Water monitoring for WCTE

Akira Konaka (TRIUMF) July 19, 2022

- Transmission in 15m water is 80% in SuperK
 - only a few % loss is expected in small WCTE in priciple if the water quality is kept at SuperK level
- WCTE water quality is expected to be worse than SuperK
 - A higher water temperature: 13.6 degrees \rightarrow 20 degrees?
 - depending on the chiller power and thermal isolation
 - bacteria growth increases rapidly above 15 degrees
 - Limited water cleaning system be installed to save costs
 - UV filter, microfilter, and chiller
 - potential uncertainty from bacteria, chemical leaching
- Water monitoring system to detect problems before impacting physics
 - bacteria growth, deterioration of the microfilter
 - prototype for IWCD which is also a smaller detector than SuperK

Continuous water monitoring of SuperK detector

80%

Drop due to insufficient flushing of newly-installed

(previously reported at last SK CM).

anion resin.

Drop due to loss

of TOC lamp.

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





Water monitoring concept

- In-line continuous monitoring of the return water
- Pulsed LED light through
 10-20m sample water
 - 230 700nm
 - parabolic mirror focus
 - SiPM at source/reception
- Relative to purified water
 - ultra-pure (RO)
 - particle filter (MF,NF)
 - ion exchange resins
 - UV steriliser (organic)

Mechanical design





modular design for assembly and maintenance

Water filtration system





- use home water purification parts
- valve and sensor control using Rasberry-pi

Optical prototype (Sahar Taghayor)

- parabolic mirror test to develop
 - 1mrad collimation (1cm @ 10m)
 - stray light
 - baffle design
 - vibration effect
 - alignment method



Sub-nsec pulsed LED



Prototyping status

<u>Task Name</u>				April			May		June			July		August			September		Т	October			November		
			<u>Resource Name</u>	3/28/22	4/4/22 4/11/22 4/18/22	5/2/22 5/9/22	5/16/22 5/33/22	22/0E/S	6/6/22	6/27/22 6/27/22	7/4/22	7/11/22 7/18/22	7/25/22	8/1/22	8/15/22 8/15/22	8/22/22	8/29/22 9/5/22	9/12/22	9/19/22	10/3/22	10/10/22	10/17/22 10/24/22	10/31/22	22/17/11	11/28/22
Bench																				_					
	Design Manufacturing	Frame Water Chamber Light Soure and Reception	Nicolas Nicolas Nicolas		100	1009 %	100%			200	14			_											
	Machine Shop MS/DSF/Kaden												1	0%				_							
	Assembly		Nicolas/Rick/?	I .																					
Filtration System																									
	Design	Flow schematics Mechanical Design	Philip Philip	10	0%	1	100	%																	
	Procurement		Philip	50%																					
	Assembly	Piping Sensor integration	Philip/Rick Philip/Rick										Ŀ						_						
	Commissionning		Philip/Rick/Kaden																						
Monitoring and Control		wadan Maslan		1000/																					
	Schematics Sensors Procurement Programmation Tests		Kaden, Nicolas Kaden Kaden Kaden/Nicolas/?		100%		1009	%	30%				-												
Integration																									
	Assembly Commissionning Delivery		Nicolas/Philip/Rick Nicolas/Philip/Kaden Nicolas/Philip																		7		7		
Documentation for Next Phase																									
Documentation			Nicolas/Philip																						

The first full prototype will be ready in November 2022 for testing



- Water quality may quickly change in WCTE
 - bacteria growth, chemical leaching, corrosion
 - Gd loading could make a significant impact
- Water monitoring could detect the change early and take an action before it gets worse
 - replacing the filter or UV lamp, lowering water temperature, speeding up the water circulation speed, etc.
 - adjust the speed of loading Gd
- Full scale prototype is under construction
 - ready by November this year