Double Chooz Slow Monitoring System

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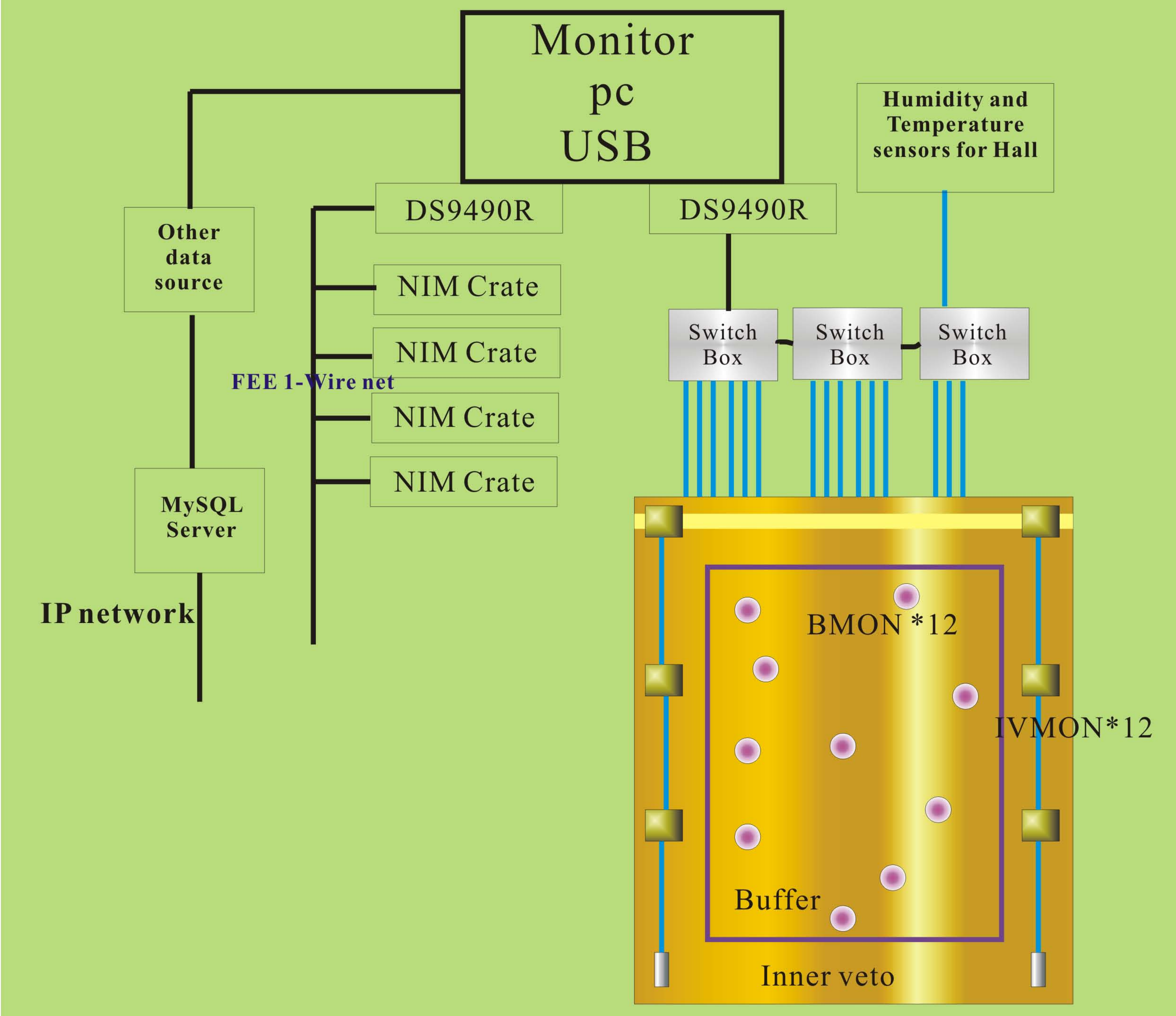
I. Introduction

The Double Chooz slow monitoring system records conditions of the experiment's environment which can impact the experiment's goals. The slow monitoring system includes liquid temperatures, PMT's magnetic field, radon concentration, humidity of control room and photo-tube high voltages. This system scans all channels automatically, stores data in a common database and warns of changes in the two detectors' physical environments.

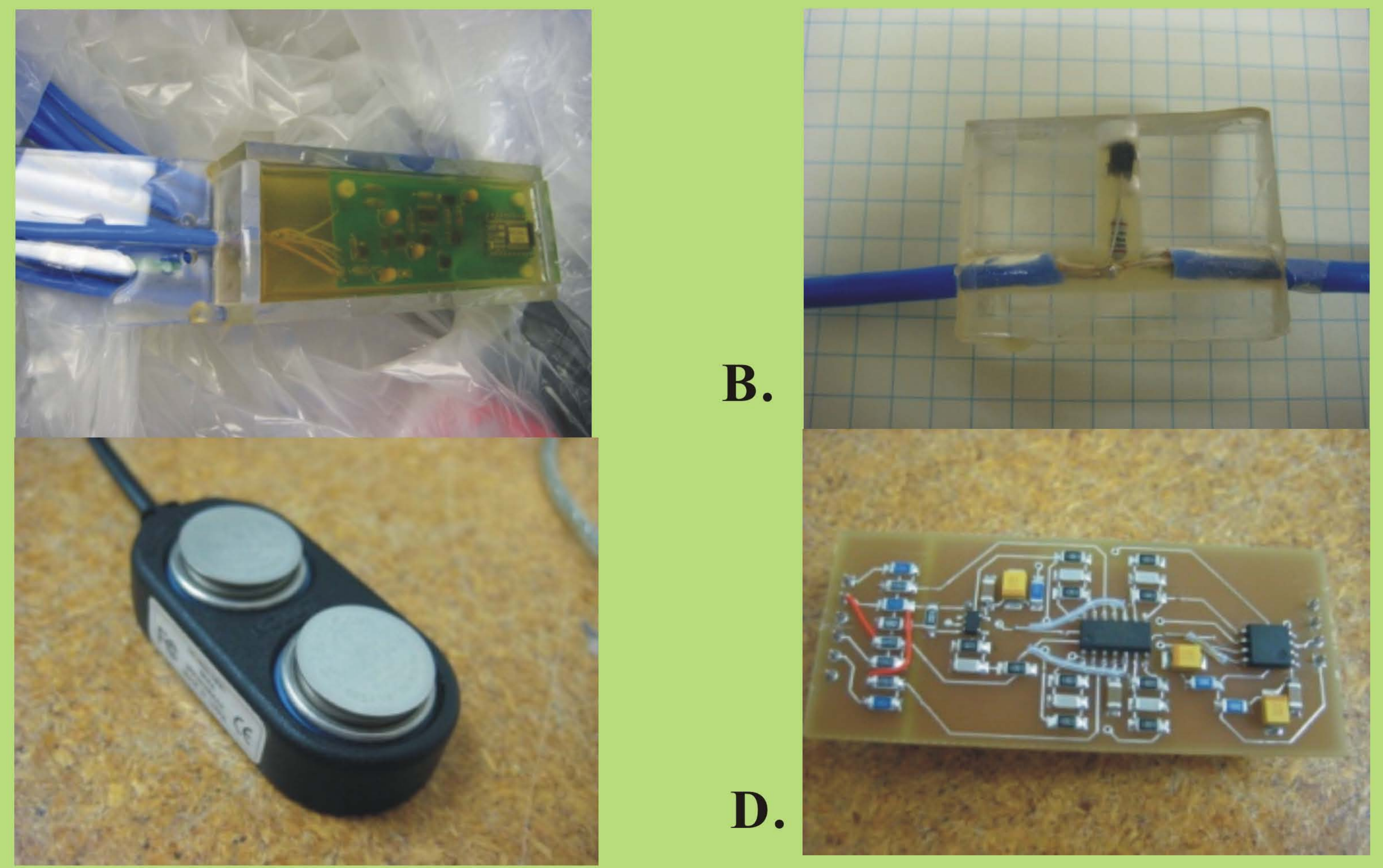


Slow monitoring system schematic cartoon.

II. Main Sensors

Most functions in this system can be accomplished by 1-Wire® from Dallas Semiconductor. We can use a single master for several functions' controls and operations supporting multiple devices on single line. Every device has a unique unalterable ID. Two subsystems have been installed, and two others are ready for installation, as of December 2009.

A. B.



C. D.

A. Buffer vessel monitor (BMON). Each of the 12 BMONs installed in the buffer volume mounts a three-axis magnetometer and a thermometer. They will collect data of PMTs' magnetic field and liquid temperature in buffer vessel. (Installed) B. Inner veto vessel monitor (IVMON). Four IVMONs are deployed on each of three symmetrically installed strings to monitor the liquid and gas blanket temperature thought the inner veto volume. C. Humidity sensor. It will monitor the environment of control room and the experiment hall. D. Front-End Electronics monitor(FEMON). It will monitor voltages of front-end circuit boards. All sensors put in the liquid are epoxy-potted on acrylic base plate.

III. Radioactivity

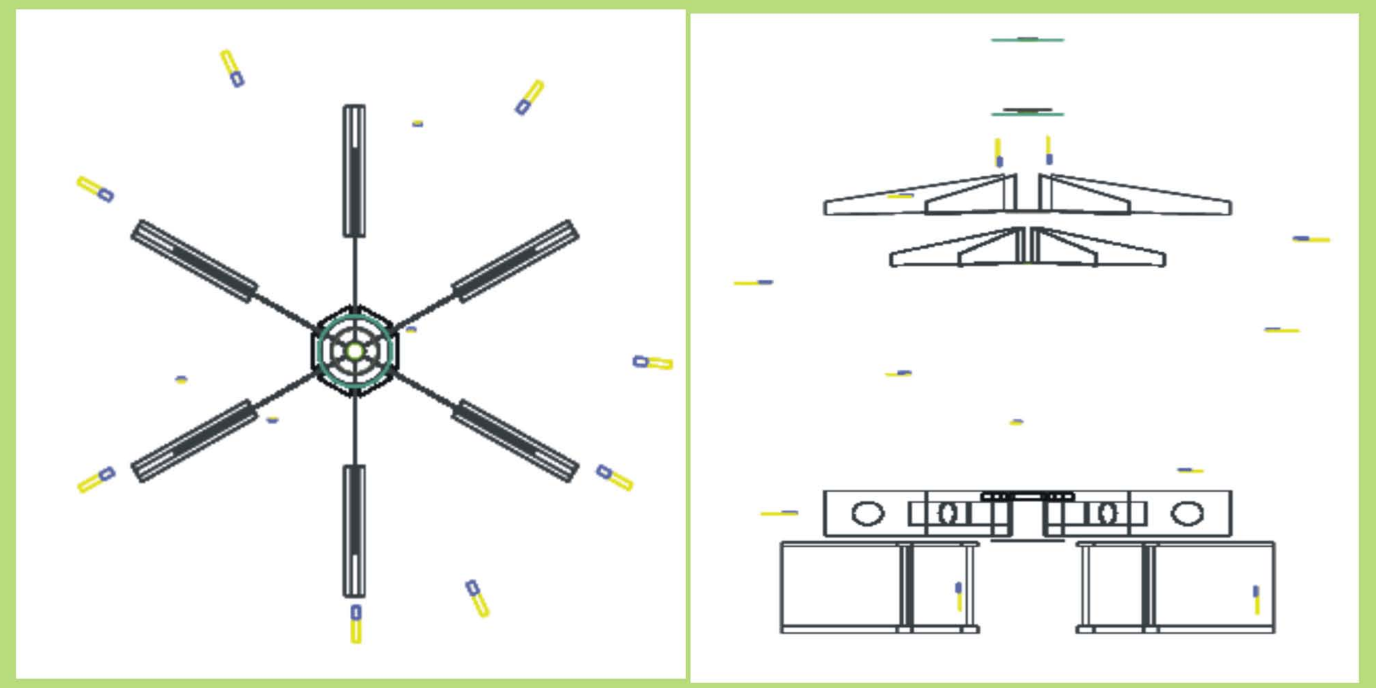
To ensure that the ambitious sensitivity goal of the Double Chooz experiment is attained, great care must be taken to keep the background trigger rate below a few Hz. This requires that a great care is taken in material selection. The background problem of slow monitoring system is the isotopes' radioactivity in all sensor assemblies and cables. After simulation, trigger rate of BMON and IVMON subsystems are low enough. We assume a painting model to consider about our all cables' distribution in detector.

<u>BMONs:Sensors assembly, epoxy-potted, on acrylic base plate</u>

- U: 0.085(6) ppm
- Th: 0.40(2) ppm
- K:<20 ppm

<u>Cables, multiconductor cable,blue sheathe, 7" O.D. By5" I.D. Roll</u>

- U:<7 ppb
- Th:<15 ppb
- K:27(3) ppb



The position of BMONs in the Buffer(the sensors pointing away from the wall).

IV. Simulation results of sensors and cables of BMON subsystem

Event rates in Target + Gamma Catcher for different thresholds (A) away from the buffer wall, (B)painting model of cable distribution.

(A)

Isotope	E>0.5 MeV(Hz)	E>0.7 MeV(Hz)	E>0.9 MeV(Hz)
U238	0.031	0.0228	0.0168
Th232	0.0655	0.0492	0.0372
K40	0.00384	0.0030	0.00216

(B)

Isotope	E>0.5 MeV(Hz)	E>0.7 MeV(Hz)	E>0.9 MeV(Hz)
U238	0.00018	0.000132	0.000132
Th232	0.00021	0.000166	0.000138
K40	0.000198	0.00013	0.000067

V. Conclusion

- The radioactivity of sensors and cables of BMONs and IVMONs don't influence experiment seriously after simulation.
- Next step will be FEMON installation

VI. Reference

- Double Chooz Proposal
- Http://www.maxim-ic.com.