Many (all) the questions have been answered during the Q&A period. Nevertheless, we ask that you provide written answers below so students can come back to read them again. Thanks!

1. (Page 4) Why quarks and leptons living together will lead to baryon-lepton number violation?

When I say living together, I am referring to being in the same group theoretical multiplet. The rules of the game are that generators of that multiplet can cause transitions. We learned from the Standard Model that this works well, and explains why electrons and electron neutrinos appear together in weak decays, as do muons and muon neutrinos. So by extension, once we unify quarks and leptons together, we think there will be transitions that can change a quark into a lepton (and vice versa). And such a transition violates baryon number.

2. (Page 19) IMB has better limits than Kamiojande in many cases but they are about the same in some cases (e.g. mu+ pi-, neutrino pi0). And noticeably worse in others such as mu+ rho, neutrino K0. Why?

Good question! When this comes up with my proton decay graduate students, I ask them to look at the details of each search and track that down. It is a good exercise. But my starting guess will be that when the detector with lower exposure (mass*time) has the better limit, it may be a mode where background is expected, and a few extra events of background will lower the limit, causing the larger detector to underperform. Conversely, observing fewer background events than expected will allow a smaller detector to over perform. So fluctuations in the observed events (assumed to be background) is my first suspicion.

3. (Page 24) So... what was the destructive accident?

Here is the coverage in Physics Today:
https://physicstoday.scitation.org/doi/10.1063/1.1457255

The upshot is a single PMT at the bottom of the detector failed, and due to the enormous static pressure, a shock wave developed that destroyed the neighboring PMTs, and the destruction continued as a chain reaction, racing up the detector until the water pressure was low enough.

We recovered the detector with half the PMTs (around 5000) to run until Hamamatsu could fabricate replacements. This is the period we call SK-II.

To prevent this from ever happening again, we designed protective shells that have small holes that allow water to rush in slowly if a PMT implodes. This causes little nearby effect and no chain reaction develops. Here is a picture.

4. (Page 25) On the left, we say the golden mode has no neutron capture. On the right, it shows neutron capture signals after a few hundred micro-sec. I must have misunderstood this page completely!

My fault for the confusion! I put the inset in to illustrate the timing and size of the signal from neutron capture. Neutron capture is present for background, but we are looking for it to be absent for signal (proton decay). I shouldn't have implied it was present in that beautiful (simulated) event.

5. There was a question about IMB vs Kamiokande limits. You said the difference is likely due to background that remained. Aren't they similar in using water and kept underground? Why would there be such large background differences?

To first order, there shouldn't be large expected background differences. My answer (see above) referred to whether an experiment was lucky or unlucky. It is also true that although IMB was three times larger, it had lower photocathode coverage. That can affect the signal efficiency and background rejection, allowing Kamiokande to catch up in sensitivity.

6. Suppose we saw an apparent signal of proton decay at Hyper-Kamiokande, but no sign of any topological defects. How would one distinguish with the help of experiment between different possible group theoretic symmetry breaking chains that might exist in nature?

That's a common problem. You see a signature but don't know what to make of it. There can be a long way to go to interpret what you are seeing. This applies to more than proton decay.

In the early days, I am sure people dreamed of seeing enough proton decay, maybe after building follow-on experiments, in order to measure several different modes. GUTs are pretty good about predicting the branching ratios. If we someday see enough proton decay to measure branching ratios, the results will give us some information about the underlying group theory.

But now, we are desperate to see just the first sign of proton decay. Still, if the first event we see is neutrino-K+ we will be excited for supersymmetry, which is pretty specific in predicting decays that involve 2nd generation quarks.

But as I alluded to: if a hint comes out, maybe at Hyper-K, then there will be a strong motivation to build a bigger experiment. Once you have an idea that there is something there, you can imagine a lot of support to build something to map things out.