Response of diamond sensor at a quench of the QCS magnet

14. September 2004

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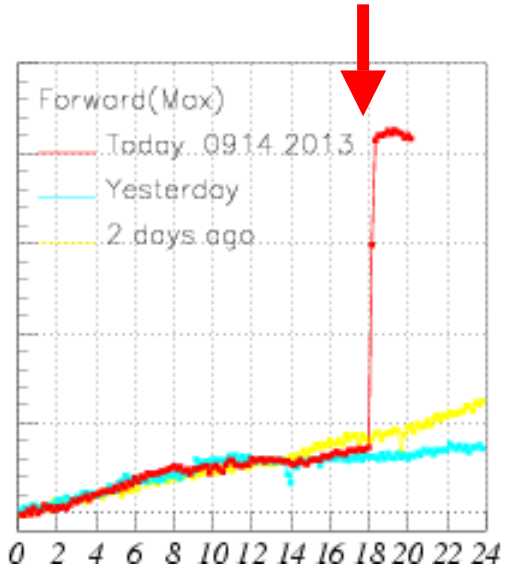
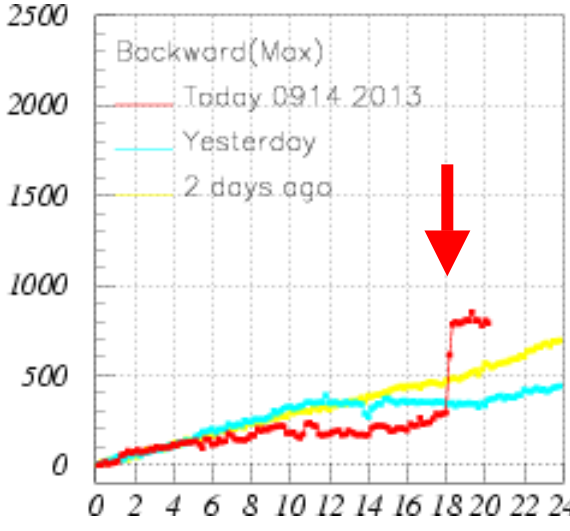
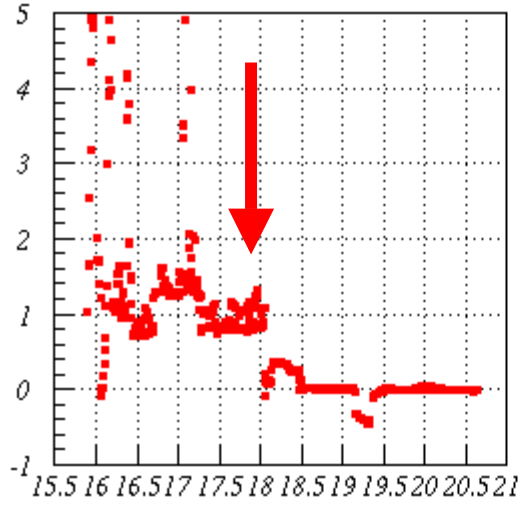
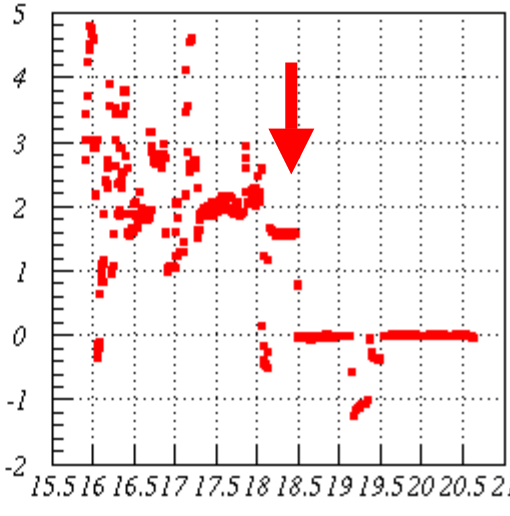
The QCS (Superconducting final focus quadruple) magnet quenched and MOSFET/PIN diode response.

- A terrible beam instability happened and beam entered QCS on Sep 14, 2004 at 18:02. QCS quenched after the beam is lost.
- Belle suffered from 2 krad at a moment. Fortunately, Belle SVD is working well.
- There were no beam abort request from Belle/SVD.
- SVD PIN monitor showed no response at 18:02.
- Further investigation is done.



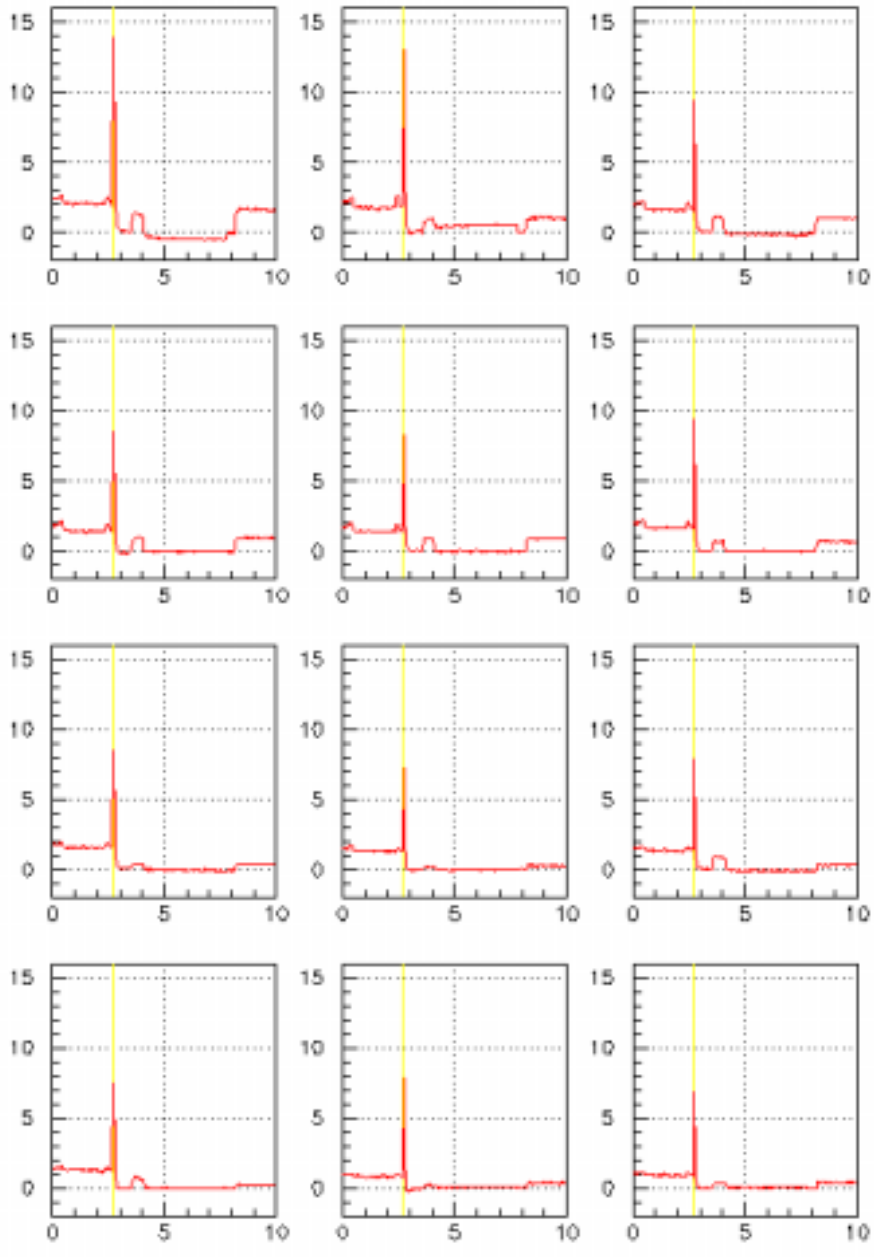






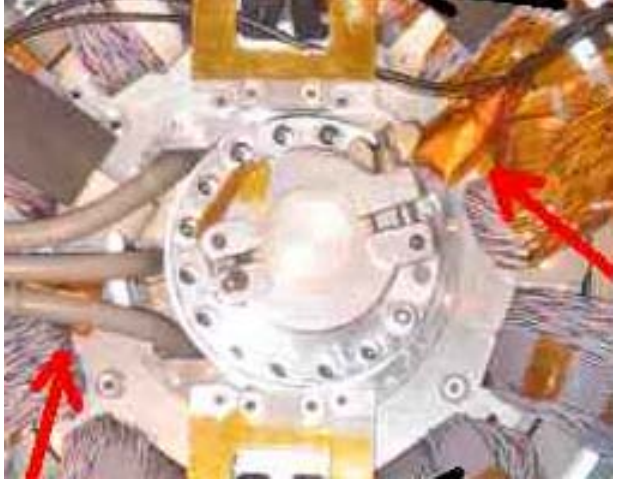
Detail PIN data

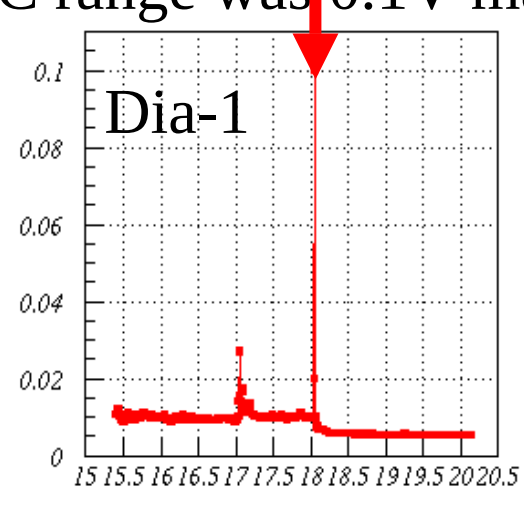
- This figure shows the PIN diode outputs with the highest time resolution. In fact, PINs show activities.
- The level is, however, still very low.
- In the previous plot, the data is averaged in 30 seconds and the narrow peak is smeared out.

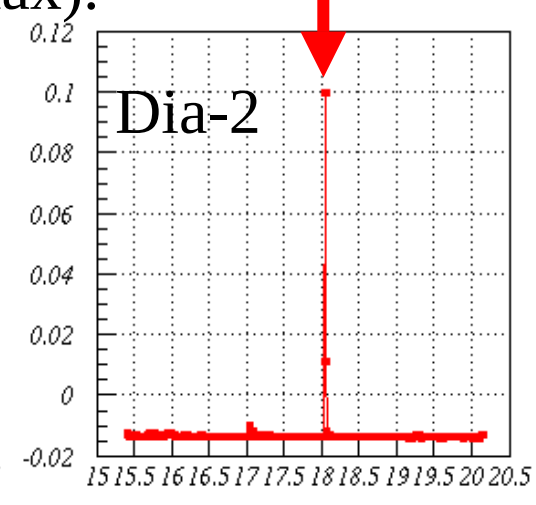


Response of CVD diamond radiation sensors

- CVD diamond sensors are put at the IP chamber entrance. We have been thinking they have much lower gain than PIN diodes. However, for this time, the result was excellent.
- Both ADCs for Dia1 and Dia2 overflowed. *Dia1* and *Dia2* showed at least 10 and 50 time, respectively, larger signal than the usual radiation level.
- A 1-sec RC low-pass filter is inserted in front of ADC. The signal could be much much more larger, had we not adopted such a filter. (Anyway, the ADC range was 0.1V max).

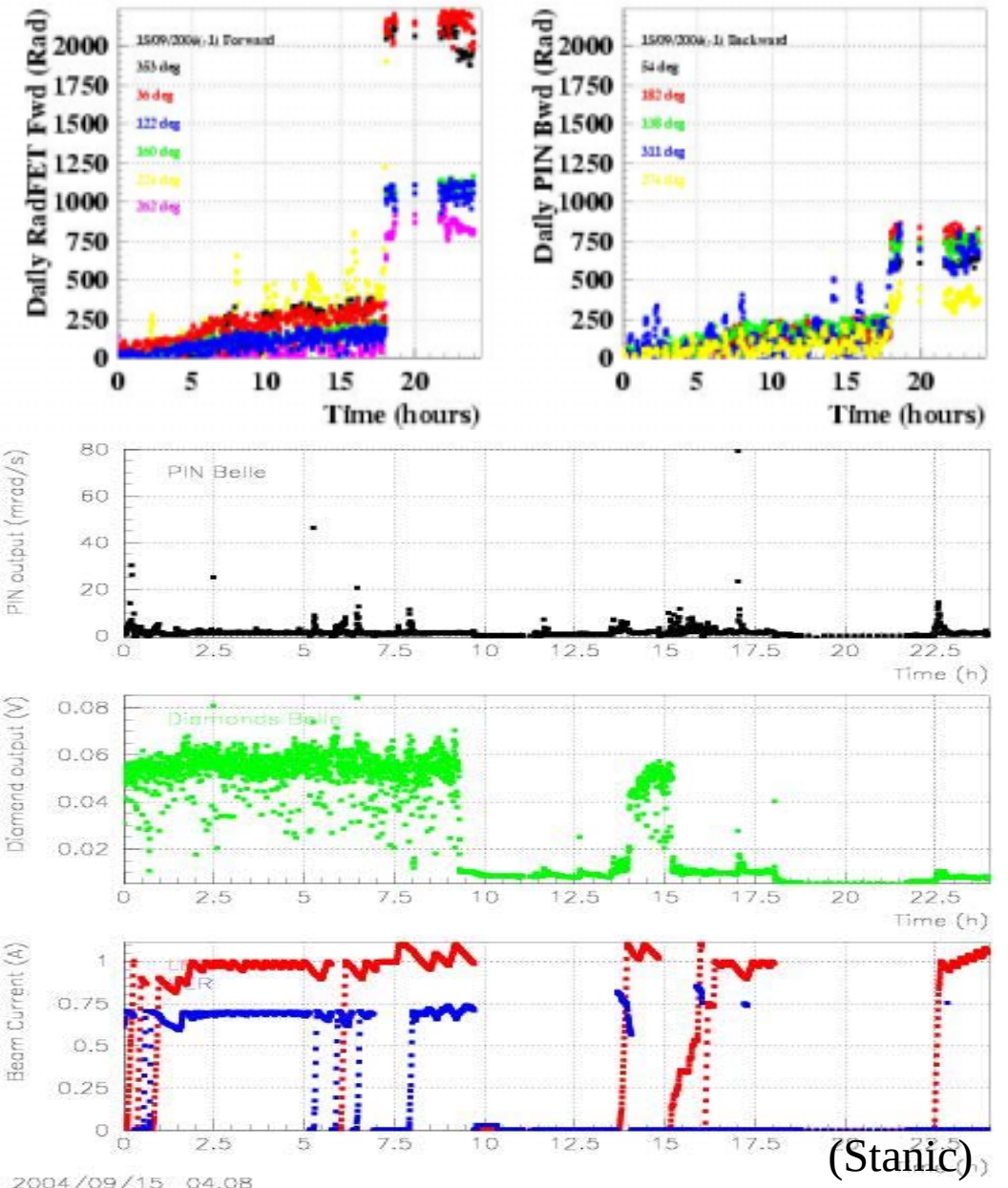






More plots

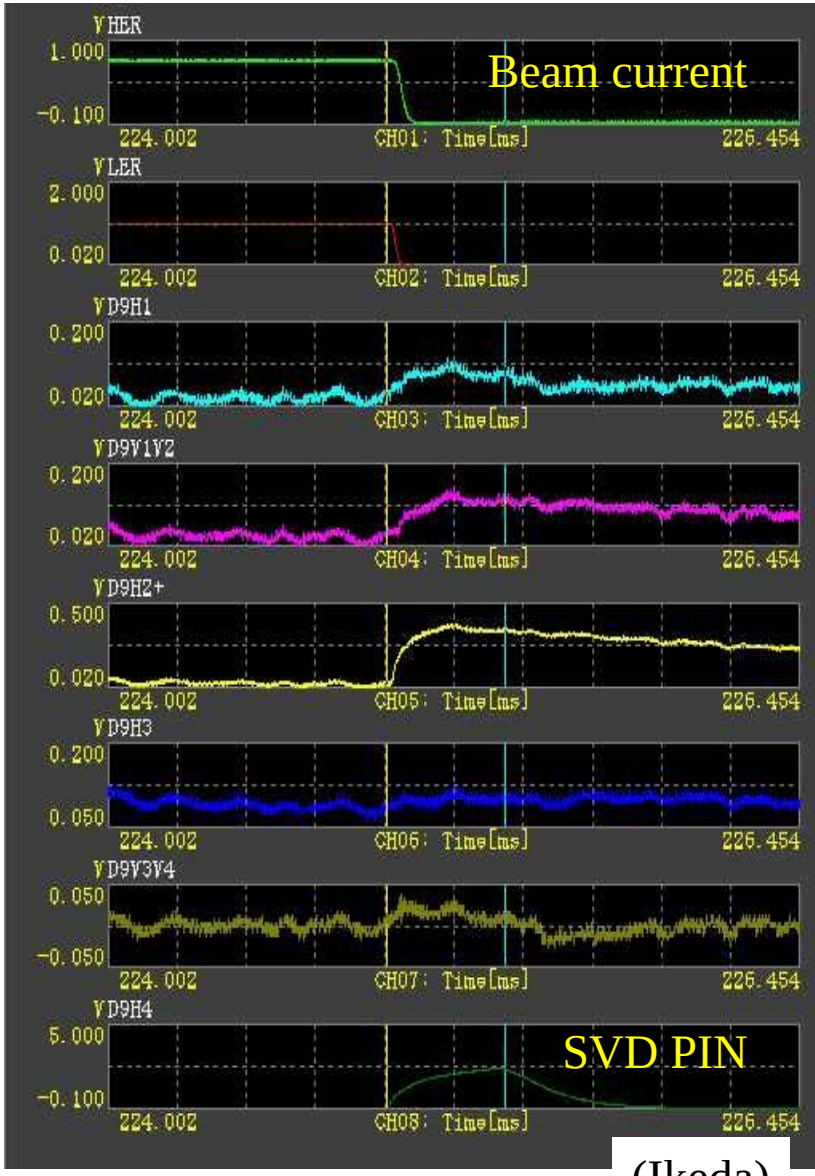
- The upper figure show the response of all RADFET sensors.
- Dose level depends on the sensor position.
- Lower figure shows diamonds and PIN diodes in the tunnel.
- PIN diodes in the tunnel show no response either.



(Stanic)

The PIN output recorded in the KEKB data logger

- The sum of output of PIN diodes is sent to KEKB in oder to correlate with KEKB monitors. The interval between the two cursors is 400 nsec.
- In this beam abort, the beam was lost in a few turns and all beam abort requests came after the beam is completely lost.
- The PIN diode output started to decrease at 400 nsec. The beam abort decision logic is equipped with an 800 nsec low-pass filter. This is why Belle beam abort request was not issued.



(Ikeda)

Summary

1. At 18:02:45, 15 September 2004, there was a terrible beam loss.
2. Beam was lost in ~100 μsec, faster than the Belle/KEKB beam abort decision.
3. It caused QCS quench, however. QCS quench are not responsible for the beam loss.
4. SVD RADFET recorded about 2 krad dose in this beam loss.
5. The output of PIN diodes was unexpectedly small.
6. Diamond sensors recorded high activity (out of the ADC range)
7. Although the low gain PIN diodes showed large pulse, the background disappeared before a beam-abort request was issued.
8. I guess that the induced charge was huge but limited in time and the output voltage of the low pass filter was really small.