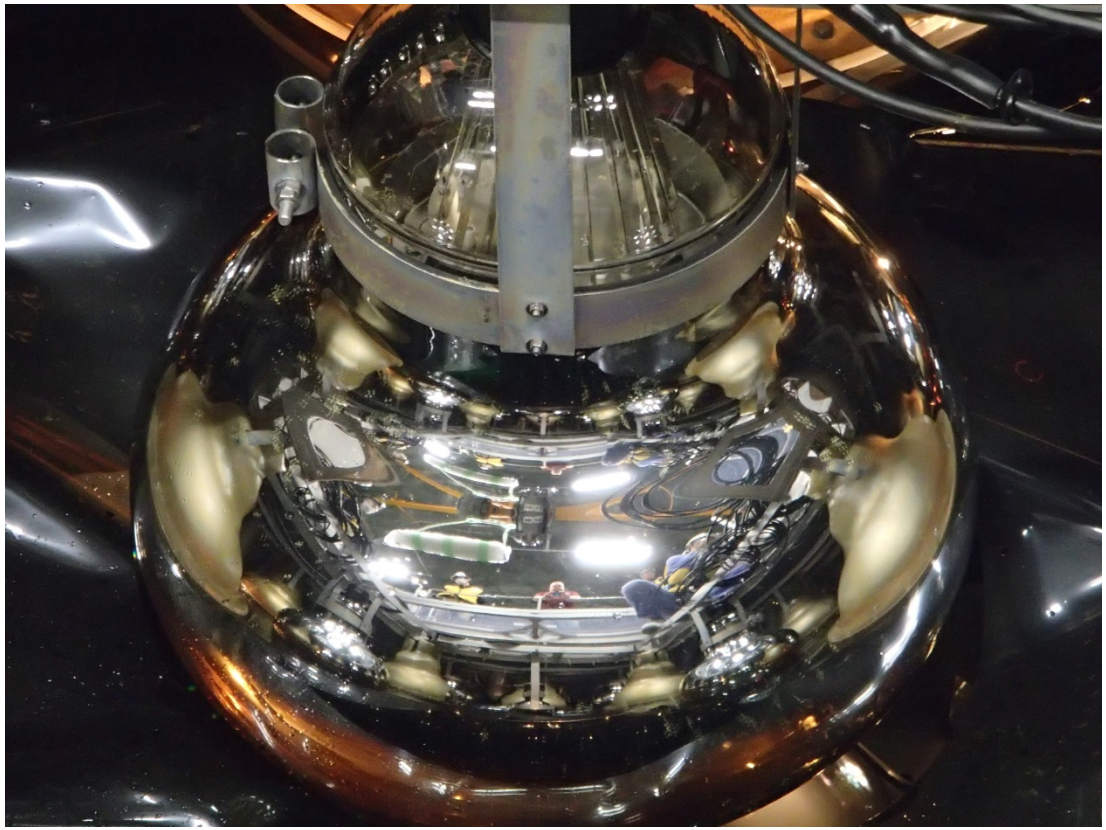
Gd Status



Mark Vagins

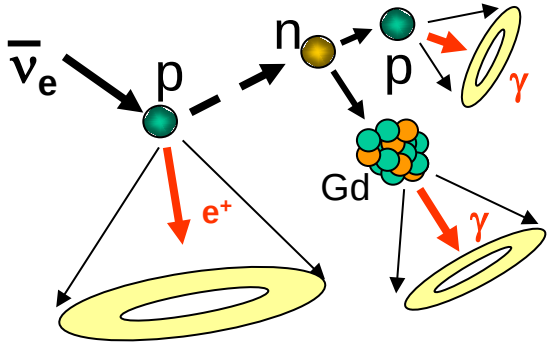
Kavli IPMU, University of Tokyo

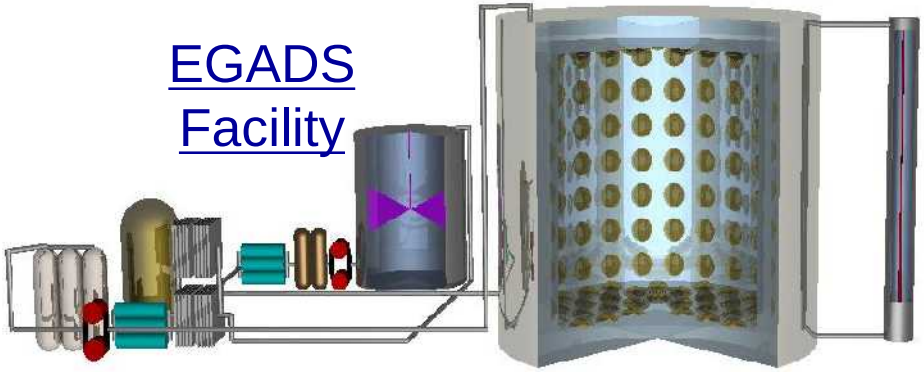
5th Open Meeting for the Hyper-Kamiokande Project

Vancouver July 21, 2014

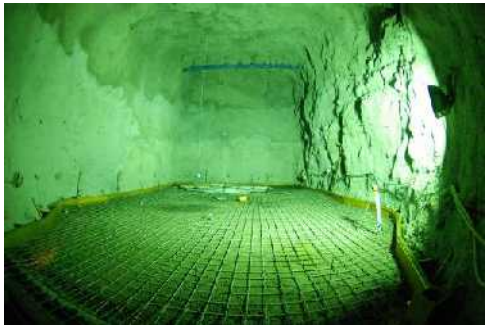
EGADS – Evaluating Gadolinium's Action on Detector Systems

Adding water soluble gadolinium to Hyper-K would greatly enhance its ability to detect antineutrinos. EGADS is a dedicated gadolinium demonstrator project which includes a working 200 ton scale model of Super-K.

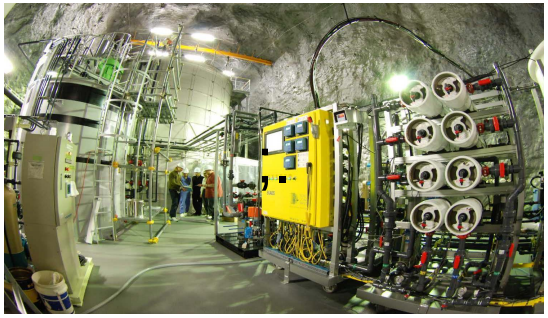




Beacom and Vagins, *Phys. Rev. Lett.*, 93:171101, 2004

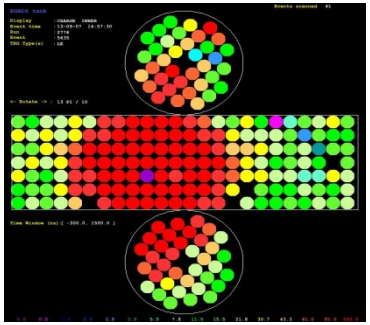


12/2009



11/2011

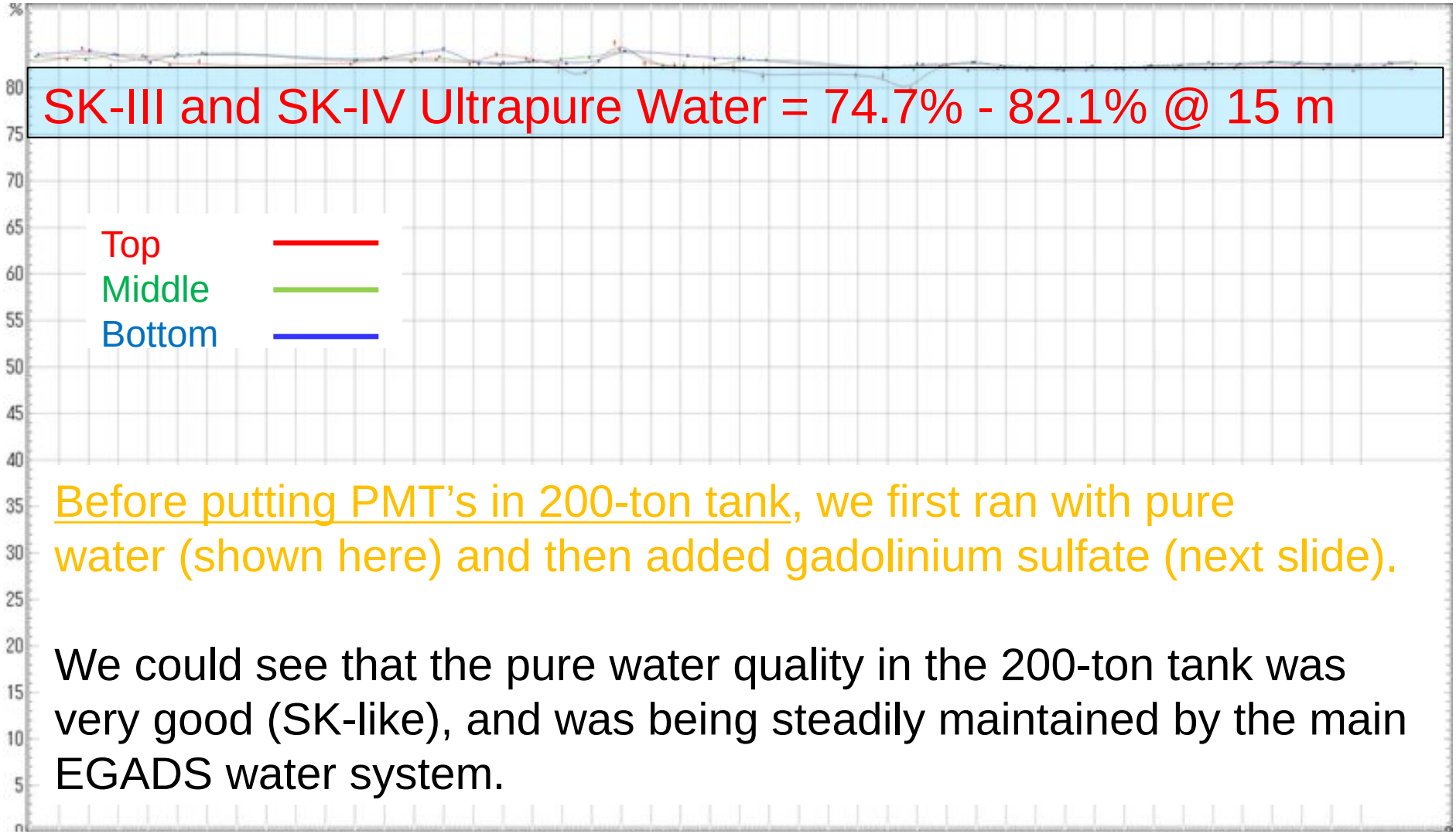
8/2013



9/2013

Within this year, EGADS will have shown conclusively whether or not gadolinium loading of Super-K/Hyper-K will be safe and effective.
If so, this is the likely future of *all* light water Cherenkov detectors.

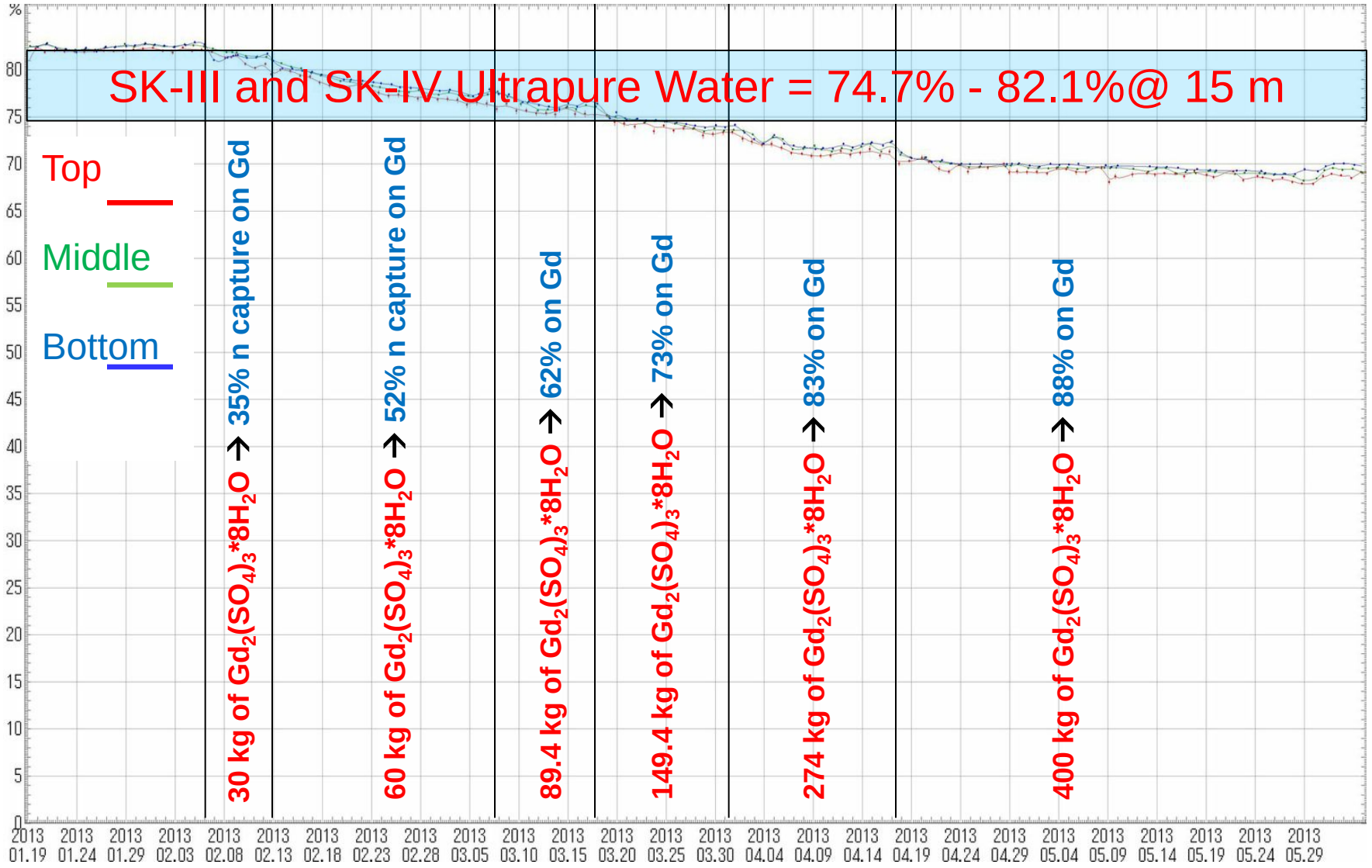
Light @ 15 meters in the 200-ton tank (pure water, no PMT's)



Before putting PMT's in 200-ton tank, we first ran with pure water (shown here) and then added gadolinium sulfate (next slide).

We could see that the pure water quality in the 200-ton tank was very good (SK-like), and was being steadily maintained by the main EGADS water system.

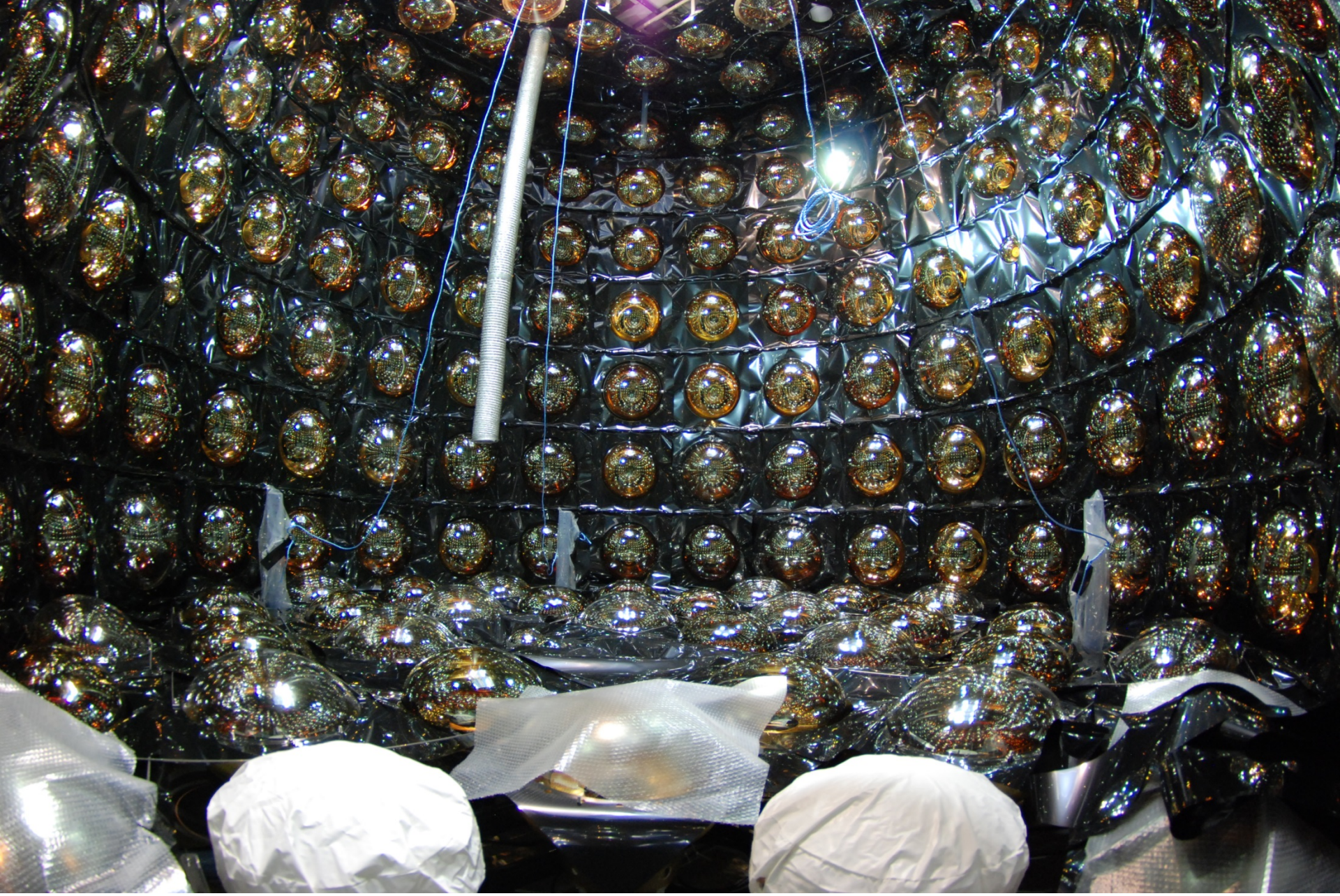
Light @ 15 meters in the 200-ton tank (Gd water, no PMT's)



Before installation of PMT's, smooth behavior as Gd is added.

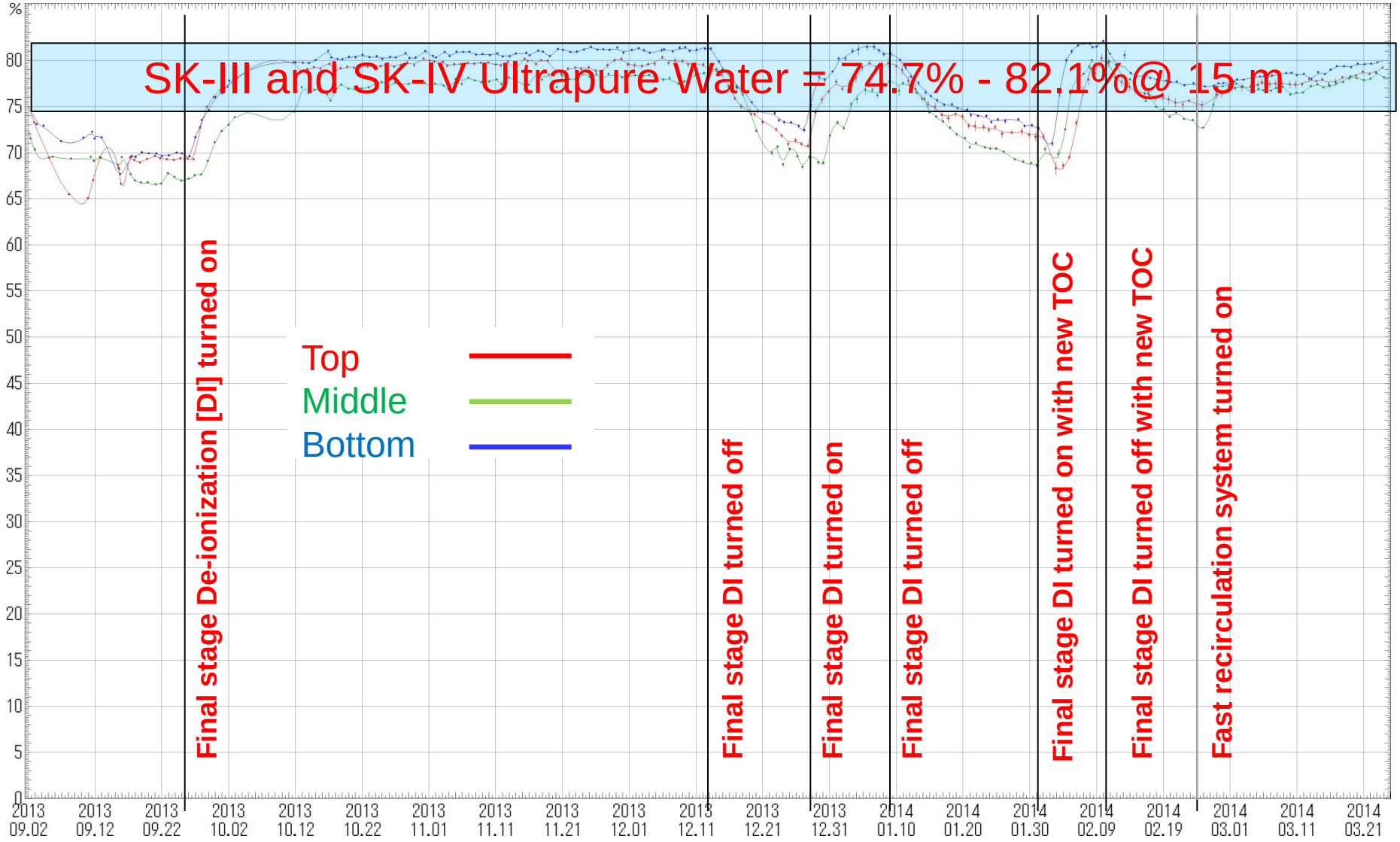
Fully Gd loaded, light dropped by <15% compared to SK-III/IV.


Looking down into the EGADS tank after four months of gadolinium exposure. No rust!



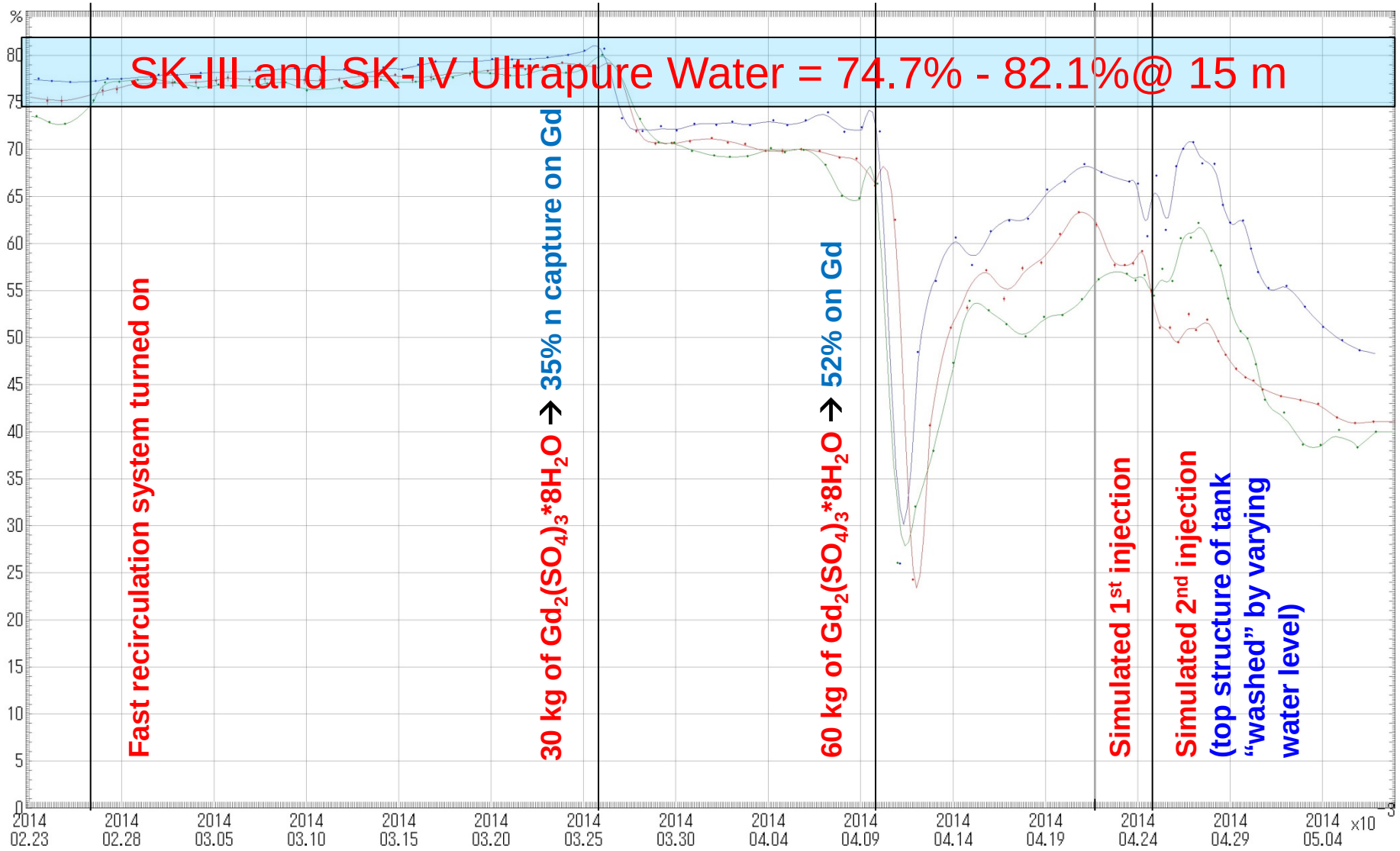
Inside of EGADS tank; August 8, 2013.

Light @ 15 meters in the 200-ton tank (pure water, with PMT's)



Although this behavior was mysterious – what was being removed by DI and/or fast recirc? – we finally decided to add gadolinium…

Light @ 15 meters in the 200-ton tank (Gd water, with PMT's)



Yikes! Very different from what we saw in the bare tank.

Now we can induce light loss without adding Gd (or anything)!

May, 2014

A trusted Japanese vendor had assured us this structural wire was 304 stainless steel based on the manufacturing company's claims, but in fact it is – at best – 410 stainless (less corrosion resistant).

This wire also has a core made of Nylon 6: <u>not designed for water.</u>

What's next?

Now that we have discovered the source of the water quality issues, we must eliminate the problem, clean up the EGADS detector, and provide the final proof of principle of Gd-loading for Super-K during 2014. Practically speaking, this means:

1) Build floating floor in 200-ton tank
2) Remove rusted wire and stained black sheets
3) Clean deposited rust off all surfaces
4) Re-passivate SS components
5) Reinstall black sheets + new wire
6) Flush tank and fill with pure water
7) Resume studies, first with pure water, then with gadolinium

All recovery work is expected to be completed by September 22nd, 2014. Data taking will resume after that.