EGADS as a real time galactic supernova detector:
HEIMDALL

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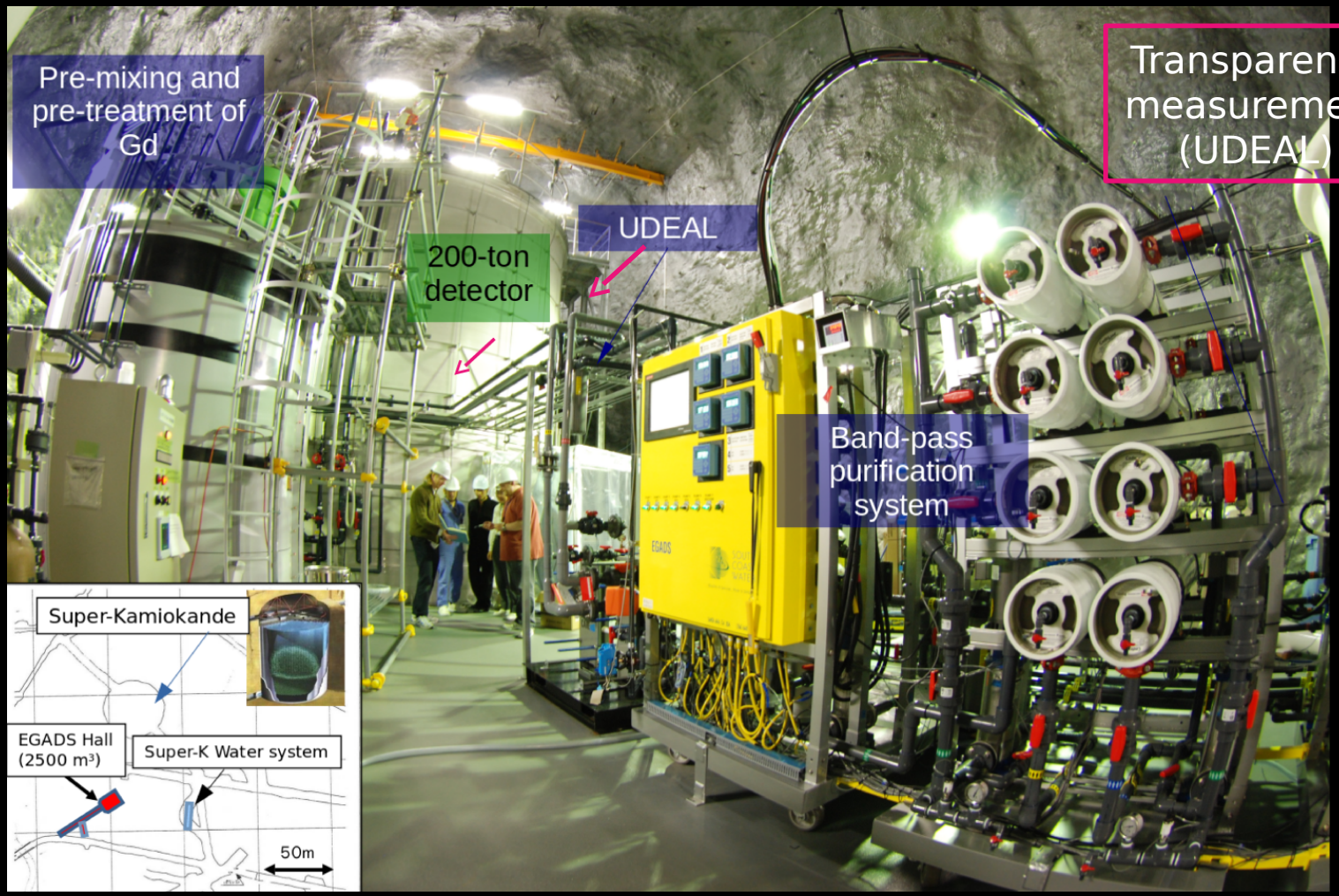
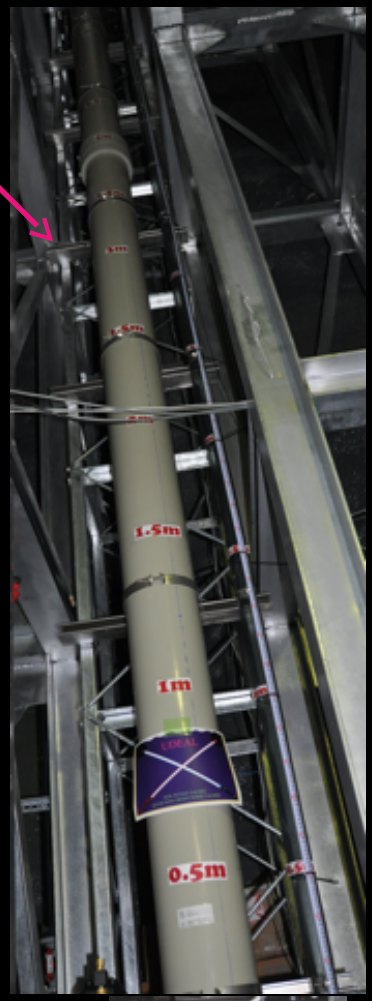
EGADS

Evaluating Gadolinium's Action on Detector Systems
Employing Gadolinium to Autonomously Detect Supernovae



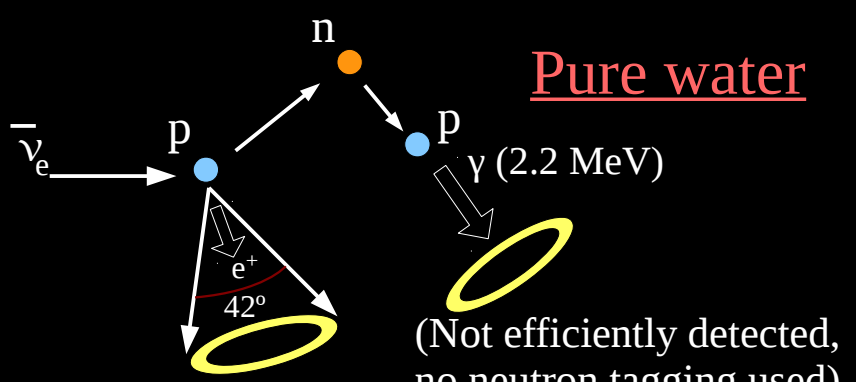
Transparency measurement (UDEAL)



R&D test facility to prove Gd related techniques for SuperK

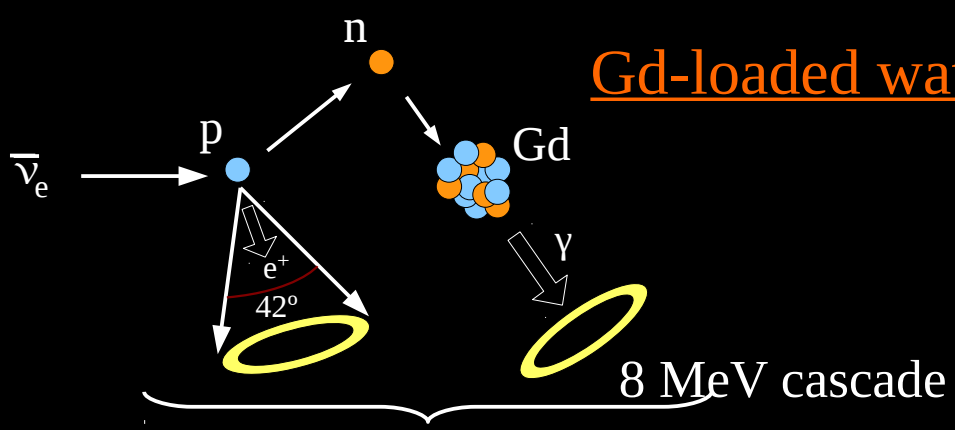
More info here:
arXiv:1908.11532v1 [physics.ins-det]

Efficient neutron tagging



Pure water

(Not efficiently detected, no neutron tagging used)



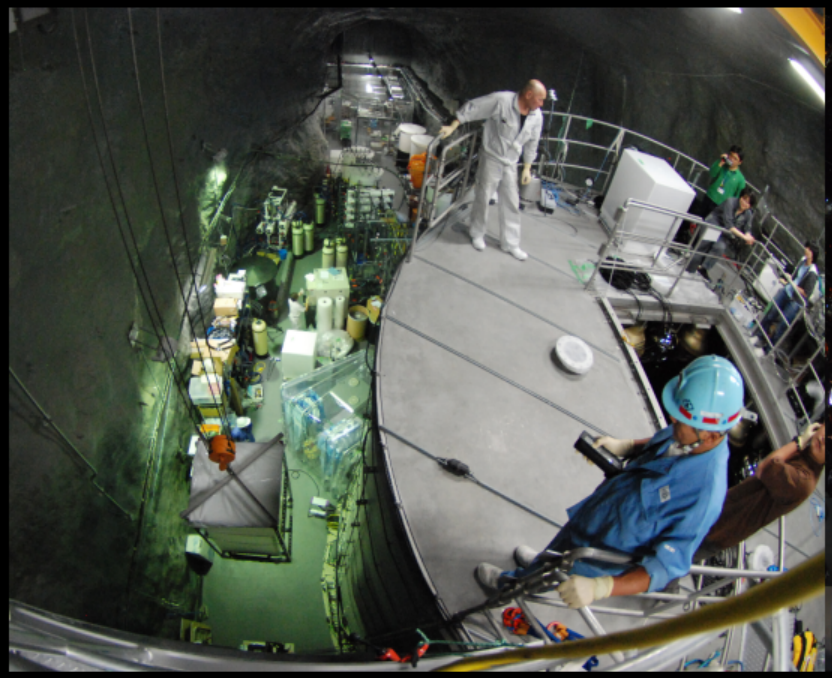
Gd-loaded water

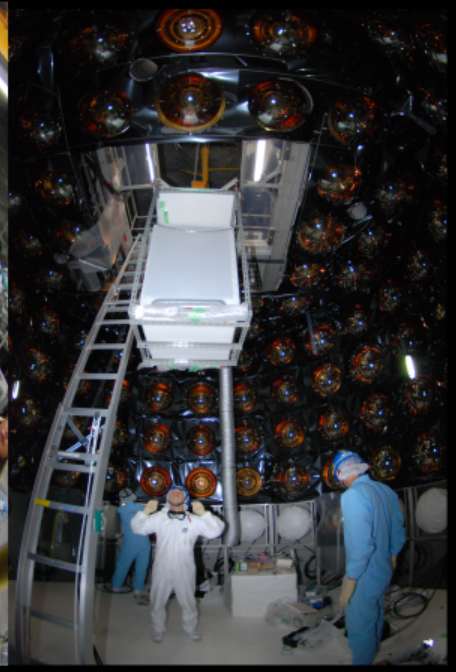
With Tight time (delayed) and position coincidence between positron and neutron capture (90% neutron capture on Gd with 0.2% $Gd_2(SO_4)_3$ concentration) we will be able to reduce backgrounds and detect SRN for the first time!

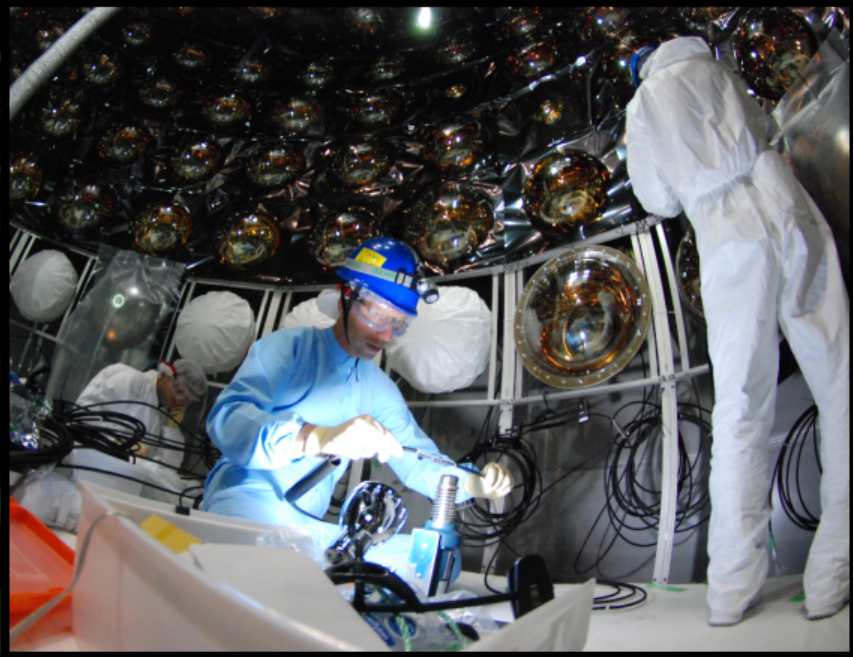
Idea proposed as GADZOOKS!
by Beacom & Vagins PRL.93, (2004) 171101

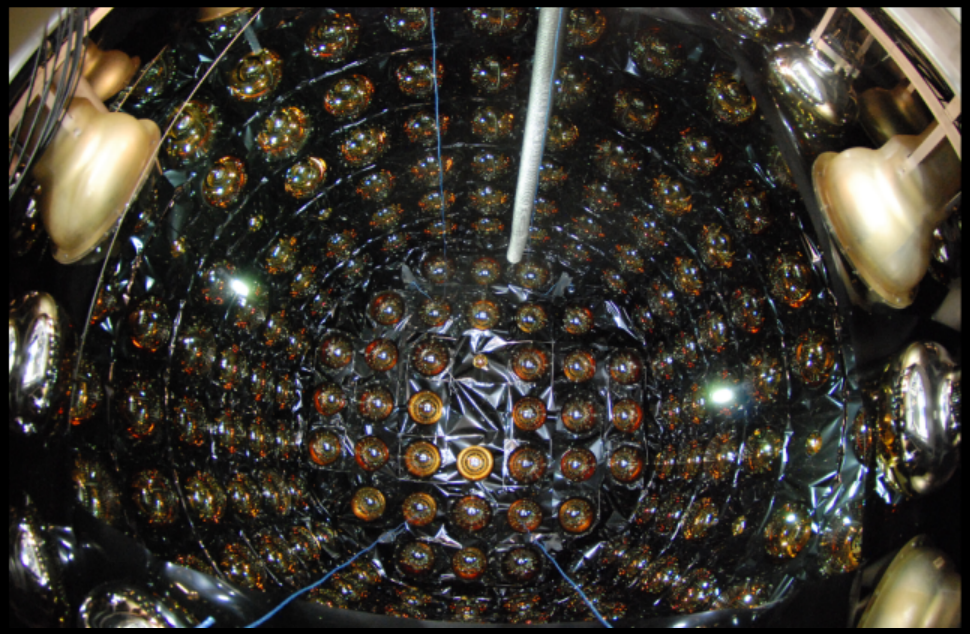
- Neutrinos from ccSNe are detected mostly from IBD events
- Because of the double signal, prompt positron and delayed neutron capture, it is difficult for backgrounds to replicate IBD's signature

PMT and electronics installation









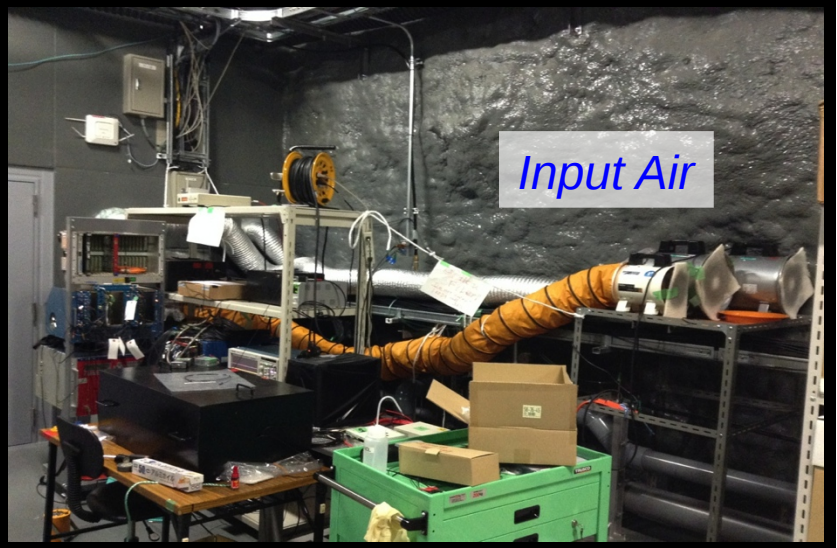
PMT and electronics installation

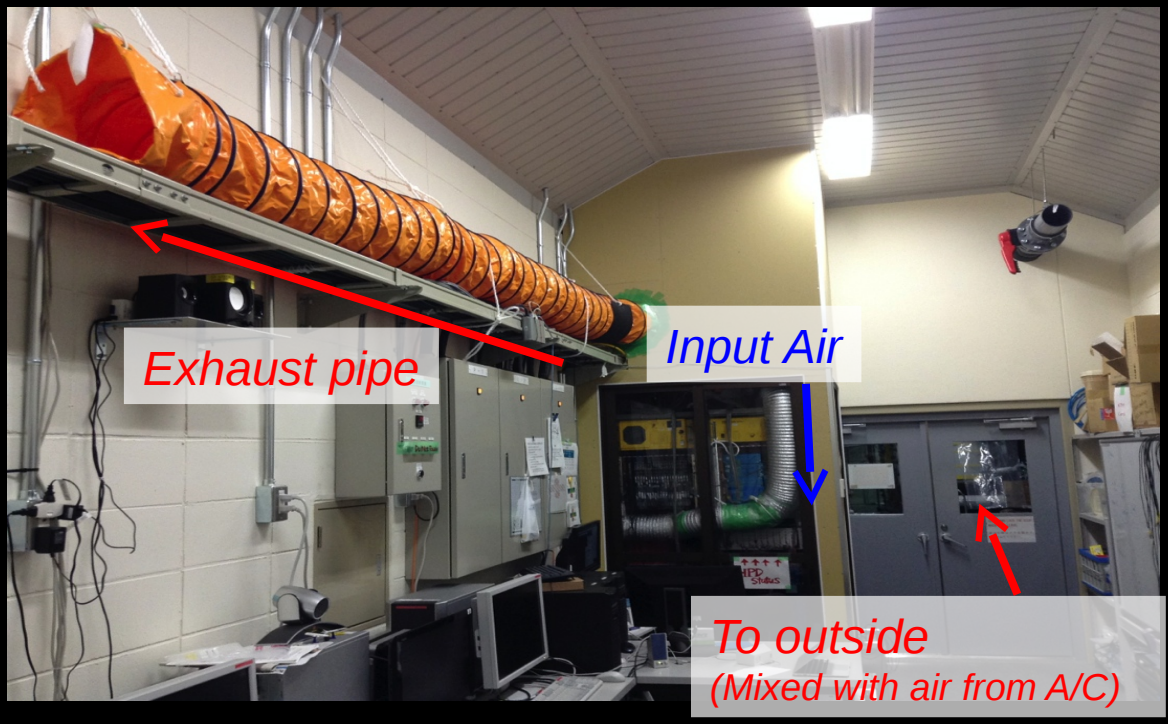
- DAQ ran with very high livetime
- Temperature stable within ~1º C

- DAQ and slow control monitor checks every 2 hours by shifters:
  - detector compensation coils
  - PMT HV (CAEN)
  - DAQ status

- Automated warning emails to experts in case of problems

In 2017 electronics was upgraded to withstand the high rates of a close SN





HEIMDALL introduction/motivation

Expected numbers for galactic SN bursts*:

Betelgeuse (~200 pc)	Galactic center (~8 kpc)
$25\text{-}65 \cdot 10^3$ IBD	15-40 IBD
800-2000 elastic scat.	$\lesssim 1$ elastic scat.

- EGADS/HEIMDALL watches in real time for galactic SNe:

→ For close SNe: new electronics allow acquisition of high event rates

→ Far SNe: neutron tagging with Gd, i.e. detecting a few IBD-compatible events will tell us a SN happened

→ HEIMDALL watches for galactic SNe and will give an instant, automatic and independent alert to us and the community

* Nakazato et al. (ApJ Supp. 205, 2 (2013)) $20M_{\odot}$