process

- Letters of Interest (LOIs)
  - Only seven specifically flagged for UF (below)
  - We will review other LOIs for UF-relevant topics
  
- 1. KURF The Kimballton Underground Research Facility
- 2. The Sanford Underground Research Facility
- 3. Advanced Germanium Detectors and Technologies for Underground Physics
- 4. Classification standard for underground research space
- 5. Development of the Boulby Underground Laboratory in the UK into a facility to host major international rare event searches
- 6. Solution-mined salt caverns as sites for underground
- 7. An Ultralow Background Facility to Support Next Generation Rare Event Physics Experiments

# Overall Snowmass 2021 Timeline

## Preliminary Snowmass Timeline / Process

Starting point for discussion with the community during CPM



# Proposed UF Timeline

## Underground Facilities Frontier Plan (DRAFT)

- Sep 2020 - Jul 2021: Participate in Scientific Frontier workshops, town halls, and breakouts. Arrange and participate in key scientific breakout sessions on topics with high impact or new opportunities for underground facilities and infrastructure. UF/I does not foresee holding distinct workshops, but participating in the Scientific Frontiers efforts.
- August - September 2020: White Paper Outline, LOI sorting, Participation in CPM workshops, etc.
  - Invite remaining co-conveners and liaisons, hold organizational meeting ✓
  - Establish outline and major chapters of White Paper ✓
  - Sort, organize and condense LOIs into White Paper Work Groups (WPWG) include additional topics from convener and co-conveners organization
  - Organize Participation by UGF members in CPM breakouts
- October 2020: CPM
  - 5 - 8 October: CPM
  - Mid-October: Assemble UF/I Conveners and Liaisons Debriefing Session: assemble key points and lessons from CPM
  - 30 October: Assemble and vet solicitation lists, establish contacts, finalize facility and infrastructure questionnaires
- November - January
  - solicit input from Facilities, Collaborations, and R&D efforts
  - 15 January: Draft Existing Supply and Projected Needs Analysis (UF/I Gap Analysis)
  - Begin work on U/FI Visionary Plan
- White Paper Draft Timeline
  - Draft Outline; ✓
  - 15 February: **White Paper 1<sup>st</sup> Draft** sans Visionary Plan (focus on supply and projected needs)
  - 15 March: **Community and Facility comment period**
  - 15 April: **White Paper 2<sup>nd</sup> Draft**, (include initial draft of Visionary Plan)
  - *APS meeting: 17-20 April*
  - 20-30 April: 2<sup>nd</sup> draft **Community and Facility comment period**
  - 15 June: **White Paper 3<sup>rd</sup> draft** of U/FI report:
  - 15 June - 1 July: 3<sup>rd</sup> **Community and Facility comment period**
- Snowmass in Seattle: 11-20 July 2021
- Final white paper deadline: 31 July 2021
- Final U/FI report: 1 September 2021
- Final Snowmass report: 1 October 2021
- 2 October, celebrate completion of report

# Community Planning Meeting (CPM) – Oct. 2020

## Tuesday Oct. 6

- 7. UF Intro
  - 11:00 AM (US/Central)
  - Orrell, Lesko, Baudis, Hall
- 77. Quantum Sensors for Wave and Particle Detection
  - 11:30 AM
  - Garcia-Sciveres, Jodi Cooley
- 122. Capabilities needed to execute underground experiments in a broad range of research categories
  - 1:00 PM
  - Schnee, Dahl, Garcia-Sciveres
- 118. Cross-community Mobility in Science
  - 1:00 PM
  - Hall, Orrell
- 51. Requirements for low background and underground detectors
  - 3:00 PM
  - Lippincott, Orrell

## Wednesday Oct. 7

- 110. Baryon and Lepton Number Violating processes
  - 1:00 PM
  - Speller, Decowski
- 115. Neutrinos, dark matter, and underground facilities
  - 1:00 PM
  - Kamaha, Mount, Orebi Gann, Lippincott
- 207. UF Planning
  - 3:00 PM
  - Orrell, Lesko, Baudis, Hall

# Go forth CPM!

- Underground Facilities & Infrastructure:
  - Critical to several major physics goals in the next decade
  - Needs assessment for community science requirements
  - Will benefit from a community-consensus visionary plan
- ***CPM launches collecting and reporting the details***
- UF&I convener contact information:
  - Laura Baudis [laura.baudis@physik.uzh.ch](mailto:laura.baudis@physik.uzh.ch)
  - Jeter Hall [jeter.hall@snolab.ca](mailto:jeter.hall@snolab.ca)
  - Kevin Lesko [ktlesko@lbl.gov](mailto:ktlesko@lbl.gov)
  - John Orrell [john.orrell@pnnl.gov](mailto:john.orrell@pnnl.gov)
- **Questions, Comments, and Discussion...**