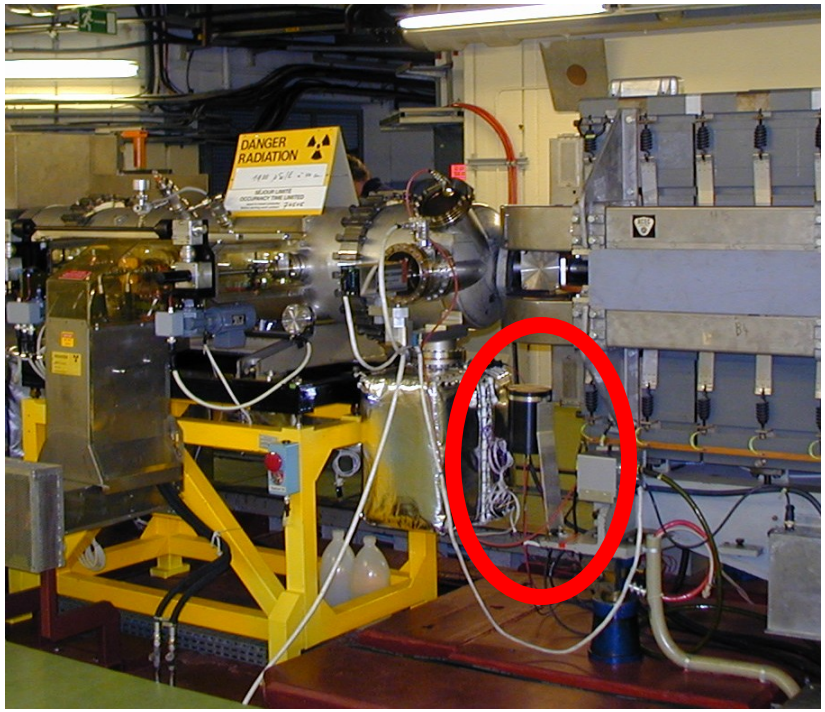
Radiation protection issues at the PS linked to MTE and CT operation

M. Widorski, DGS/RP

Summary

- Measurement by induced activity monitors
- Evolution of induced activity in the PS tunnel
- Stray radiation impact

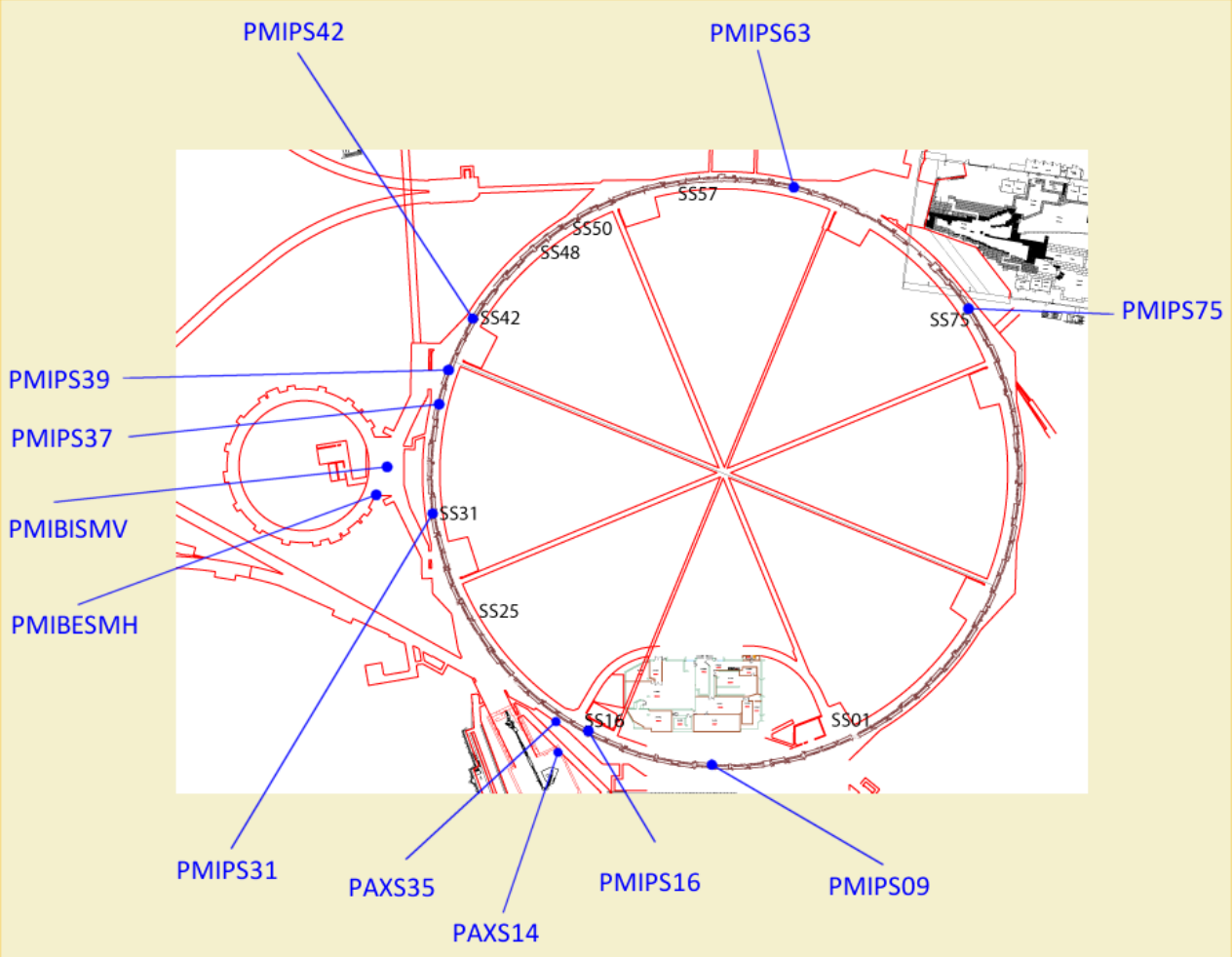
Induced Activity Monitors



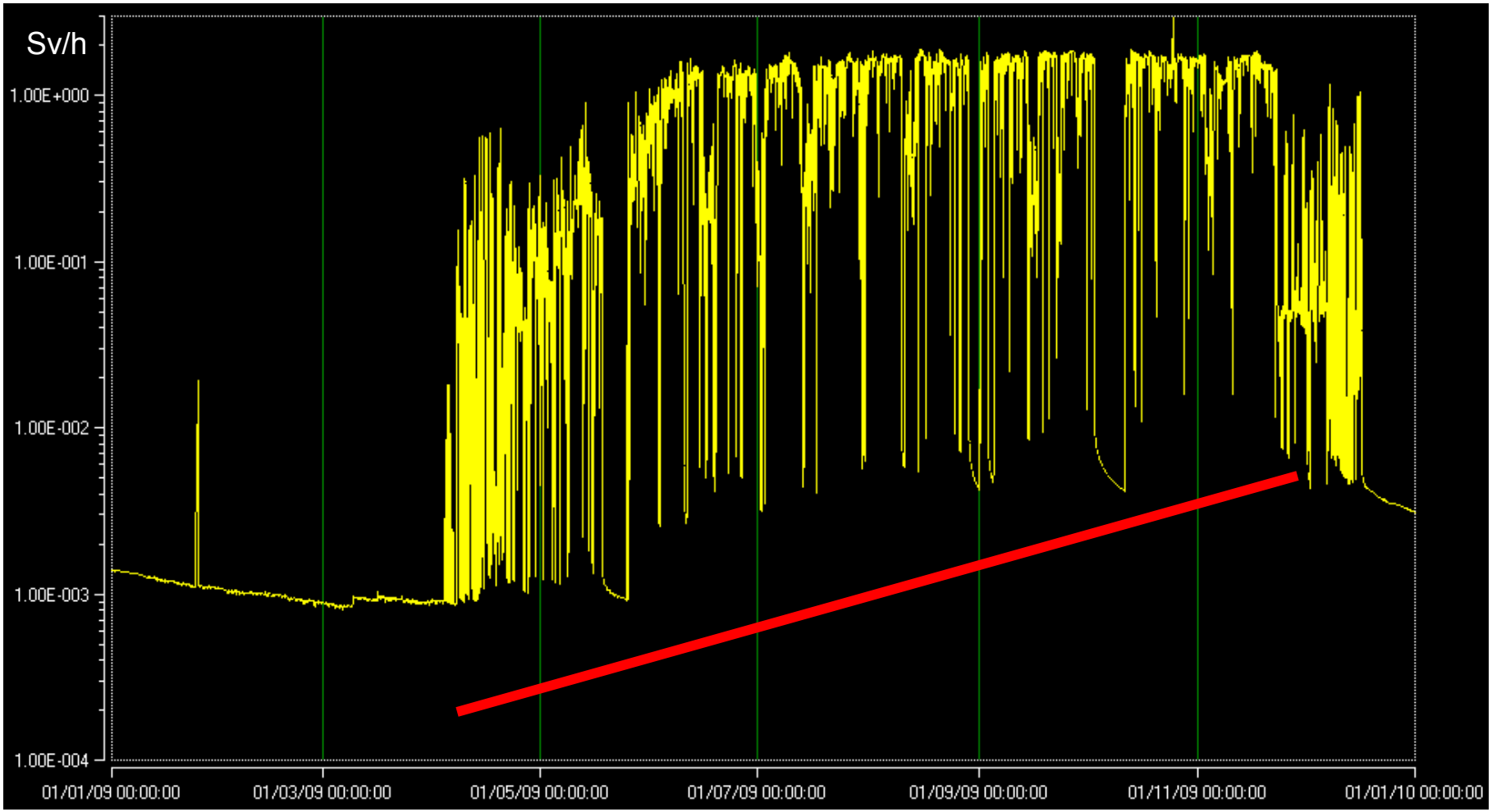
- 8 fixed installed ionisation chambers in the PS ring
- In sections:

  9, 16, 31, 37, 39, 42, 63, 75
- Intended measuring range:
  - 0.02 ~ 400 mSv/h
- No beam loss monitors !
- Following slides: Measured values in 2009 and 2010

Radiation detectors PS



PMIPS16 - 2009



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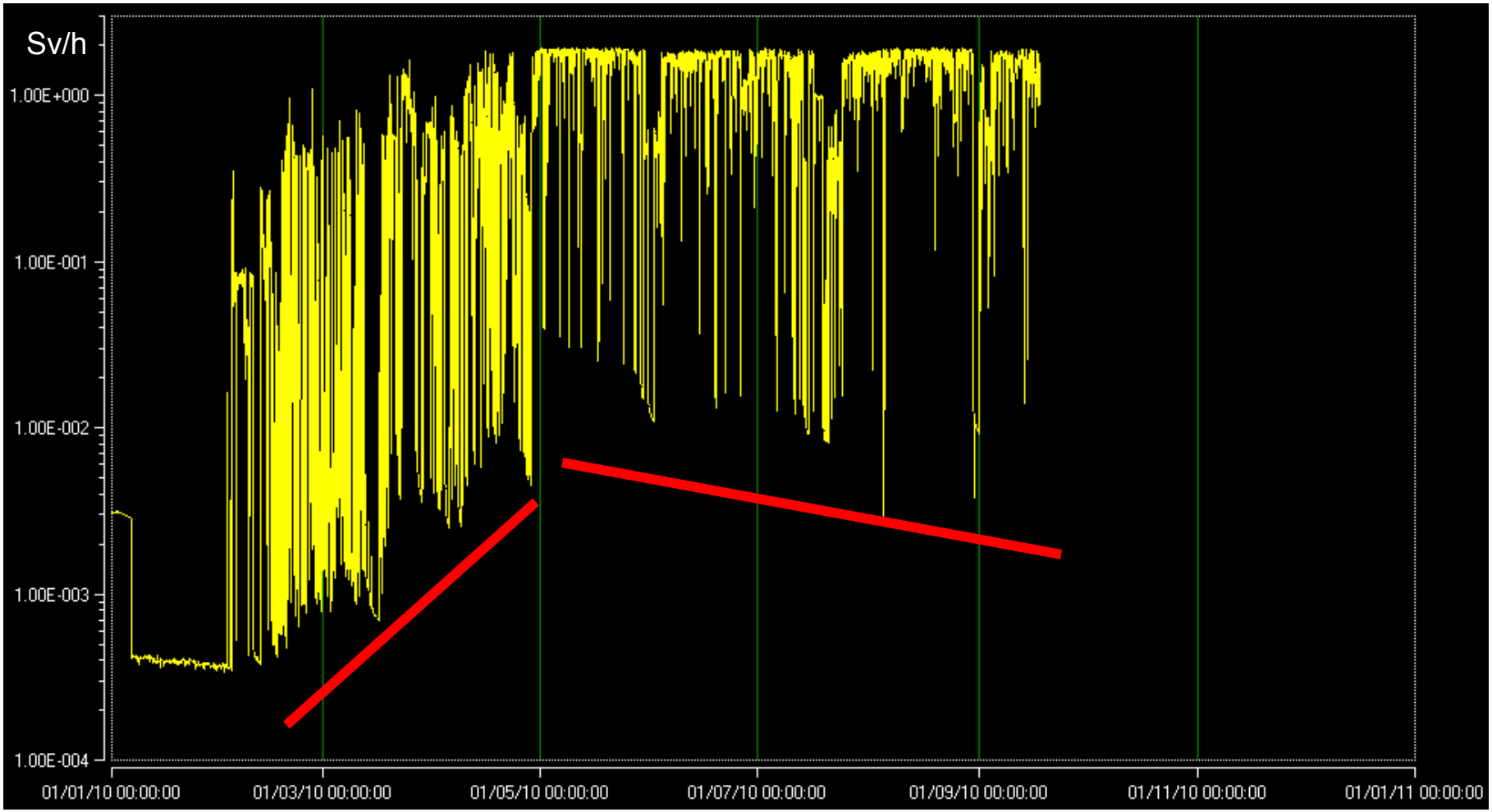
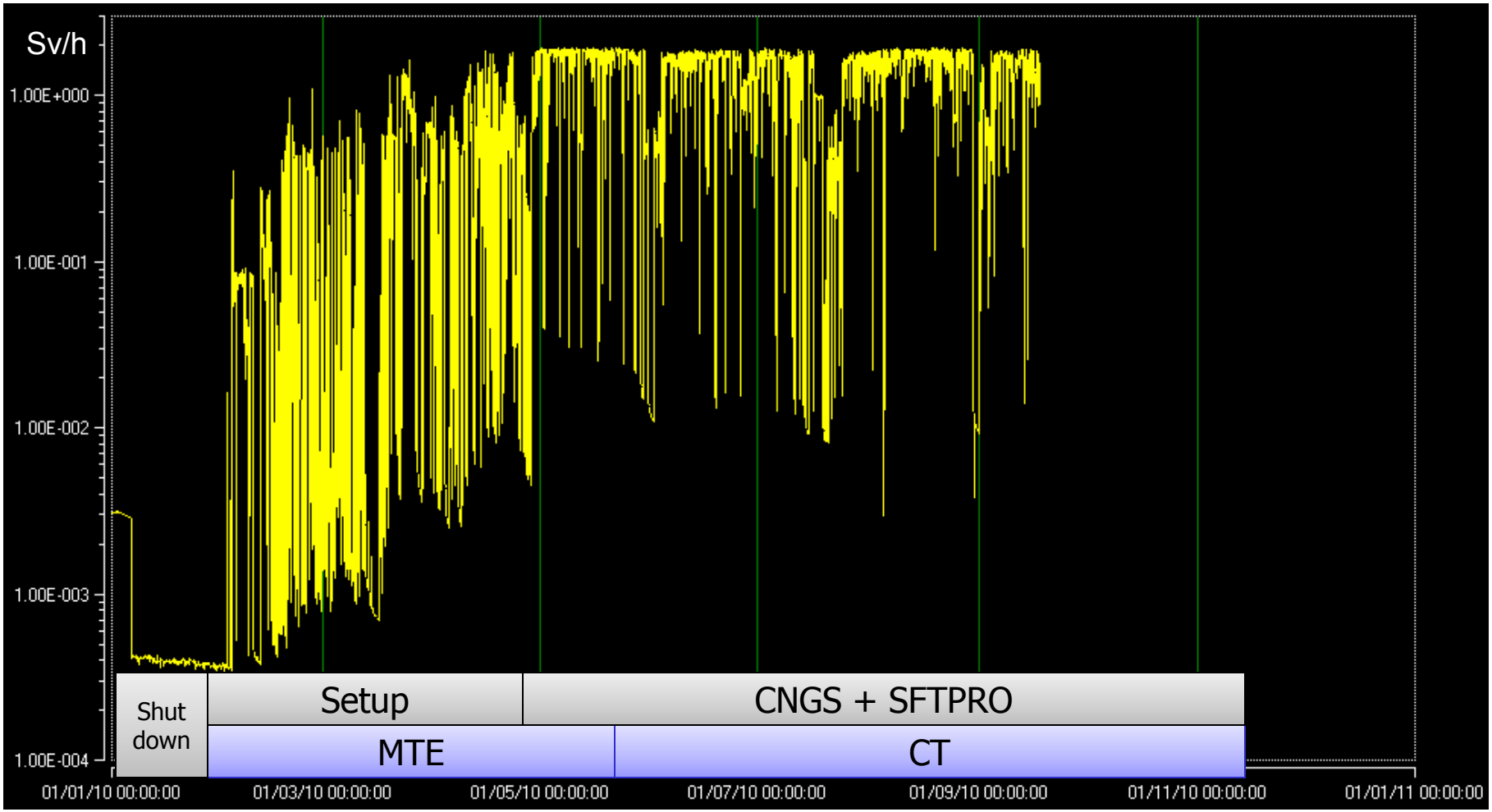
PMIPS16 - 2010



PMIPS16 - 2010



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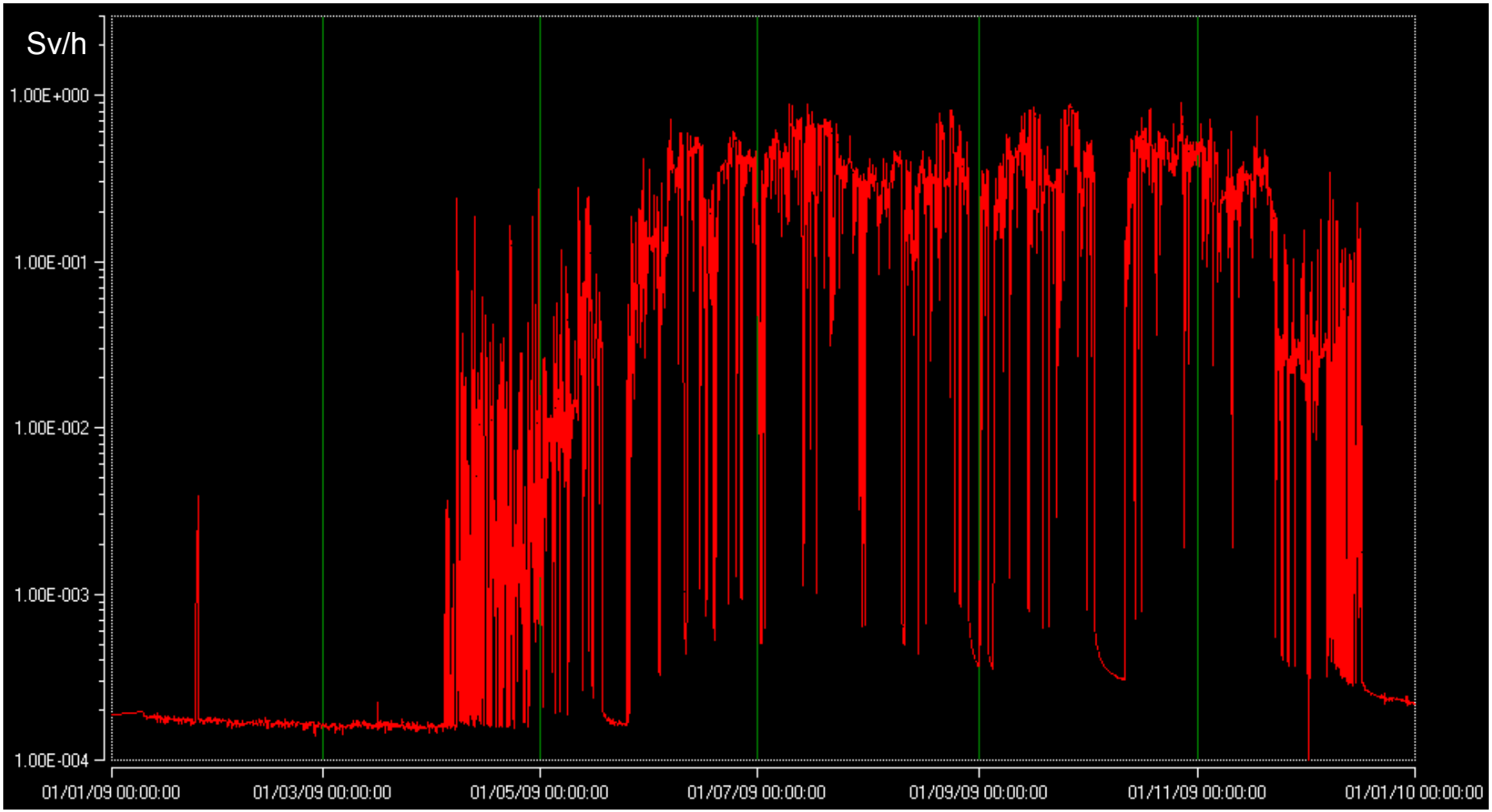
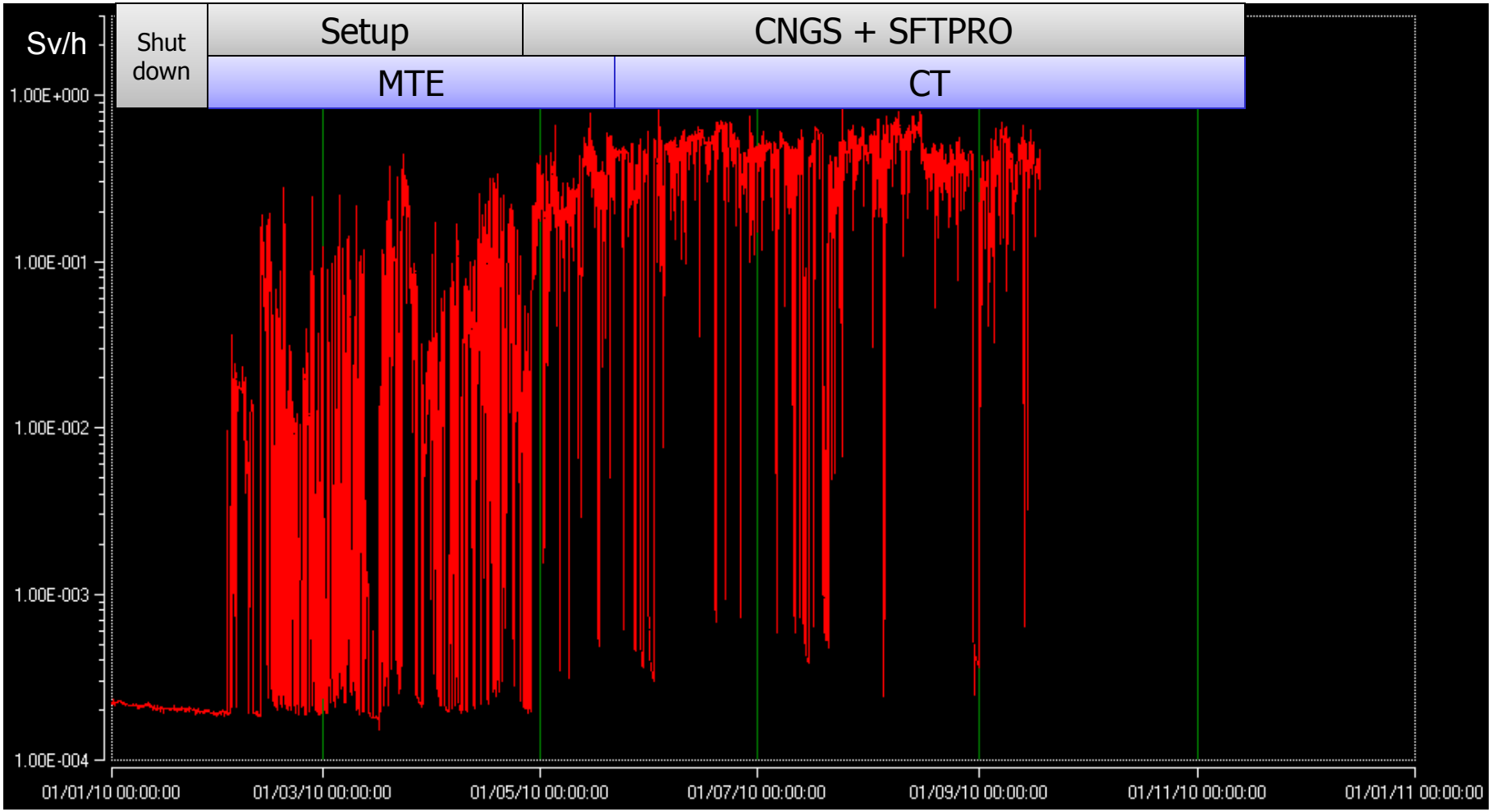
PMIPS09 - 2009



PMIPS09 - 2010



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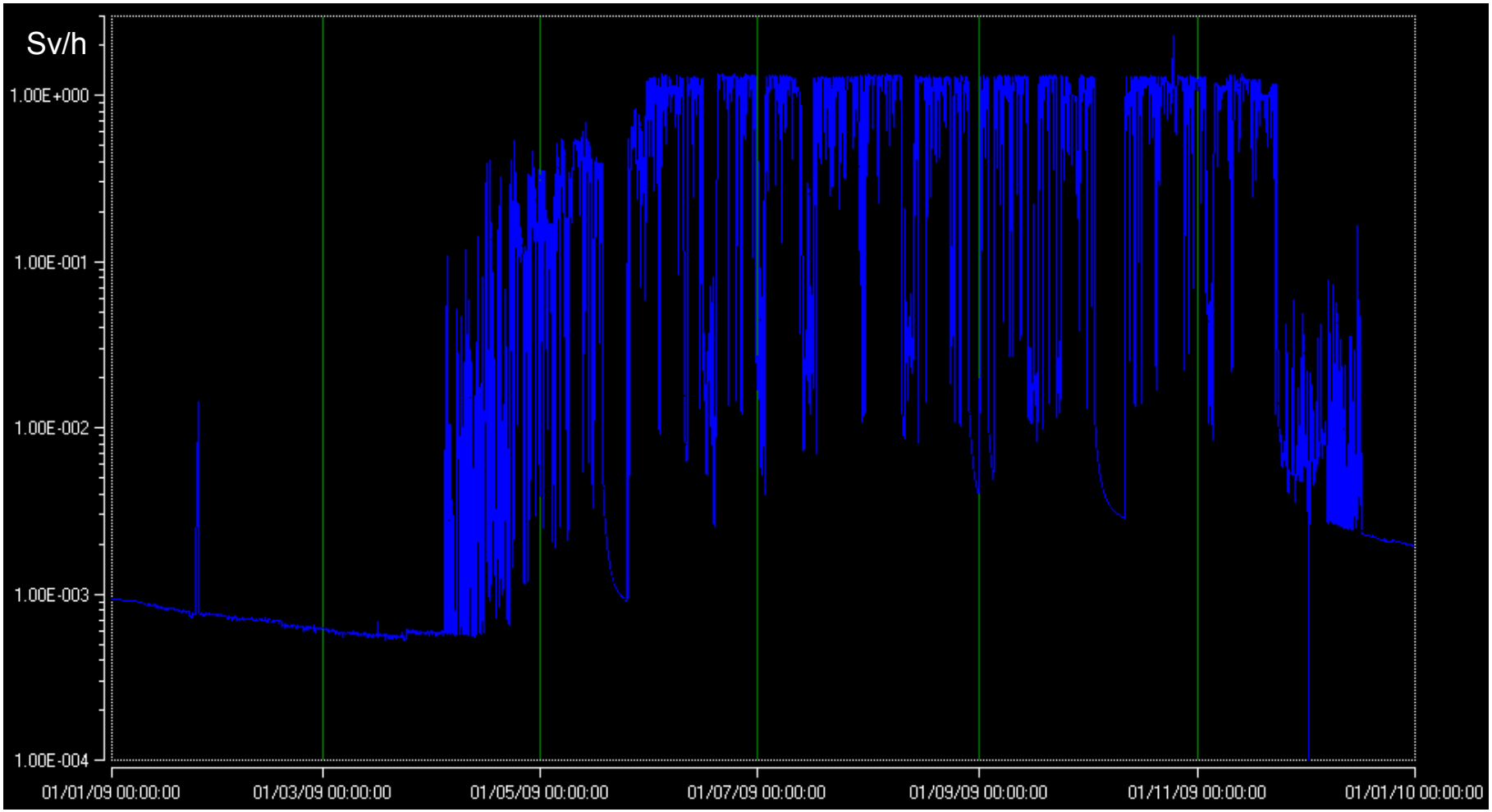
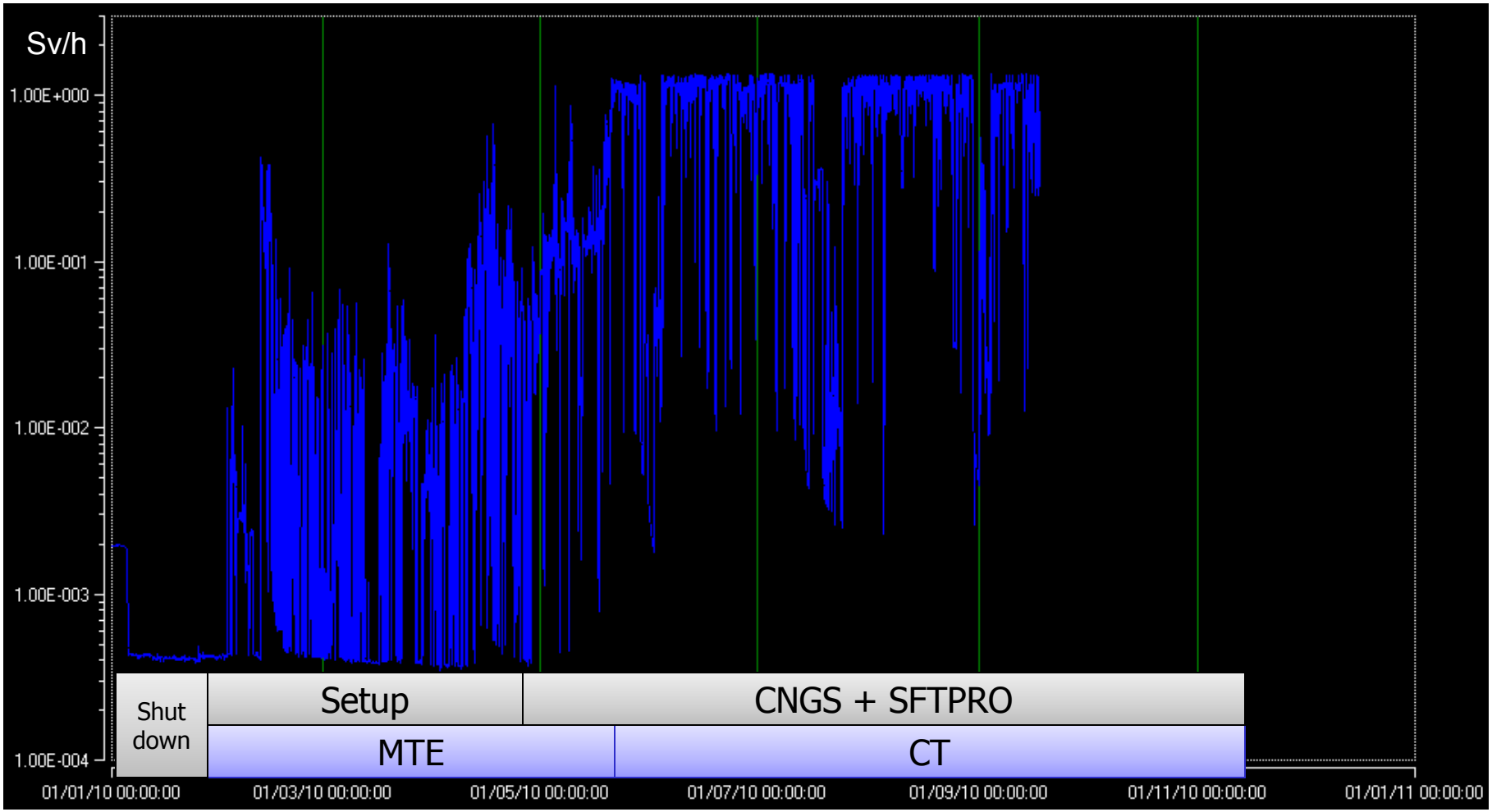
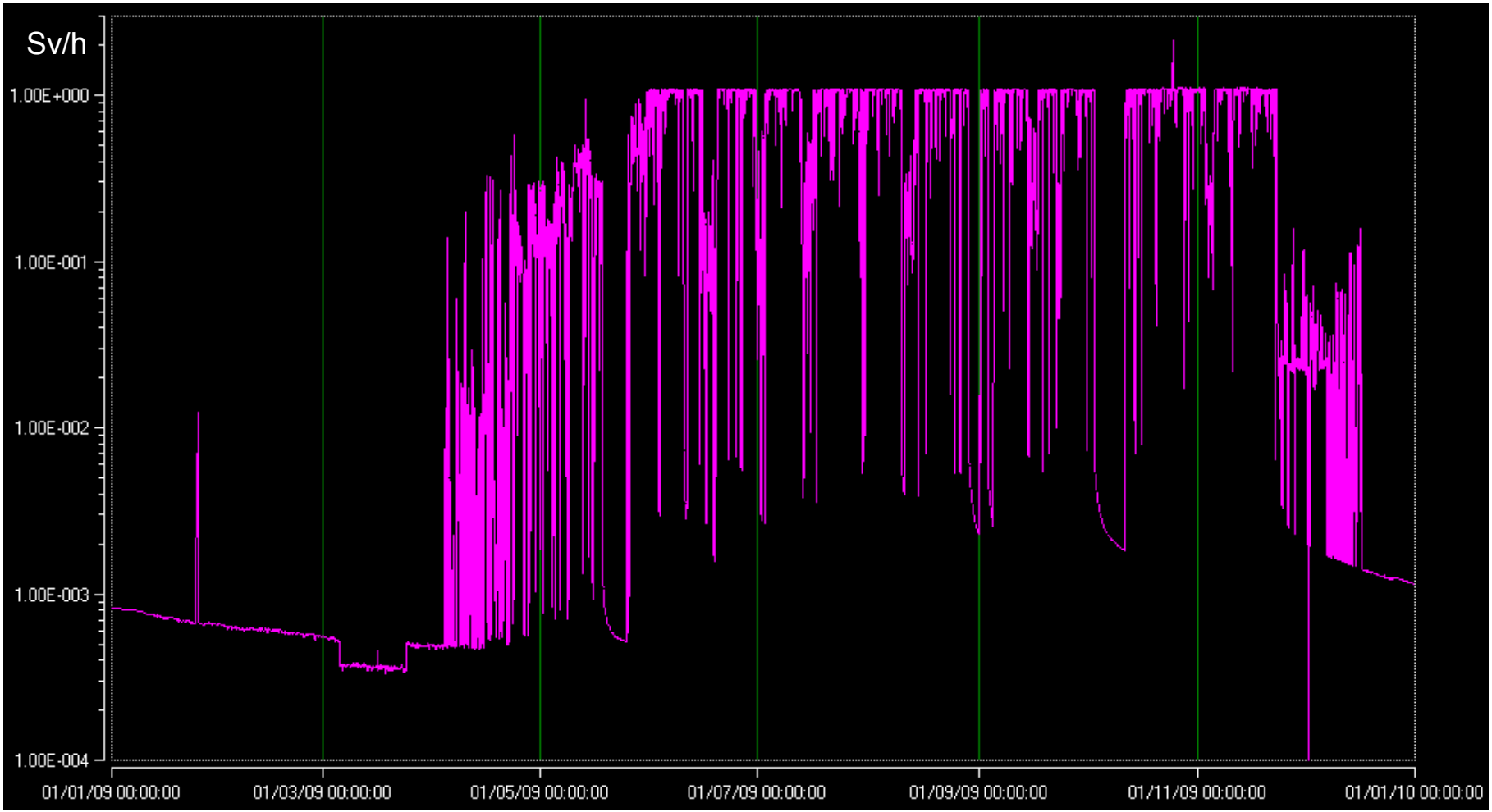
PMIPS31 - 2009



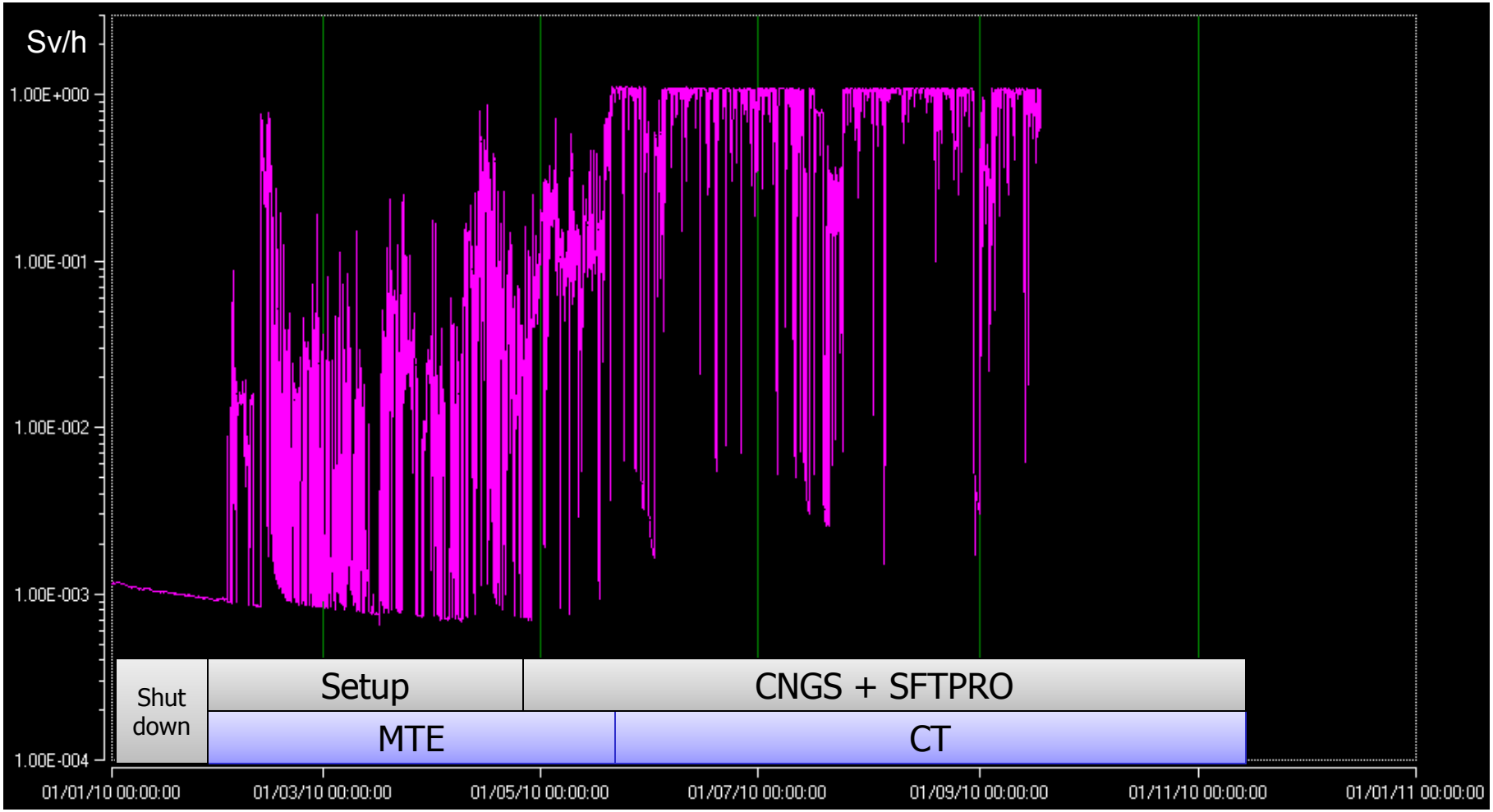
PMIPS31 - 2010



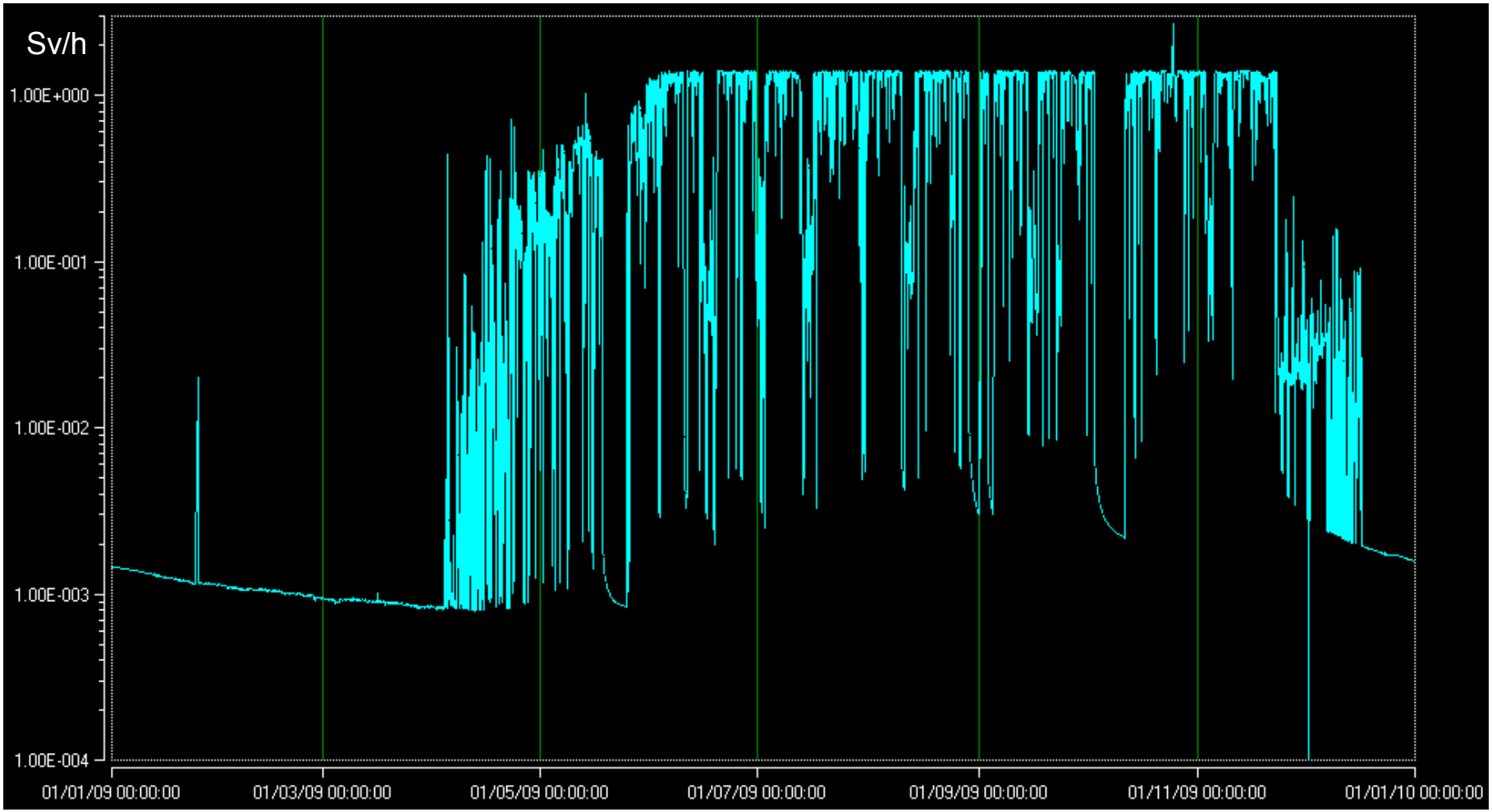
PMIPS37 - 2009



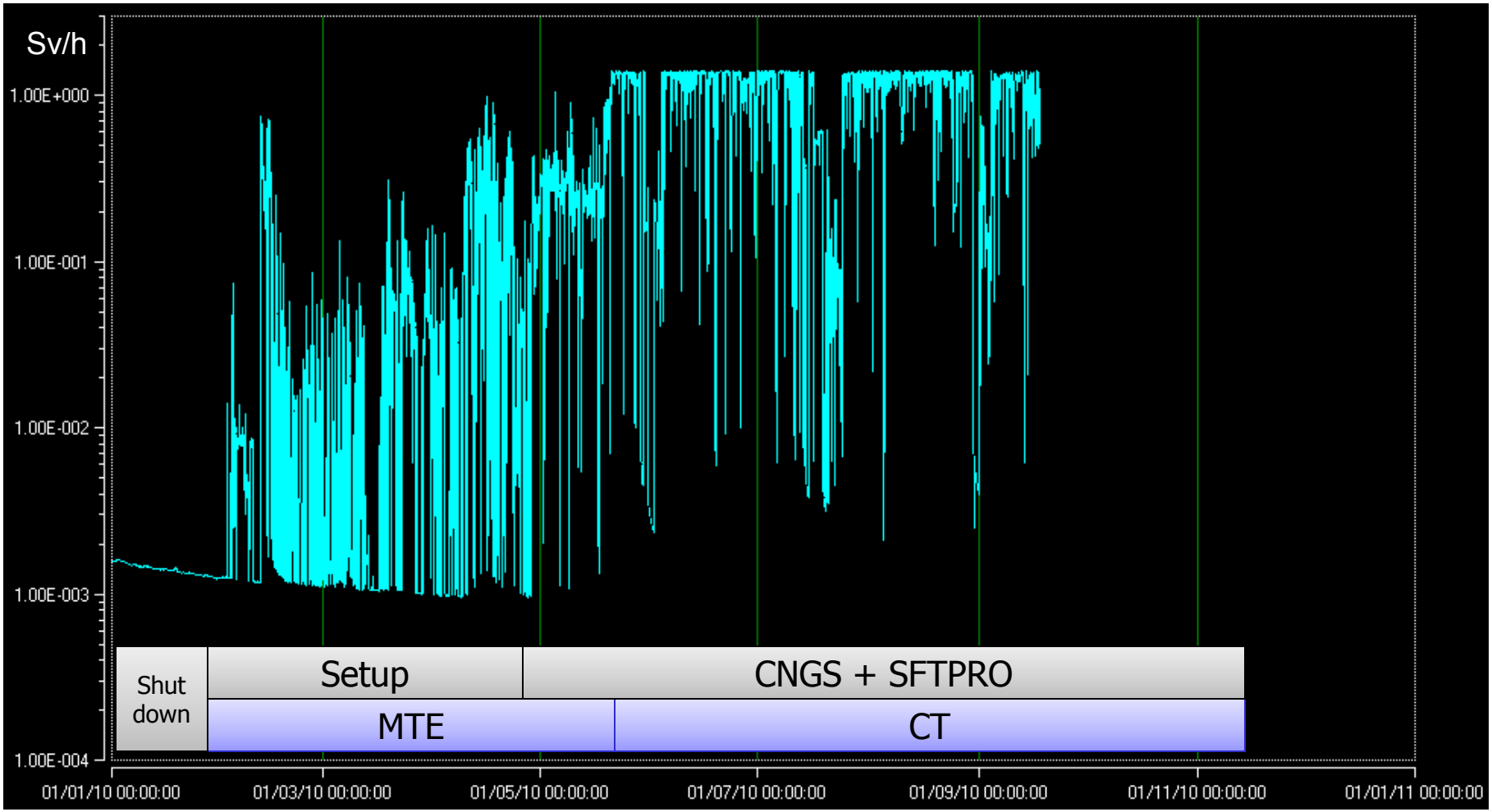
PMIPS37 - 2010



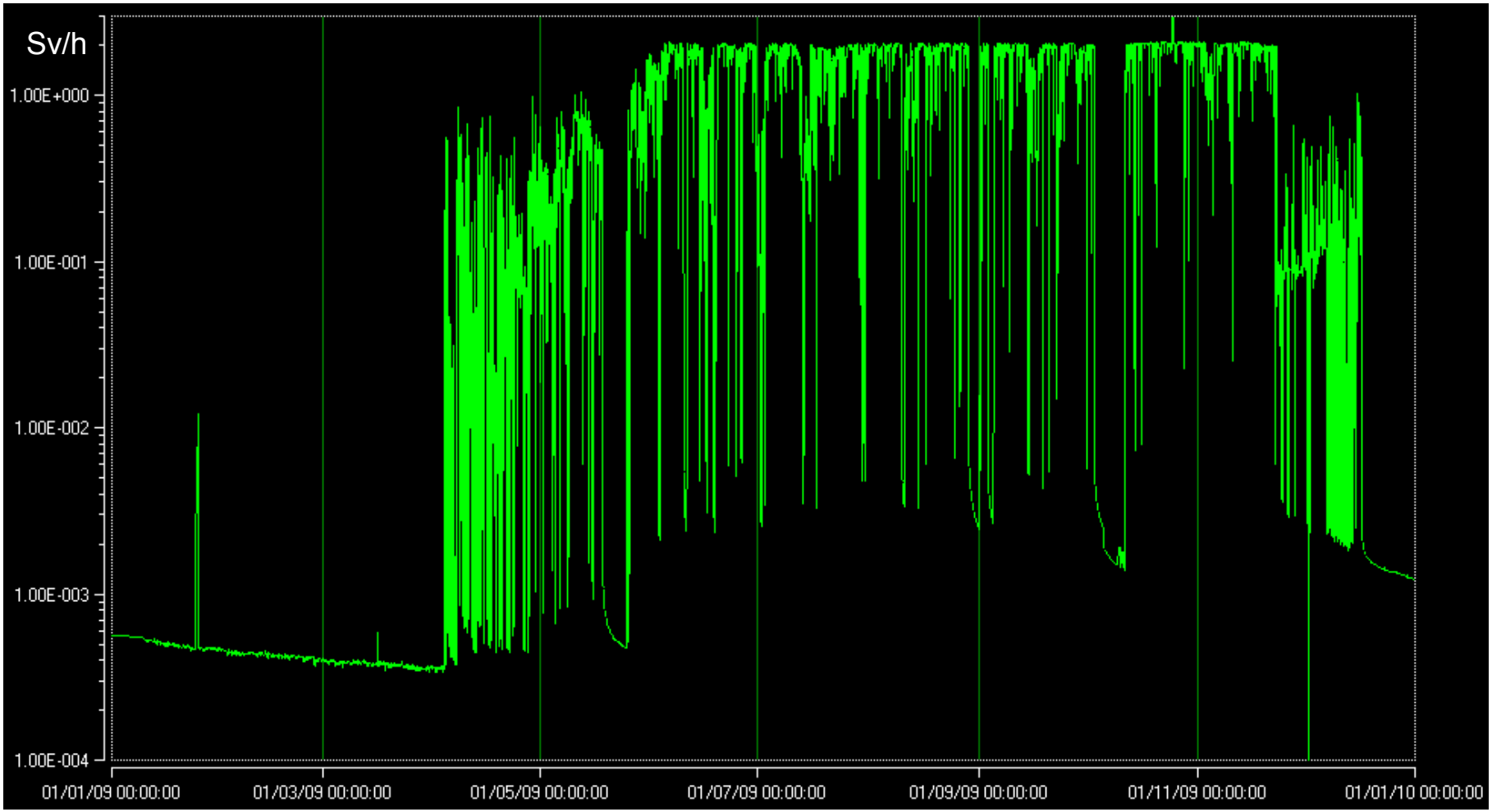
PMIPS39 - 2009



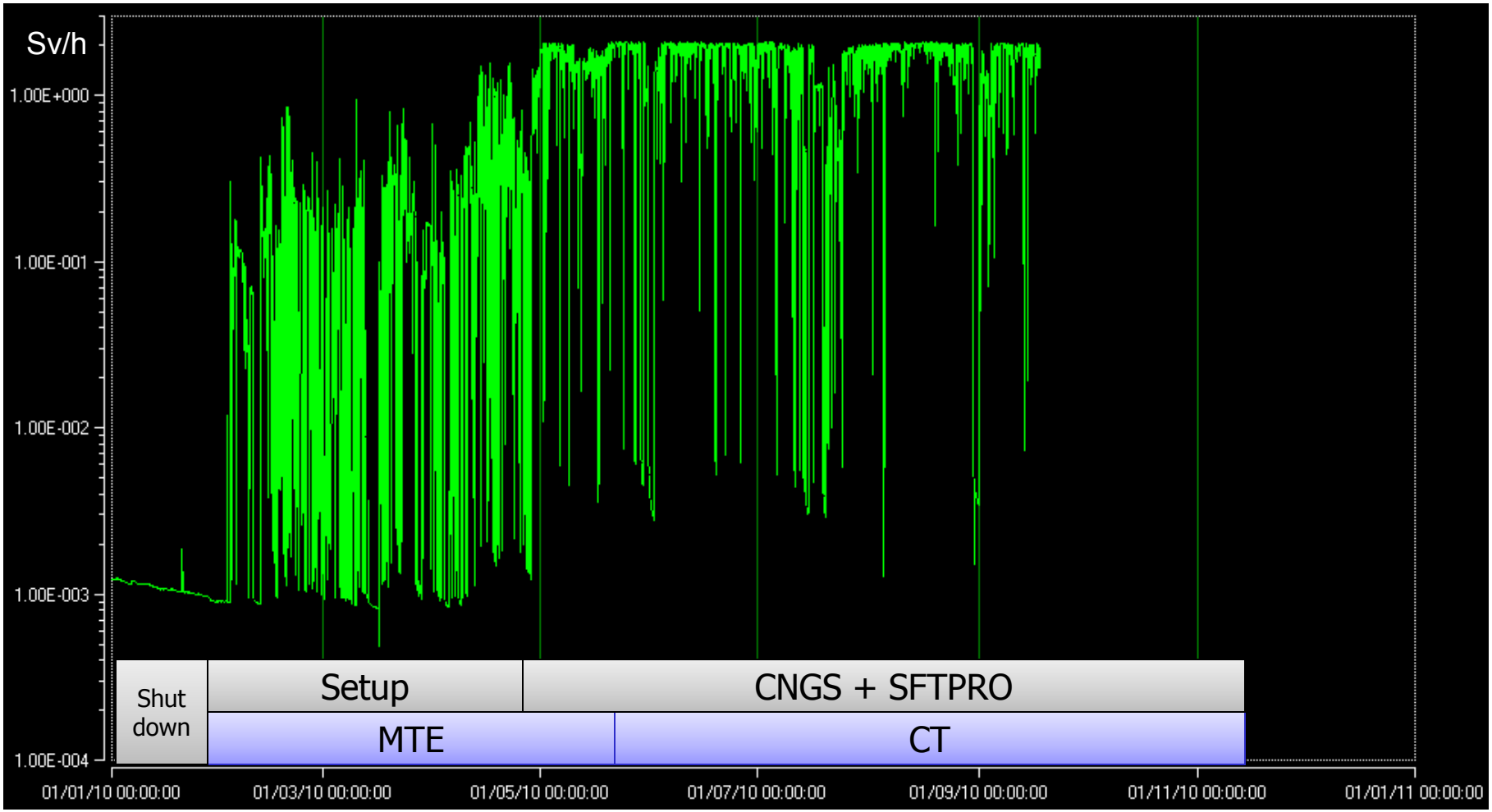
PMIPS39 - 2010



PMIPS42 - 2009



PMIPS42 - 2010



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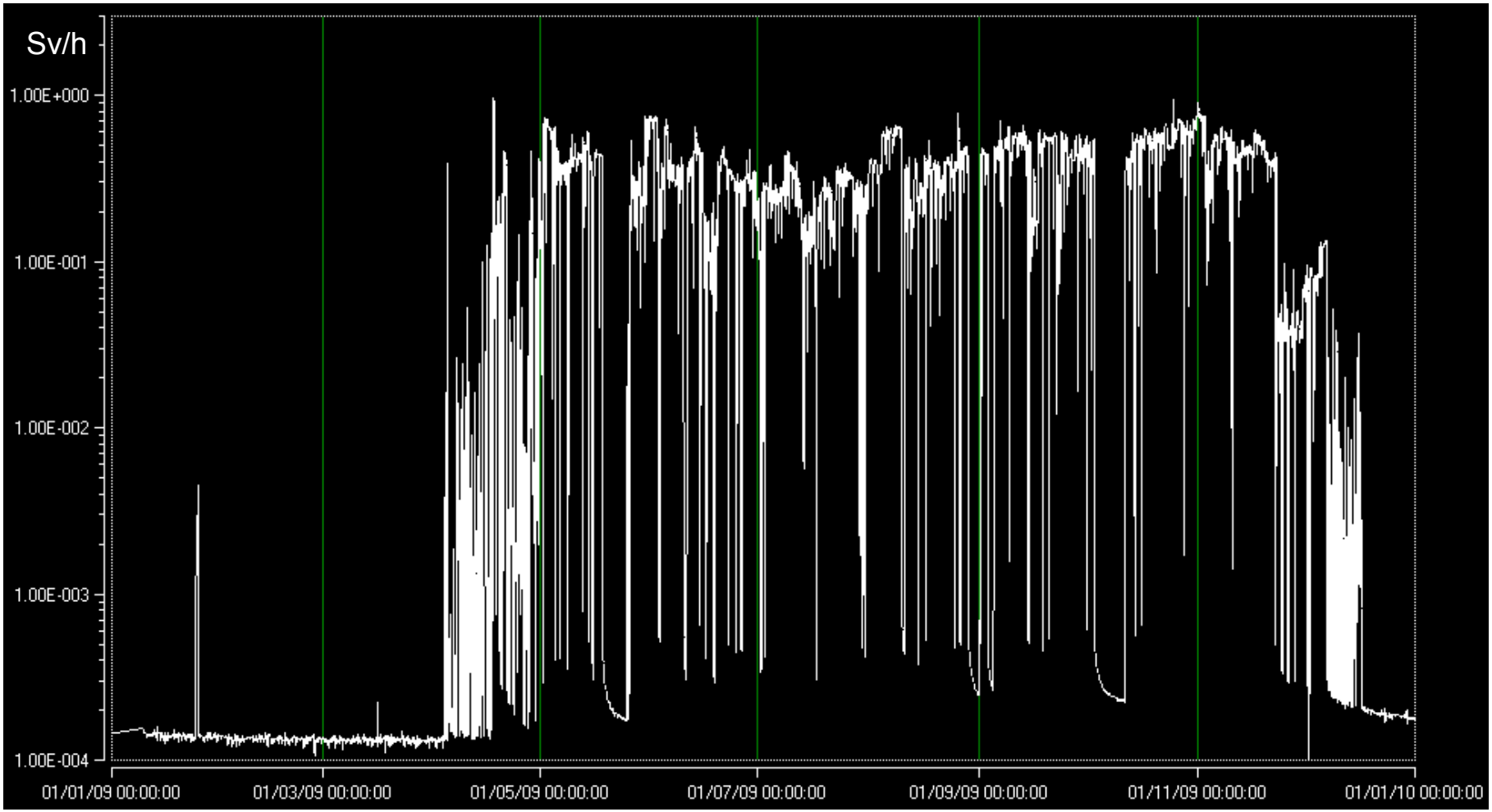
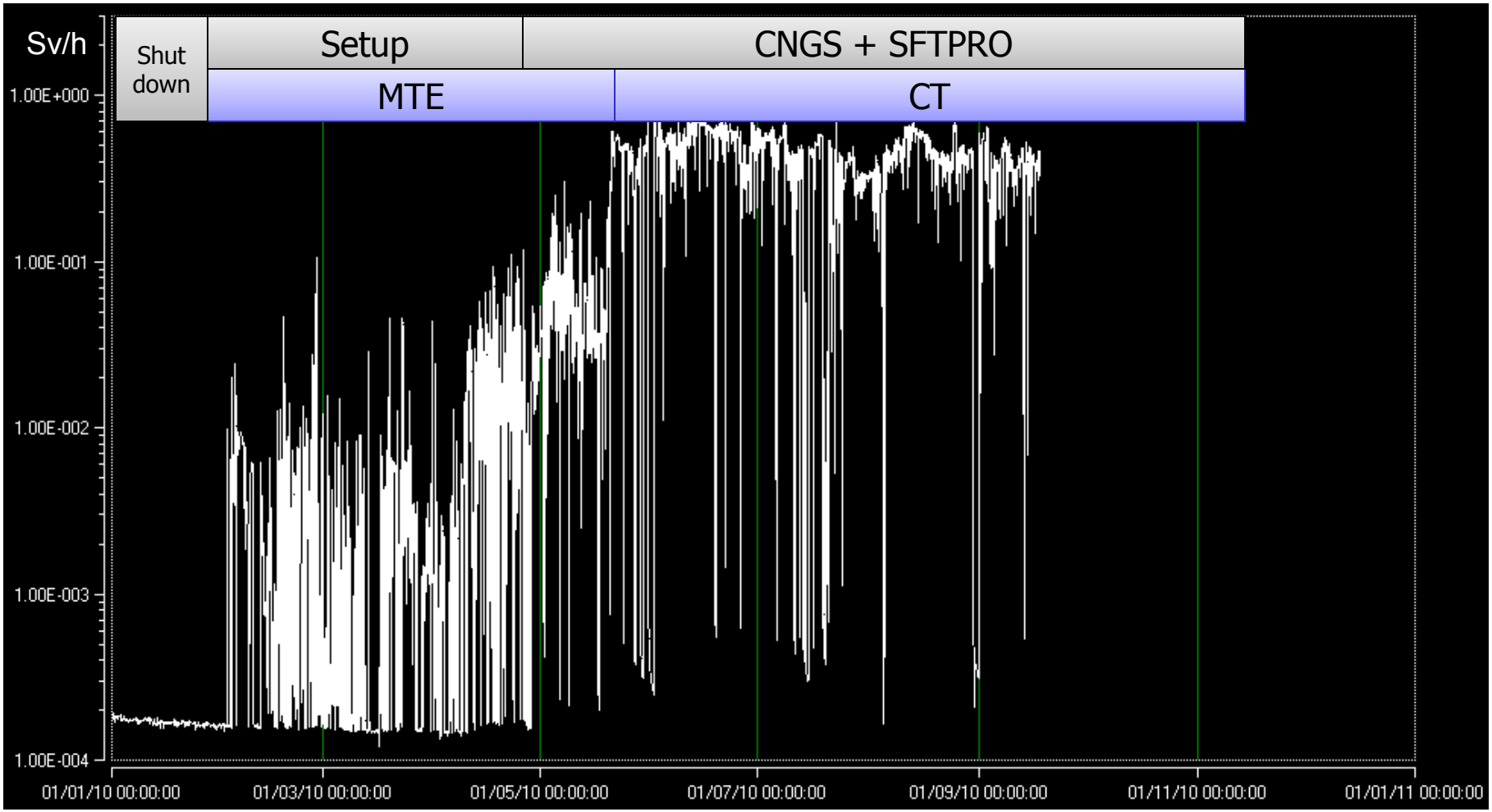
PMIPS63 - 2009



PMIPS63 - 2010



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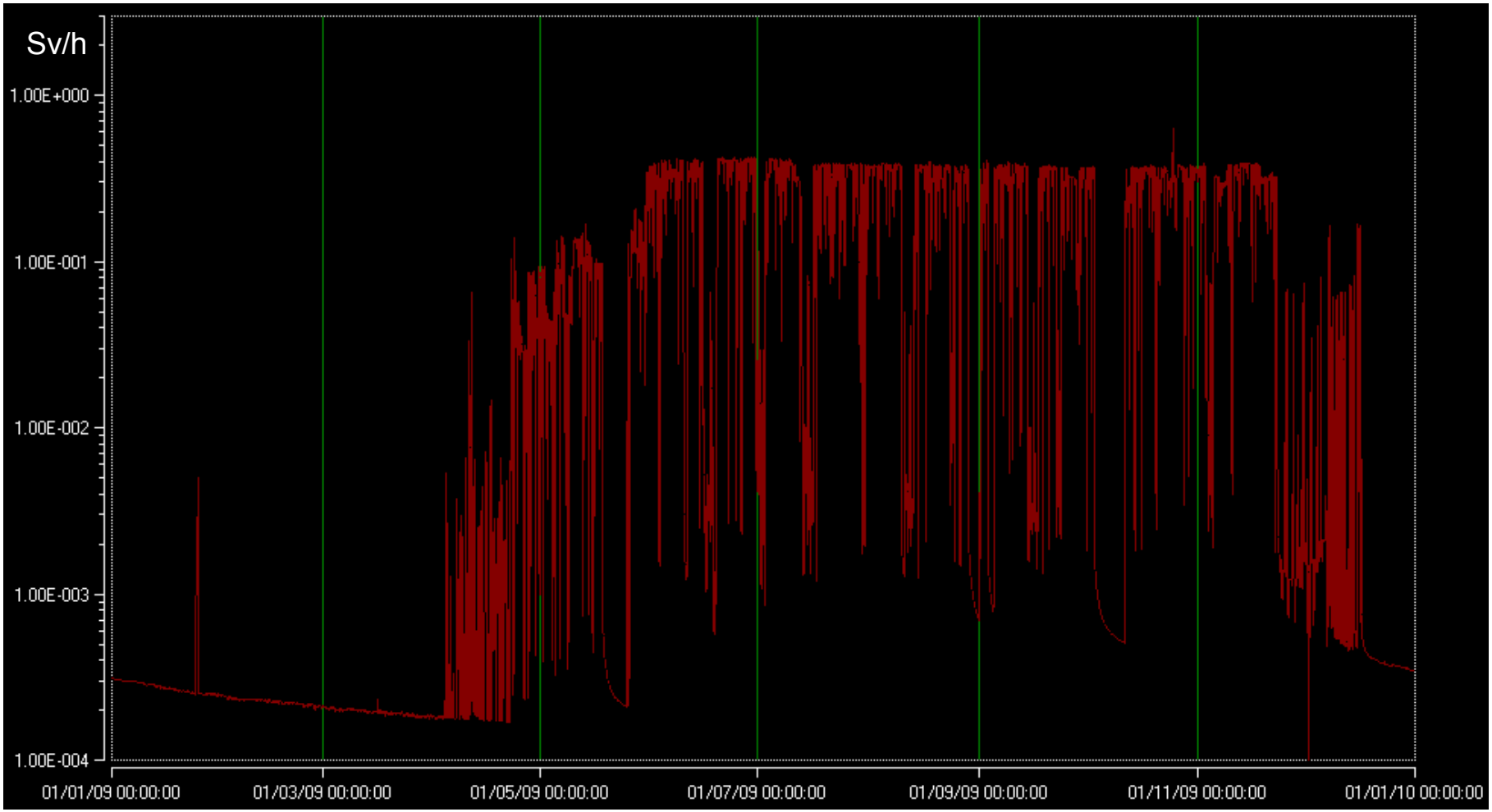
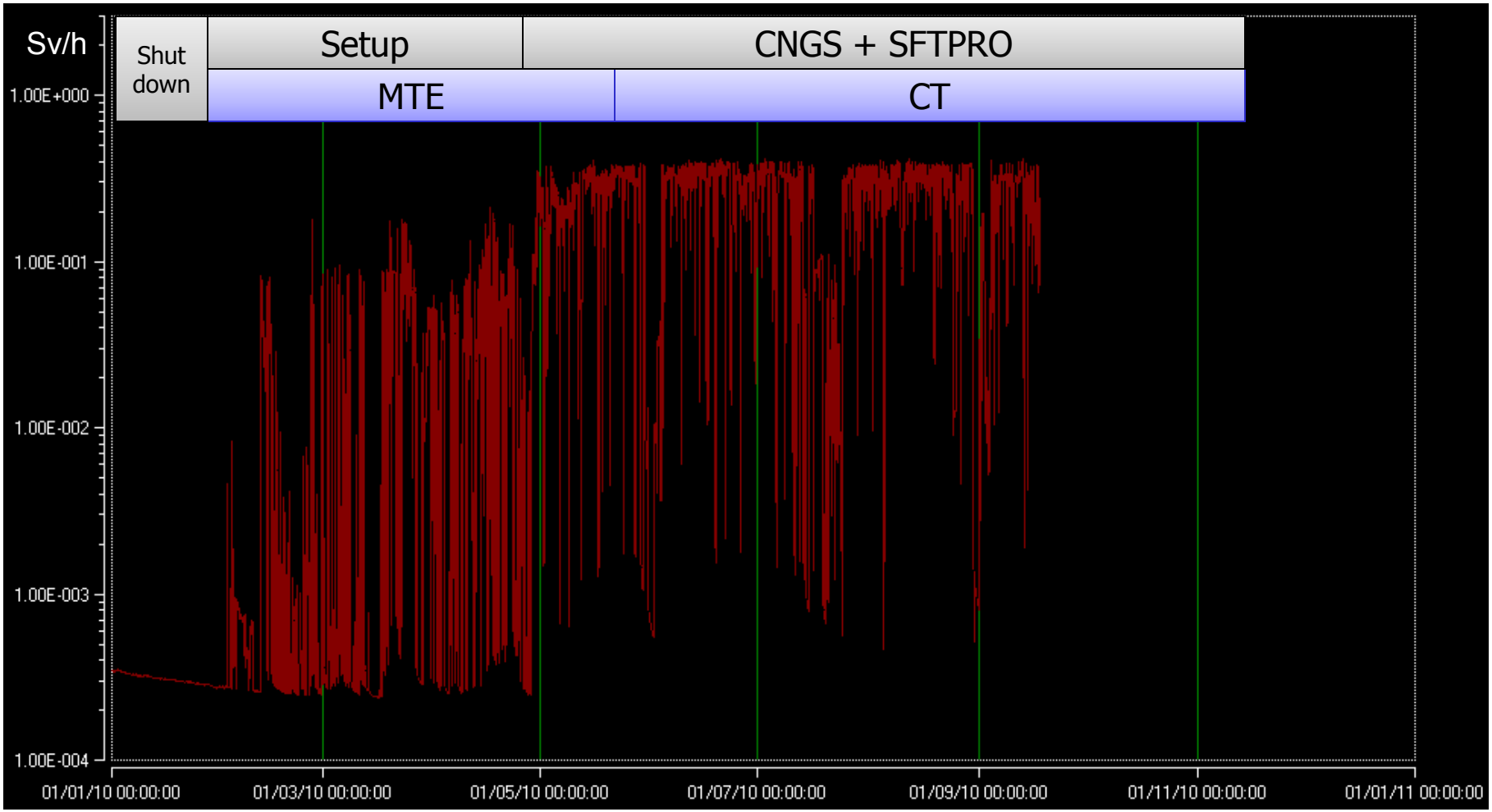
PMIPS75 - 2009



PMIPS75 - 2010

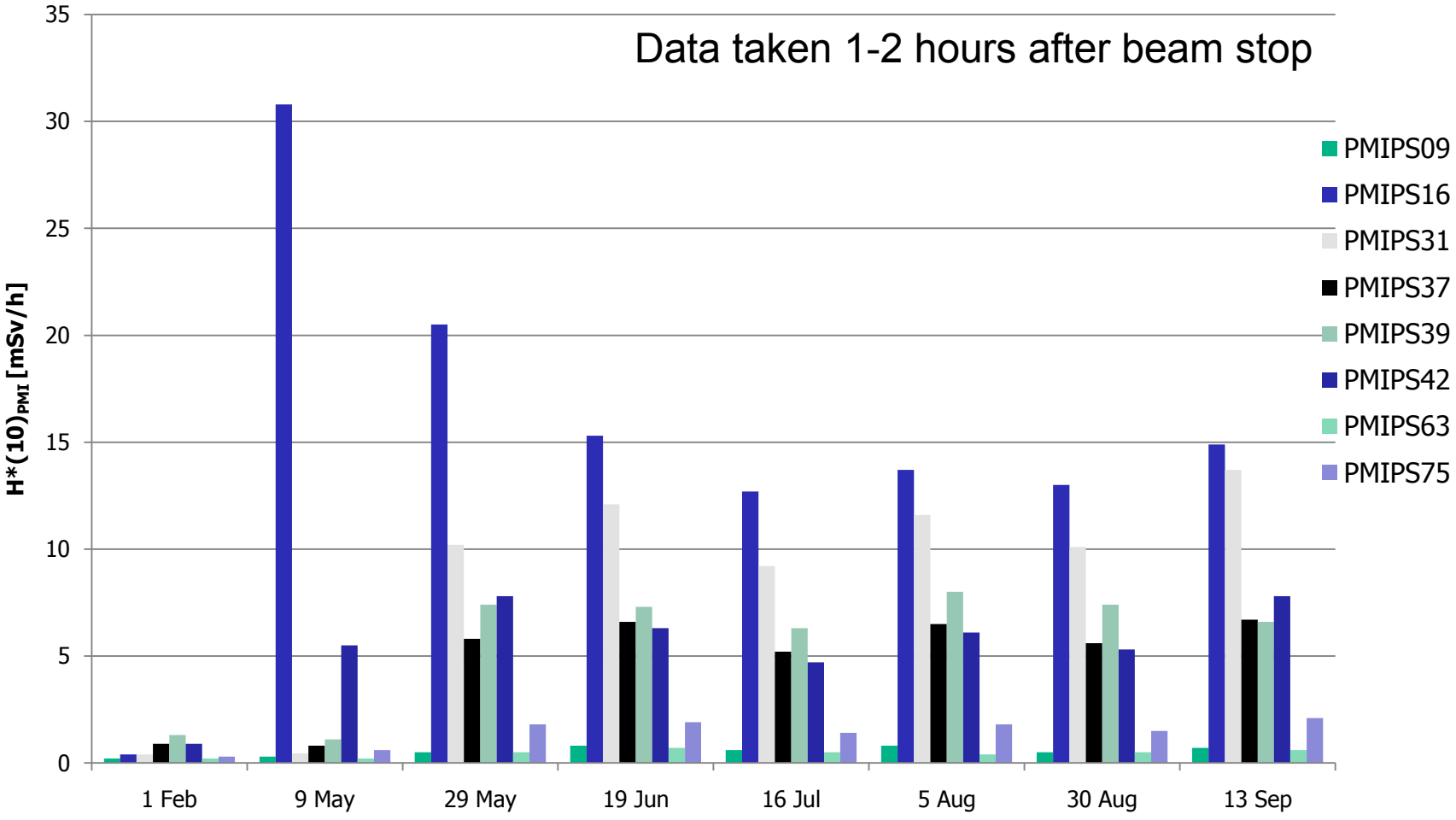


Evolution of dose rates in 8 PS sectors

Monitor	01/02/10	09/05/10	29/05/10	19/06/10	16/07/10	05/08/10	30/08/10	13/09/10
PMIPS09	0.2	0.3	0.5	0.8	0.6	0.8	0.5	0.7
PMIPS16	0.4	30.8	20.5	15.3	12.7	13.7	13	14.9
PMIPS31	0.4	0.45	10.2	12.1	9.2	11.6	10.1	13.7
PMIPS37	0.9	0.8	5.8	6.6	5.2	6.5	5.6	6.7
PMIPS39	1.3	1.1	7.4	7.3	6.3	8	7.4	6.6
PMIPS42	0.9	5.5	7.8	6.3	4.7	6.1	5.3	7.8
PMIPS63	0.2	0.2	0.5	0.7	0.5	0.4	0.5	0.6
PMIPS75	0.3	0.6	1.8	1.9	1.4	1.8	1.5	2.1

Data taken 1-2 hours after beam stop
$H^*(10)_{PMI}$ [mSv/h]

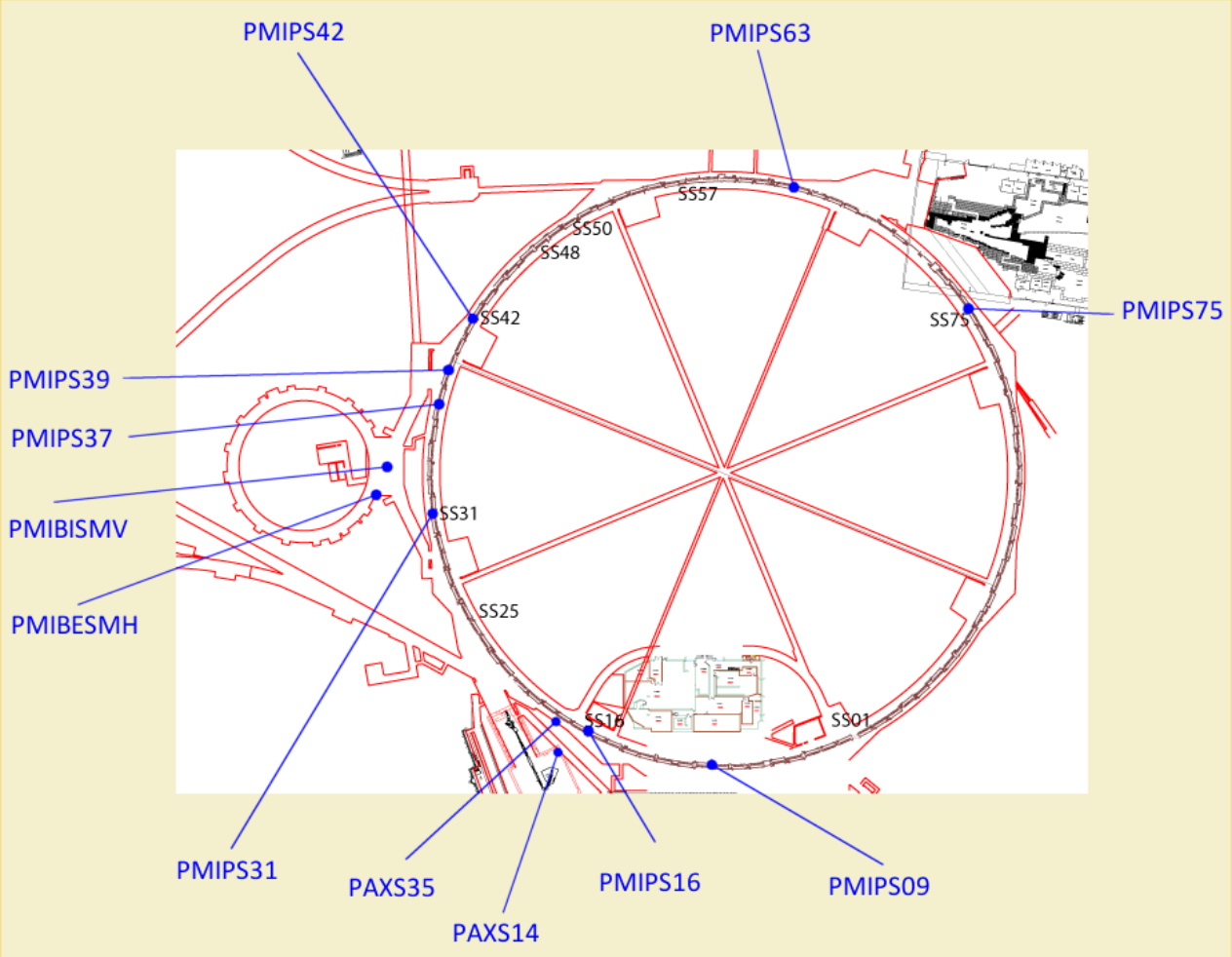
Evolution of dose rates in 8 PS sectors



MTE <-> CT

- MTE: high impact on SS16, other sectors much less affected
- SS42 is mostly depending on injected intensity, not on MTE (CT has a certain impact, but not visible from this data)
- CT has a high impact on a big number of sectors (31 onwards)
- CT has smaller impact on SS16 than MTE

Radiation detectors PS



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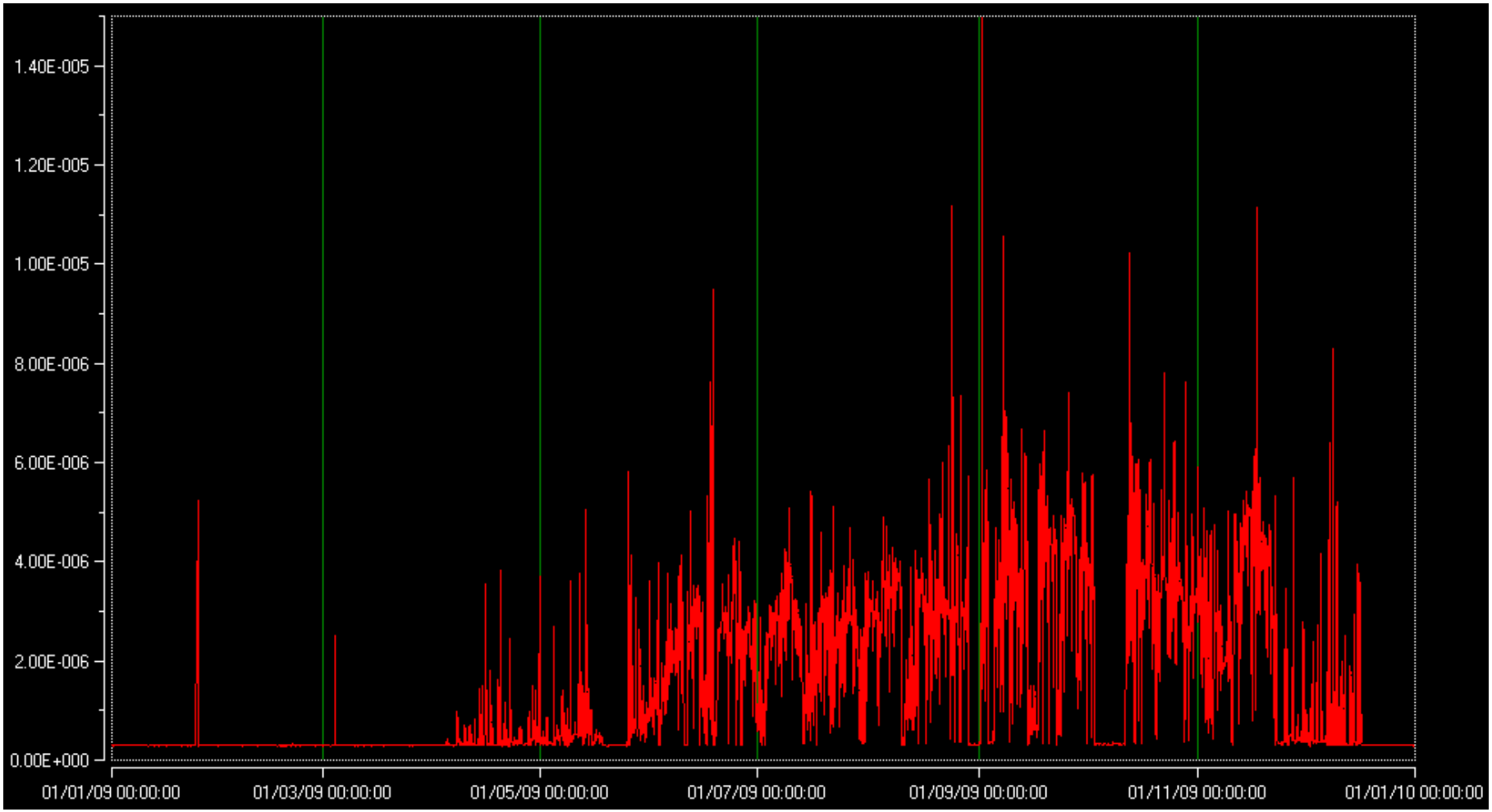
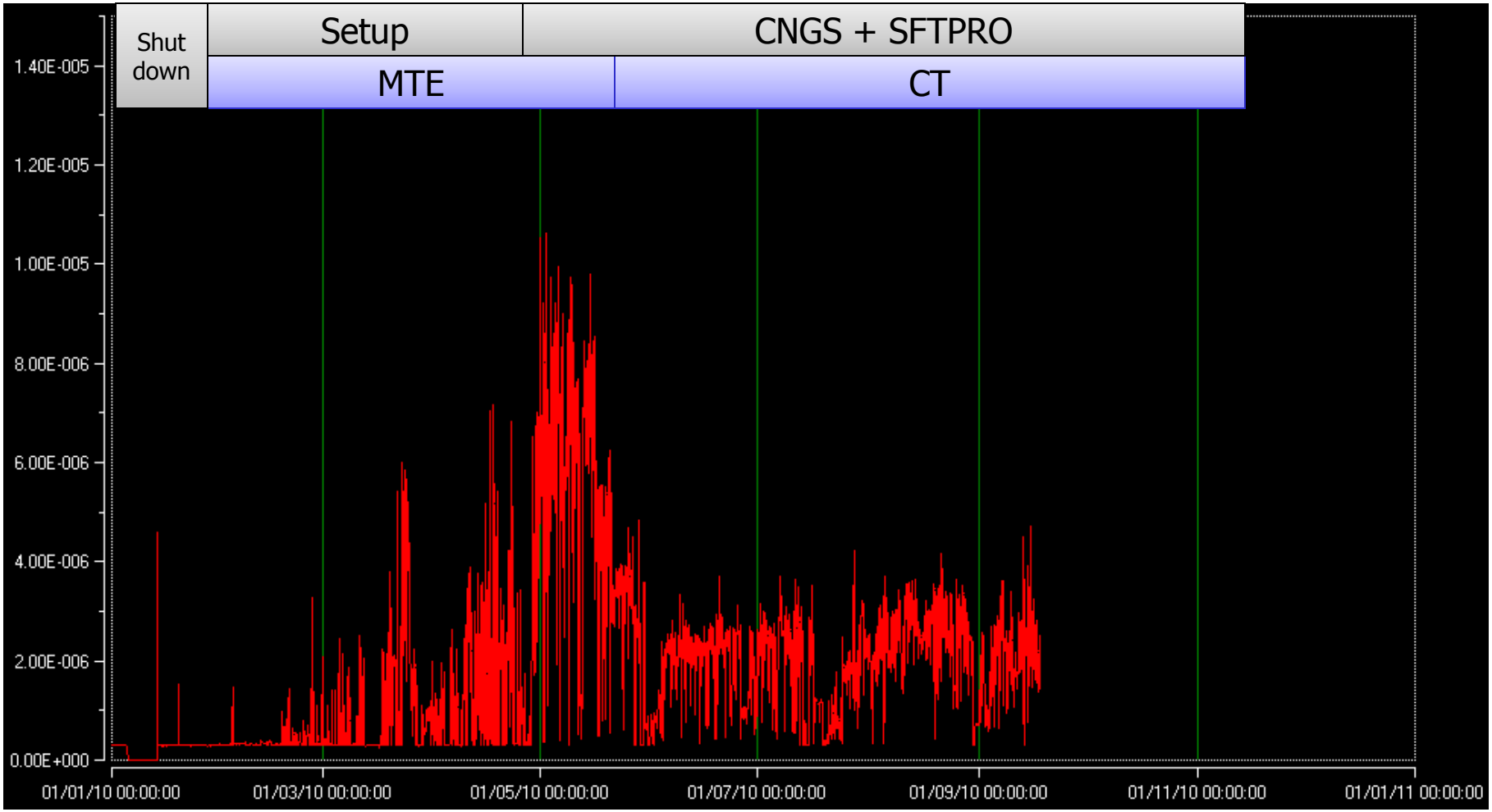
Linac 3: PAXS14 (2009)

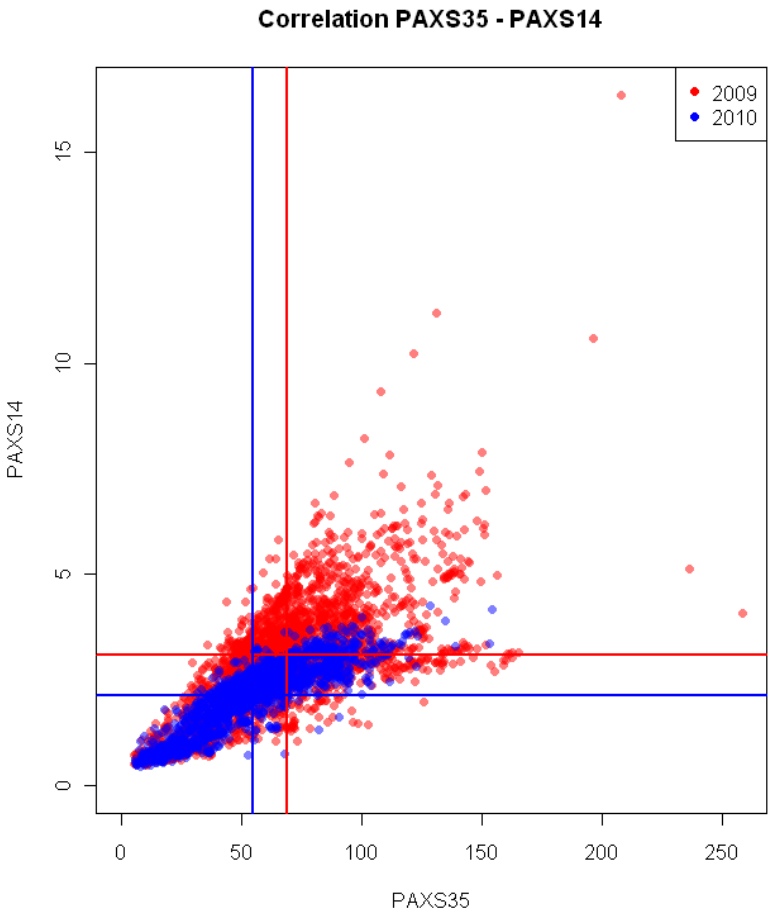


Stray radiation in LINAC 3

Linac 3: PAXS14 (2010)

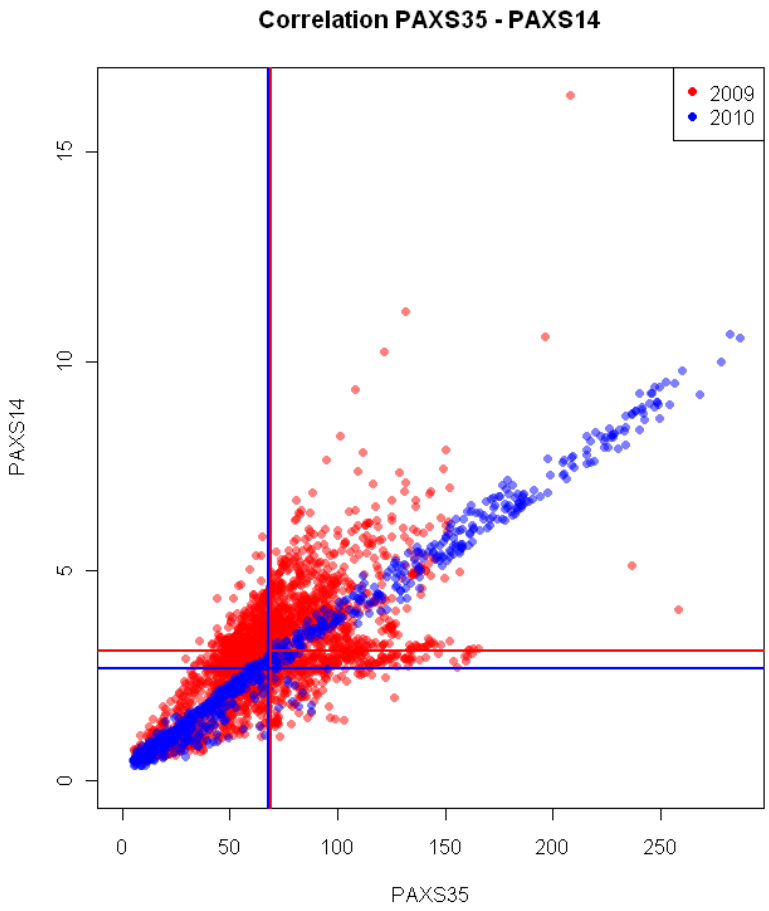


CT beam losses in SS16



- Red dots = CT + MTE (2009)
- Blue dots = CT (May 2010 →)
  - Maximum and average dose rate were reduced compared to 2009
  - Effect of shielding wall visible but less than expected factor (complicated geometry, multisource case)
  - Less problems in CT ejection in 2010 (?)

CT and MTE beam losses in SS16



- Red dots = CT + MTE (2009)
- Blue dots = MTE only (beginning 2010)
  - Higher correlation between PAXS35 and PAXS14: Losses from MTE are much more 'targeted'
  - Same average value for PAXS35, lower value for PAXS14

Survey SS16-FT16 (17/12/2009)

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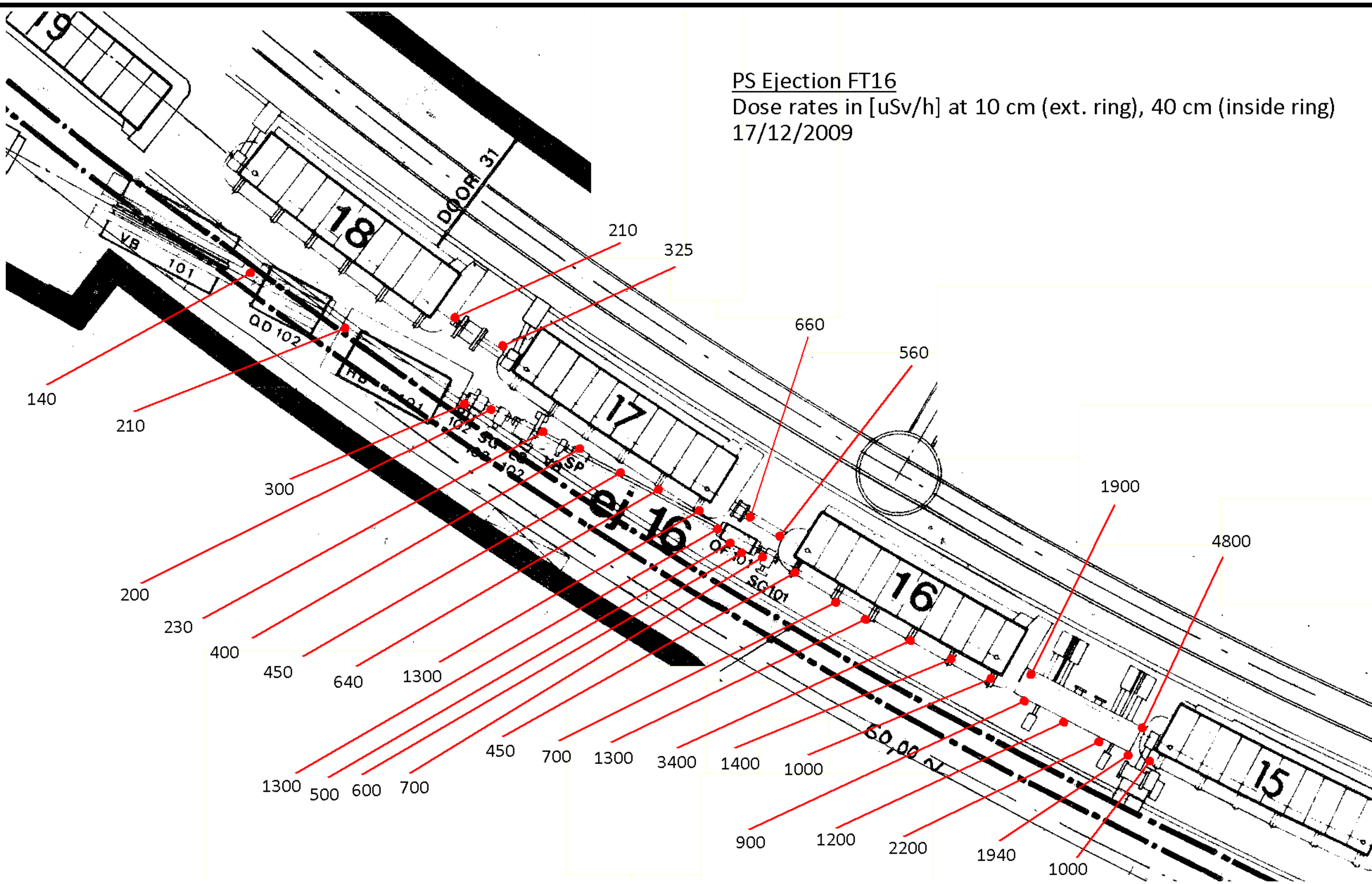
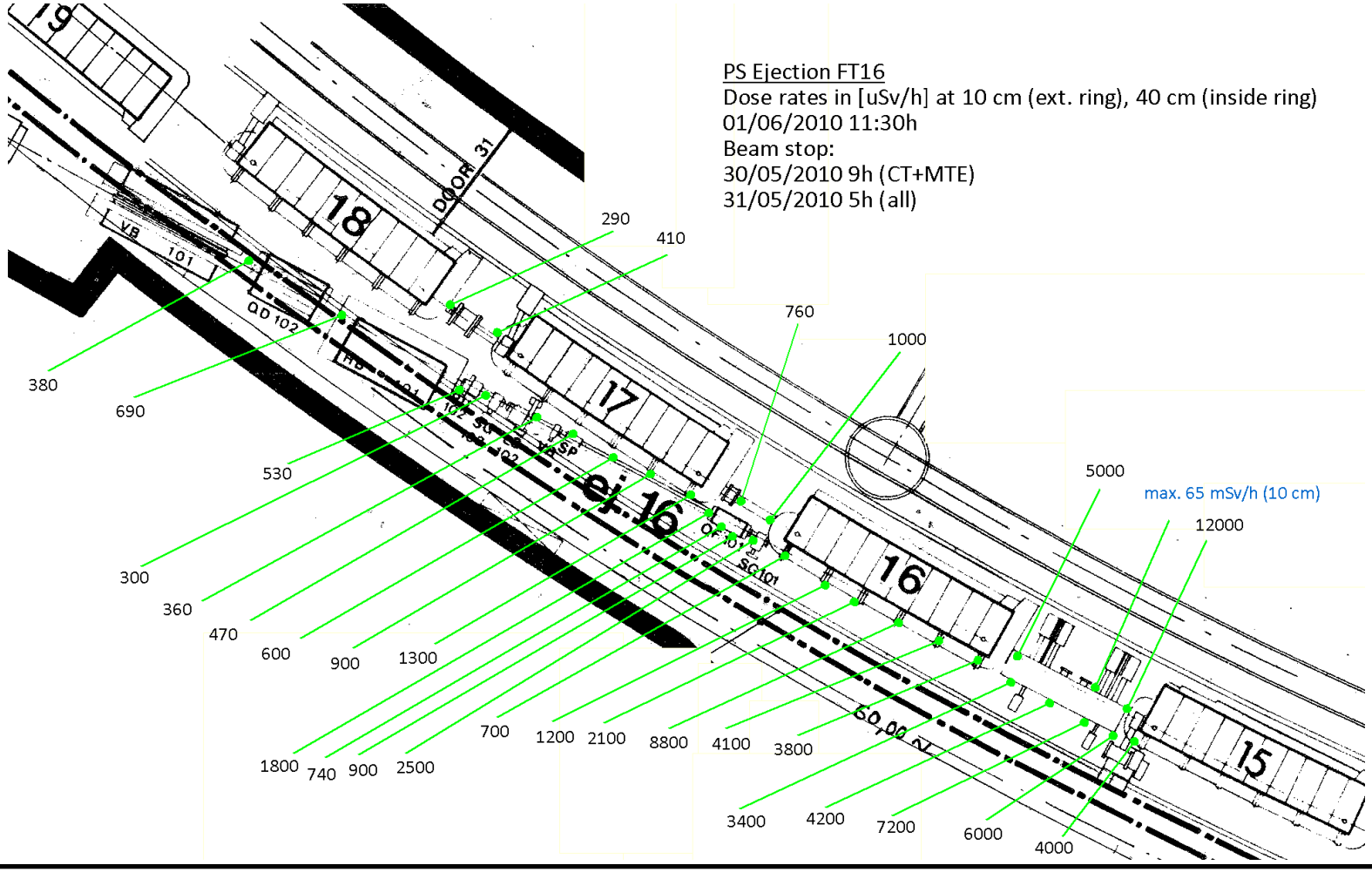
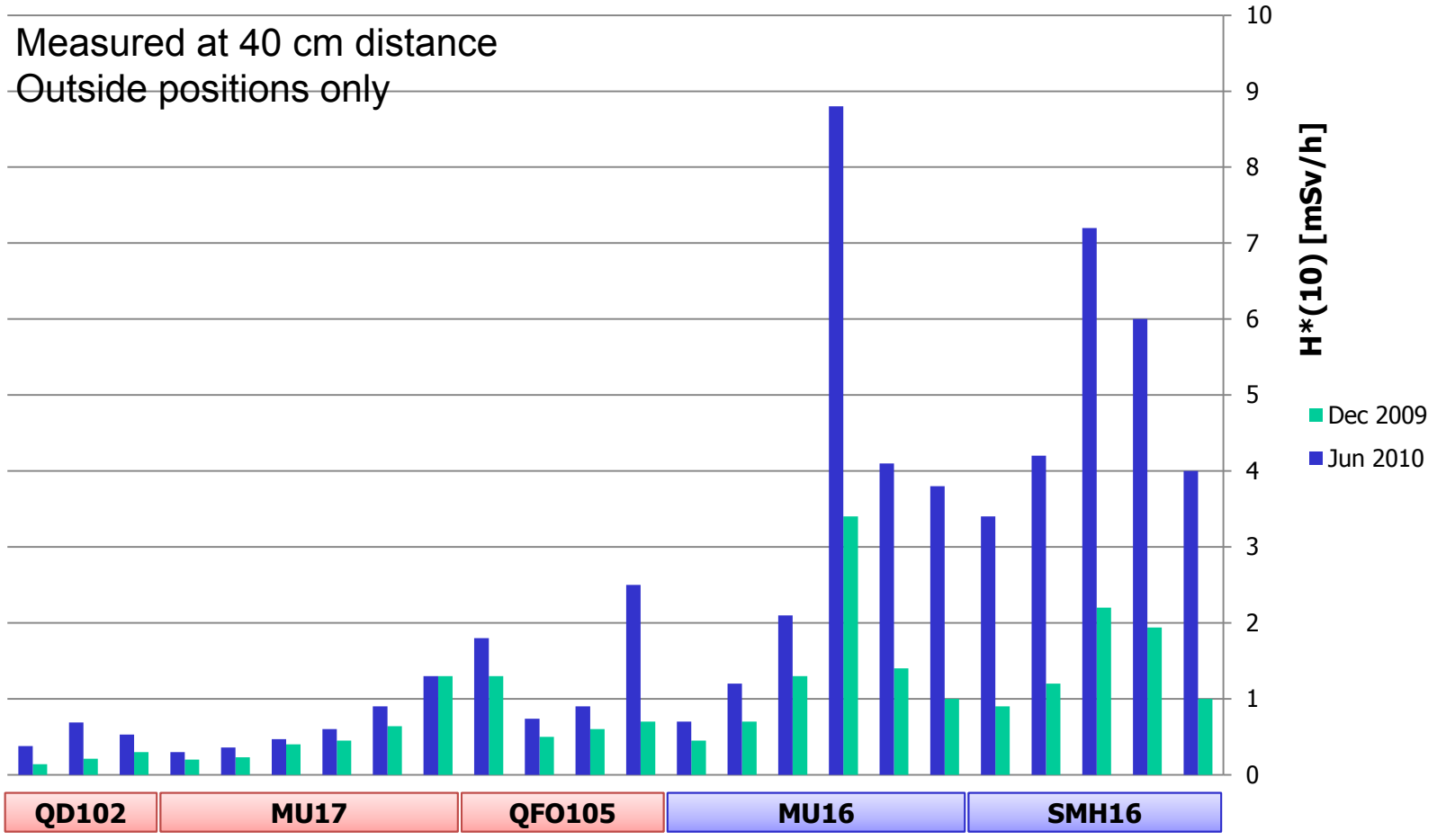


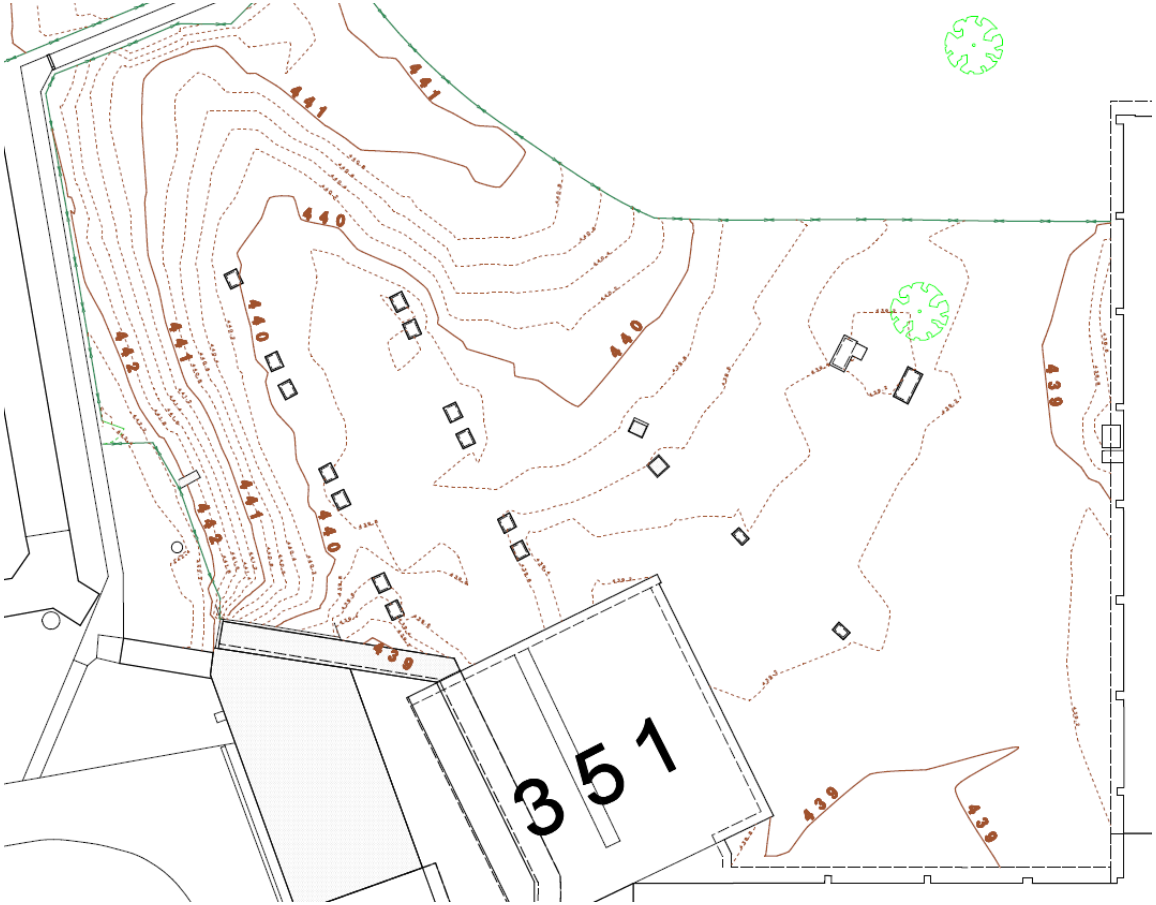
Survey SS16-FT16 (01/06/2010)



Detailed measurements SS16/FT16



Shielding on top of SS16



<u>New altimetry data:</u>

Region on top of SS16

- 0.8 – 1m less shielding than on Rt. Goward
- 1-2 m less shielding compared to other parts of the PS

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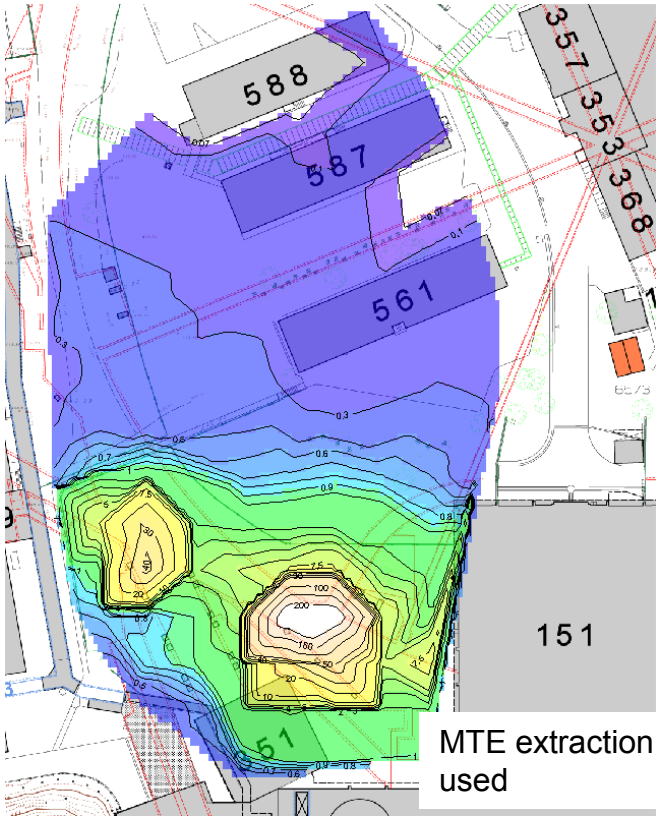
Stray radiation from weak top shielding in SS16

Measured ambient dose equivalent rate *H**(10)

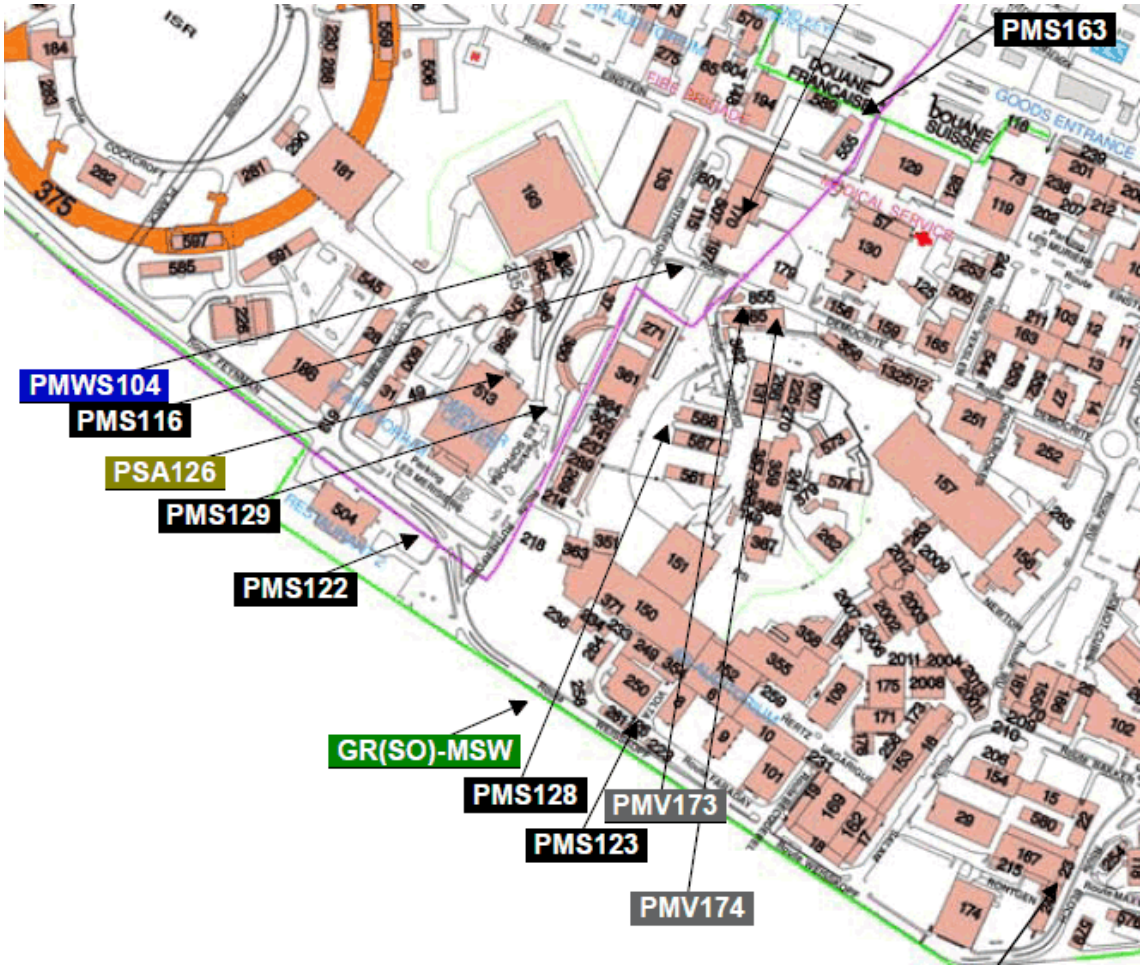


MTE extraction used

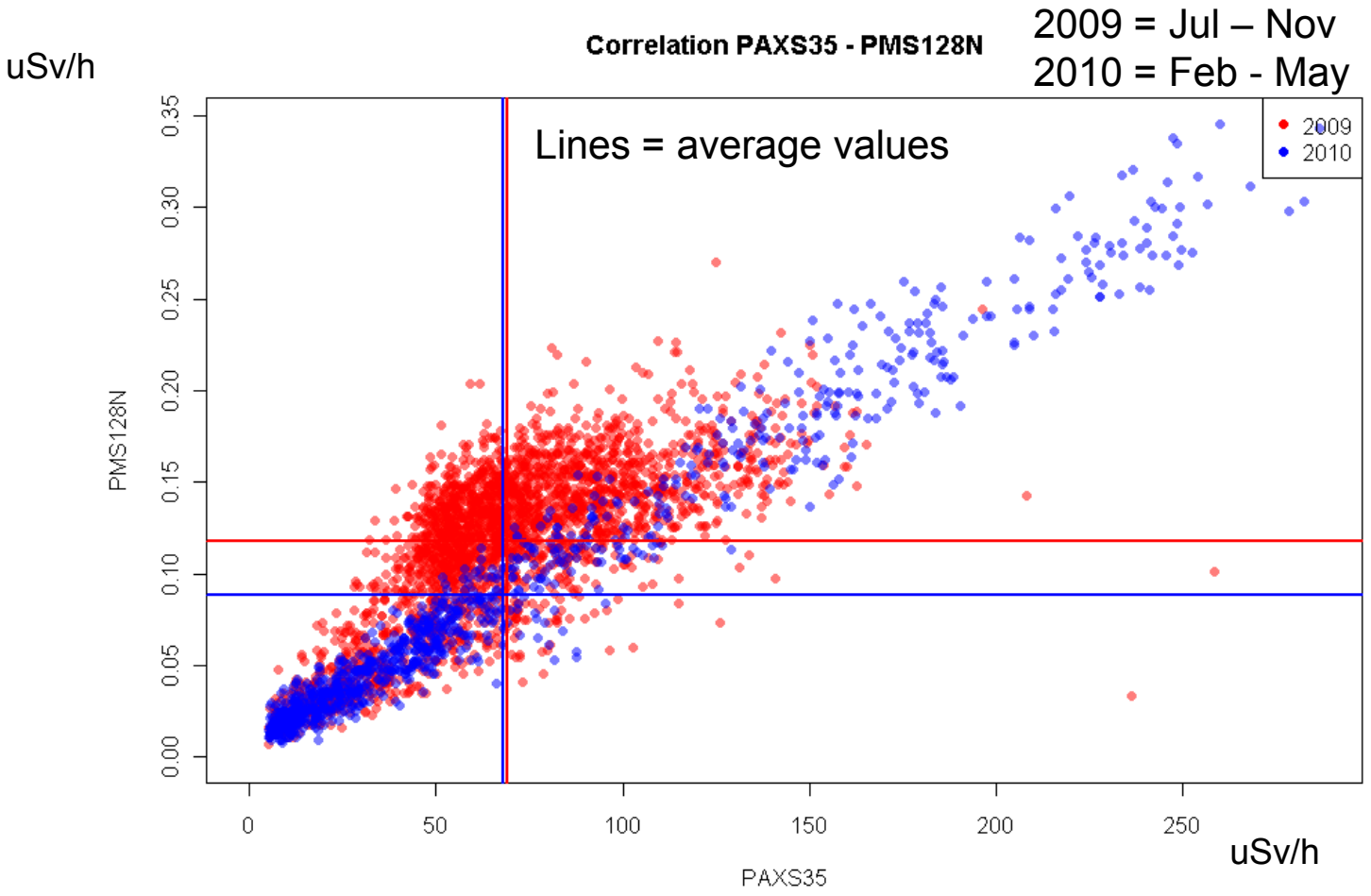
Consequences

- At present beam intensities, **annual dose** to workers in some centre-of-ring offices exceed 100 μSv/year
- Offices close to PS justified only for work in direct relation with PS operation
- Similar issue for CT extraction
- Impact reaching further on a number of office buildings at the PS complex (getting closer to justification level)

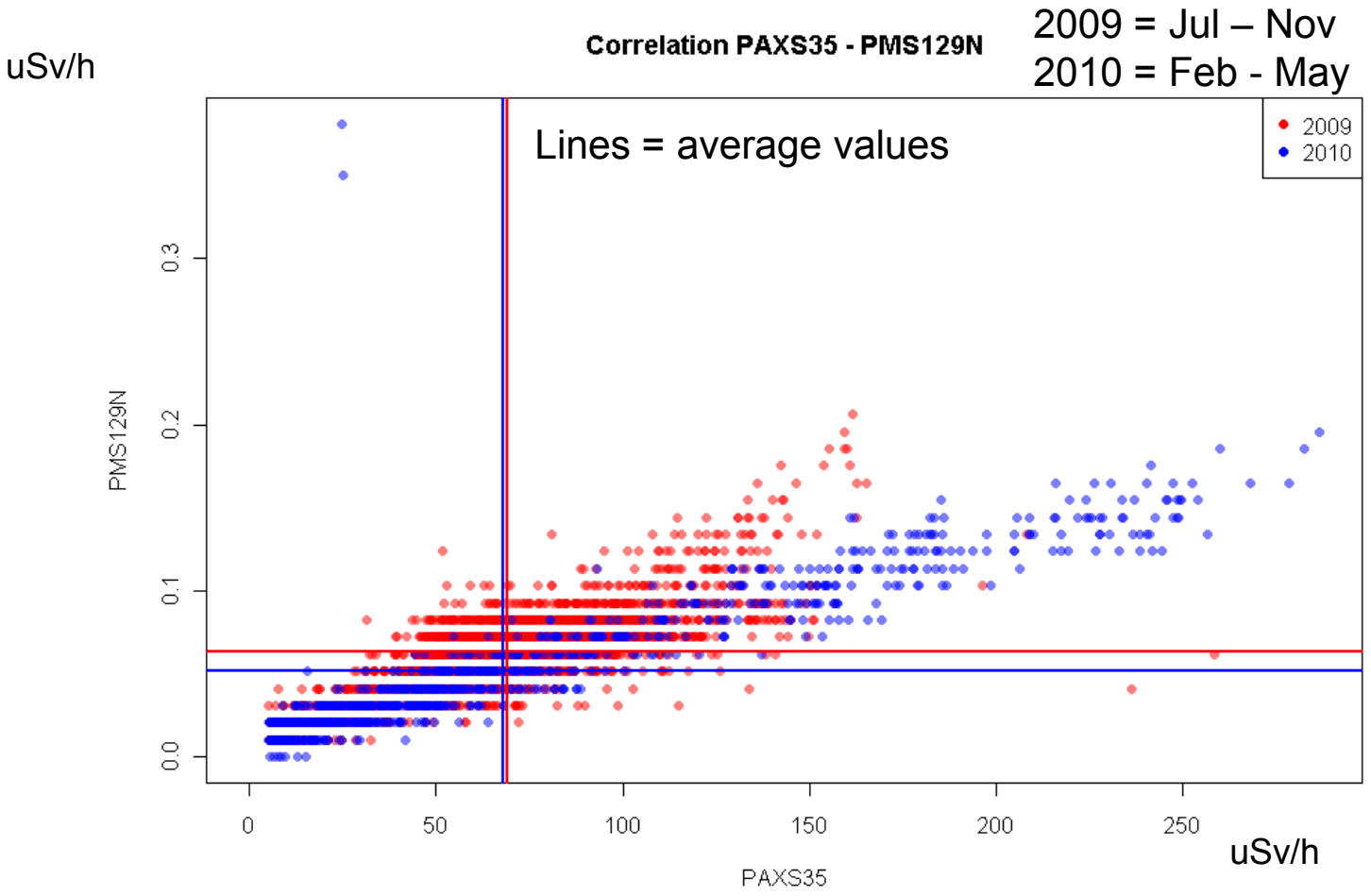
Stray radiation monitors on site



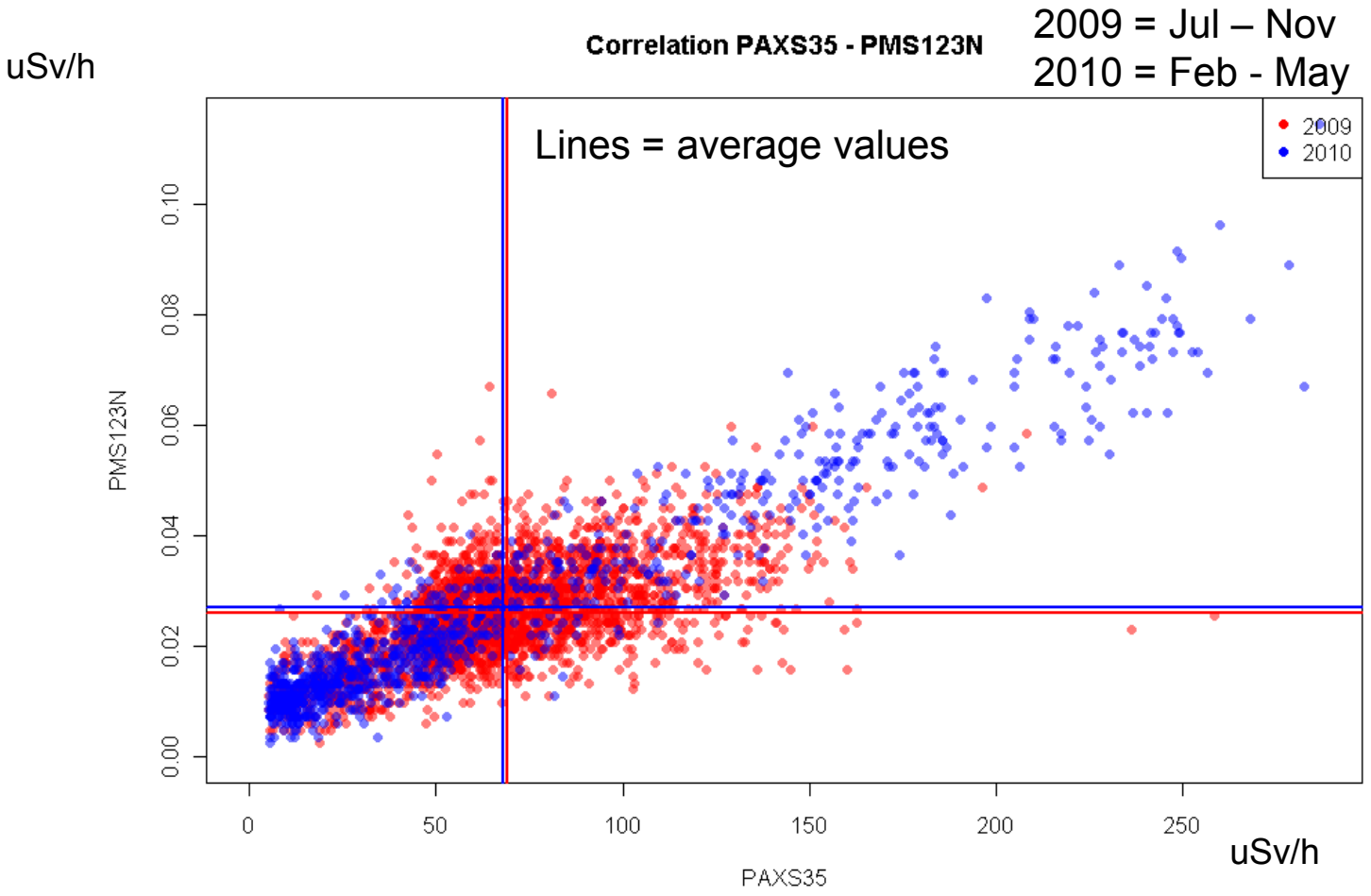
PMS128N (PS ring, SS31)



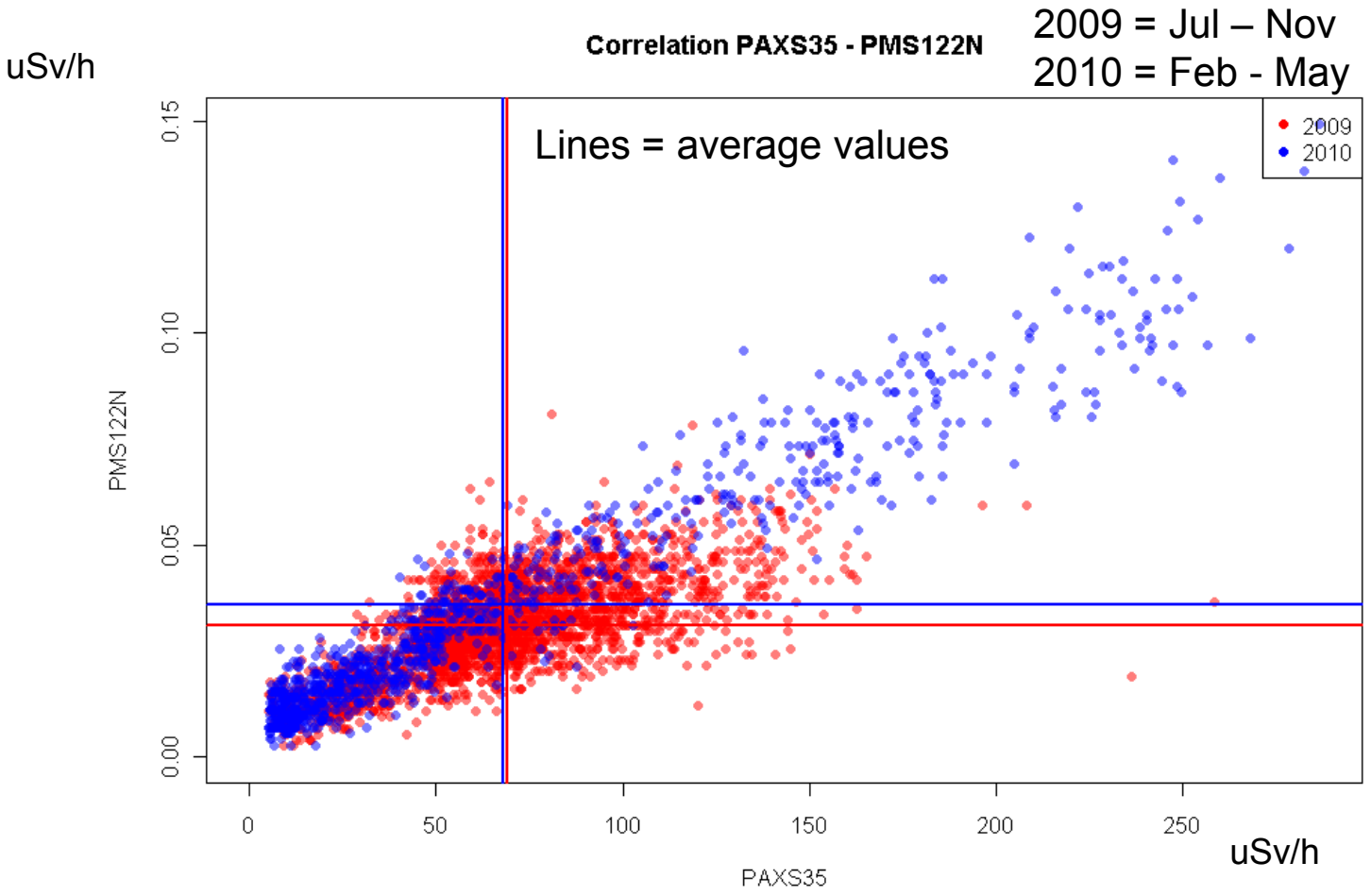
PMS129N (behind Booster)



PMS123N (close to fence)



PMS122N (Rest. 2)



Conclusions

- MTE operation much cleaner than CT in all parts of the PS ring, except SS16. As such, MTE is clearly preferred to CT (if SS16 problem solved) !
- Only reason against MTE:
  - High losses in SS16 → leading to too high activation levels and increased stray radiation levels outside tunnel. SS16 is the less shielded location at the PS !
  - Activation is critical in terms of intervention time for septum and magnet replacement → no MTE possible with current losses
- Actions:
  - Reduce losses (minimum factor 2-3) or concentrate losses in uncritical well-shielded sector
  - Increase shielding on top SS16
  - Study and integrate improved shielding at door 122
  - Review usage of Linac 3 area and building 151 (RF workshop)