

# New Open Data Challenges Summary

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Roger Huang

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**Goal**: Come up with a list of potential “next” data challenges within DORAEMON

1. What are potential ideas for new data challenges?
2. Why are they interesting? What's the impact?
3. What is needed to make them happen?
4. Are there synergies with other data challenges / science domains?

# Data Challenge Classification

We judge every open data challenge proposal by asking:

1. Is the problem of broad interest to neutrino physicists?
2. How hard is it to generate the required dataset, and could it be reused for other challenges?
3. Are there clearly defined metrics for evaluating solutions?
4. What computational resources would be needed?

We then sort every proposal into near-term, mid-term, and long-term proposals based on these criteria, as a suggestion for how to prioritize effort

# Covered in White Paper in Some Way

- Multi-modal reconstruction (**mid-term**)
- Rare event detection => can expand **Anomaly Detection (short-term)** proposal to cover this
- Fast simulation surrogate (**short-term**) criticisms:
  - Originally put this under “short-term” partially because it seemed closely related to T3
  - But if we’re putting T3 as a post-T1 project, we can agree to move this to mid-term
- Deghosting (**short-term**) criticisms:
  - Can remain short-term, but expand to general tomographic reconstruction as suggested
- Domain shift, data/MC discrepancy => expand **Reconstruction Robustness against Detector Variations (mid-term)**

Will modify the existing proposals in white paper to incorporate this new discussion

# New Short-term Proposals

- Low-energy reconstruction and signal-identification
  - The variation that includes using this for online triggering is covered under the existing **mid-term** Online Triggering proposal
- Neutron reconstruction
- Ice/Water neutrino telescope unified reconstruction

These all seem reasonably doable as open data challenges in the near future

# New Short/Mid-term Proposals

- Virtual monoenergetic neutrino beam construction with PRISM
  - Unsure what we would need to release exactly and how easy it will be to construct the proper constraints for a challenge
- Detector systematics surrogate model
  - Not sure how easy it will be to come up with a set of systematics that would be the right combination of realistic and difficult to be a useful challenge
- Emulsion detector reconstruction from raw data
  - Not sure if the simulations for this are just ready-to-go for a data challenge, or some development is needed

# New Mid/Long-term Proposals

- Cross-detector alignment of shared representations in foundation model embeddings
  - Would require measuring submission performance on a lot of things simultaneously, since the models need to do their job in each detector while also being aligned
  - And how well do we understand what it means for the representations to be aligned in the embedding space?
- Foundation models transferable between fields
  - How would we test this in an open DC format?
- Cross-detector transfer learning
  - Not obvious how to structure this as an open data challenge

# ??-Term Challenges

- Error detection using natural language supervision
- Analysis benchmark (AI scientist type challenge)

These challenges involve working with tuning frontier models in some way. Is this something worth a specific open data challenge in neutrino physics?

**My thought:** if people are interested in this, it seems better-suited for a much larger collaboration including at least other areas of particle physics (and probably other parts of science)