RPC gas status and TS1 plans

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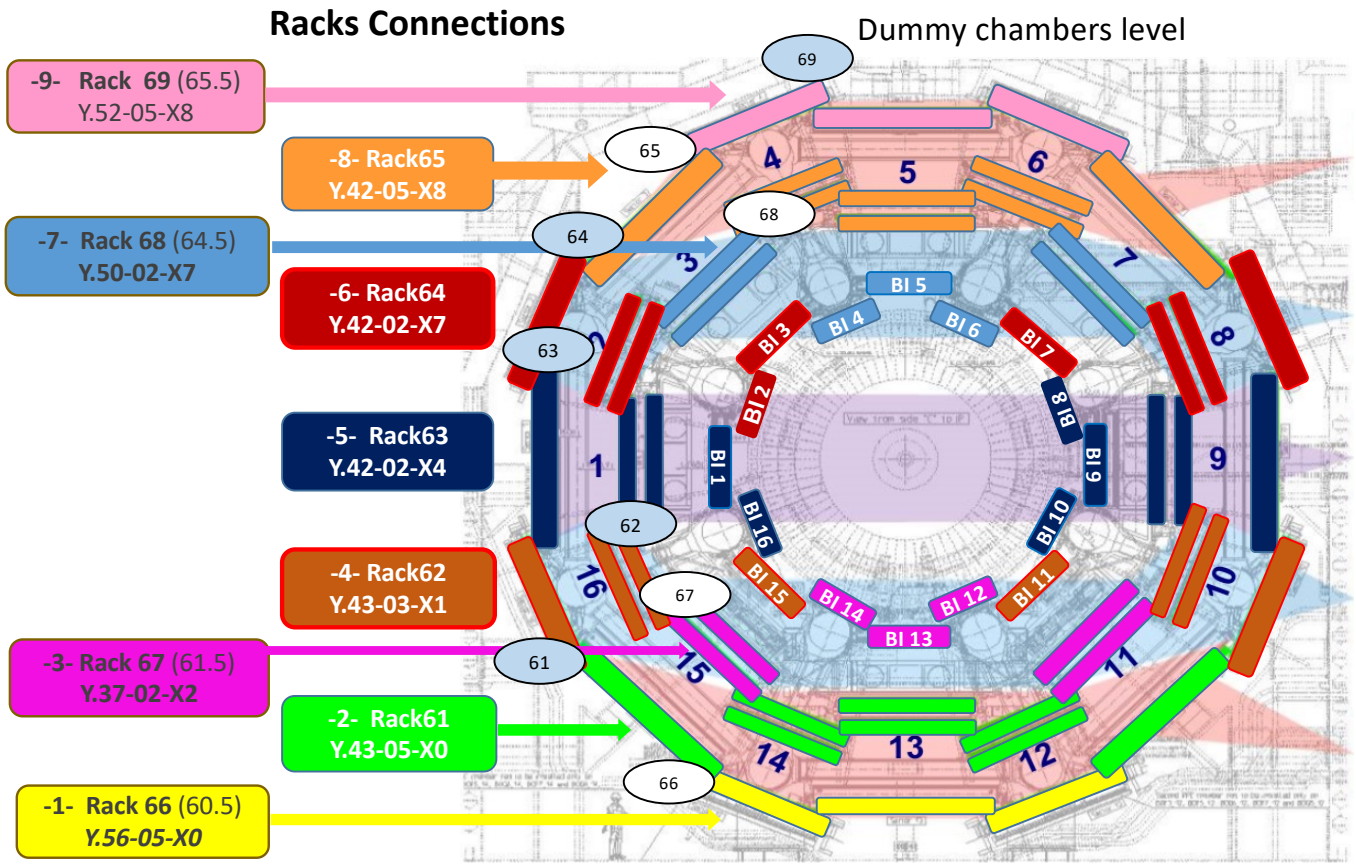
CERN, 03/05/2024

RPC gas distribution: racks



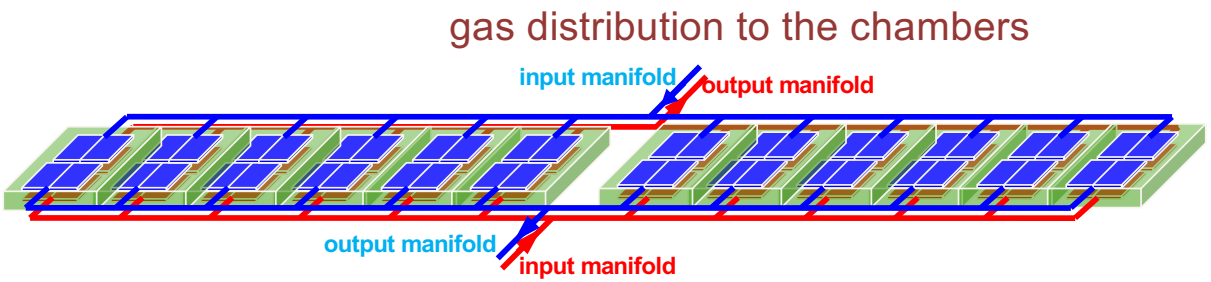
Rack channel map

RPC Bypass situation									
Ch	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
1	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers
2	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers
3	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers
4	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers	Chambers
5	Bypass	Chambers	Chambers	Chambers	FREE	Chambers	Chambers	Chambers	Chambers
6	Bypass	Chambers	Chambers	Chambers	FREE	Chambers	Chambers	Chambers	Chambers
7	Bypass	Chambers	Chambers	Chambers	FREE	Chambers	Chambers	Chambers	Chambers
8	Bypass	Chambers	Chambers	Chambers	FREE	Chambers	Chambers	Chambers	Chambers
9	Chambers	Bypass *	Chambers	BI Chamber *	Chambers	Chambers	Bypass *	Bypass *	Chambers
10	Chambers	Bypass *	Chambers	Bypass *	Chambers	Chambers	Bypass *	Bypass *	Chambers
11	Chambers	Bypass *	Chambers	Bypass *	Chambers	Chambers	FREE *	Bypass *	Chambers
12	Chambers	Bypass	Chambers	Bypass *	Chambers	Chambers	FREE *	Bypass *	Chambers
13	Bypass	FREE (NQ)	Chambers	FREE (NQ) *	Bypass	FREE (NQ NF)	FREE *	Bypass *	Bypass
14	Bypass	Bypass	Chambers	Bypass *	Bypass	FREE (NQ NF)	FREE *	Bypass *	Bypass
15	Bypass	Bypass *	Chambers	Bypass *	Bypass	FREE (NQ NF)	FREE *	FREE *	Bypass
16	Chambers	FREE *	Chambers	FREE *	Chambers	Dummy	FREE *	FREE *	Dummy
17	Chambers	FREE *	FREE *	FREE *	Chambers		FREE *	FREE *	
18	Chambers	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
19	Chambers	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
20	Chambers	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
21	Bypass	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
22	Bypass	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
23	Bypass	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
24	Bypass	Chambers	FREE *	Chambers	Chambers		FREE (NQ NF)	FREE (NQ NF)	
25	Chambers	Chambers	FREE *	Chambers	Bypass		FREE (NQ NF)	FREE (NQ NF)	
26	Chambers	Dummy	FREE *	Dummy	Bypass		Dummy	Dummy	
27	Chambers		FREE *		Bypass				
28	Chambers		FREE *		Bypass				
29	Chambers		FREE *		Chambers				
30	Chambers		FREE *		Chambers				
31	Chambers		FREE *		Chambers				
32	Dummy		Dummy		Dummy				

+Rack bypass

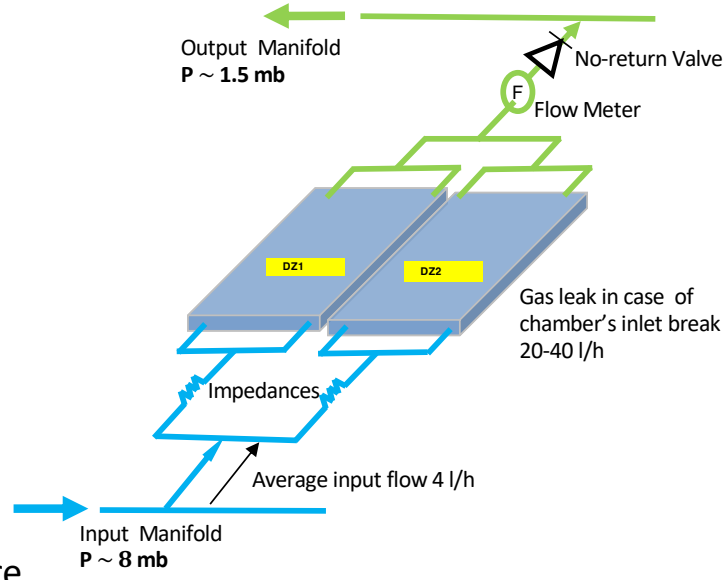
FREE	Channel empty with quicks and flowcells
FREE (NQ)	Channel empty with flowcells but no quicks
FREE (NQ NF)	Channel empty without quicks and flowcells
*	Channels previewed for PHASE 2 - RUN 4

RPC gas distribution: manifolds to chambers



RPC gas distribution description

- 3714 RPC gas gaps are present in ATLAS
- total gas volume is 15 m^3
- gas distributed by 128 input manifold lines (up to 24 RPC layers each) with an overpressure of ~10 mbar falling on input impedances which determine the input flow
- gas recuperated by 128 output manifolds connected to a pump regulating the RPC internal pressure
- recuperated gas is purified and reinjected in the system

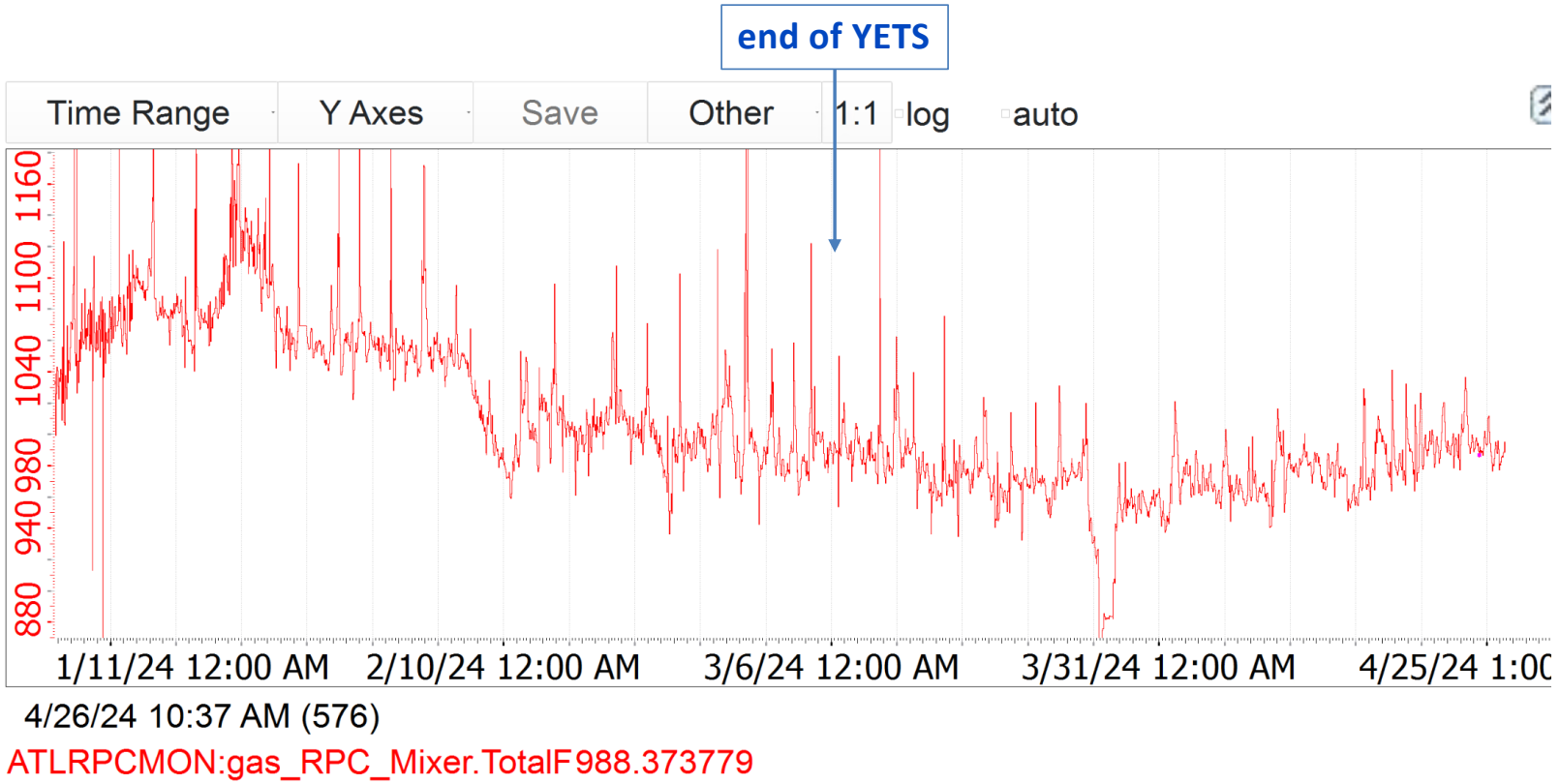


- A gas layer is connected through 2 inlets and 2 outlets
- There are 2280 independent gas layers
- Per each 2 gas layers there is an output flow meter
- The RPC gas gap is kept at max 3 mbar above the atmospheric pressure

Flow status: fresh gas from mixer

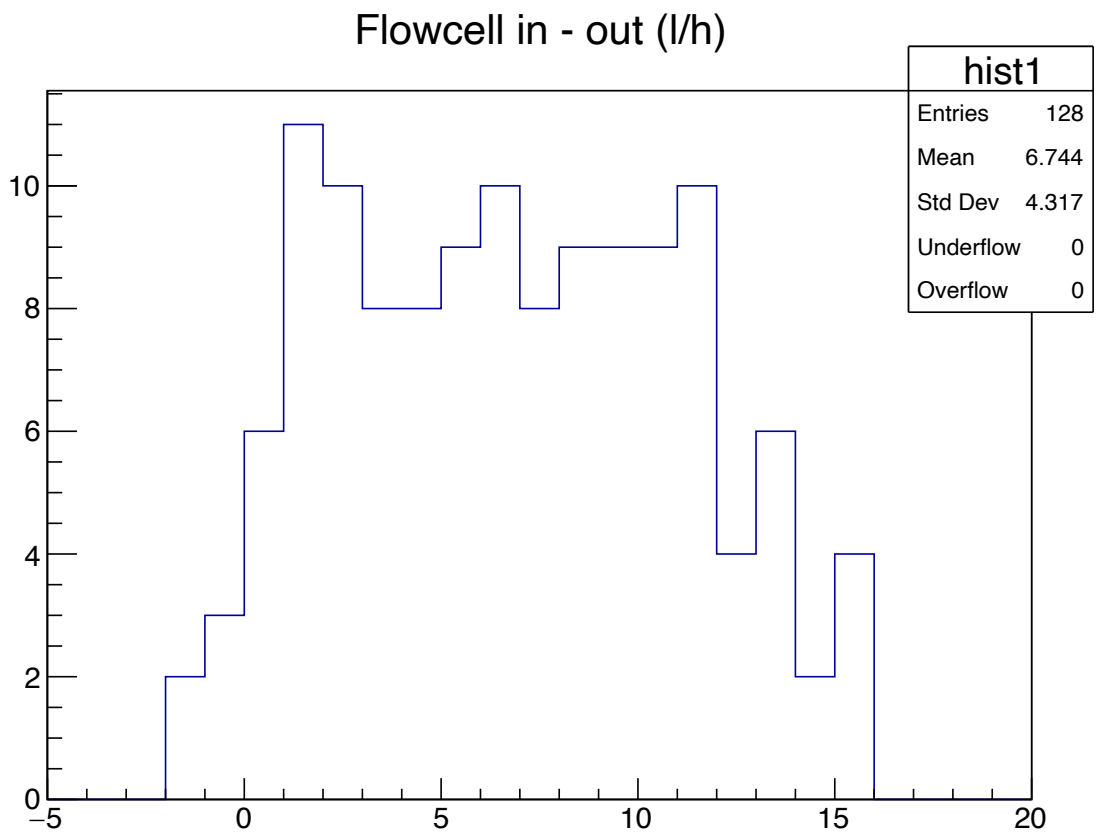
Total flow: ~3500 l/h

Fresh gas injection at end of YETS: ~980 l/h



Flow status: flowcells in - out

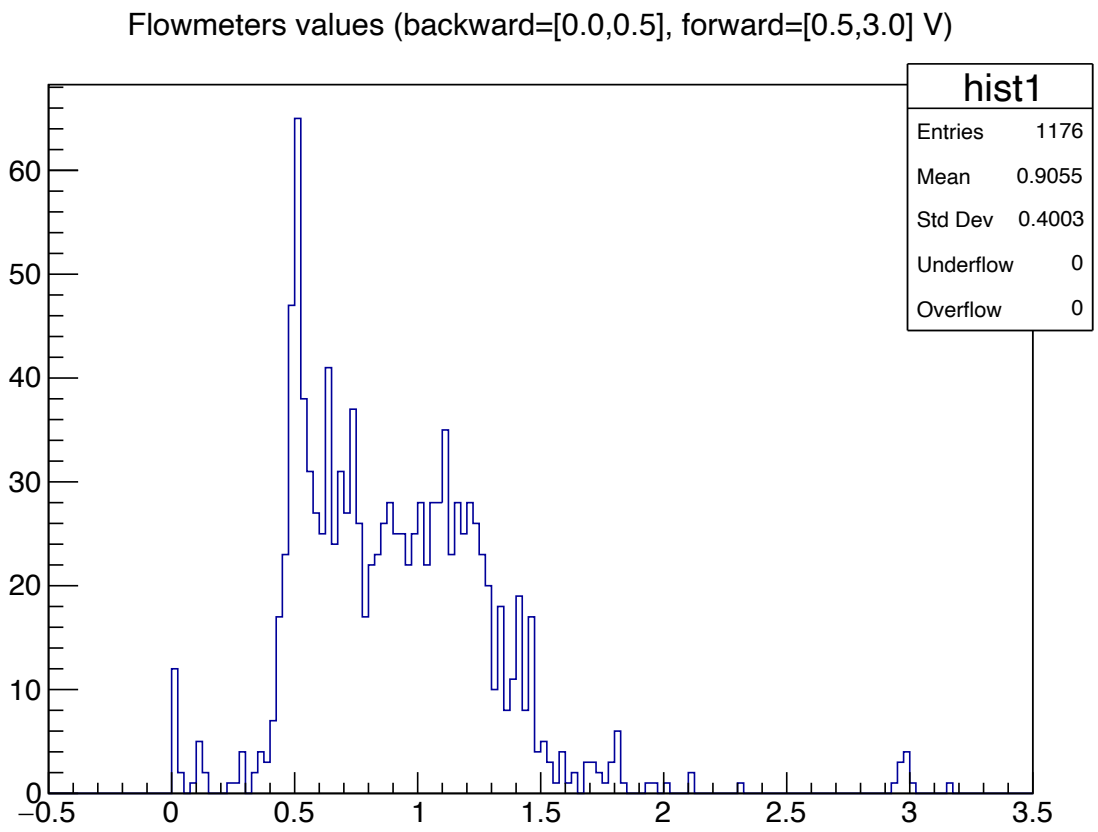
Flowcells input – ouput (l/h)



Flow status: flowmeters

Flowmeter values distribution (row values)

- allowed range: 0.0 – 2.5 V
- 0.5 V → no flow
- (0.0, 0.5) → backward flow
- (0.5, 2.5) → forward flow
- ~0 or ~3 V → faulty readout/flowmeter



Flow status

Manifold lines with largest leaks (absolute value)

PLC OK

RPC Gas Channel Panel v. 5.0 ACR Version on ATLRPCSCS: Show Channels Close

Dip Gas Channels

Gas Channel	RPC Alias	RpcFlow	InFlow	OutFlow	Rel Diff %	Diff	RpcFsm	Mask	inF-calib	outF-calib	outF-scale
Rack65_Channel22	Sector/6/Ly_Gas/BMS..06CO.Ly1	21.04	23.10	12.5	45.68	10.6	80000fe0	0	18.70	8.80	0.98
Rack61_Channel31	Sector/15/Ly_Gas/BOL.C.15.Ly0	7.12	19.70	9.8	50	9.9	80000fc0	0	15.29	5.60	0.99
Rack62_Channel5	Sector/16/Ly_Gas/BMS..16CO.Ly0	12.06	23.29	14.3	38.46	8.999	80000fe0	0	18.10	9.50	0.99
Rack66_Channel11	Sector/14/Ly_Gas/BOS.C.14.Ly0	14.77	25.10	15	40.07	10.1	80000fe0	0	21.29	11.50	1.06
Rack66_Channel4	Sector/12/Ly_Gas/BOS.C.12.Ly1	20.45	25.00	14.69	41.03	10.3	80000fe0	0	20.89	10.80	0.75
Rack63_Channel5	Sector/1/Ly_Gas/BML..01CO.Ly0	20.44	25.29	15.8	37.4	9.499	80000fe0	0	20.89	11.89	0.96
Rack65_Channel31	Sector/7/Ly_Gas/BOL.C.07.Ly0	8.04	19.50	8.8	54.59	10.69	80000fc0	0	15.20	5.10	0.90
Rack68_Channel2	Sector/3/Ly_Gas/BML..03CO.Ly1	13.17	26.79	15.19	43.12	11.59	80000fe0	0	23.20	10.80	1.01
Rack63_Channel14	Sector/9/Ly_Gas/BOL.A.09.Ly1	5.05	18.39	7.199	60.54	11.19	80000fc0	0	13.89	2.60	1.08
Rack63_Channel6	Sector/1/Ly_Gas/BML..01CO.Ly1	9.14	25.70	15.5	39.53	10.2	80000fe0	0	21.29	10.50	1.00
Rack61_Channel20	Sector/13/Ly_Gas/BML..13CO.Ly1	14.38	22.79	11	51.52	11.79	80000fc0	0	18.39	8.00	1.06
Rack63_Channel12	Sector/9/Ly_Gas/BML..09PI.Ly1	7.92	21.00	10	52.13	11	80000fc0	0	16.60	6.20	0.99
Rack68_Channel5	Sector/7/Ly_Gas/BML..07CO.Ly0	13.39	28.10	17	39.36	11.1	80000fe0	0	24.89	12.60	1.07
Rack65_Channel16	Sector/7/Ly_Gas/BOL.C.07.Ly1	11.05	23.89	12.5	47.49	11.39	80000fe0	0	19.29	9.10	0.91
Rack61_Channel18	Sector/13/Ly_Gas/BML..13PI.Ly1	11.09	22.60	10.89	51.54	11.7	80000fc0	0	17.89	7.20	1.01
Rack64_Channel8	Sector/2/Ly_Gas/BMS..02PI.Ly1	12.59	23.20	11.5	50.21	11.7	80000fc0	0	18.79	7.30	1.06
Rack67_Channel4	Sector/15/Ly_Gas/BML..15PI.Ly1	12.58	24.79	14.8	40.16	9.999	80000fe0	0	20.10	9.70	1.01
Rack63_Channel7	Sector/1/Ly_Gas/BML..01PI.Ly0	10.10	23.60	11	53.16	12.6	80000fc0	0	19.20	7.40	1.06
Rack68_Channel4	Sector/3/Ly_Gas/BML..03PI.Ly1	12.20	27.89	14.5	47.85	13.39	80000fe0	0	23.29	8.90	1.11
Rack67_Channel7	Sector/11/Ly_Gas/BML..11PI.Ly0	18.94	25.89	11.6	54.99	14.29	80000fc0	0	20.79	9.40	1.01
Rack61_Channel29	Sector/15/Ly_Gas/BOL.A.15.Ly0	6.27	20.20	7.4	63.05	12.8	80000fc0	0	15.79	4.20	1.01
Rack65_Channel19	Sector/5/Ly_Gas/BML..05PI.Ly0	18.93	29.10	15.5	46.57	13.6	80000fe0	0	24.60	11.00	1.03
Rack67_Channel5	Sector/11/Ly_Gas/BML..11CO.Ly0	18.23	33.29	21.5	35.32	11.79	80000fe0	0	28.70	14.20	1.05
Rack63_Channel11	Sector/9/Ly_Gas/BML..09PI.Ly0	6.80	21.70	7.9	63.3	13.8	80000fc0	0	17.39	4.50	0.96
Rack66_Channel9	Sector/14/Ly_Gas/BOS.A.14.Ly0	15.39	25.20	11.19	55.33	14	80000fc0	0	21.39	7.50	0.93
Rack63_Channel9	Sector/9/Ly_Gas/BML..09CO.Ly0	9.58	24.60	10.8	55.87	13.8	80000fc0	0	19.70	6.60	0.93
Rack63_Channel8	Sector/1/Ly_Gas/BML..01PI.Ly1	7.67	24.70	10.6	56.85	14.1	80000fc0	0	20.10	6.10	0.95
Rack66_Channel8	Sector/13/Ly_Gas/BOL.C.13.Ly1	9.35	26.10	12.89	50.38	13.2	80000fc0	0	22.39	11.10	0.80
Rack67_Channel3	Sector/15/Ly_Gas/BML..15PI.Ly0	15.89	26.10	11.19	56.87	14.9	80000fc0	0	21.50	6.90	1.00
Rack66_Channel5	Sector/13/Ly_Gas/BOL.A.13.Ly0	14.02	30.79	16.29	46.92	14.5	80000fe0	0	26.79	14.70	0.73
Rack67_Channel8	Sector/11/Ly_Gas/BML..11PI.Ly1	16.55	30.60	15.89	47.88	14.7	80000fe0	0	25.89	12.20	0.96
Rack61_Channel19	Sector/13/Ly_Gas/BML..13CO.Ly0	10.44	27.39	13.89	49.09	13.5	80000fe0	0	23.10	10.19	1.04
Rack63_Channel3	Sector/1/Ly_Gas/BOL.C.01.Ly0	7.14	17.39	2.4	85.71	14.99	80000f80	0	12.89	-1.09	0.92
Rack67_Channel2	Sector/15/Ly_Gas/BML..15CO.Ly1	12.38	29.39	12.6	56.94	16.79	80000fc0	0	24.50	9.40	0.95
Rack65_Channel20	Sector/5/Ly_Gas/BML..05PI.Ly1	27.63	30.50	13.1	56.86	17.39	80000fc0	0	26.00	9.60	0.96

Flow status: rack summary

Overview: all racks

Output flow from flowmeter sum

Flowcells values

Dip Gas Rack

Gas Rack	In Pres	Reg Pres	Ch Pres	RpcFlow	InFlow	OutFlow	Rel Diff %	Diff
Rack61	4.102	1.086	0.31	128.7	544.3	415.2	23.71	129.1
Rack62	4.053	1.579	0.192	173.6	352.5	295.2	16.25	57.29
Rack63	4.239	0.627	0.261	132.2	347.9	189.2	45.61	158.7
Rack64	3.926	-0.34	0.1	251.1	327.9	252.8	22.87	75
Rack65	3.887	-0.46	0.095	387.5	542.6	421.9	22.24	120.6
Rack66	6.105	0.378	0.183	224.6	340.2	243.3	28.44	96.8
Rack67	4.737	0.471	0.412	133.3	317.5	230	27.54	87.49
Rack68	3.956	-0.27	0.109	122.1	426.8	352.2	17.45	74.5
Rack69	6.915	0.09	0.188	160	255.7	191.5	25.09	64.2
Total Input Flow/Fresh:	3442	979.1	RackSums:	1715	3457	2588	25.14	869.3

Mismatch between flowmeters and flowcells due to:

faulty flowmeters, missing shunts

by-passes, calibration, dummy chambers

Flow status: rack summary

Values (l/h) corrected via removal of flow in by-passed channels

Output flow from flowmeter sum

Flowcells values

corrected outflow

corrected diff

flowmeters - flowcells (l/h)

Dip Gas Rack

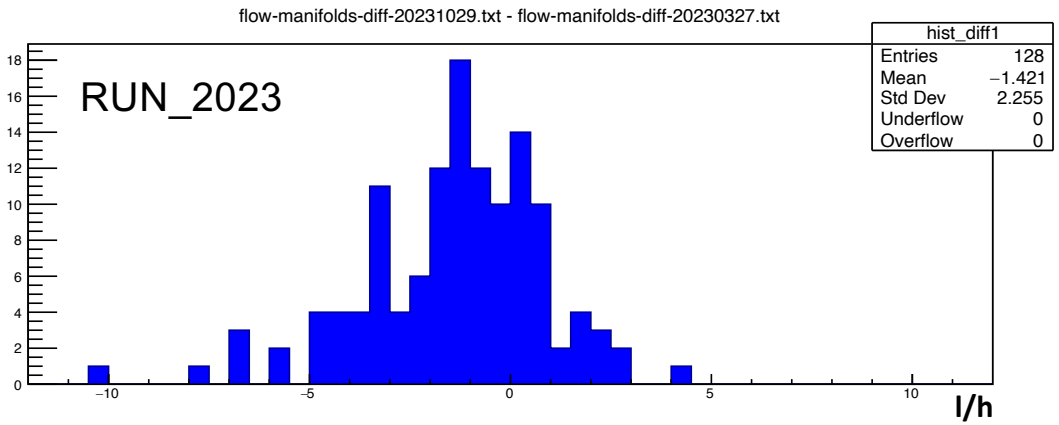
Gas Rack	In Pres	Reg Pres	Ch Pres	RpcFlow	InFlow	OutFlow		Rel Diff %	Diff		
Rack61	4.102	1.086	0.31	128.7	544.3	175	415.2	23.71	129.1	123	-50
Rack62	4.053	1.579	0.192	173.6	352.5	171	295.2	16.25	57.29	64	0
Rack63	4.239	0.627	0.261	132.2	347.9	187	189.2	45.61	158.7	153	-50
Rack64	3.926	-0.34	0.1	251.1	327.9	208	252.8	22.87	75	74	40
Rack65	3.887	-0.46	0.095	387.5	542.6	332	421.9	22.24	120.6	125	50
Rack66	6.105	0.378	0.183	224.6	340.2	226	243.3	28.44	96.8	92	0
Rack67	4.737	0.471	0.412	133.3	317.5	130	230	27.54	87.49	87	0
Rack68	3.956	-0.27	0.109	122.1	426.8	142	352.2	17.45	74.5	72	-20
Rack69	6.915	0.09	0.188	160	255.7	139	191.5	25.09	64.2	58	20
Total Input Flow/Fresh:	3442	979.1	RackSums:	1715	3457	**1710**	2588	25.14	869.3	**848**	

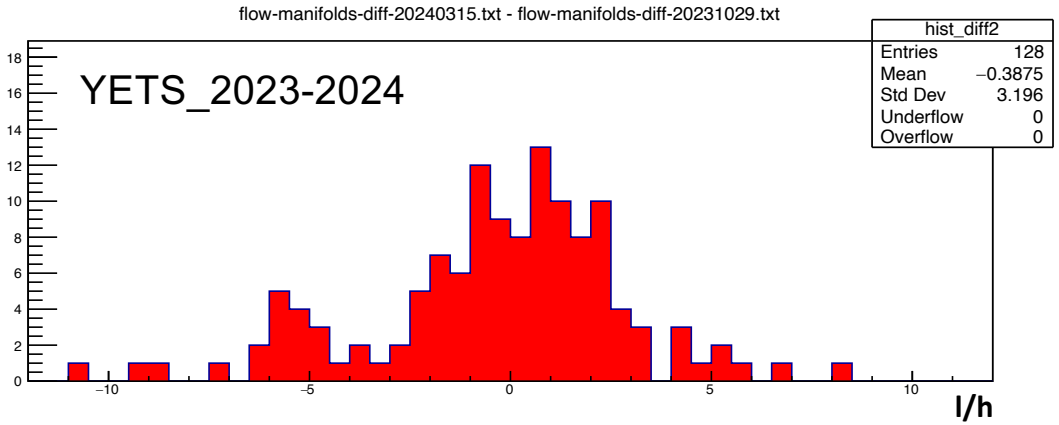
faulty flowmeters, missing shunts

~~by-passes~~, calibration, dummy chambers

1. Leak unchanged with or without by-pass channels
2. Output flows: flowcells vs flowmeters very similar
3. Differences: -50 values could be due to failures in 2 flowmeter chains, +40,50 to be checked

Leak variation per manifold channel (flow-cells)





ΔLeak(RUN_2023) = -180 l/h

ΔLeak(YETS_2023-2024) = -50 l/h

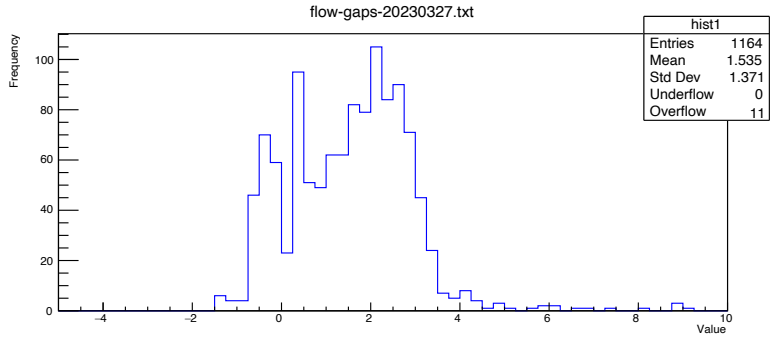
Channels with |leak variation| > 5 l/h
(both periods together)

```
BOS.A.16.Ly0   ->   diff RUN_2023 = -0.700001     ---     diff YETS_2023-2024 = -5.8
BMS..10CO.Ly1   ->   diff RUN_2023 = 1.5      ---     diff YETS_2023-2024 = -6.1
BOS.A.16.Ly1   ->   diff RUN_2023 = -1.9      ---     diff YETS_2023-2024 = -6.2
BOS.C.16.Ly1   ->   diff RUN_2023 = 0.2      ---     diff YETS_2023-2024 = -5.6
BOL.A.01.Ly1   ->   diff RUN_2023 = -0.500001     ---     diff YETS_2023-2024 = -5.7
BOL.C.01.Ly0   ->   diff RUN_2023 = -1.5      ---     diff YETS_2023-2024 = 8
BML..01CO.Ly1   ->   diff RUN_2023 = 0.9      ---     diff YETS_2023-2024 = 6.6
BOS.A.02.Ly0   ->   diff RUN_2023 = -1.9      ---     diff YETS_2023-2024 = -8.9
BMS..04PI.Ly0   ->   diff RUN_2023 = 0      ---     diff YETS_2023-2024 = -7.4
BOL.C.07.Ly1   ->   diff RUN_2023 = -5.9      ---     diff YETS_2023-2024 = 1.8
BML..05CO.Ly1   ->   diff RUN_2023 = -3.1      ---     diff YETS_2023-2024 = -5.6
BML..05PI.Ly0   ->   diff RUN_2023 = -6.8      ---     diff YETS_2023-2024 = -4.8
BML..05PI.Ly1   ->   diff RUN_2023 = -7.7      ---     diff YETS_2023-2024 = -0.799999
BOL.C.07.Ly0   ->   diff RUN_2023 = -3.9      ---     diff YETS_2023-2024 = 5.4
BOS.A.14.Ly1   ->   diff RUN_2023 = -1      ---     diff YETS_2023-2024 = -5.1
BOS.C.14.Ly1   ->   diff RUN_2023 = -2      ---     diff YETS_2023-2024 = -5.3
BOL.A.13.Ly1   ->   diff RUN_2023 = -3.3      ---     diff YETS_2023-2024 = -9.5
BML..15PI.Ly0   ->   diff RUN_2023 = -5.6      ---     diff YETS_2023-2024 = -0.9
BML..03CO.Ly1   ->   diff RUN_2023 = -6.7      ---     diff YETS_2023-2024 = 1.5
BML..03PI.Ly0   ->   diff RUN_2023 = -3.1      ---     diff YETS_2023-2024 = 5.5
BML..03PI.Ly1   ->   diff RUN_2023 = -10.2      ---     diff YETS_2023-2024 = 0.6
BML..07CO.Ly0   ->   diff RUN_2023 = -6.9      ---     diff YETS_2023-2024 = 0.5
BML..07CO.Ly1   ->   diff RUN_2023 = -1.6      ---     diff YETS_2023-2024 = 5.2
BOS.A.04.Ly0   ->   diff RUN_2023 = -1      ---     diff YETS_2023-2024 = -5.3
BOS.A.04.Ly1   ->   diff RUN_2023 = -2.6      ---     diff YETS_2023-2024 = -11
BOS.C.04.Ly0   ->   diff RUN_2023 = -9.53674e-07     ---     diff YETS_2023-2024 = -5.7
BOS.C.04.Ly1   ->   diff RUN_2023 = -0.900001     ---     diff YETS_2023-2024 = -5.4
```

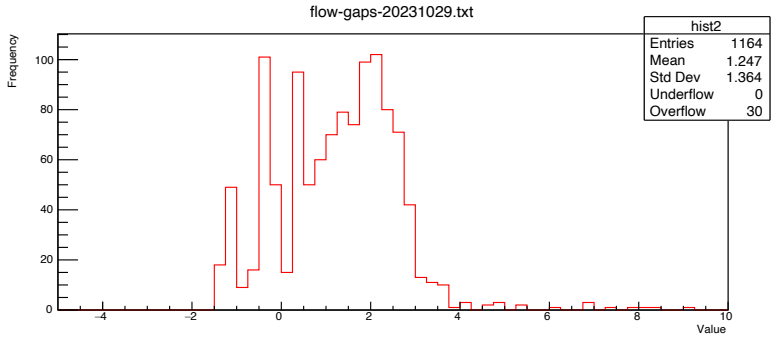
repaired with resin at end of YETS, flowmeters have good values
reconnection problems? → to be checked

Flowmeters in RUN_2023

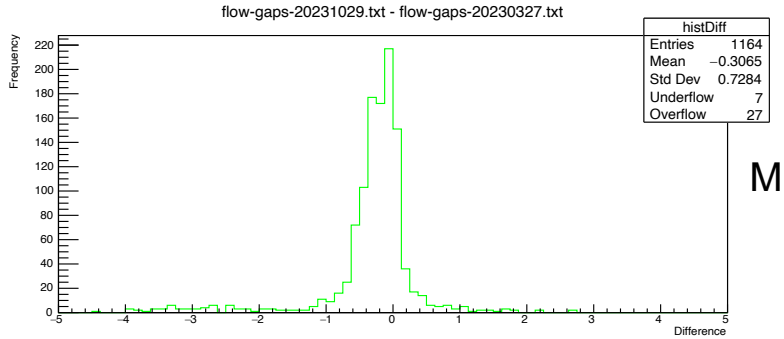
Start of 2023 data taking
(2023-03-27)



End of 2023 data taking
2023-10-29



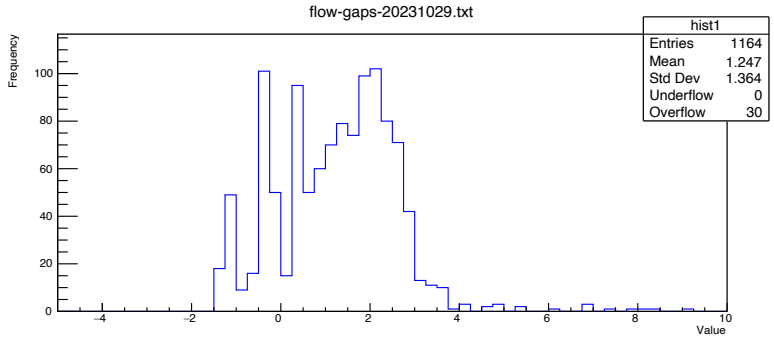
Difference (start – end) of 2023 data taking



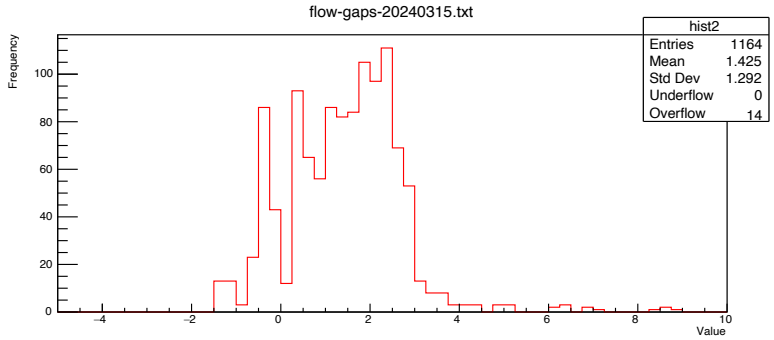
Mean value = – 0.3 l/h

Flowmeters in YETS_2023-2024

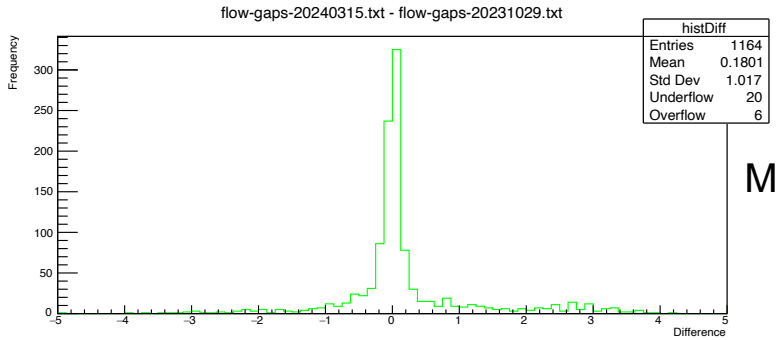
Start of 2023-24 YETS
(2023-10-29)



End of 2023-24 YETS
2024-03-15



Difference (start – end) of 2023-24 YETS



Mean value = 0.18 l/h

Activity list (proposal)

TS1

1) Check quick connectors at rack level with sniffer [gas-group]
2) Check point of leaks found with sniffers by gas group [RPC-team]
3) Check line reconnections for (a subset of) repaired chambers [RPC-team]
4) Check lines with flowmeter with bad value (i.e. very low or no flow) [RPC-team]
5) Pilot test for spotting leaks outside the chambers: [gas-group + RPC-team]
   a) test lines downstream the chambers
      overpressure on output manifold with open input → spot leaks on output lines and faulty valves
   b) test lines upstream the chambers
      set low pressure on an input line closing the chambers at the impedance
      use secondary system to select a single line?

YETS

1) Development of a flowmeter system in view of an installation on each rack line (A.Ozbey) [RPC-team + gas-group]
2) Removal of bypass from flowmeters (installed in view of a very large flow) [RPC-team]
3) Calibration of flowcells (if rack upgrade ongoing, to minimize stop-and-start) [gas-group]
4) O2 sensor installed locally on each rack [gas-group]
5) Tests for spotting leaks outside the chambers [gas-group + RPC-team]
6) Upgrade of old racks (protect chambers by pressure spikes, possibility to save gas, …)
   need funding approval by muons/ATLAS [gas-group]

Check lines with flowmeter with bad value

Flowmeters with too low flow (i.e. <0.6V) → currently ~250

- each line to be checked

- preliminary check at end of YETS on 40 cases corresponding to repaired chambers,
  about half of them have shown problems, i.e. line still leaking
  1) chamber repair validated with pressure test, possible pipe reconnection problems
  2) broken flowmeters
  3) valve problems

<u>Being defined:</u>

→ person-power

→ detailed instructions

Leak search: instructions

draft

1. Check input and output pipe connections up to manifold
2. Check flowmeter integrity
3. Measure flowmeter readout with voltmeter
4. Test valve functionality
5. Check all connections with sniffer
6. ….