Daya Bay RPC Gas System Installation and Commissioning

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April, 2011 — finished EH1 gas system installation and started commissioning;

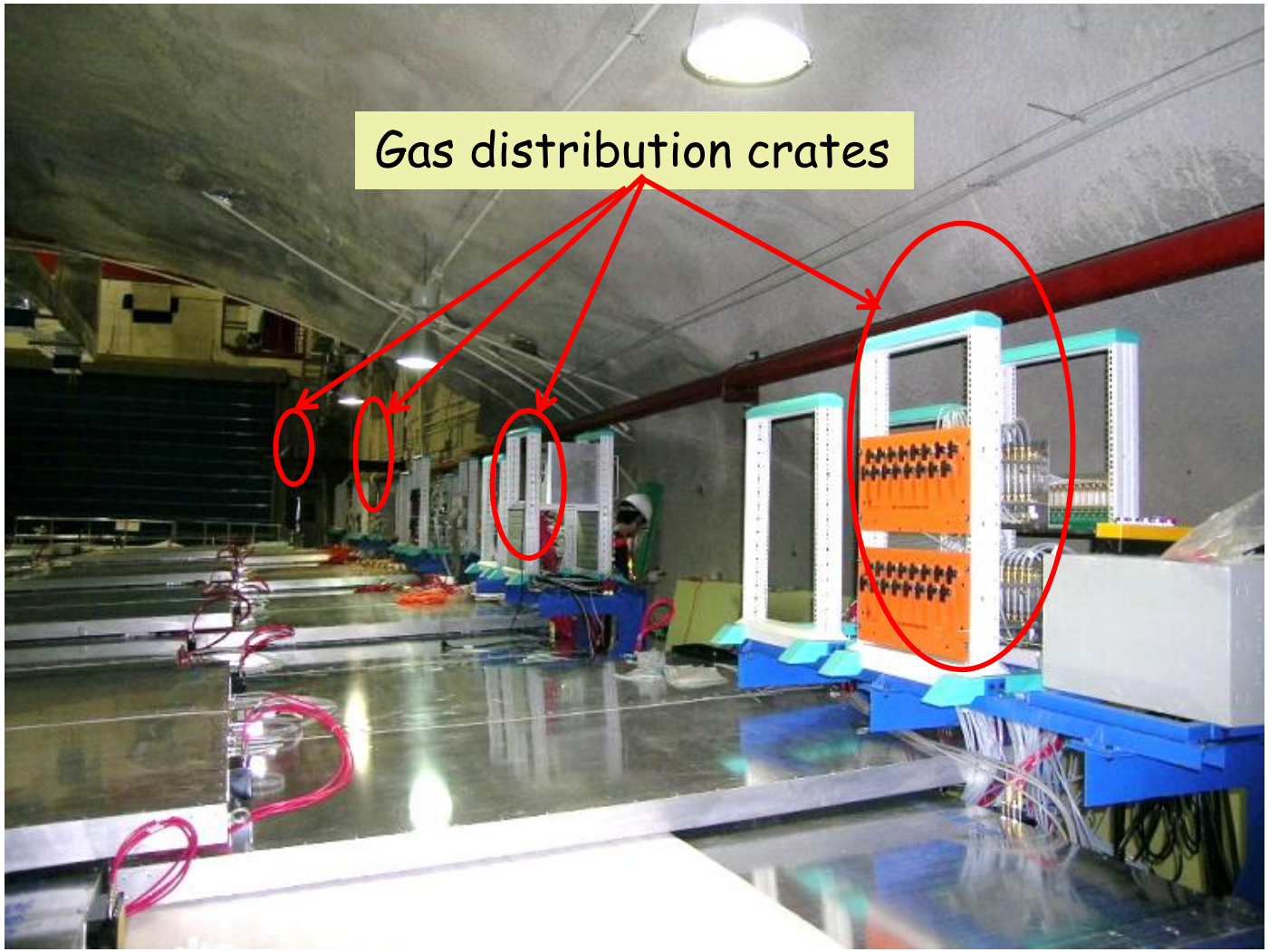
September, 2011 — finished EH2 gas system installation and started commissioning;

November, 2011 — finished EH3 gas system installation and started commissioning.

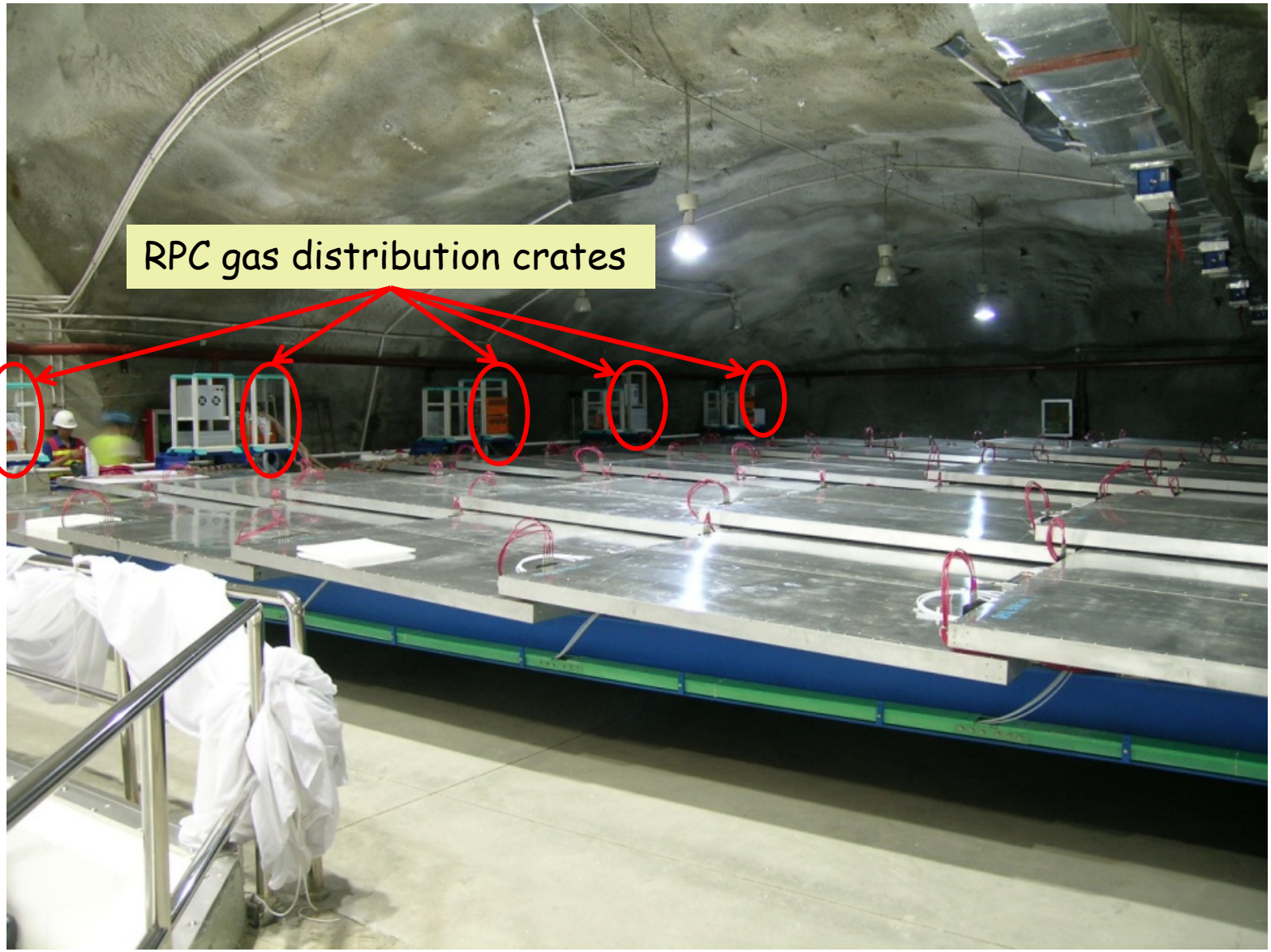
So far, all three systems are working properly, providing Daya Bay RPC gas mixture to all 195 RPC modules (1560 RPCs) plus RPC telescopes.

RPC Gas System Hardware Installation

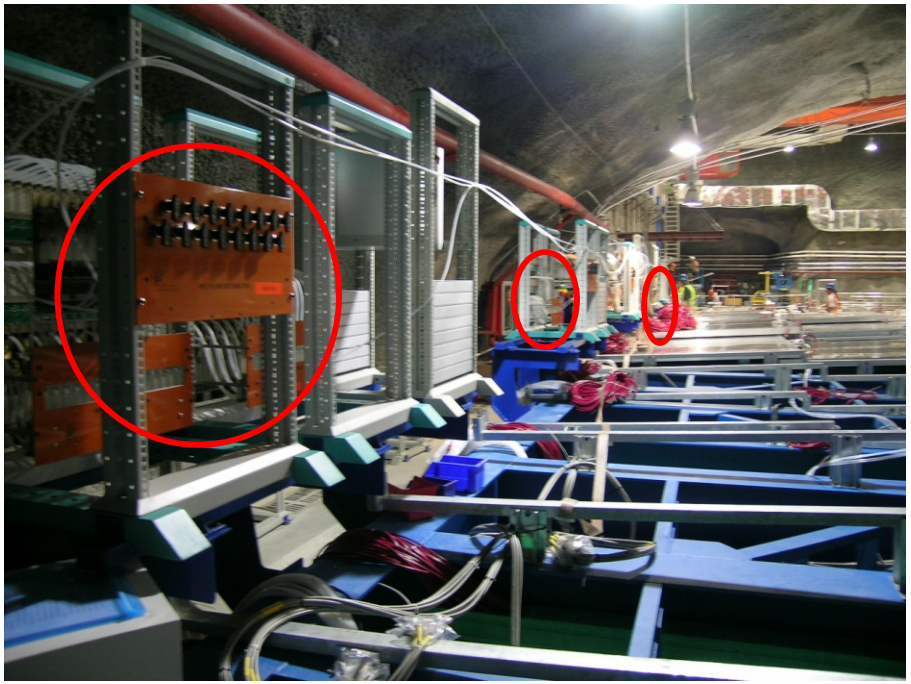
Gas distribution crates (EH#1)

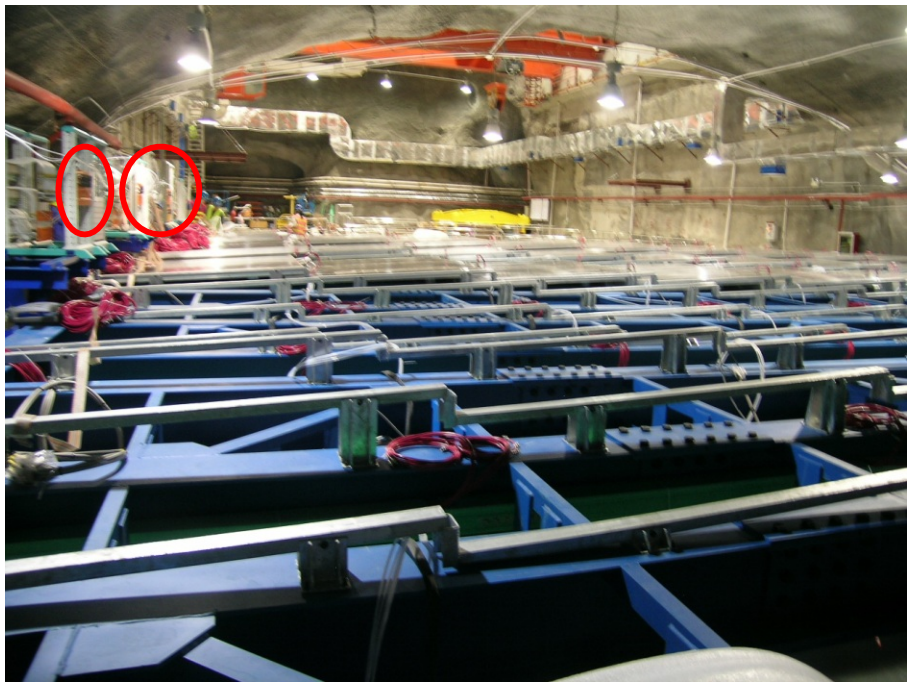


RPC Gas Distribution Crates Parked at Dwarf Hall of EH#2



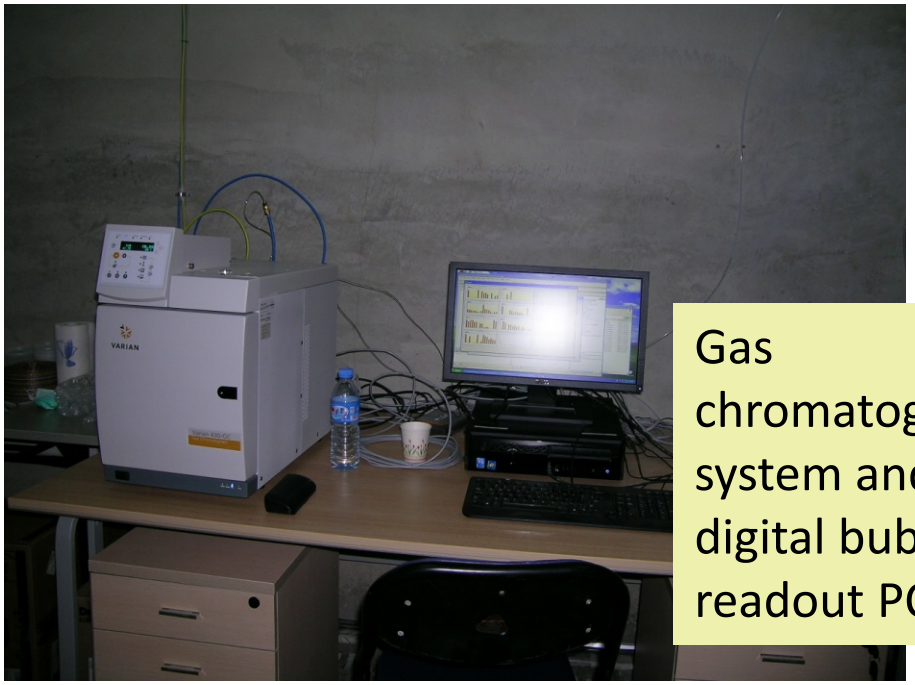
RPC Gas System – Gas Distribution Crates (EH#3)





RPC Gas Room in EH#2

Gas cylinder manifold



Gas chromatograph system and digital bubbler readout PC.

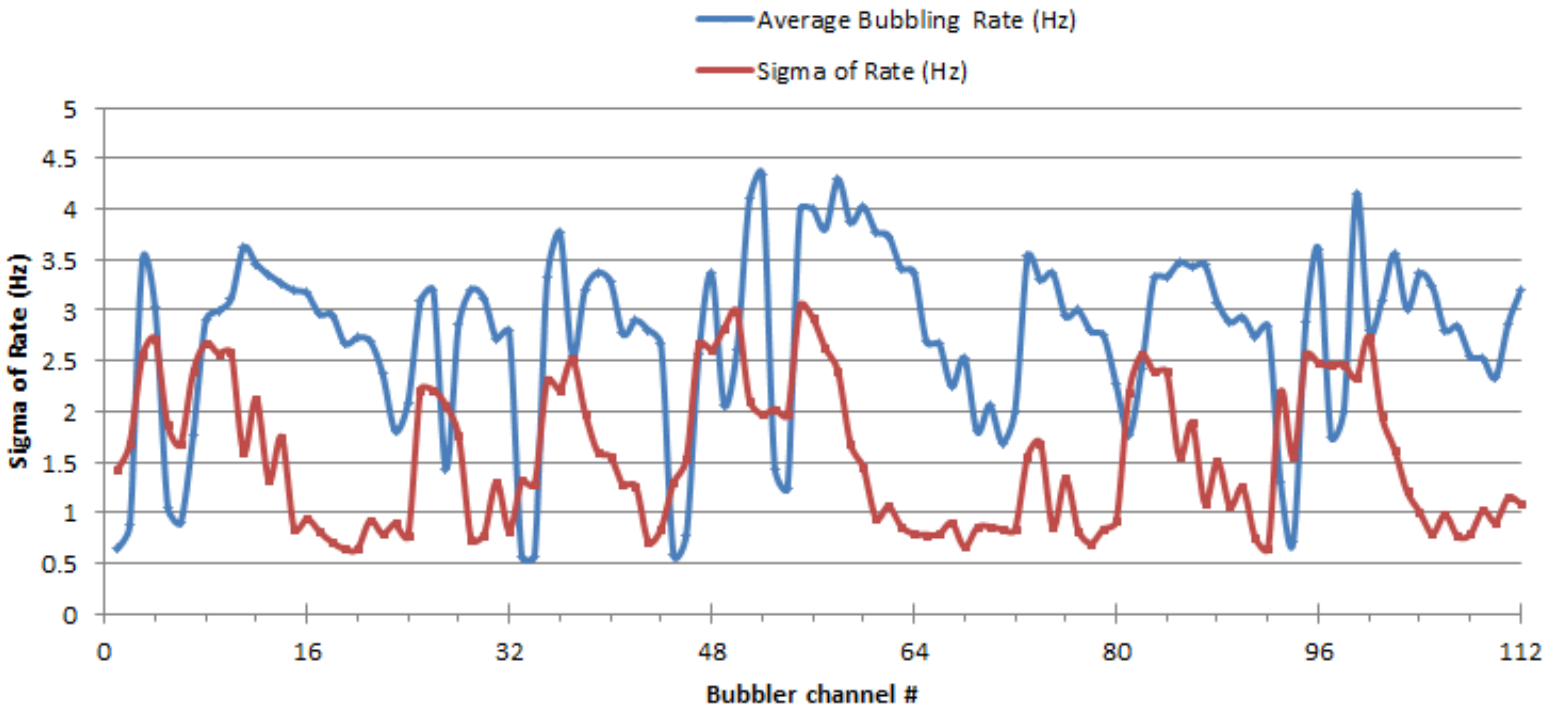
Gas control crates

Isobutane gas cabinet

Digital Bubblers Measure Gas Flow Rate

We monitor the bubbling rates for all 2 x 108 gas channels in two near halls and 162 channels in the far hall. There is no channel that is not bubbling, though the bubbling rates are not so uniform.

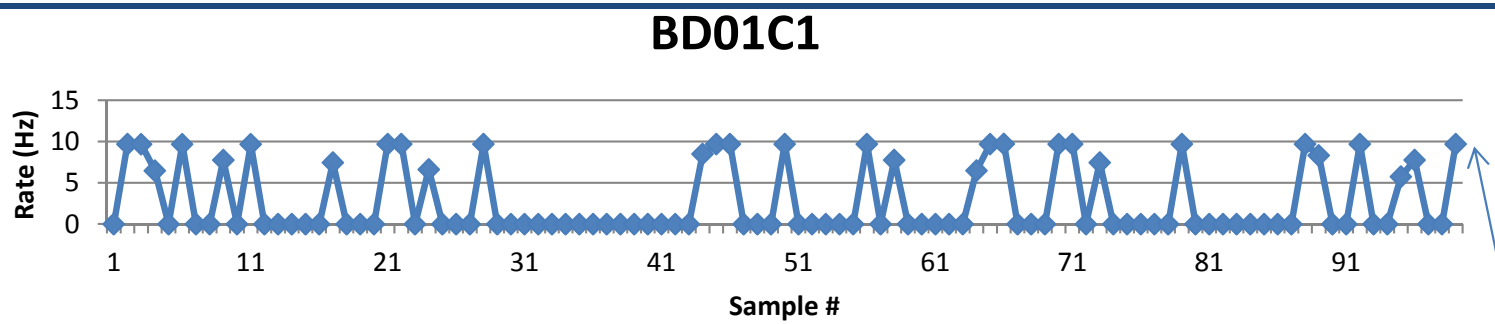
EH1 bubbling rate and the rate fluctuation

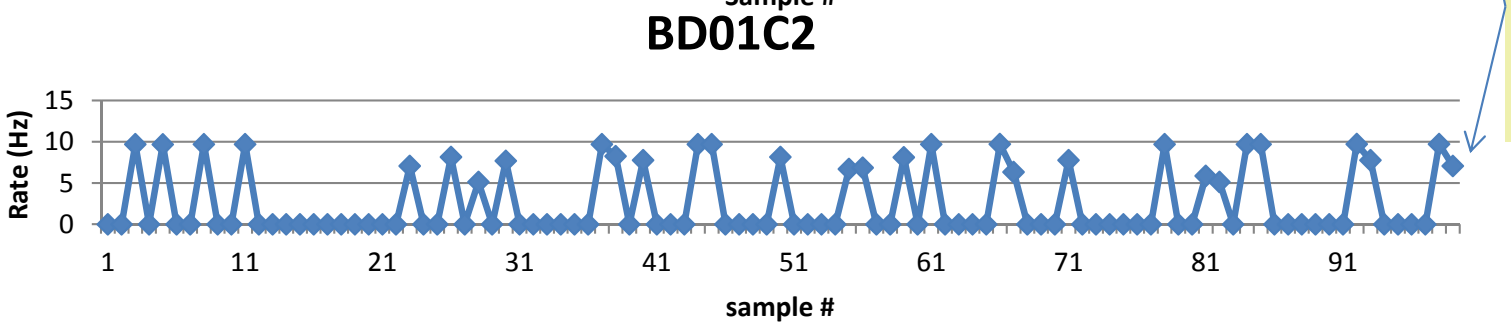


The red curve shows rate fluctuation (sigma) for each individual channel, it reflects the variation of their "breathing". Larger sigma indicates heavier "breathing".

Different "Breathing" Behavior among Gas Channels

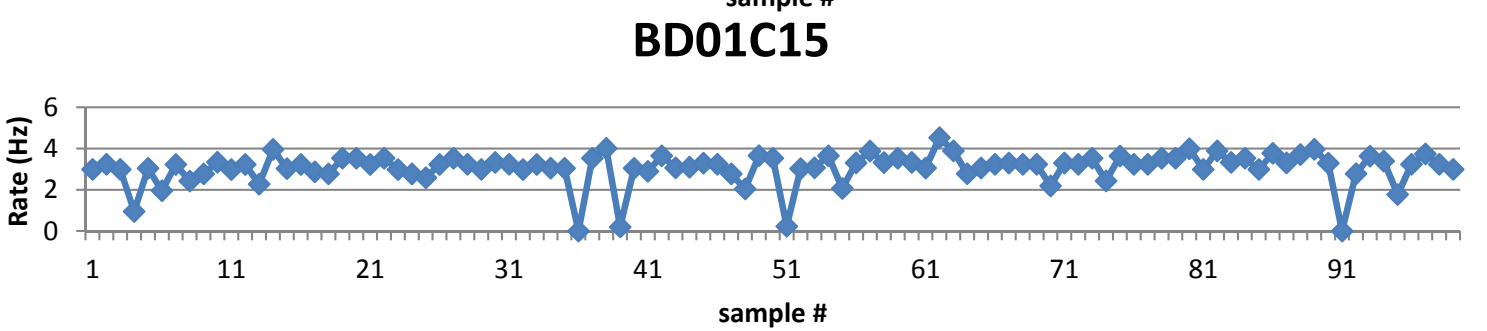
These two channels are "breathing" heavily.

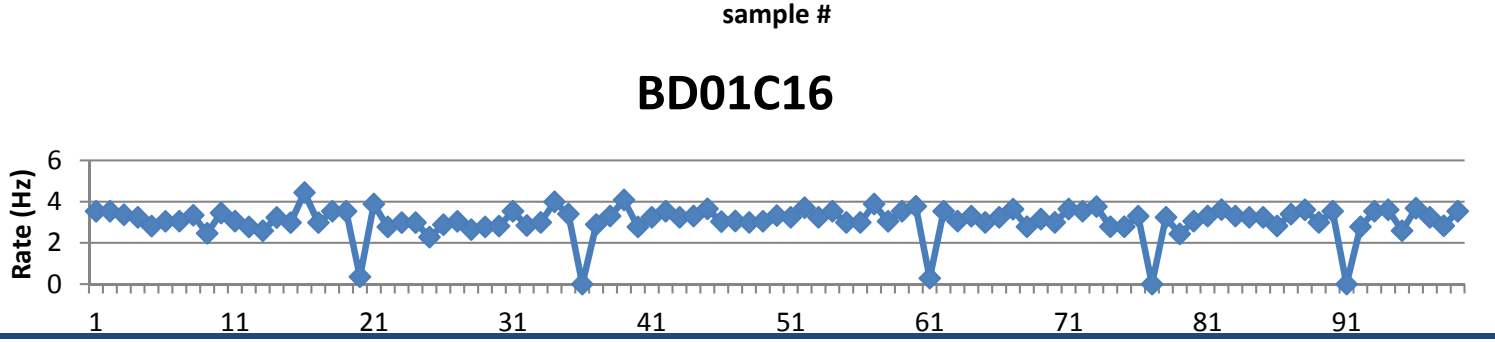




Saturated maximum bubbling rate in digital bubbler

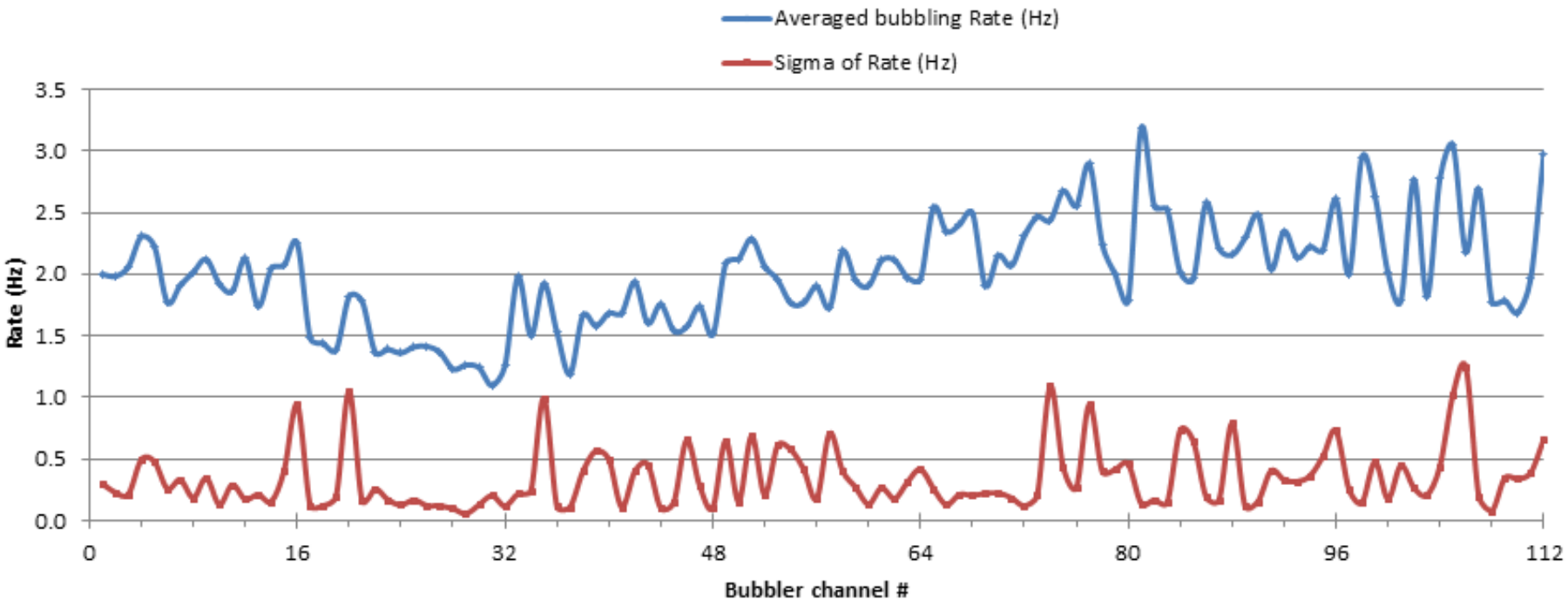
These two channels are "breathing" lighter.



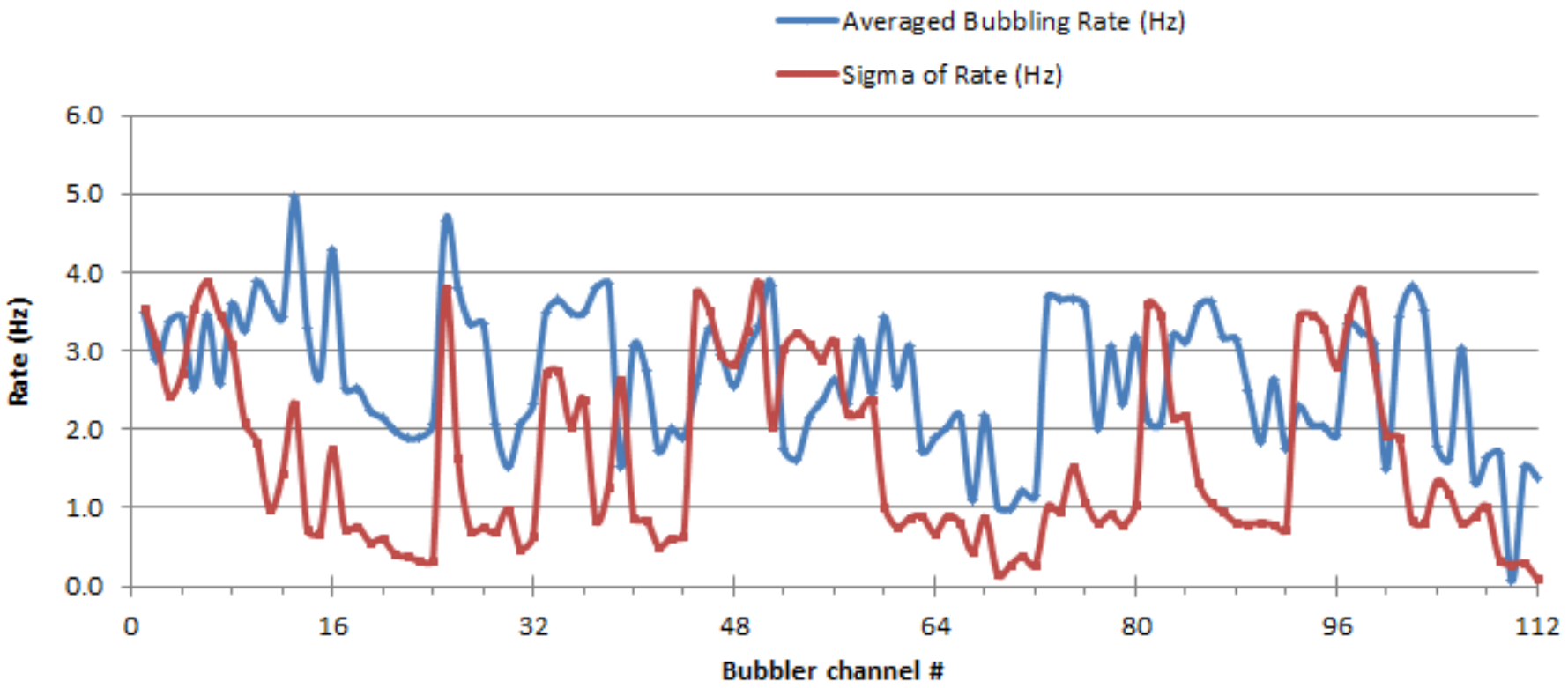


EH #1 Bubbling Rate (w/o RPC Modules)

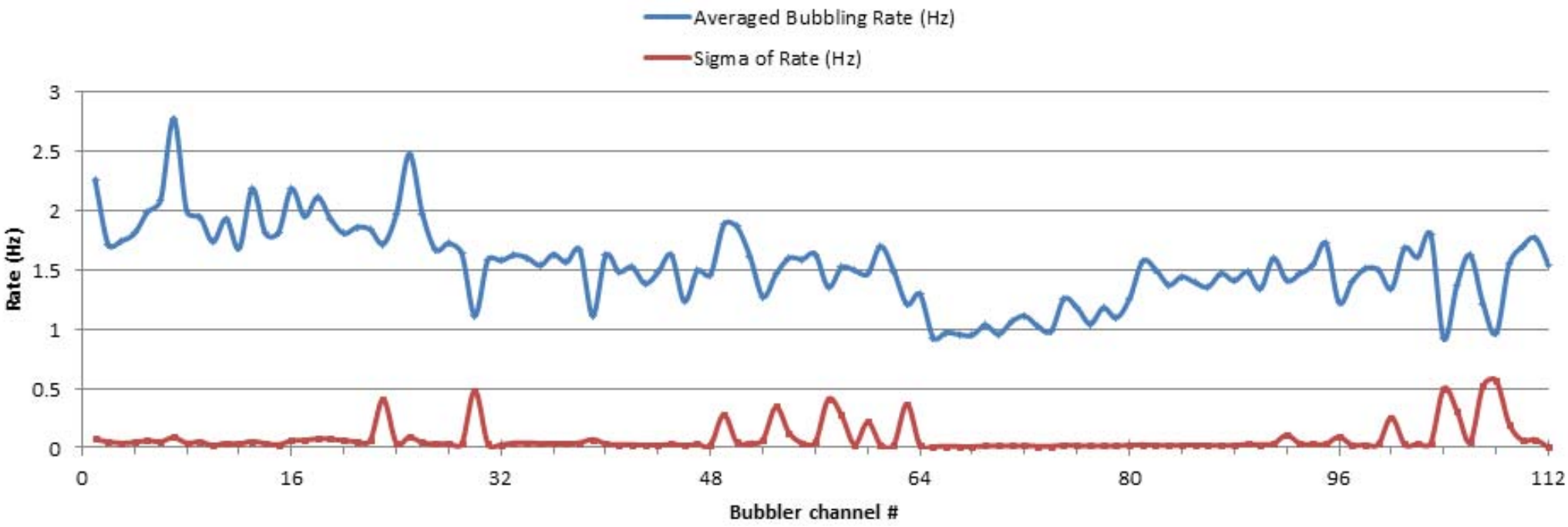
To make sure the rate variation among the gas channels is not due to gas flow resistors, we also plot the bubbling rate for these channels without RPCs (which were replaced by short tubes). This plot shows the variation of gas flow resistors among 108 channels.



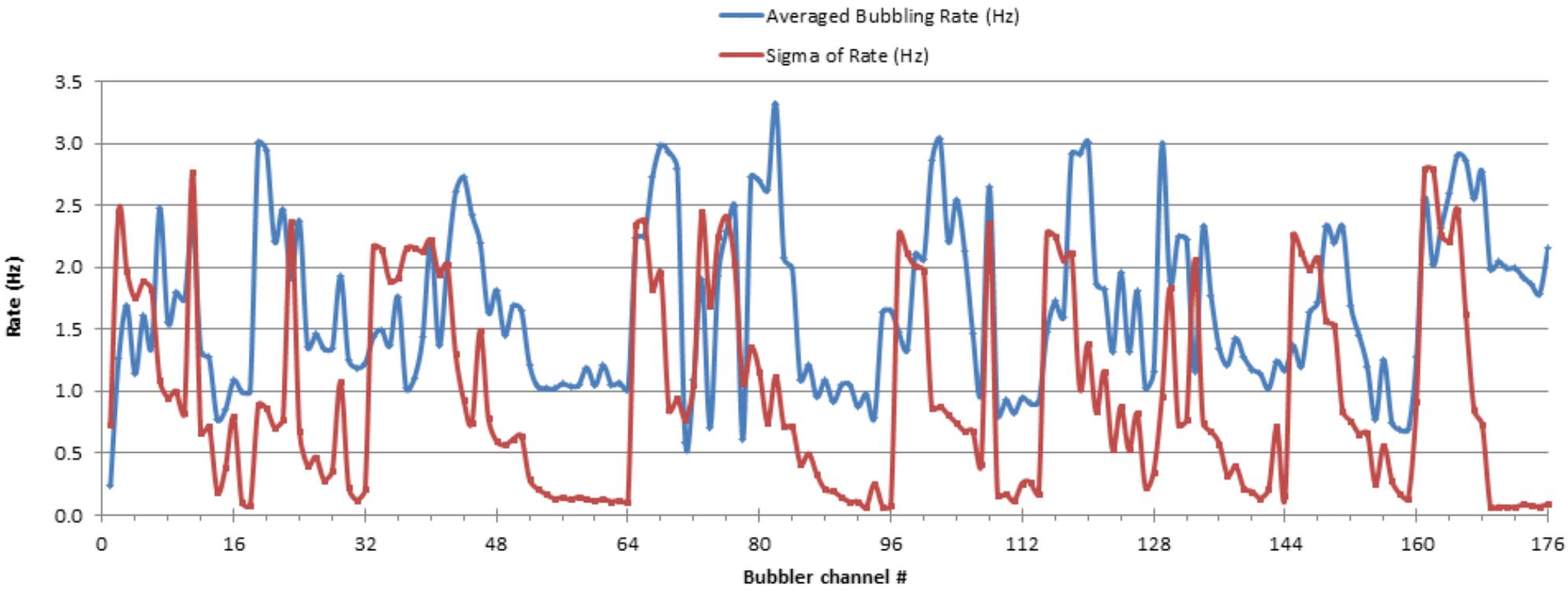
EH #2 Bubbling Rate (with RPC Modules)



EH #2 Bubbling Rate (w/o RPC Modules)

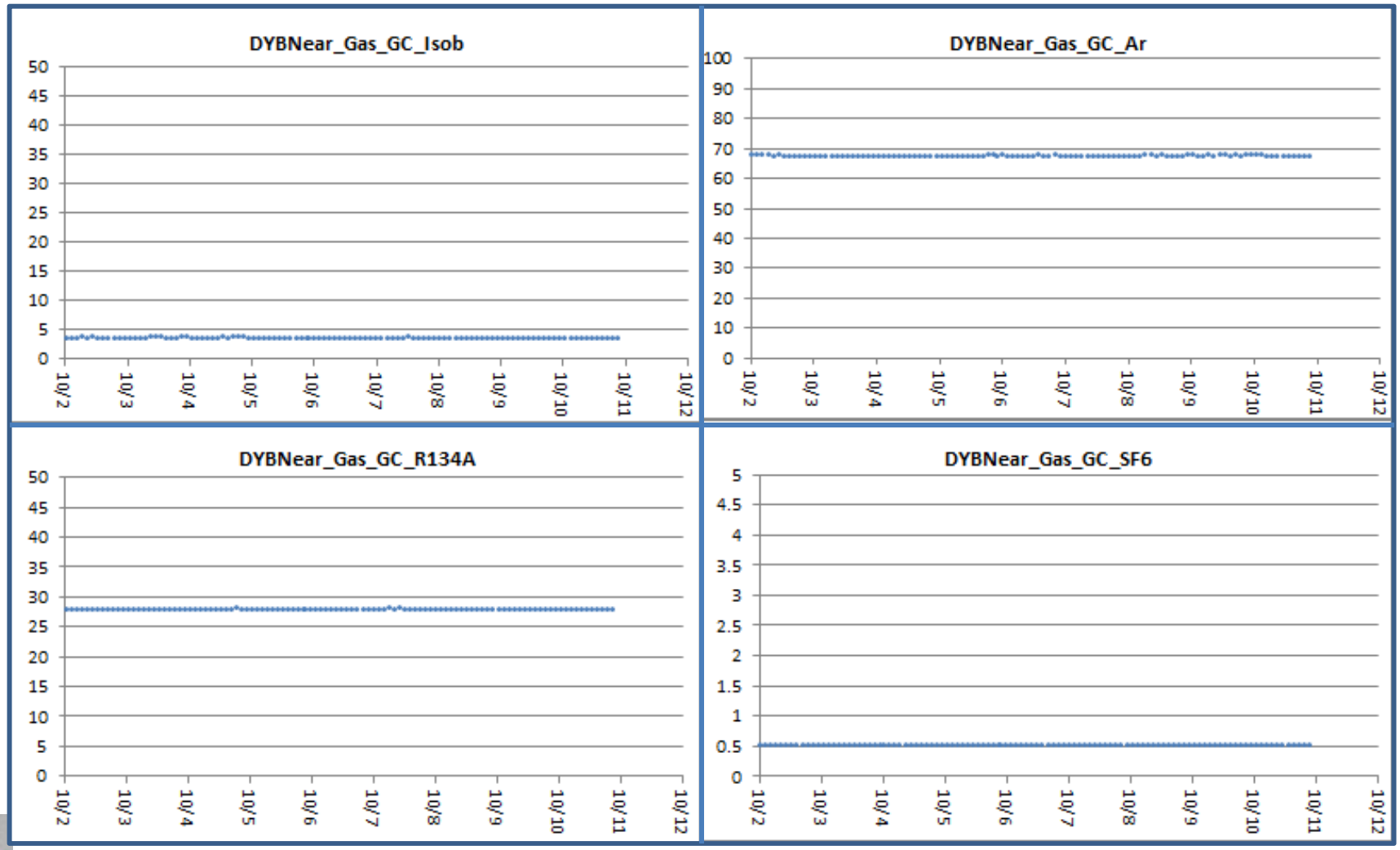


EH #3 Bubbling Rate (with RPC Modules)

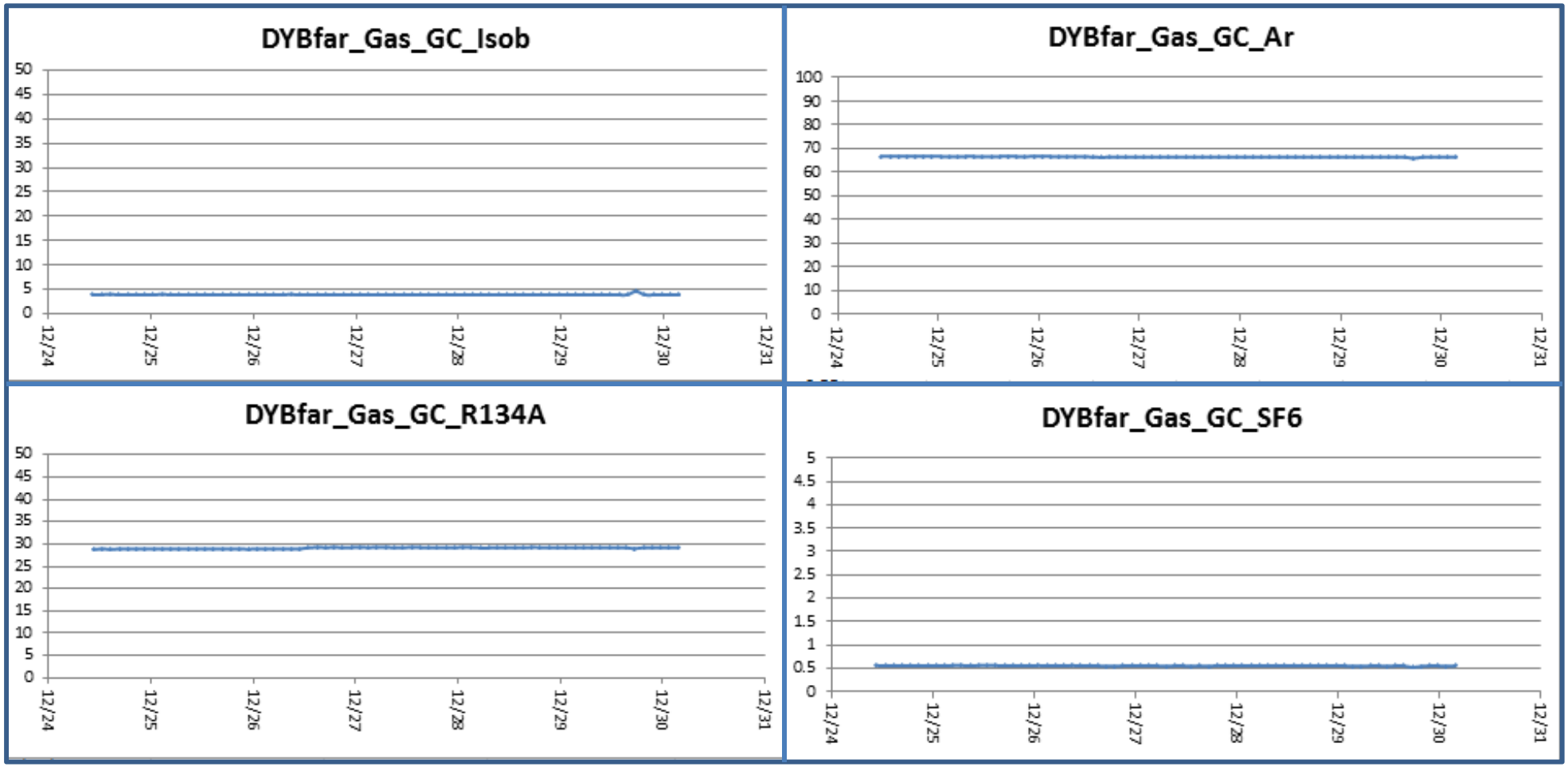


Gas Chromatograph Analysis of Gas Mixing Ratio (EH#1)

Nominal Daya Bay RPC gas mixing ratio is Isob/Ar/R134A/SF6 (4/65.5/30/0.5), the GC-tested mixing ratio is stable and quite close to nominal.

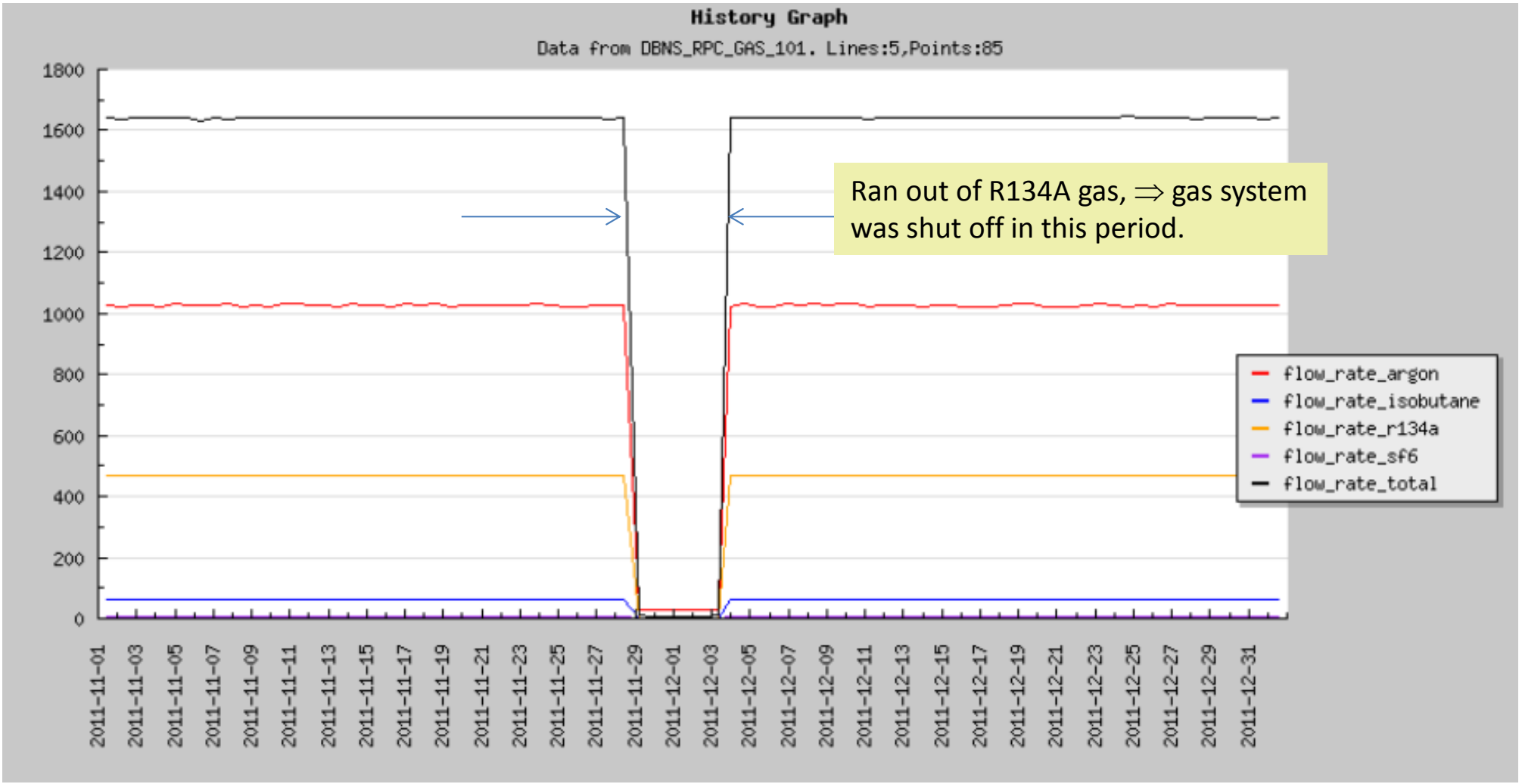


Gas Chromatograph Analysis of Gas Mixing Ratio (EH#3)



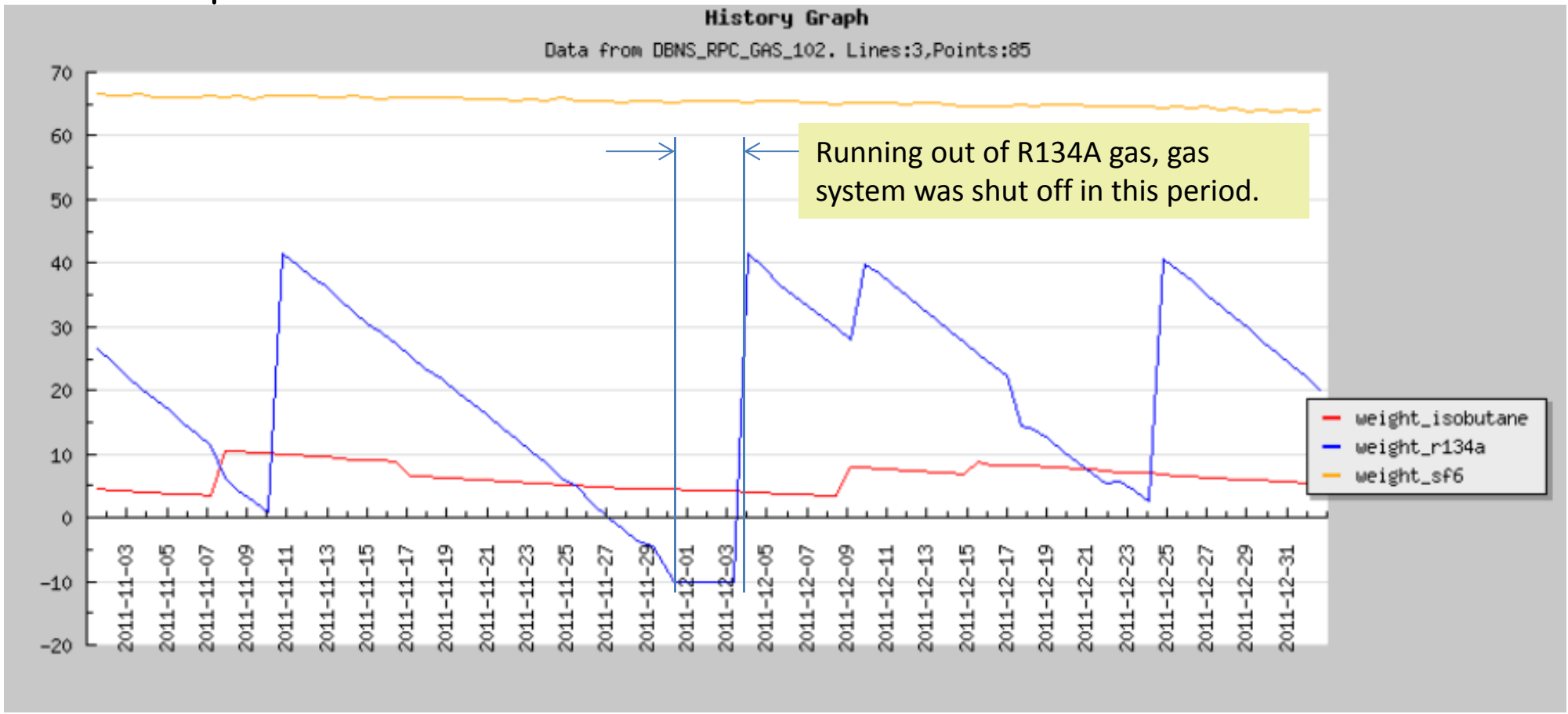
DCS History Plot of the Gas Flow Rate

EH #1



History Plot of the Gas Cylinder Weights (EH1)

From the decreasing slope of weight *vs.* time we can tell the gas consumption rate.



Summary of RPC Gas System Status

The Princeton RPC gas system has been delivered and commissioned within the Daya Bay experiment's aggressive schedule;

So far, all three gas systems are working properly, providing the proper gas mixture and flow rate to the RPC modules;

The IHEP gas team lead by Hansheng Sun has made big contributions to the installation and continue to be in charge of daily operations;

We at Princeton have been able to monitor the gas system operation remotely. If there is any gas system problem we can communicate with on-site IHEP relevant personal (Mengyun Guan, Qingmin Zhang, Jilei Xu and Zhe Ning) to solve it in time. So far, this has worked out well.

We would like to thank Victor Pec and Czech group, Logan Lebanowski, Shih-kai Lin, and many other Collaboration members for their help during the installation and commissioning. Special thanks to LIMs for their strong and efficient support.