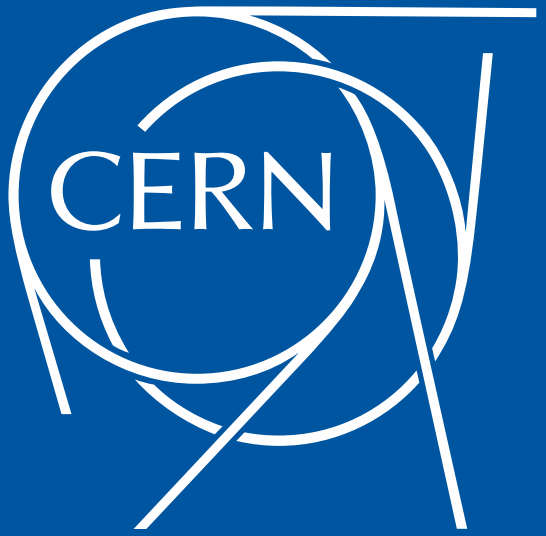

CERN

Diamond Particle Detectors for Machine Protection

Plans for Run 2

D. Wollmann, B. Dehning

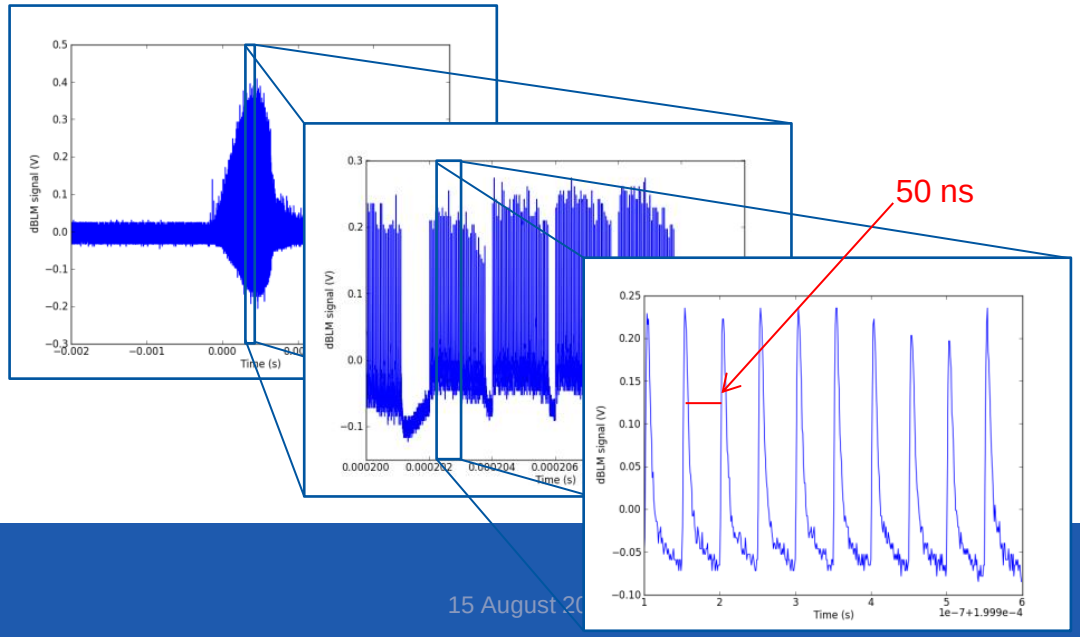
Acknowledgments: F. Burkart, O. Stein, C. Buehl Soerensen, T. Baer, H. Janson, M. Hempel, E. Castro, C. Kurfuerst

Outline

- Recap of dBLM properties
- Experience from Run 1.
- Planned installation for Run 2.
- Monitoring of abort gap population with dBLMs at BGI in Pt 4.

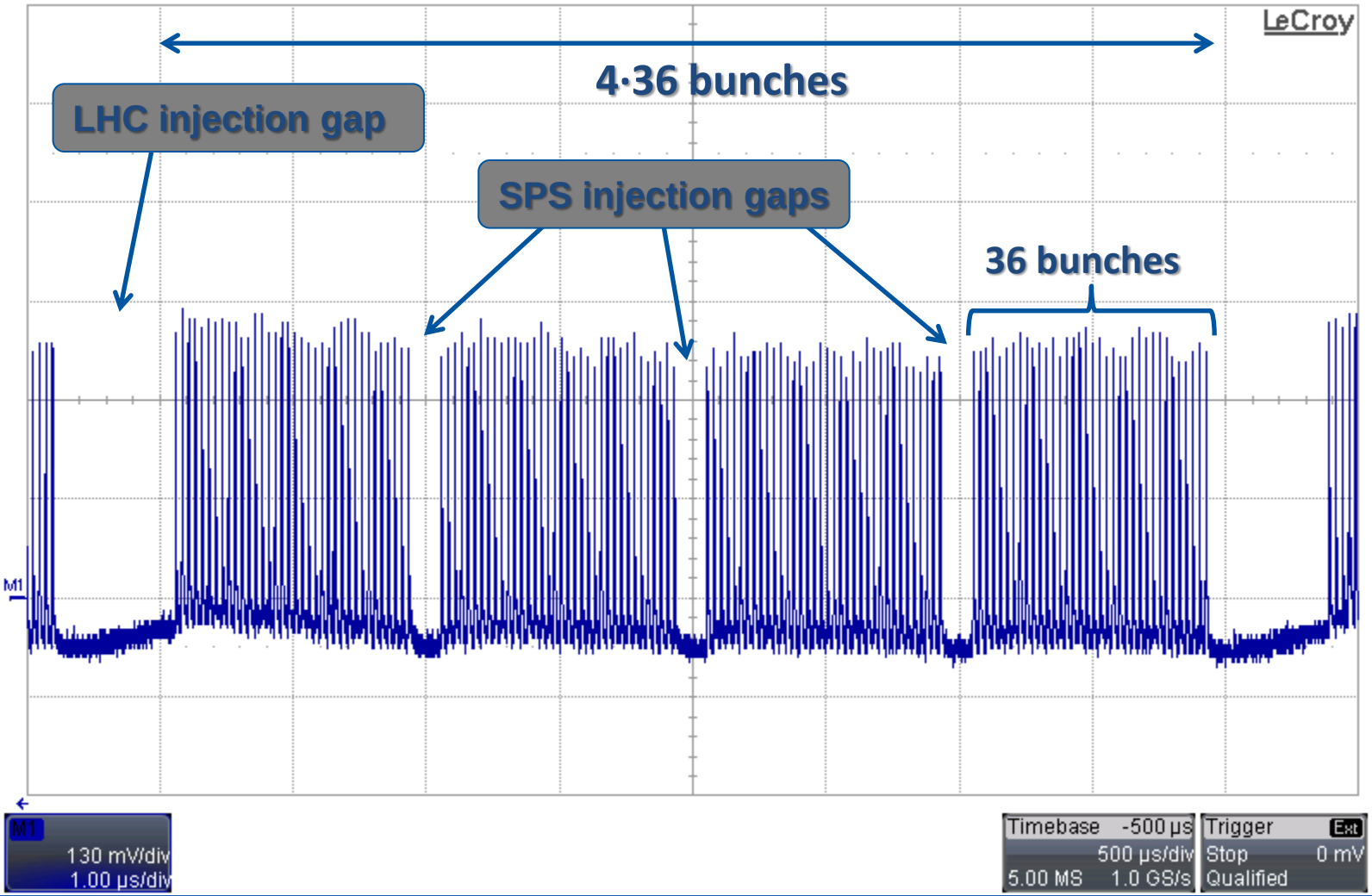
Recap properties of Diamond BLMs

- Rise time: ~1.5 ns
- Pulse duration: ~5 ns
- Dynamic range: 9 orders (a few tens to 10^{10} MIPs)
- → Bunch-by-Bunch resolution of losses.



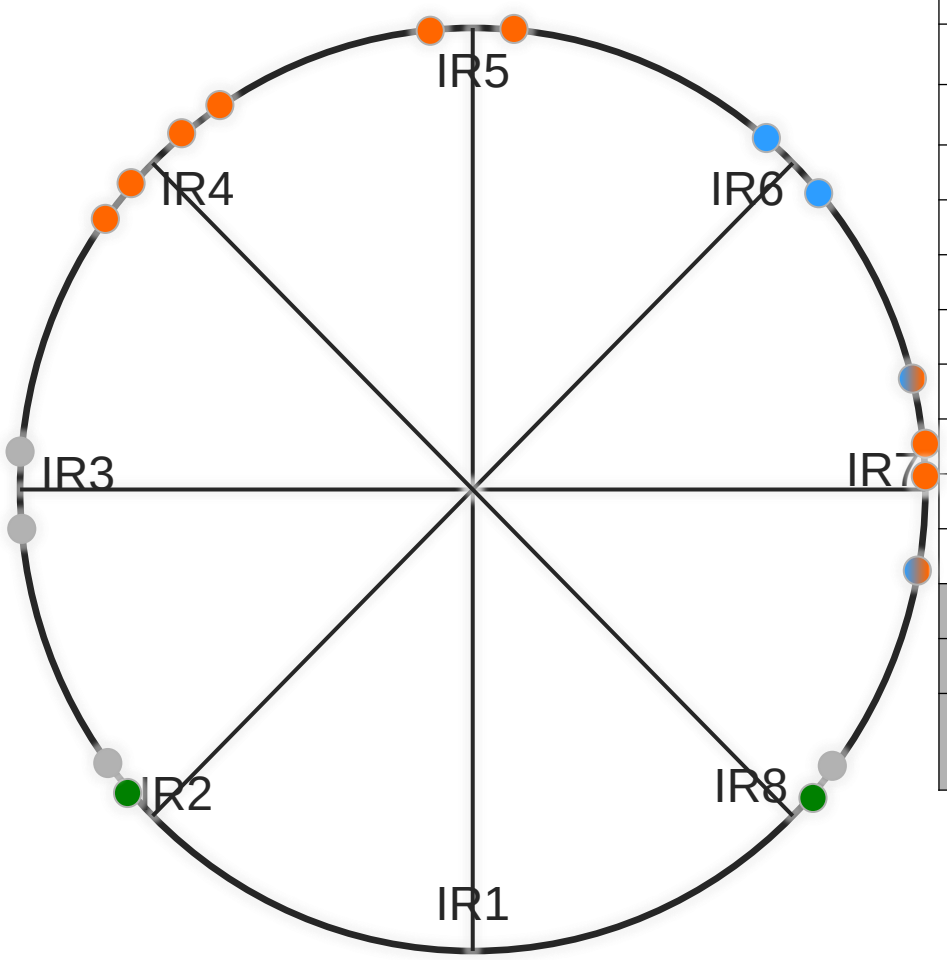
Courtesy O. Stein

Measurements of 4 batches



Courtesy T. Baer

Planned installation for Run 2

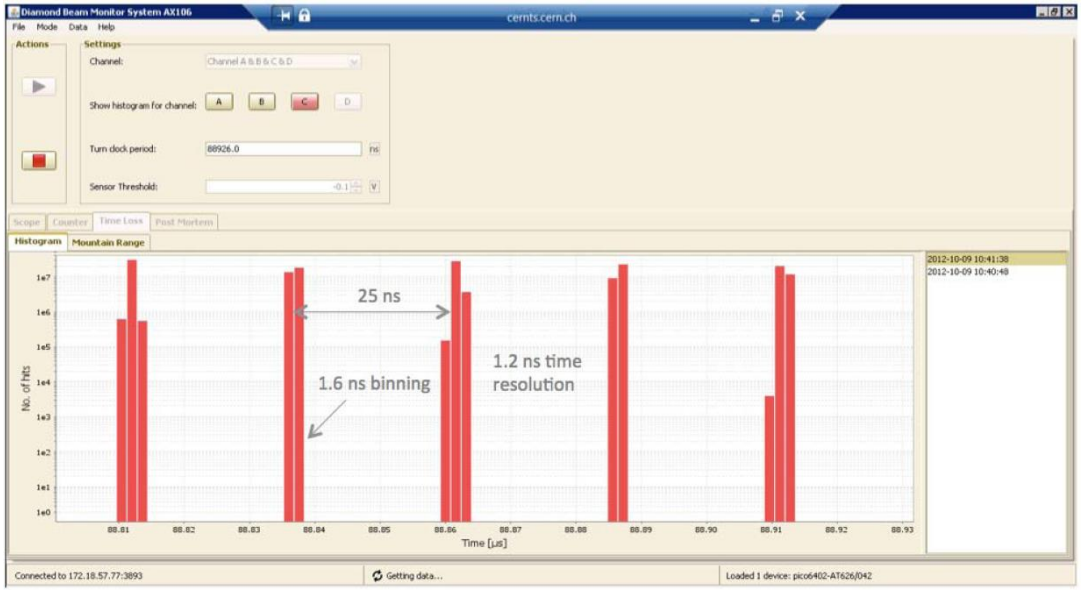


IP	Position	Hist.	Scope	trigger / synchro.
2	TCTVB.4L2	no	Yes	injection
6	TCSG.4L6.B2	-	yes	post
6	TCSG.4R6.B1	-	yes	post
7	TCHSS.6L7	yes	yes	post / rev./ bunch
7	TCHSS.6R7	yes	yes	post / rev./ bunch
8	TCTVB.4R8	no	yes	injection
7	Crystal (2x)	yes	no	rev./ bunch
4	BGI B1 (2x)	yes	no	rev./ bunch
4	BGI B2 (2x)	yes	no	rev./ bunch
5	TCTVA.4L5.B1	yes	no	rev./ bunch
5	TCTVA.4R5.B2	yes	no	rev./ bunch
3	2x TCP	Cables and diamond detectors available/installed. **No connection to readout system planned!**		
2	TDI			
8	TDI			

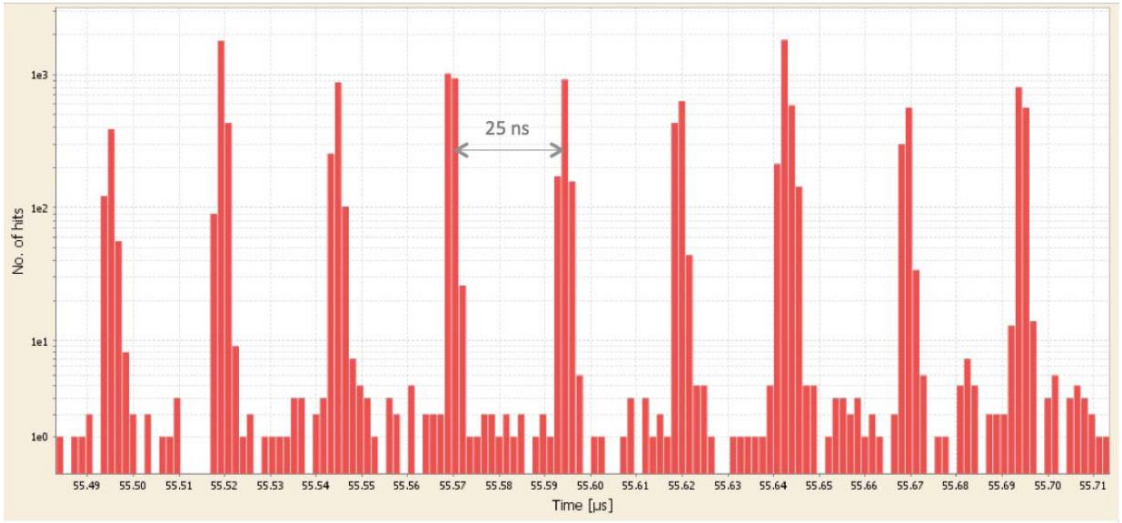
Connections (tbc):

- Logging
- Post Mortem
- IPOC?
- Online display in CCC (IP7)

Readout system for 2015 – arrival histogram



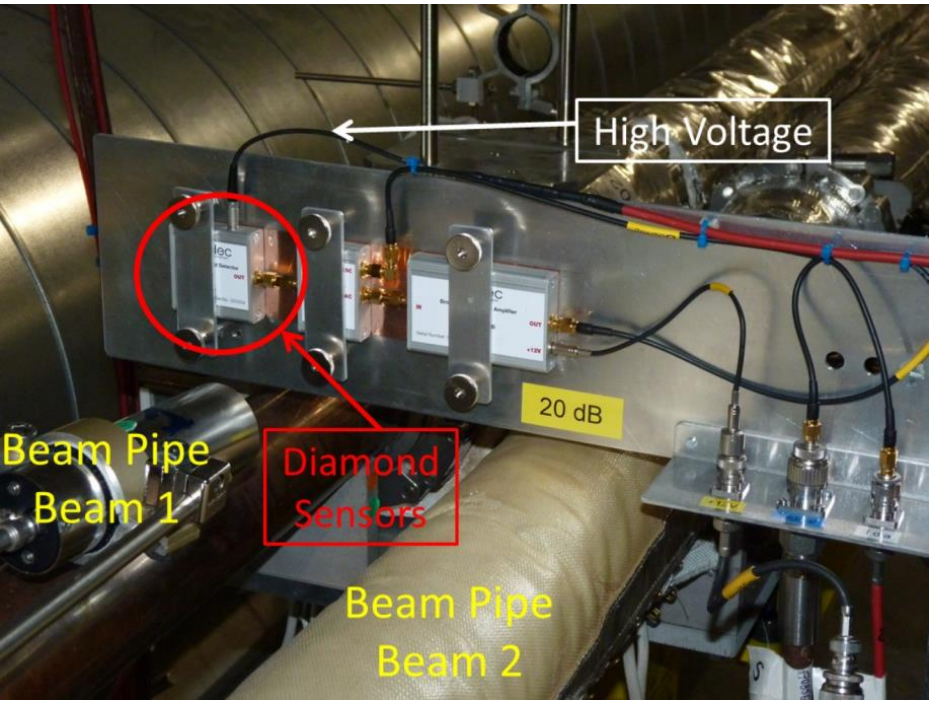
40MHz signal from signal generator



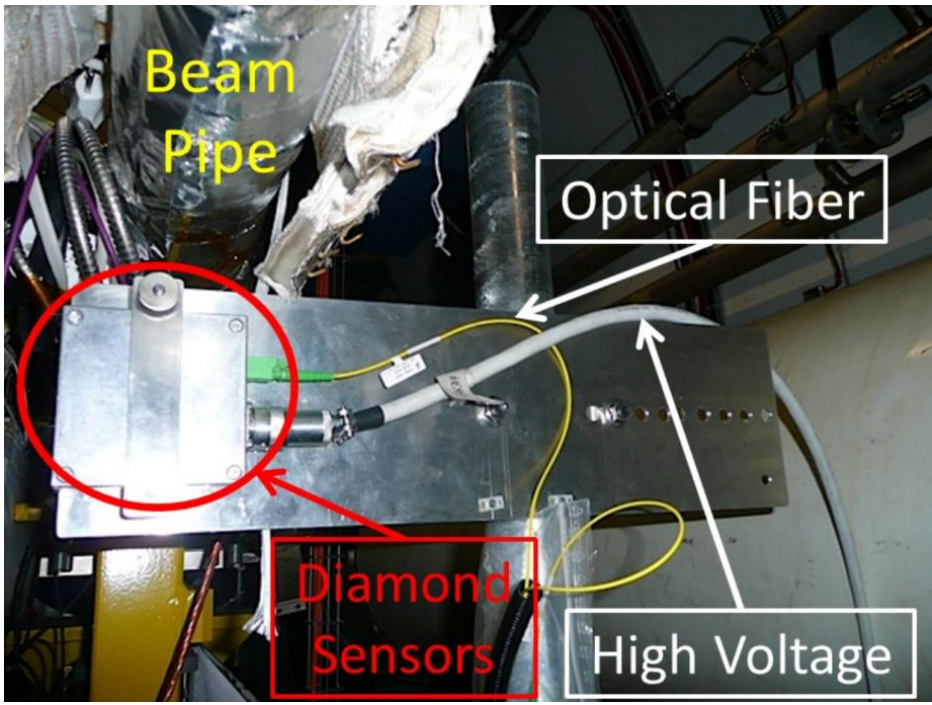
Measurements with beam (25ns bunch spacing)

Courtesy B. Dehning

Setups in tunnel



CIVIDEC system

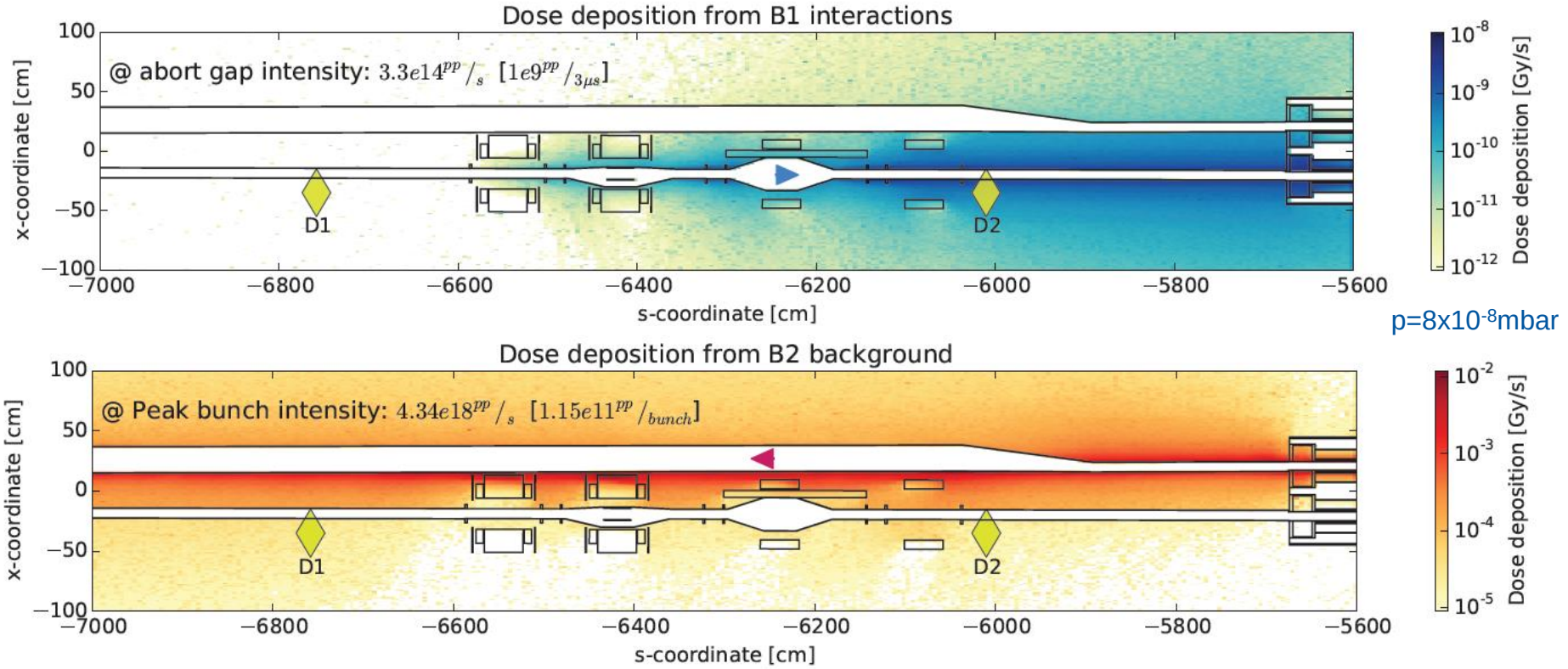


CMS DESY/Zeuten system

Courtesy B. Dehning

Monitoring of Abort Gap Population with Diamond Particle Detectors @ BGI (Pt4)

Expected dose deposition (FLUKA)



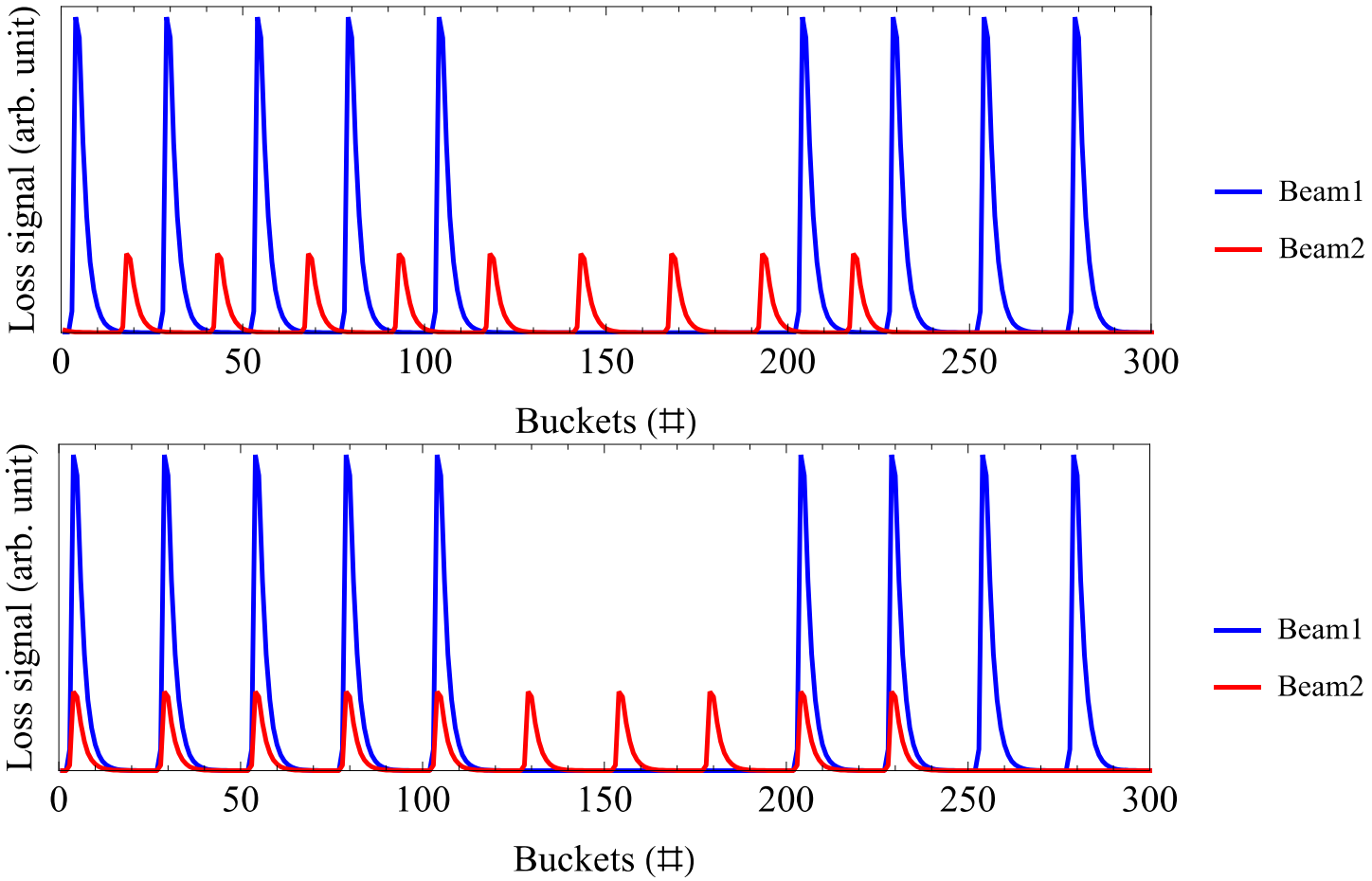
p=8x10^{-8}mbar

Assumptions for two detector setup:

- Time integrated signal from other beam equal in D1 and D2.
- Un-bunched beam equally distributed of circumference.

Courtesy C. Buehl Soerensen

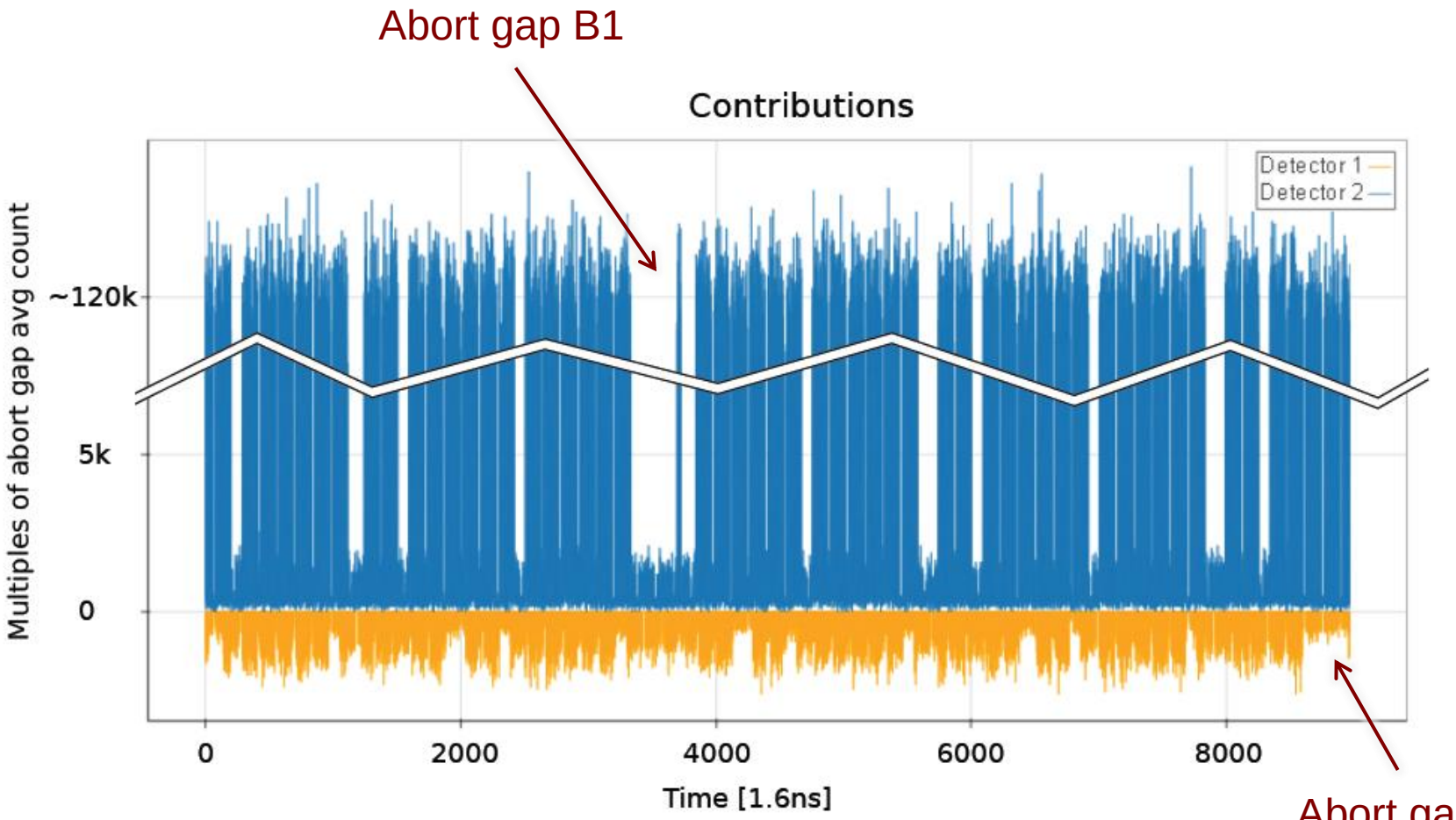
Optimized detector position – Maximized integration time



- Distance of detector from IP1 n x 1.5m.
- Distance between detectors m x 1.5m. (m,n integer)

Courtesy O. Stein

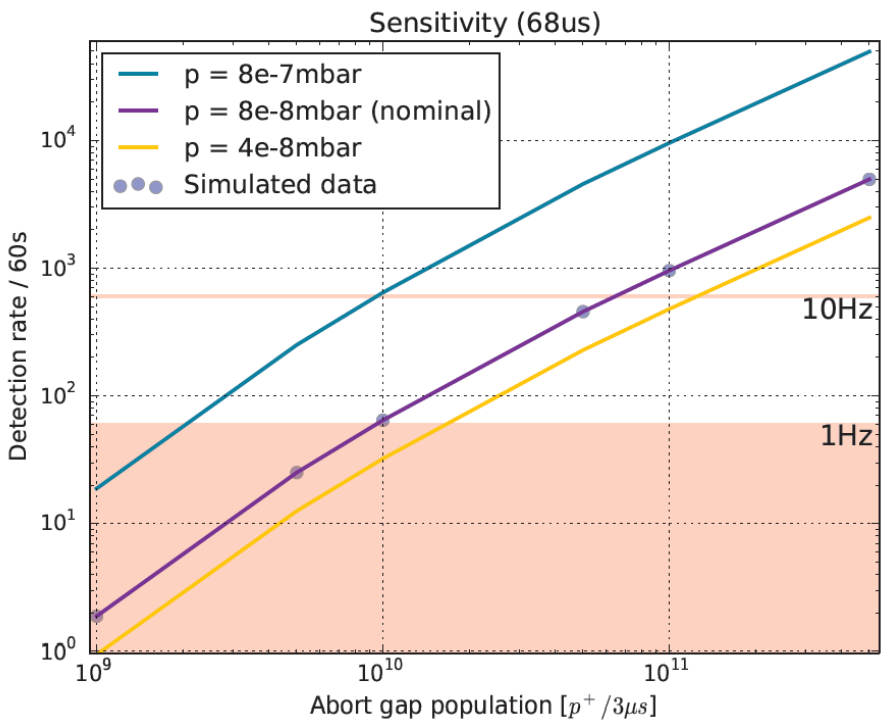
Simulated signal in diamonds

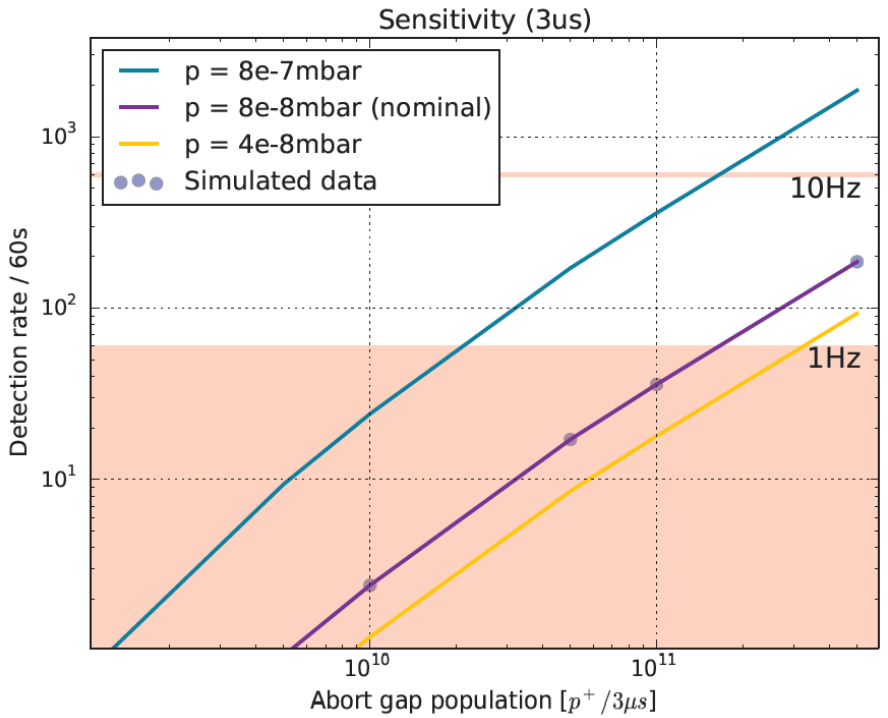


p=8x10^{-8}mbar, 1x10^{9} p/abort gap, 1.15x10^{11} p/bunch

Courtesy C. Buehl Soerensen

Expected sensitivity





- The higher the abort gap population the faster and more accurate it can be detected.
- Sensitivity increases linearly with BGI pressure.
- Low un-bunched beam intensities → integrate over whole circumference
- High un-bunched beam intensities → “gate” on abort gap.

Courtesy C. Buehl Soerensen

Conclusion

- **14 diamond** particle detectors to detect fast losses during injection, dump, normal operation, MDs, … to be operational for Run2.
- New **readout system**, which allows histogram like recordings and wave forms (scope like).
- Signals should be **reliably implemented** in logging, PM, IPOC (tbc).
- Online display of losses (IP7) in CCC.
- **Monitoring of abort gap population** with diamonds up- and downstream of the BGI (IP4).
  → Feasibility study shows: **$1x10^{10}$ in abort gap** are expected to be detectable (1Hz signal).
- TBC how far **vacuum pressure** can be increased
  → **increase of sensibility**.

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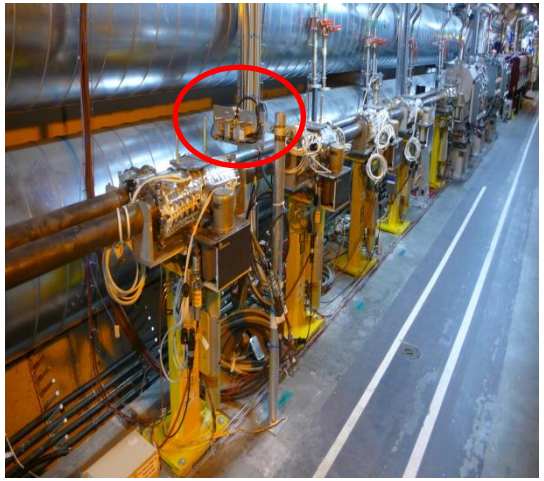
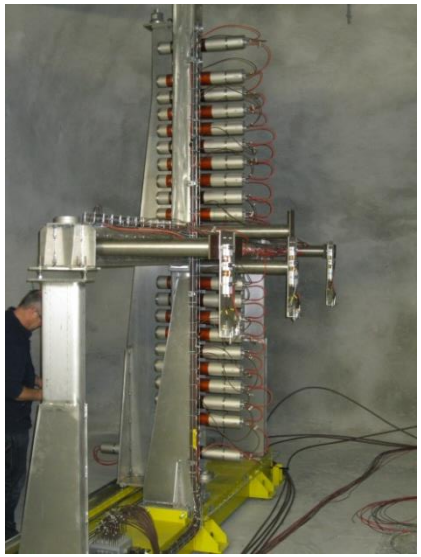
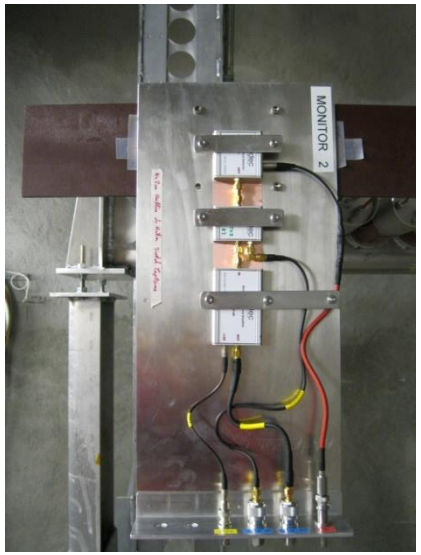
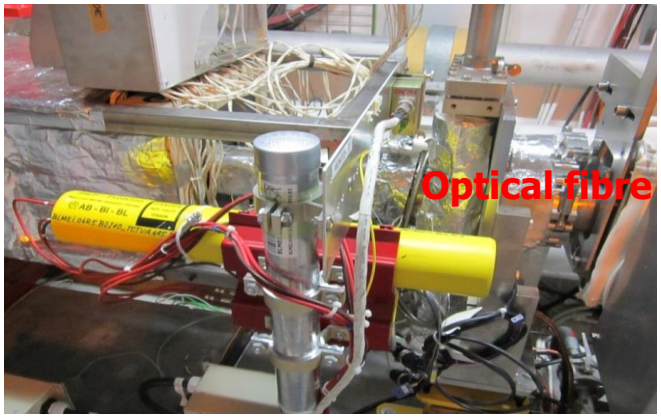
Tunnel set-ups







CIVIDEC system



CMS DESY/Zeuten system