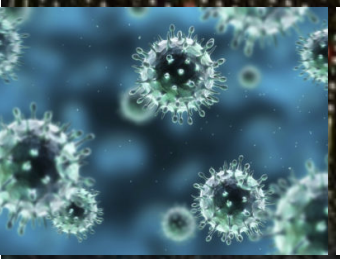
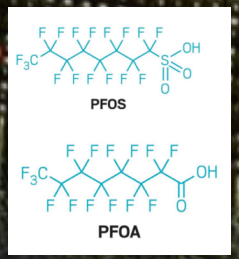
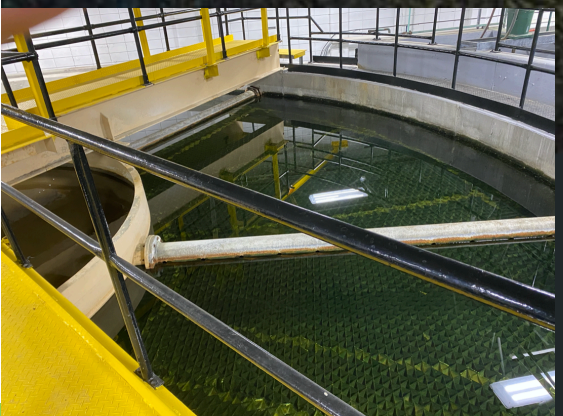


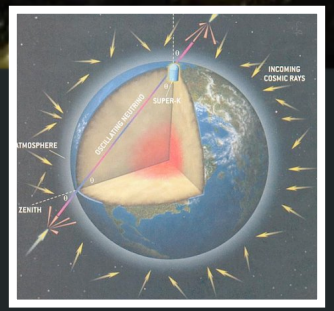




Water monitoring project

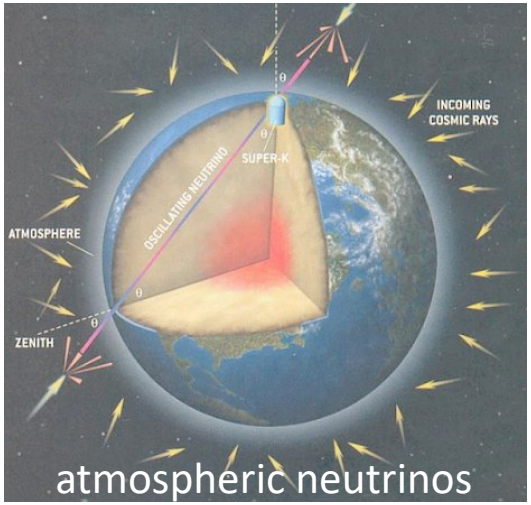
Akira Konaka (TRIUMF)

August 2, 2023




15

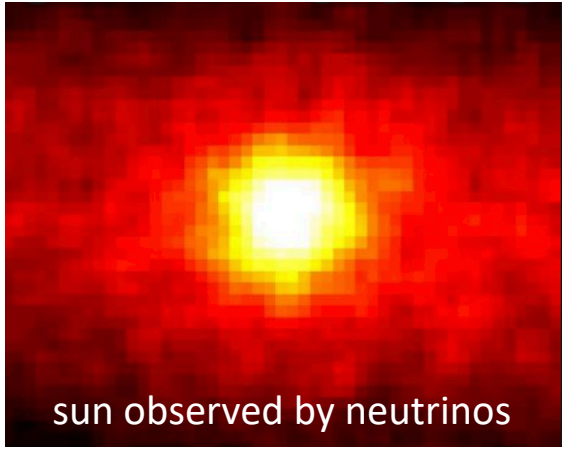
Neutrino observatory: Super-Kamiokande

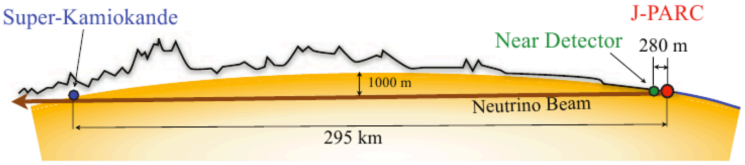


atmospheric neutrinos

- Study of neutrinos
  - penetrate the earth and the stars:
    - study deep inside
  - the fundamental property of neutrinos


supernova neutrinos

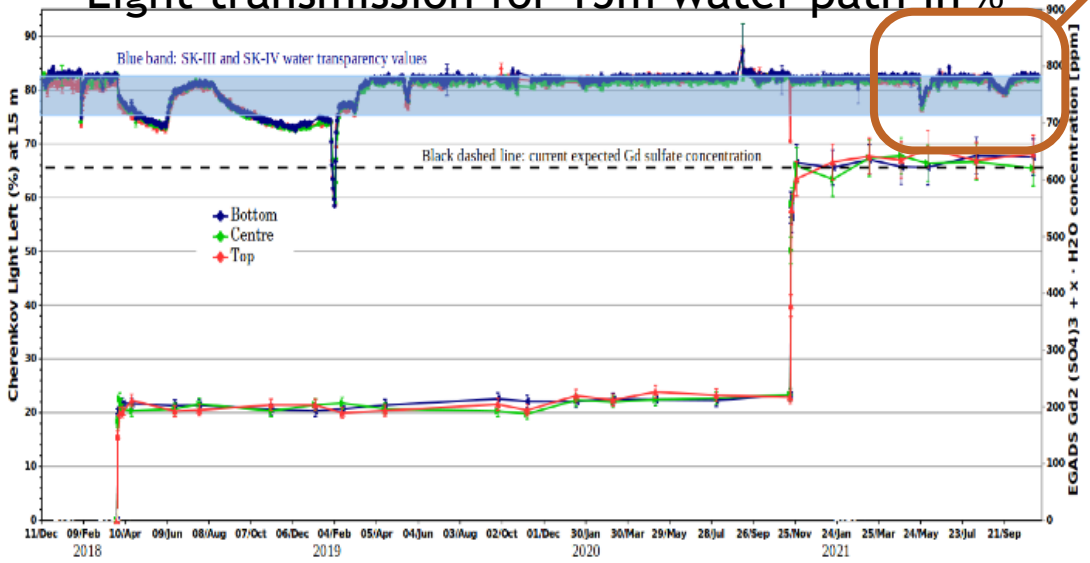

sun observed by neutrinos

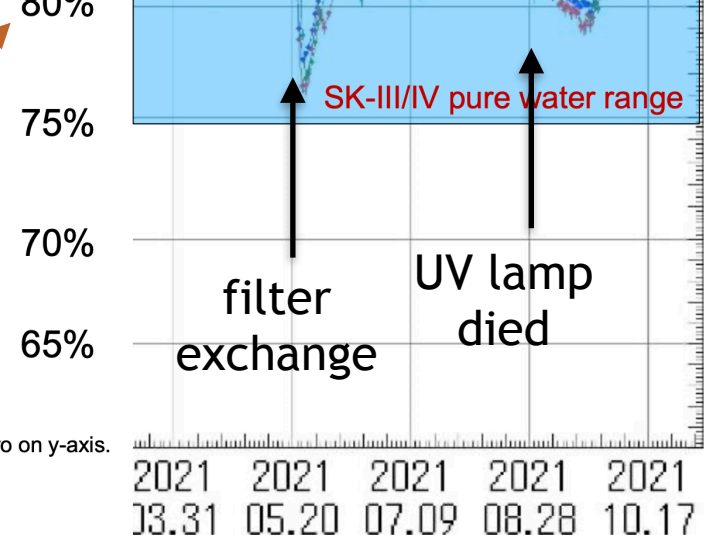



galactic neutrinos

Real-time water monitoring in Super-Kamiokande

- Transmission continuously monitored
  - time correlation is a powerful tool in identifying the source
- New tool in water monitoring
  - instead of water sampling and lab. test

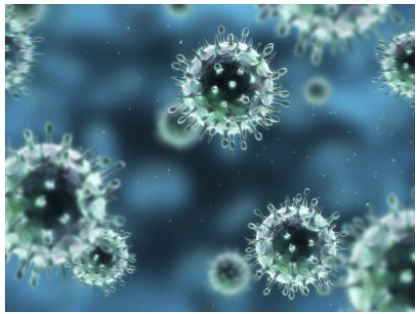


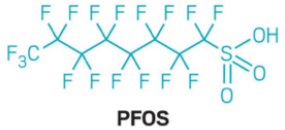


sed zero on y-axis.

Drinking water quality challenge

- Pollution
  - Cyanobacterial harmful algae-blooms
  - Pesticides, oil contamination, industrial waste
  - Emerging organic pollutants, such as pharmaceuticals and PFAS (forever chemicals)
  - Microplastics, Pathogens
- Disproportionally affects Indigenous communities
  - 31 long-term drinking water advisories
  - Water sampling tests take too long and are costly
- Monitoring techniques
  - Limited parameters: turbidity, pH, chlorine, etc.
  - Lacking cost-effective and fast detection techniques
    → Our Water Quality Monitoring can be a solution





PFOS

PFOA

- Today
  - Strange smell
  - Samples sent to lab
  - 2-3 weeks for test result while water unavailable

- Vision
  - real-time monitoring
  - immediate detection to prevent illness and environmental damage

Nov. 2021

Iqaluit: A month without clean water in Canada's north

13 November 2021

BBC NEWS

Sensitivity to drinking water

	drinking water limit	absorption coeff.	absorption in 10m	absorption in 1cm
Benzene	5 µg/L	240 /mol/cm @254nm	1.47% @254nm	0.00147%@254nm
Microcystin	1.5 µg/L	13,225 mol/cm @254nm	4.5% @254nm	0.0045% @254nm
	1.5 µg/L	40,000 mol/cm @240nm	13.2% @240nm	0.0132%@240nm
NDMA	0.04 µg/L	10,000 /mol/cm @240nm	1.2% @240nm	0.0012%@240nm

- Benzene: typical toxic pollutant from oil spills
- Microcystin: cyanotoxin from algae
- NDMA: disinfection by-product from water treatment

10 m provides 1000 x the optical signal of a 1cm lab sample

Metal contaminant example: Mercury

CBC

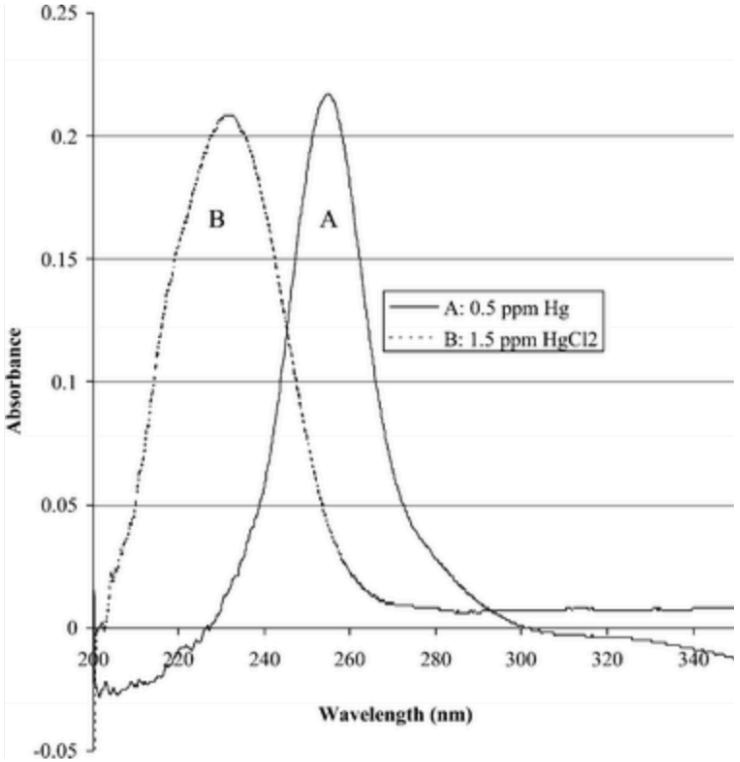
'Significant' amounts of mercury in permafrost threatens Arctic food supply, research says

Speed at which permafrost is releasing toxic metal is still being studied

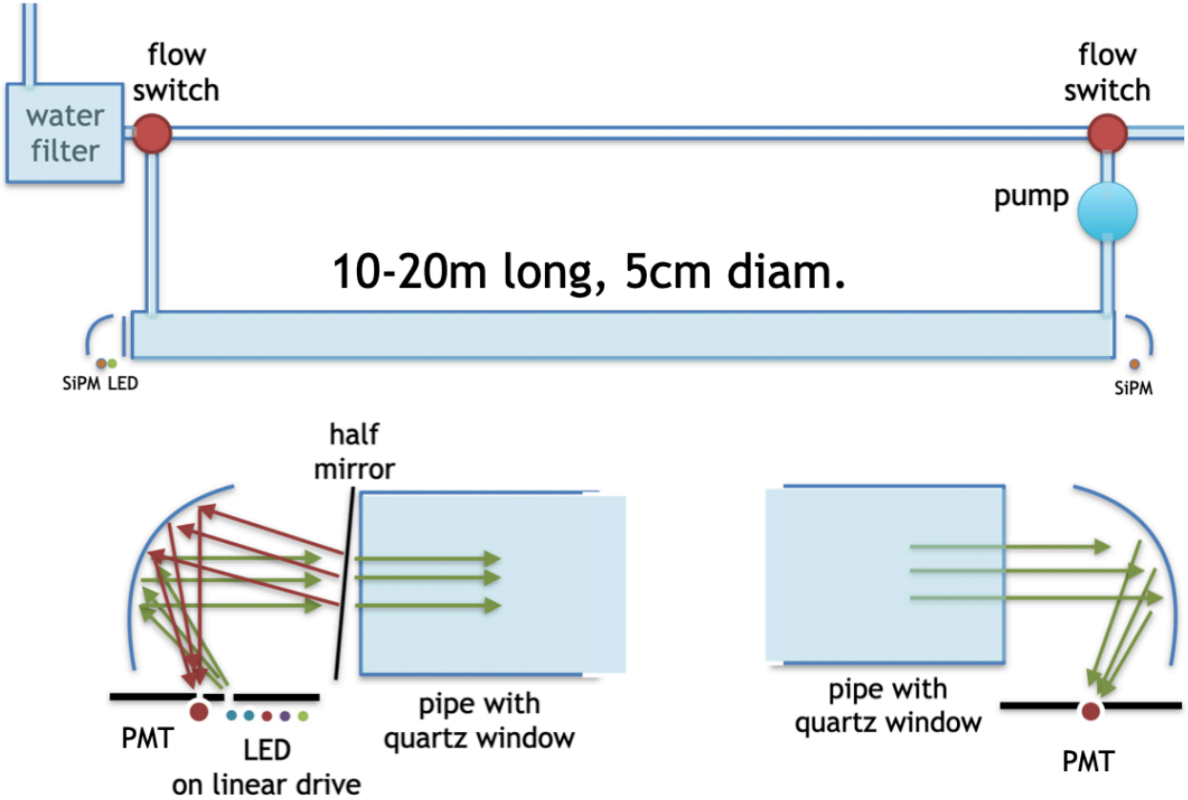
Liny Lamberink · CBC News · Posted: Jun 02, 2022 4:55 PM PDT | Last Updated: June 2, 2022

- Hg drinking water limit: 1µg/L = 1ppb
- 1.6m 150ppb 8%
  → 20m 1ppb 0.67%
- Metal contaminants have narrow absorption lines
  - deep UV accessible with LED
  - peak shifts for compounds ($HgCl_2$)

Analyst, 2004,**129**, 342-346

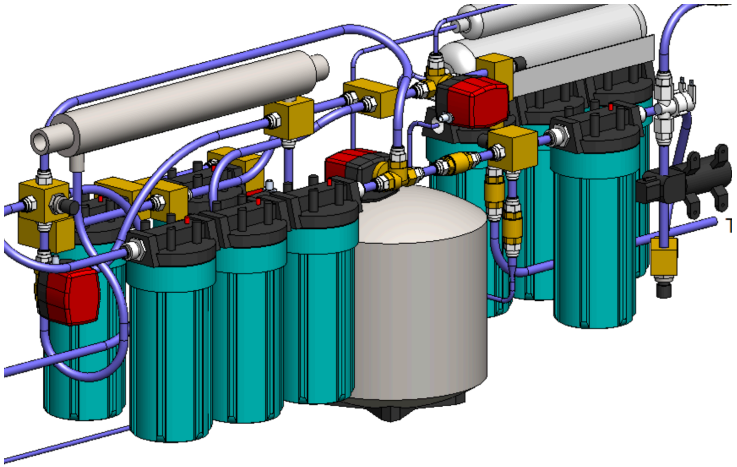


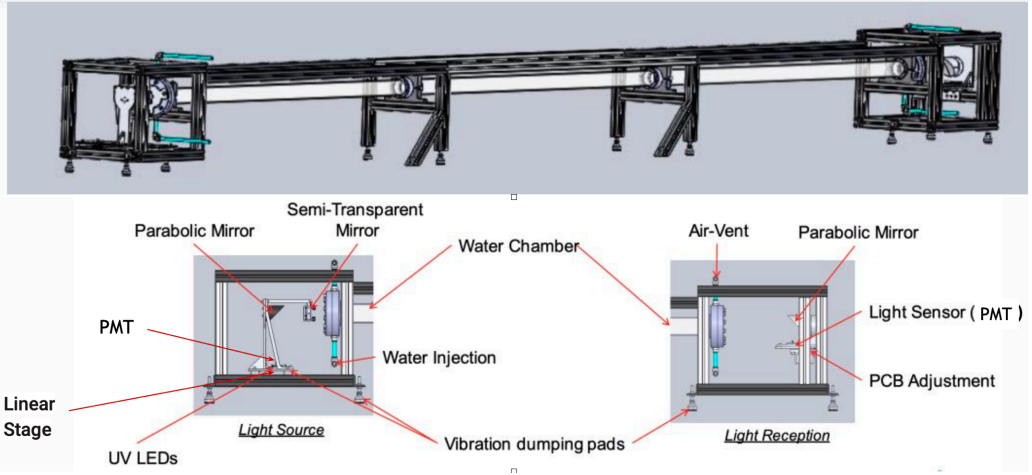
Proposed drinking water system

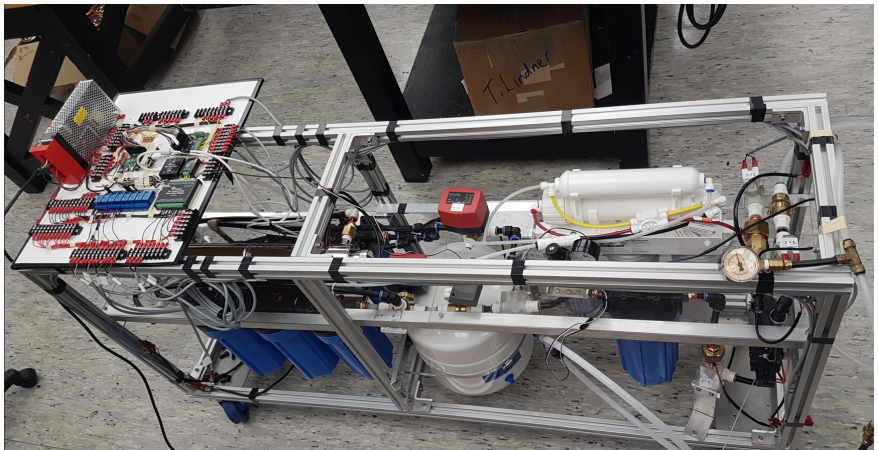


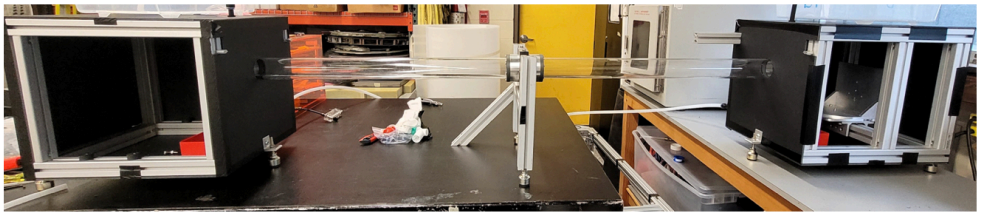
- High sensitivity
  - long water pipe
  - deep UV LED
- Sensitive to drinking water level
- Low cost system

Proposed drinking water system









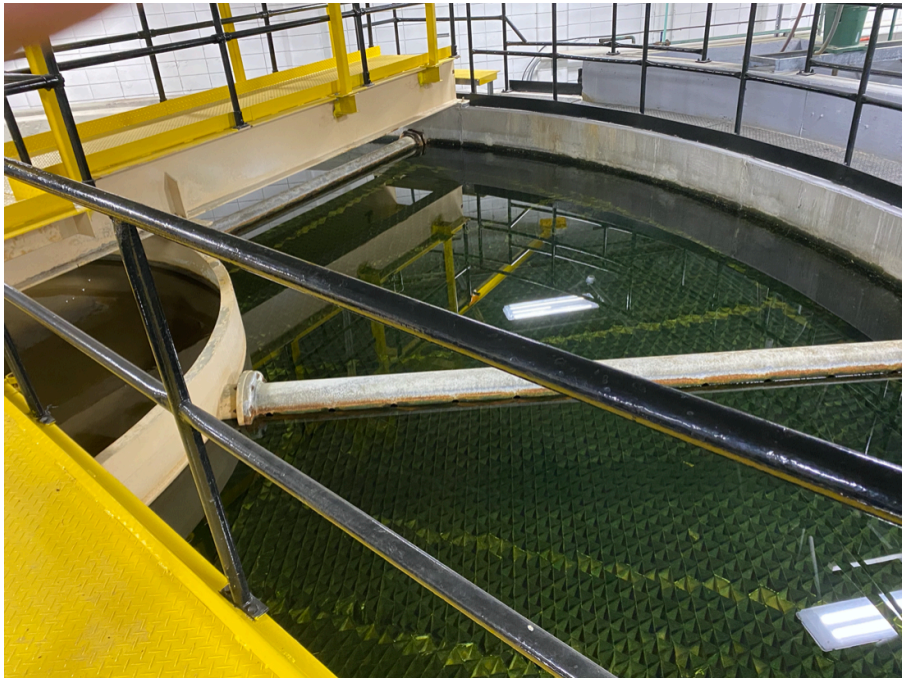
Sahar Tagnayor's presentation yesterday

Pilot project

Cowesses First Nation

deployment experience
at the First Nations community

Weyburn Water Treatment Facility



dynamically adjust water treatment chemicals
(opening a new paradigm)

Future deployment consideration

- Ahtahkakoop Cree Nation
  - Jana's home nation
  - water quality issue exists
- Water source quality of lakes
  - Algae growth with climate change
  - Prof. Kerri Finley (Regina), Prof. Norra Casson (Winnipeg)
- NWT, Scotty Creek research station
  - Prof. Elise Devoie (Queens)
  - release of mercury from melting permafrost
  - underground water storage with chlorine disinfection only

Iqaluit: A month without clean water in Canada's north

13 November 2021