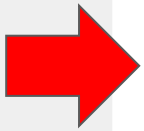
DPF PHENO 2024 panel: What is the ASTAE thing? (Sarah Eno)



Recommendation 3: Create an improved balance between small-, medium-, and large-scale projects to open new scientific opportunities and maximize their results, enhance workforce development, promote creativity, and compete on the world stage.

In order to achieve this balance across all project sizes we recommend the following:

a. Implement a new small-project portfolio at DOE, Advancing Science and Technology through Agile Experiments (ASTAE), across science themes in particle physics with a competitive program and recurring funding opportunity announcements. This program should start with the construction of experiments from the Dark Matter New Initiatives (DMNI) by DOE-HEP (section 6.2).

b. Continue Mid-Scale Research Infrastructure (MSRI) and Major Research Instrumentation (MRI) programs as a critical component of the NSF research and project portfolio.

c. Support DESI-II for cosmic evolution, LHCb upgrade II and Belle II upgrade for quantum imprints, and US contributions to the global CTA Observatory for dark matter (sections 4.2, 5.2, and 4.1).

The Belle II recommendation includes contributions towards the SuperKEKB accelerator.

n.b. ***DMNI*** are DOE ***Dark Matter New Initiatives*** based on Basic Research Needs (BRN) panel/report. (https://www.osti.gov/servlets/purl/1659757)

Area Recommendation 2: For the ASTAE program to be agile, we recommend a broad, predictable, and recurring (preferably annual) call for proposals. This ensures the flexibility to target emerging opportunities and fields. A program on the scale of $35 million per year in 2023 dollars is needed to ensure a healthy pipeline of projects.

Area Recommendation 3: To preserve the agility of the ASTAE program, project management requirements should be outlined for the portfolio and should be adjusted to be commensurate with the scale of the experiment.

Area Recommendation 4: A successful ASTAE experiment involves 3 phases: design, construction, and operations. A design phase proposal should precede a construction proposal, and construction proposals are considered from projects within the group that have successfully completed their design phase.

Area Recommendation 5: The DMNI projects that have successfully completed their design phase and are ready to be reviewed for construction, should form the first set of construction proposals for ASTAE. The corresponding design phase call would be open to proposals from all areas of particle physics.

We are excited about ASTAE!

Here are some benefits we (and P5) have identified.

- **Filling in the gaps & making connections on different scales (time, size, range)**
  - Supports technology development
  - Supports cross-frontier, cross-agency, international efforts
  - Fills in holes for physics that has no home
  - Allows fast response to new ideas
  - Fully exploit existing facilities
- **Workforce development**
  - Experience across lifecycle of an experiment gives breadth of workforce education
  - Provides leadership experiences
  - Continuity of workforce development between big projects

Panelists will expand on these and pull out some examples

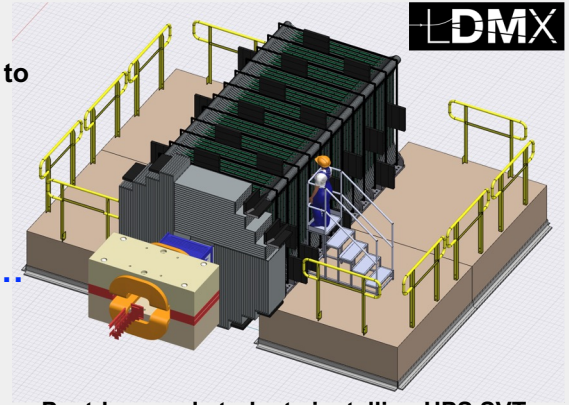
"*What is the ASTAE Thing?*"

Tim Nelson

Some highly motivated science goals require targeted small experiments.

DMNI Example: Light Dark Matter eXperiment searches for sub-GeV dark matter, with sensitivity to fully explore couplings implied by observed relic abundance across the MeV-GeV mass range

LDMX, like many small experiments deploys technologies and techniques developed (or being developed) for large experiments (LCLS-II, CMS, Mu2e), leveraging major investments.



In addition, small experiments turn the clock back to a time when one could…

- design, build, operate, analyze on one experiment as an early career researcher.
- know the detailed workings of an entire experiment "from ionization to publication".
- lead a critical effort and be an important stakeholder as postdoc or student.

Postdocs and students installing HPS SVT

To enable small experiments to deliver these promises, ASTAE must…

- Select small (cost+timescale) experiments with clear science impact
- Provide consistent support and management needed to realize science in a timely way

There are some challenges in striking the right balance:

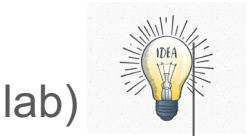
- *Science goals*: wide open vs. topical by science driver (e.g. DMNI) or frontier?
- *Pipeline*: breadth (size of portfolio) vs. cadence (timely implementation)

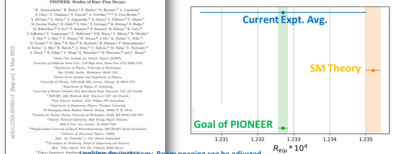
This forum presents an opportunity to hear current thinking from OHEP on key issues and elicit feedback from the community on ASTAE and small projects.

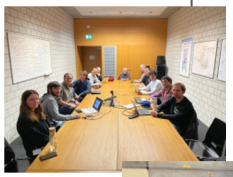
Support needed for the Life Cycle of new "small" initiatives in the context of ASTAE, David Hertzog

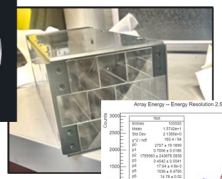
(I helped launch: MuLan, Muon g-2, Pioneer)

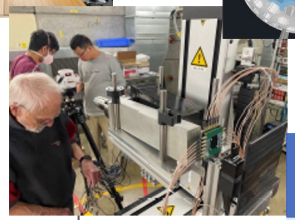
- **A Physics Idea*** (perhaps, ideally approved by a lab)
- ***Pre*-ASTAE** Stage needs:
  - **R&D seed funding** to develop prototypes
  - **Personnel support** of students/postdocs
  - **LDRD** support for National Labs
  - **Travel** for test beams
- **ASTAE Stage support****
  - **Mature design,** large prototypes; engineering
  - **Project** funding
- **Coordination among Agencies** can be tricky
  - DOE **HEP** & **NP** & **NSF** groups
  - Negotiating US share with **International partners**

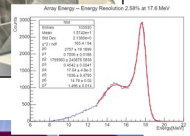












LDRD
Laboratory Directed Research and Development

U.S. DEPARTMENT OF ENERGY
Office of Science
NSF

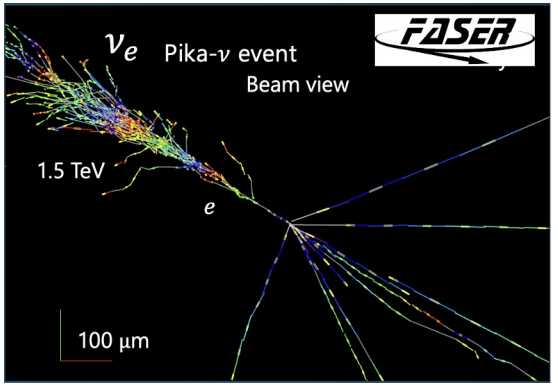
*Some kind of external "endorsement" required (PAC, or panel)

1 or 2 rounds here depending on scale of **Project

Pioneer: e-Print: 2203.01981

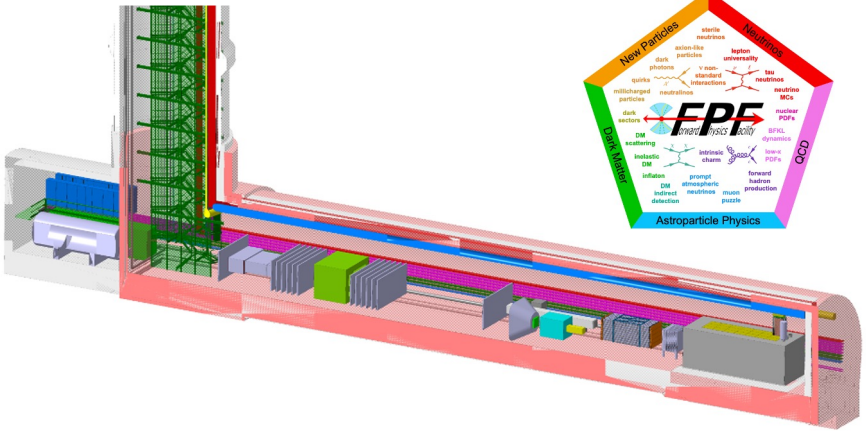
How can ASTAE be used to improve our field?
Jonathan Feng

We have recently opened a new window on physics at the high energy frontier; ASTAE could be used to allow us to look through it.



2023: First direct detection of collider neutrinos: a new source (at TeV energies!), following reactors, acceler, solar, atm, SN,…what will we learn?

2029- : Forward Physics Facility @ HL-LHC: small, fast, ASTAE experiments will allow us to see millions of TeV neutrinos, search for BSM physics, enhance prospects for discovery at ATLAS, CMS, IceCube, …



Lessons from FASER:
– Small, cheap experiments can greatly (and quickly) enhance the physics potential of existing large investments;
– Construction to analysis in 1 grad student lifetime
– Provides continuity between large projects (e.g., between HL-LHC upgrades and future colliders)
– Develops future leaders of our field

How can ASTAE be used to improve our field?

Kate Scholberg

Support efforts that have

multiple homes or no home:

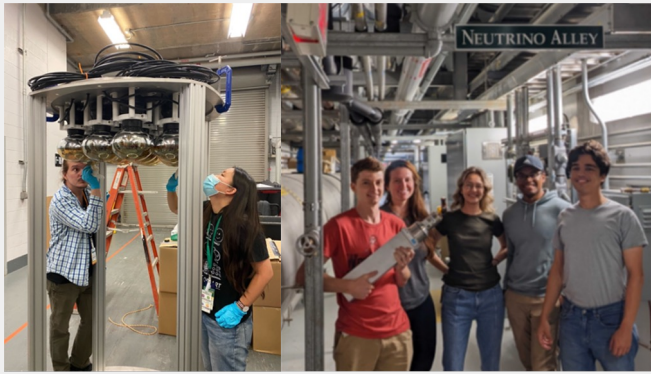
Physics that “falls between the cracks":

- between physics frontiers (IF-CF),
- between agencies (e.g. HEP-NP)
- between fields (particle-nuclear-astro, …)

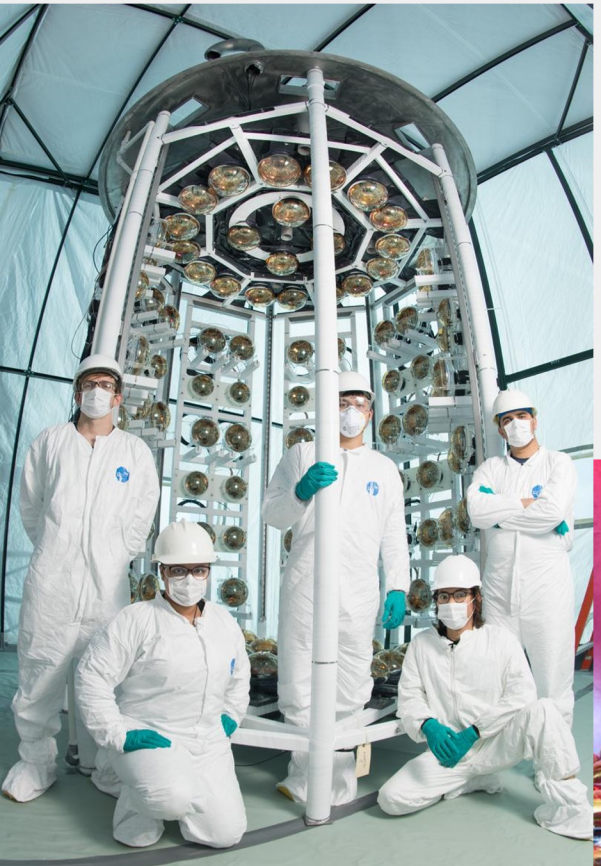
Optimize use of existing facilities

Broad training: Students and postdocs get to *experience the whole experimental life cycle,* and *take leadership roles*

- Design, simulation, R&D
- Construction & commissioning (hands on!)
- Data analysis



How can ASTAE be used to improve our field?
Mayly Sanchez



It's about the PEOPLE!

Essential hands-on training through the life cycle of an experiment: design, construction, installation, commissioning, data taking and analysis.

Neutrinos experiments like ANNIE, EMPHATIC, COHERENT have a **high fraction of students and postdocs moving on to laboratory staff and faculty positions**.

A **predictable funding** stream for a **diverse portfolio of experiments** provides **opportunities for** junior scientists to take on ownership and **leadership of new ideas** carrying them to fruition.

How can ASTAE be used to improve our field? Sven Vahsen

Technology: smaller experiments play vital role

- Hands-on training of new detector R&D experts
- Revitalize specialized tech workforce and capabilities
- Incubators/pathfinders for new technologies that will ev have much wider and larger applications

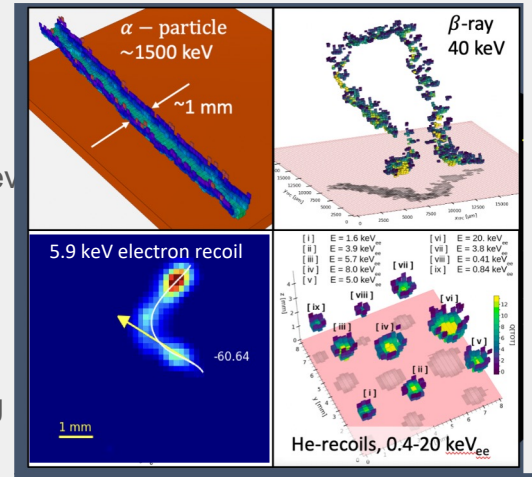
Example: advanced gaseous detectors

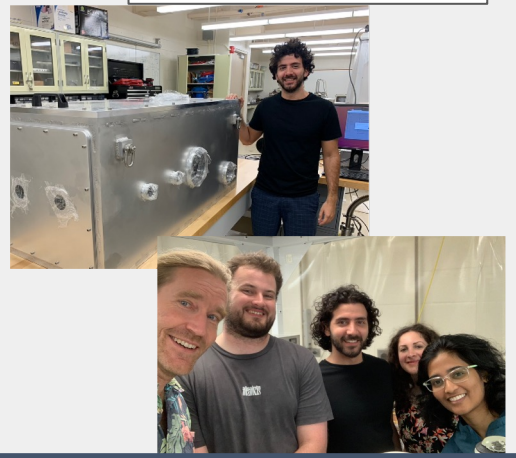
- *Required* in virtually all HEP and NP experiments for ionization detection in large volumes w/ low scattering
- **Lacking US investigators and manufacturing!**

Science: ASTAE can enable groundbreaking new experiments with multiple homes or no home

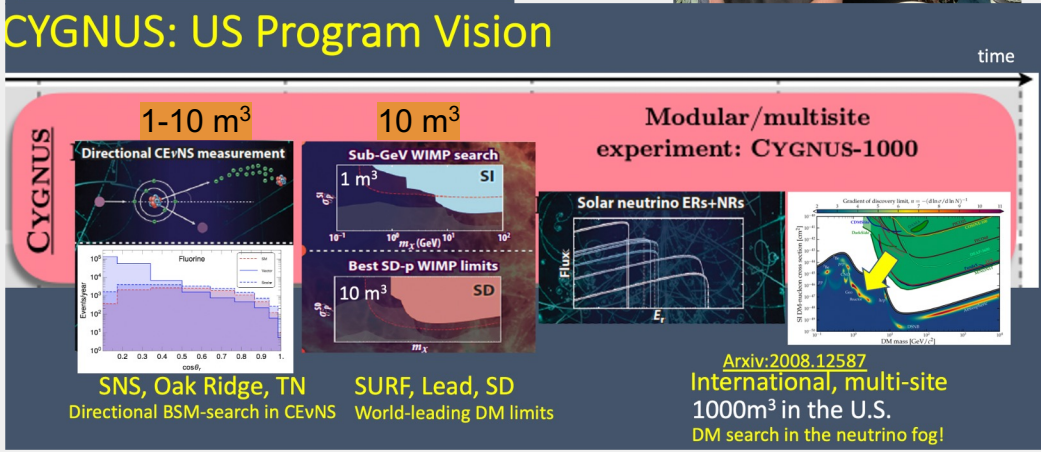
Example: CYGNUS Experiment

- Advance ionization detection to the sensitivity limit
- 3D single-electron-counting in m^3 volumes
- 30 eV threshold, room temperature operation
- Comparable capabilities do not exist
- **Transformative for MIGDAL, CEvNS, DM ++**





CYGNUS: US Program Vision



We are very excited about ASTAE!
What's the optimum way to configure it to achieve the goals?

- Should calls organized by Frontier or topic (like DMNI)?
- Or should it be open to all areas? (recommended by P5 post DMNI first construction: *"The corresponding design phase call would be open to proposals from all areas of particle physics. "*)
  - Pros and Cons of an "open" call?
- Or a combination of open and focused?
  - Rotations among areas?
- *Require* some "beyond focus" areas?
  "Over time, this portfolio should maintain a balance of experiments across the science driver focus areas. The possibility of projects that ***push beyond these focus areas*** *should be left open for compelling scientific or technological cases. The projects should be reviewed for their potential for discovery, technology innovation, and ability to provide critical inputs to the success of the greater HEP mission."*
- How should ASTAE funding level scale with overall HEP program funding?

A word from DOE: Mike Procario

Feeder questions

- How can DOE-HEP and DOE-NP and NSF work together to fund small experiments that have mutual interest?
- How can DOE establish some R&D to develop new ideas for small efforts?
- What is the “just-right” mix of projects for the ASTAE portfolio?
- In the case of a wide open call, how does one convene a panel capable of reviewing and prioritizing projects covering a vast range of science topics to choose only one per year? Similarly, how does one ensure that all of the best ideas for addressing a particular focus area are being compared to each proposal of a wide open call?
- In the case of focused calls, how does one choose/order the calls to focus areas?
- A disadvantage of agility is being more easily set aside than larger projects when there is budget stress. What guardrails will protect the ASTAE pipeline?
- How will ASTAE prioritize and manage international partnerships? (DMNI FOA stated that projects were expected to be >75% DOE-funded.)
- How does one balance/prioritize the “S” (science) vs. the “T” (technology)
- How should the project management scale with size of the project?