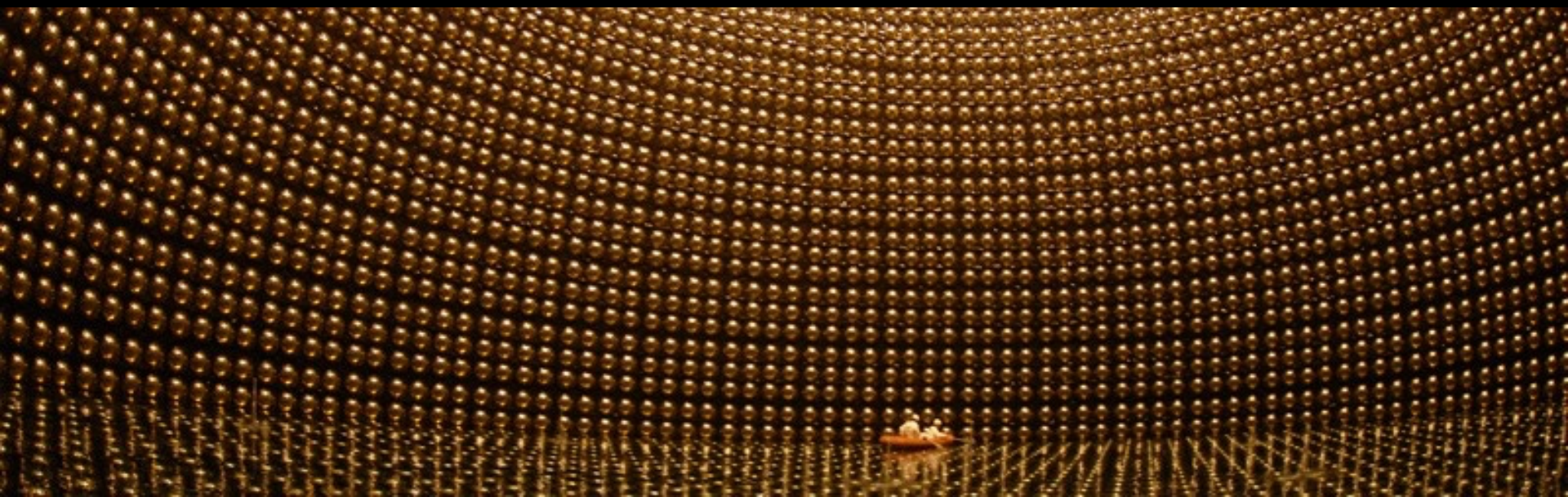
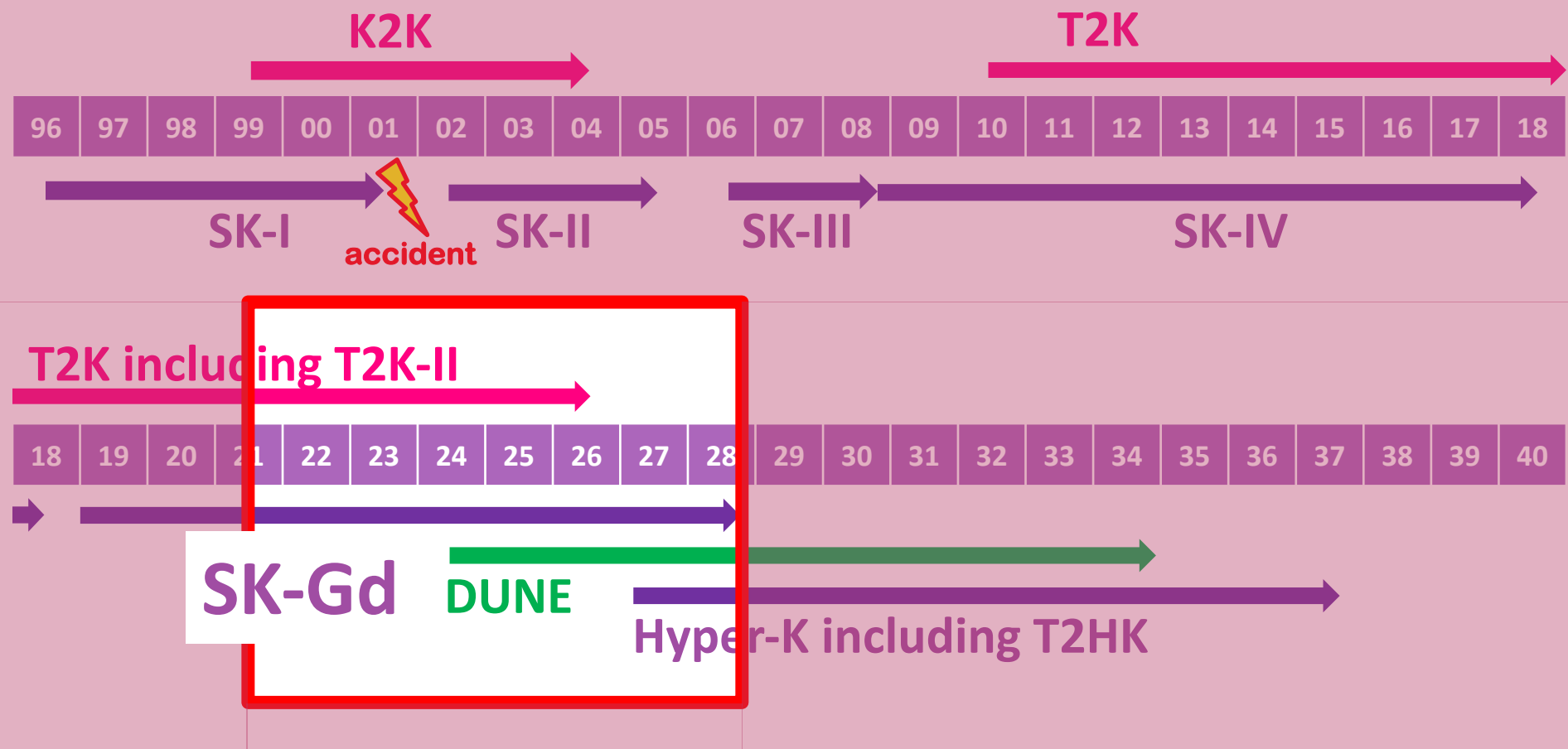


Ongoing Science Program of Super-Kamiokande
Ed Kearns, for the Super-K Collaboration





Super-K very much appreciates the vibrant community interest and encouragement over 20+ years.

The U.S. group especially appreciates operation and research support by D.O.E.

We are now in the final phase that bridges our broad science program to the next generation of experiments.

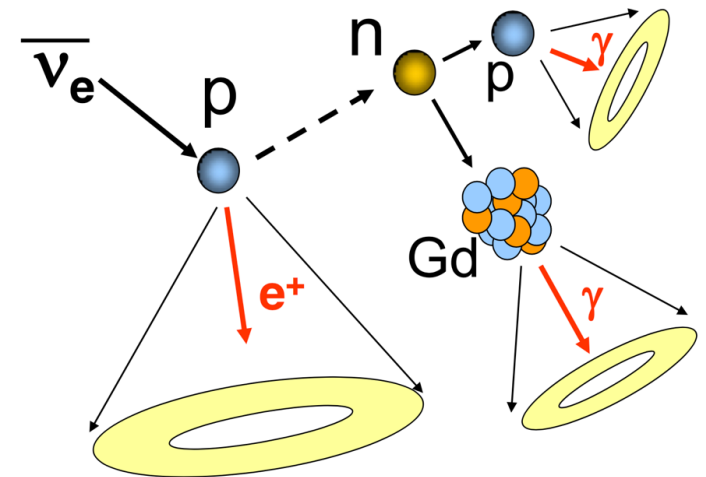
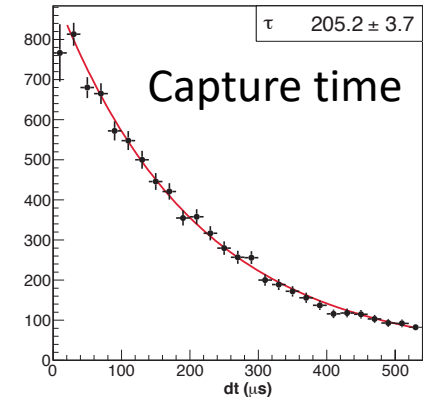
Technology for SK-Gd

SK-IV Electronics and DAQ upgrade has allowed us to demonstrate neutron capture

- $n + p \rightarrow {}^2\text{H} + \gamma$ (2.2 MeV)
- 25% efficiency
- 200 μs capture time

We have developed techniques to add Gd ions to SK

- Gd has an enormous neutron capture cross section
- Produces 8 MeV gamma cascade (4 MeV equivalent)
- Shorter capture time ($\sim 30 \mu\text{s}$)
- Challenges:
 - Purify water without removing Gd
 - Maintain high light transparency
 - Maintain low radioactivity
 - No degradation or corrosion of materials'
 - Prevent any Gd-water from leaking into the environment

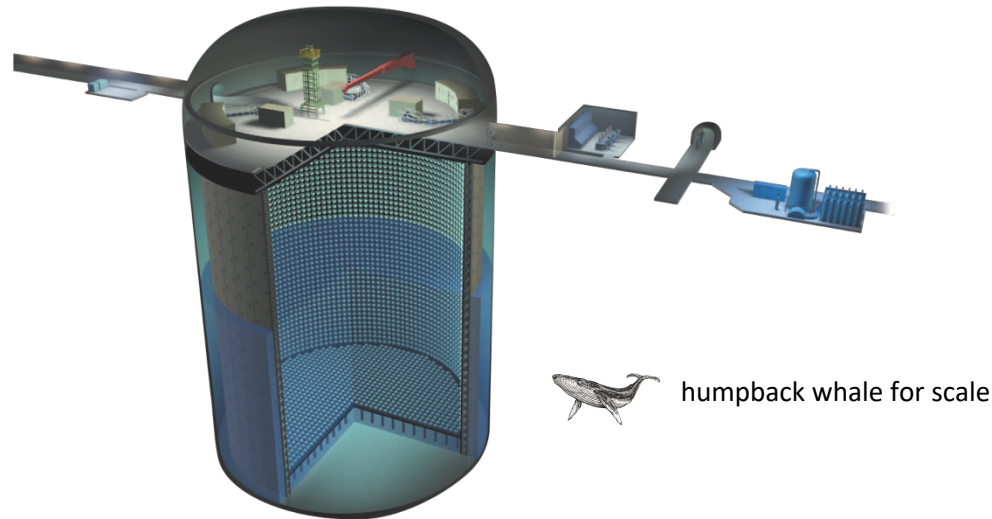


**We have started initial SK-Gd operation (8/21/2020).
Operation looks good so far (water transparency, etc.)**

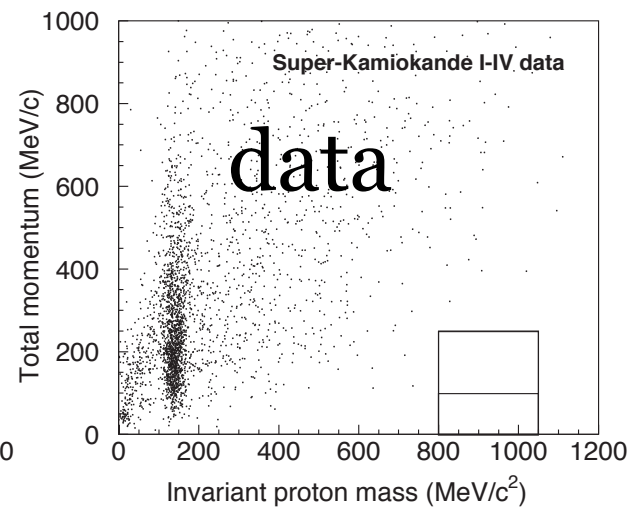
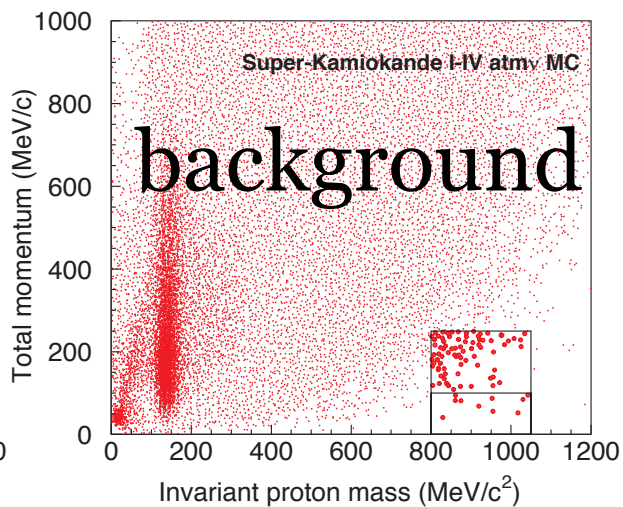
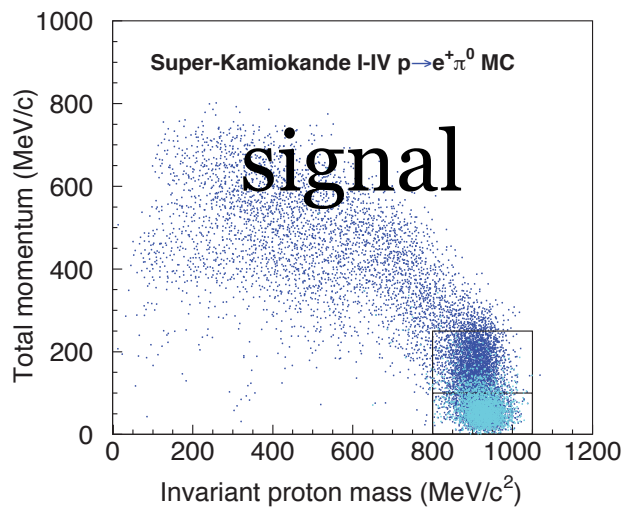
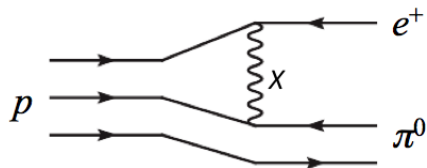
Science Goals for Continued Operation of (Upgraded) Super-K

- 1 Study the science of **supernova neutrinos**
- 2 Continue to extract information from **atmospheric neutrinos**
- 3 Continue the search for **nucleon decay**
- 4 Continue to extract information from **solar neutrinos**

this talk



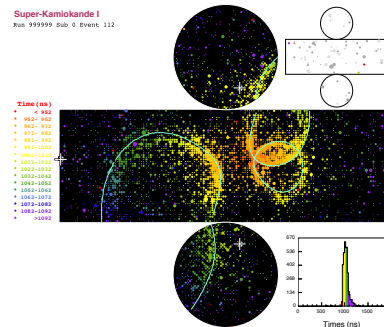
+ Be the far detector for **T2K**

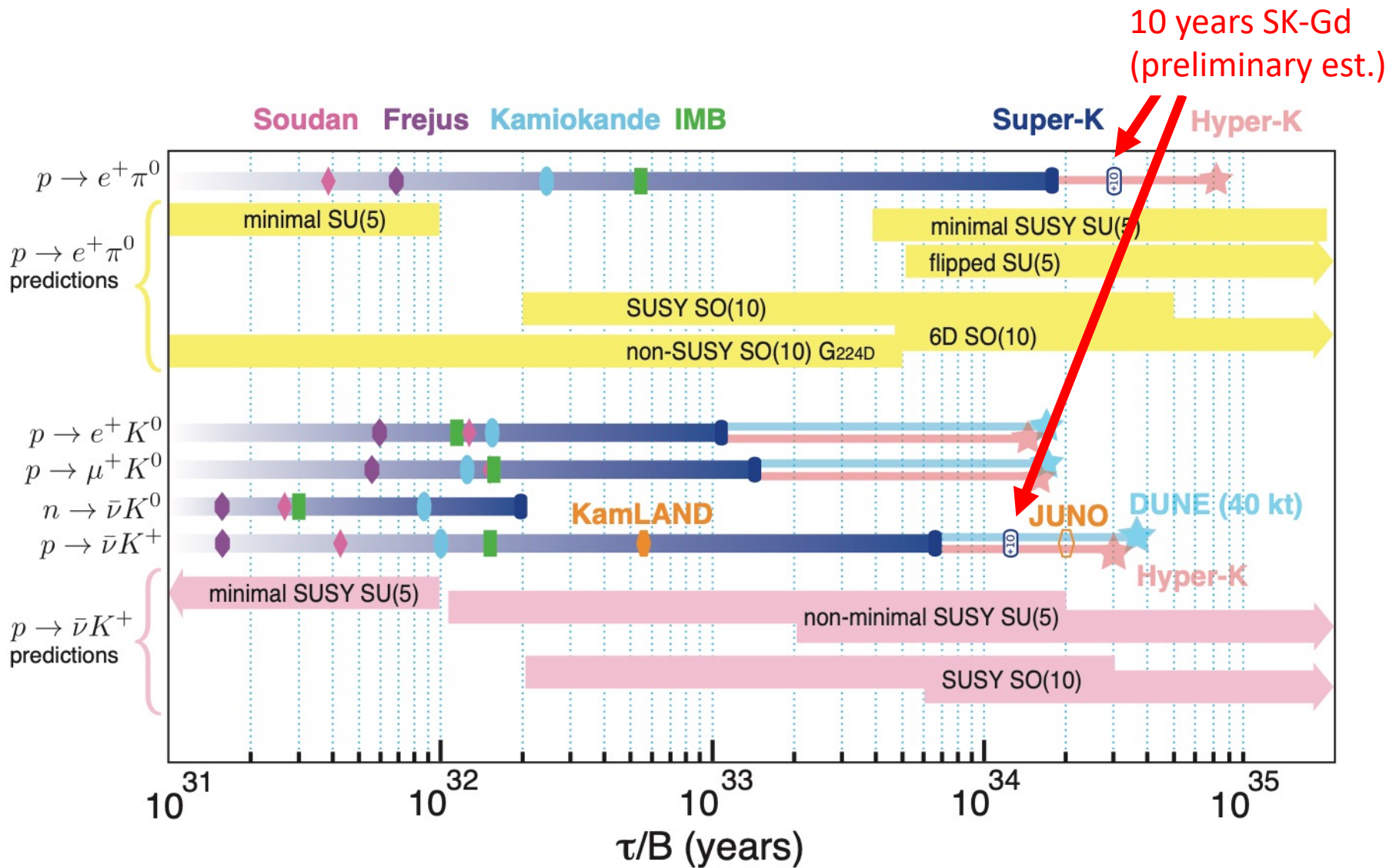


$$\tau / B(e^+ \pi^0) > 2.4 \times 10^{34} \text{ years}$$

preliminary, with expanded fiducial mass (450 kt-y)

clean signature,
negligible background
for this and many searches





Admittedly modest additional sensitivity. But we are looking in well-motivated territory. We are developing new techniques, improving our understanding of background. We are training the next generation of proton decay hunters. And we may get lucky: little additional investment for a potentially enormous reward.

*** What is the physics / motivation for your LOI?**

The broad science program of supernova, neutrino oscillation, and baryon number violation

*** What will you work on between now and Snowmass, and what is your schedule for developing a contributed paper?**

Operating the experiment! Commissioning SK-Gd for full science operation.
Publishing SK research that has been in progress (many Ph.D. topics).

We should be able to generate a white paper documenting our development of SK-Gd,
The science goals, and the associated sensitivities.

*** What common data sets, joint efforts, etc. do you need?**

We always benefit from the neutrino interaction community.
New theoretical ideas that can be studied with our existing data.

*** What would you like to come out of the Snowmass process?**

Community support for the science program so we can continue to conduct Super-K
through the beginning of the next generation of experiments.