Slow control and monitoring system for JSNS²-II experiment

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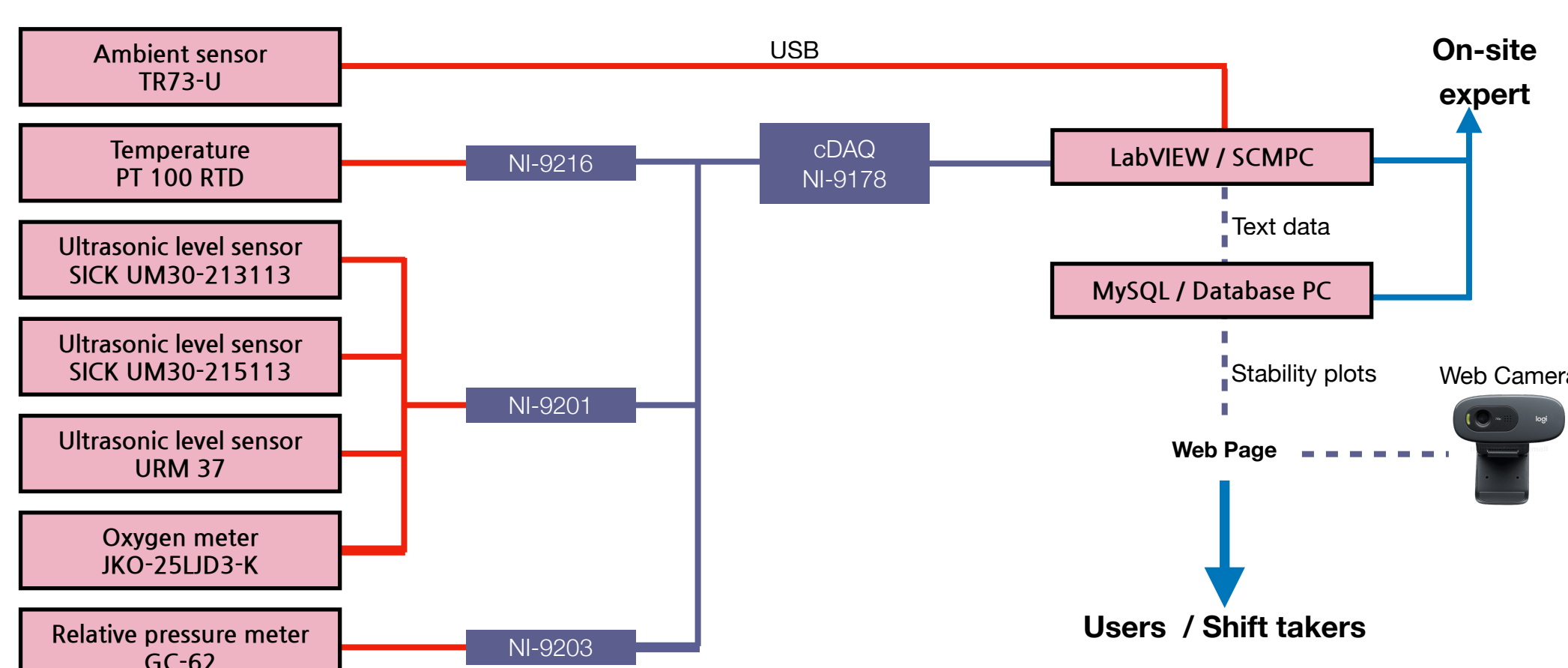[3]Laboratory for high energy physics, Dongshin University

Introduction

- **The second phase [1] of the JSNS² experiment**
  (**J**-PARC **S**terile **N**eutrino **S**earch at **J**-PARC **S**pallation **N**eutron **S**ource)
- JSNS²-II far detector will improve the sensitivity significantly, especially at low Δm^2 region.
- 37 m³ Gd-LS for the neutrino target
- 150 m³ LS for the gamma catcher and veto
- Acrylic vessel for target [2] and SUS tank for gamma catcher and veto
- Installed 220 10-inch PMTs (inner : 172 , veto : 48) / baseline : 48 m (near detector : 24 m)
- SCM(Slow Control and Monitoring system) is essential for stable operation.
- HVCM(High Voltage Control and Monitoring system) [3] is monitoring PMT stability.

(Expected)
JSNS² 3years + JSNS²-II 5 years

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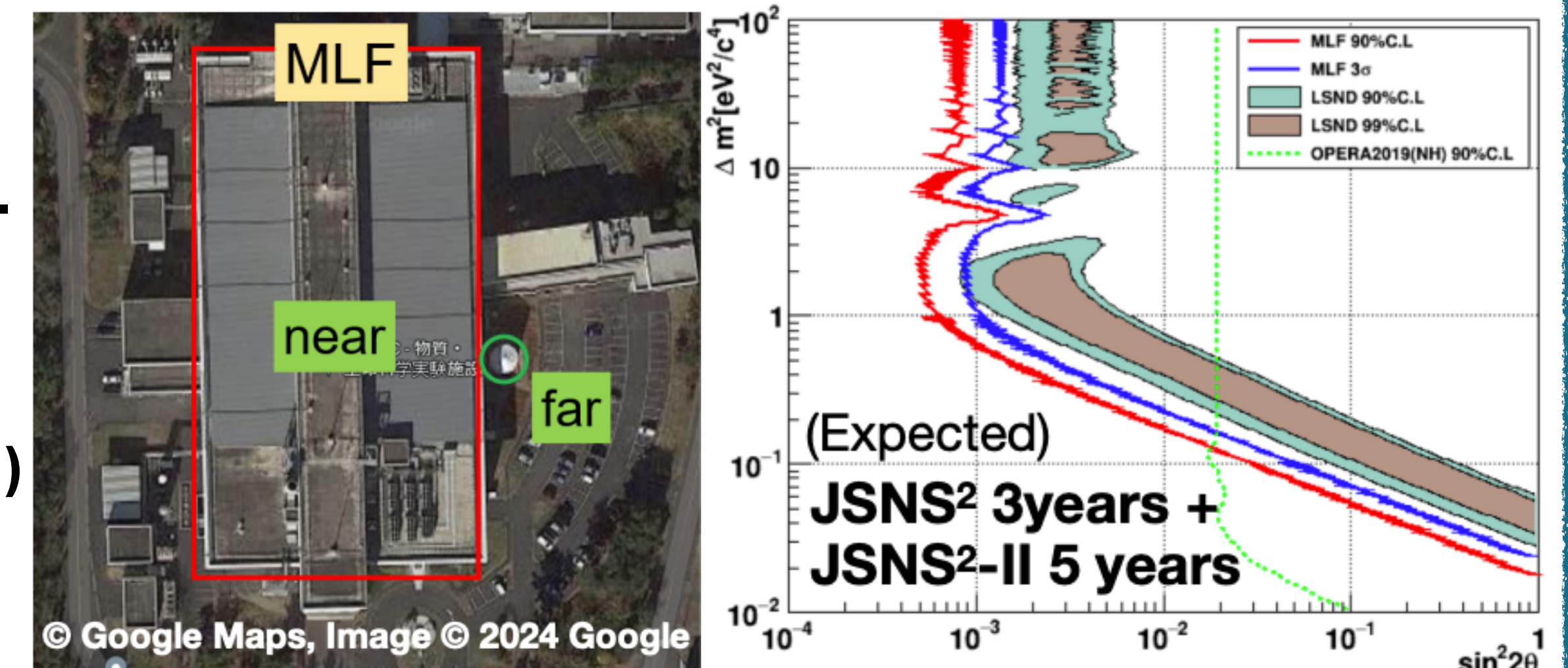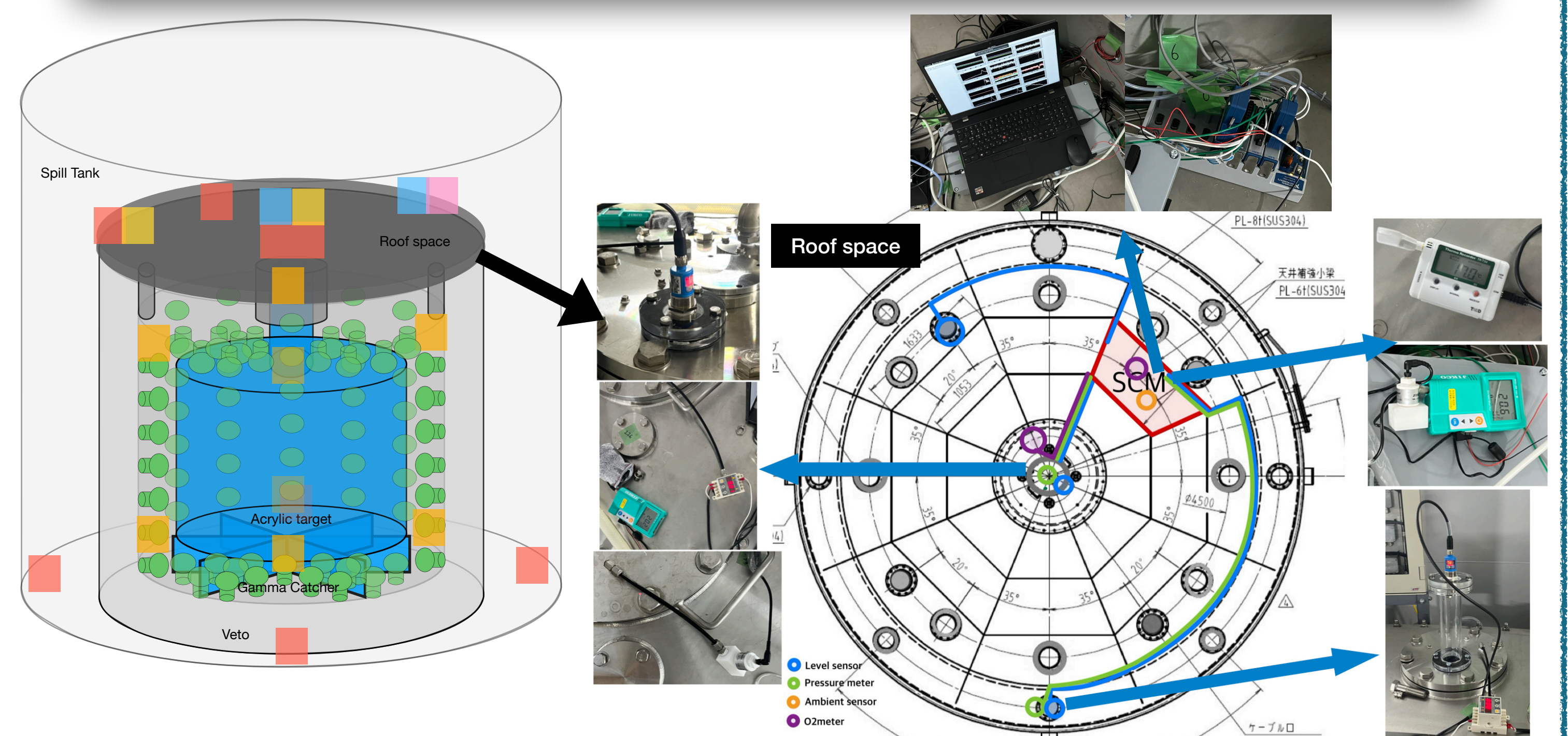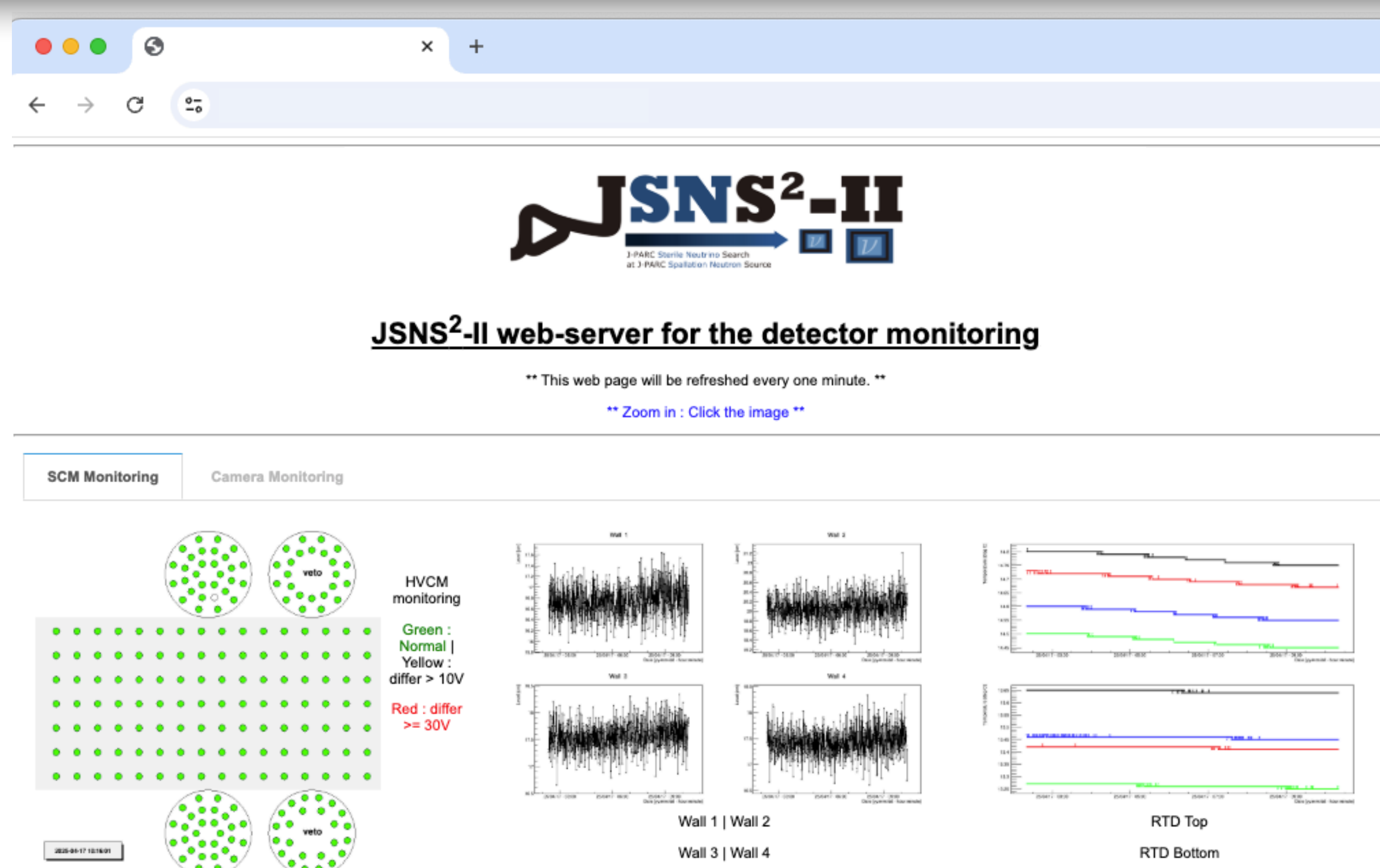
Algorithm of the program

- Development environment
  - Rocky Linux 8.8
  - MySQL 8.0
  - Linux based LabVIEW 2022 Q3
  - NI cDAQ-9178 crate
- Completed development
  - Test and build in KNU and CNU
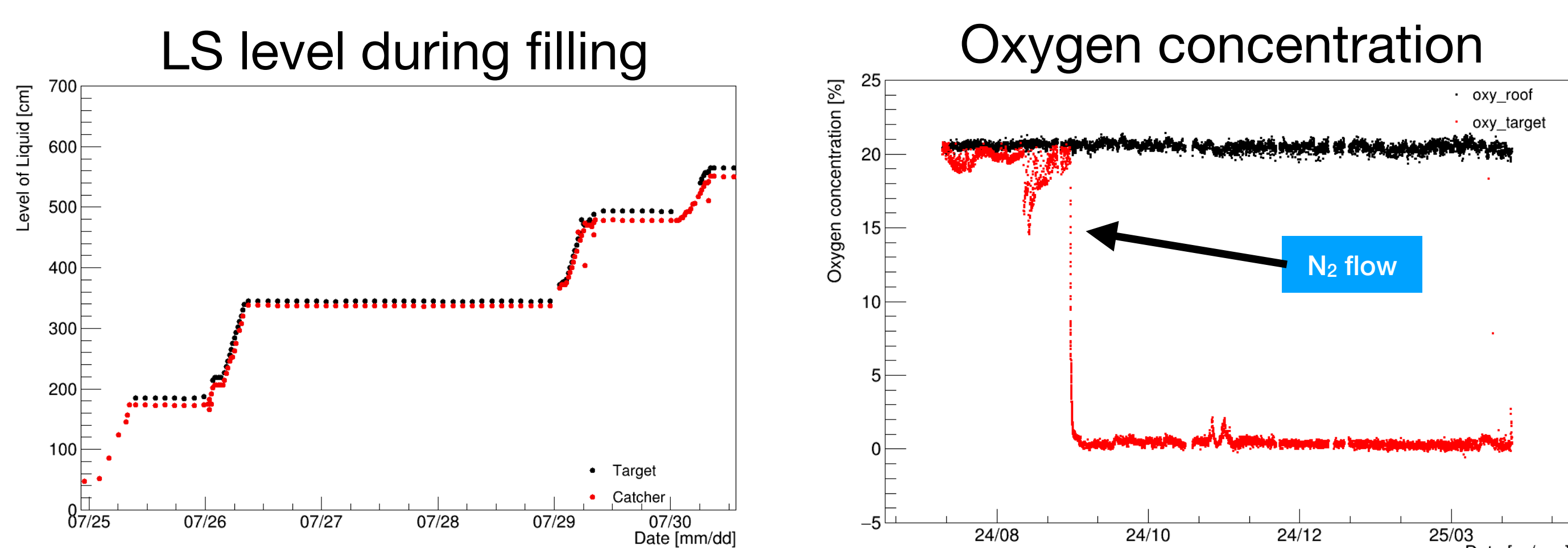 - **Installed system in JSNS2-II far detector in July 2024**

Monitoring system

- For Web monitoring, plots are drawn by values saved in MySQL.
  These polts are saved as png file.
- These png files are sending to web-server and consists the web page.
- **Web page is on going for remote shift from July 2024.**

LS level during filling

Oxygen concentration

Long-term trend visualization based on archived database data

Configuration of sensors

Installation location	Sensor type	Model ID	Detection	Readout	Index	Picture
Target	Pressuremeter	GC-62 343452A	Differential pressure of inlet	NI-9203	🟨	
	Ultrasonic level sensor	SICK UM30-213113	Level of Gd_LS	NI-9201	🟥	
		SICK UM30-215113				
	Oxygenmeter	JKO-25LJD3-K	Concentration of oxygen in Target		🟦	
Gammacatcher	Ultrasonic level sensor	URM 37	Level of LS		🟥	
	RTD (8)	PT 100 RTD	Temperature of LS	NI-9216		
Veto	Pressuremeter	GC-62 343452A	Differential pressure of outlet	NI-9203	🟨	
	Ultrasonic level sensor	SICK UM30-213113	Level of LS	NI-9201	🟥	
Roof space	Oxygenmeter	JKO-25LJD3-K	Concentration of oxygen in roof space		🟦	
	Ambient sensor	TR-73U	Temperature, Humidity, Atmosphere pressure in roof space	USB	🟪	
Spill tank	Ultrasonic level sensor (4)	URM 37	Detection of liquid leakage	NI-9201	🟥	

- Monitoring is essential to ensure the optimal performance of the detector and liquid scintillator.
- **Key parameters tracked by sensors:**
  - Liquid scintillator level and temperature
  - Oxygen concentration inside and outside the detector
  - Differential pressure between the detector and external environment
- **Roof space environment monitored for stable operation:**
  - Temperature, humidity, atmospheric pressure, and oxygen concentration
- **Spill tank equipped with:**
  - Four level sensors and a camera for real-time liquid leakage monitoring
- A total of 20 sensors are installed to provide comprehensive monitoring of the detector and surrounding environment.

Summary

- The construction of the JSNS²-II far detector has been successfully completed.
- Collaborators from KNU and CNU developed and installed the Slow Control Monitoring (SCM) system in the far detector.
- The liquid scintillator was filled into the detector in July 2024, with SCM monitoring the entire process.
- **Since July 2024, the SCM has been fully operational and is available for remote monitoring and shifts.**

Reference

[1] arXiv:2012.10807
[2] C.D.Shin et al, "The acrylic vessel for JSNS2-II neutrino target", 2023 JINST 18 T12001
[3] J. W. Ryu et al, New Physics: Sae Mulli, Vol. 73, No. 9, September 2023, pp.716~722