Workshop on Beam Induced Quenches, Sept. 15, 2014,

Beam Losses at HERA and Tevatron

extracted by Mariusz Sapinski from publications
suggested by Nikolai Mokhov and Kay Wittenburg

Disclaimer

No one from DESY or FNAL could come to CERN in this period and give the presentations.

Nikolai Mokhov (FNAL) and Kay Wittenburg (DESY) kindly suggested literature on which we based this short presentation, which is does not claim to have any level of completeness.

Just scratching the surface…

BLM systems

	Tevatron	HERA	LHC
detectors	Gas ionization chambers	PIN diodes	Gas ionization chambers
Integration time	21 μs	5.2 ms	40 μs

- HERA recovers from quench within 1 hour, no significant loss of lumi
- Tevatron – may lead to significant loss of luminosity
- In HERA beam is dumped if 4 monitors exceed threshold (lack of sensitivity to localized losses)

Tevatron

FERMILAB-CONF-11-129-APC

TEVATRON ACCELERATOR PHYSICS AND OPERATION HIGHLIGHTS

A. Valishev for the Tevatron group, FNAL, Batavia, IL 60510, U.S.A.

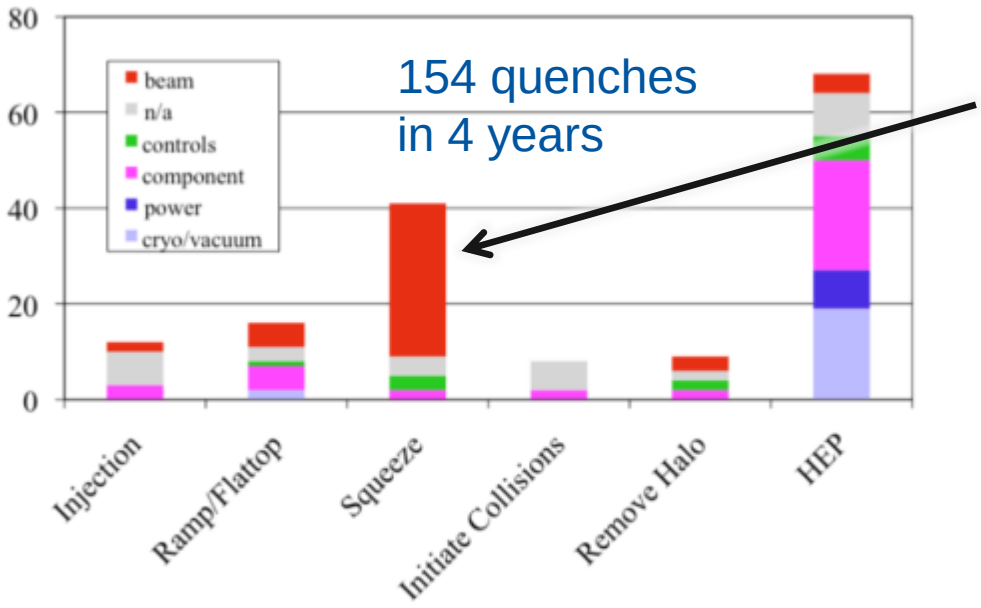
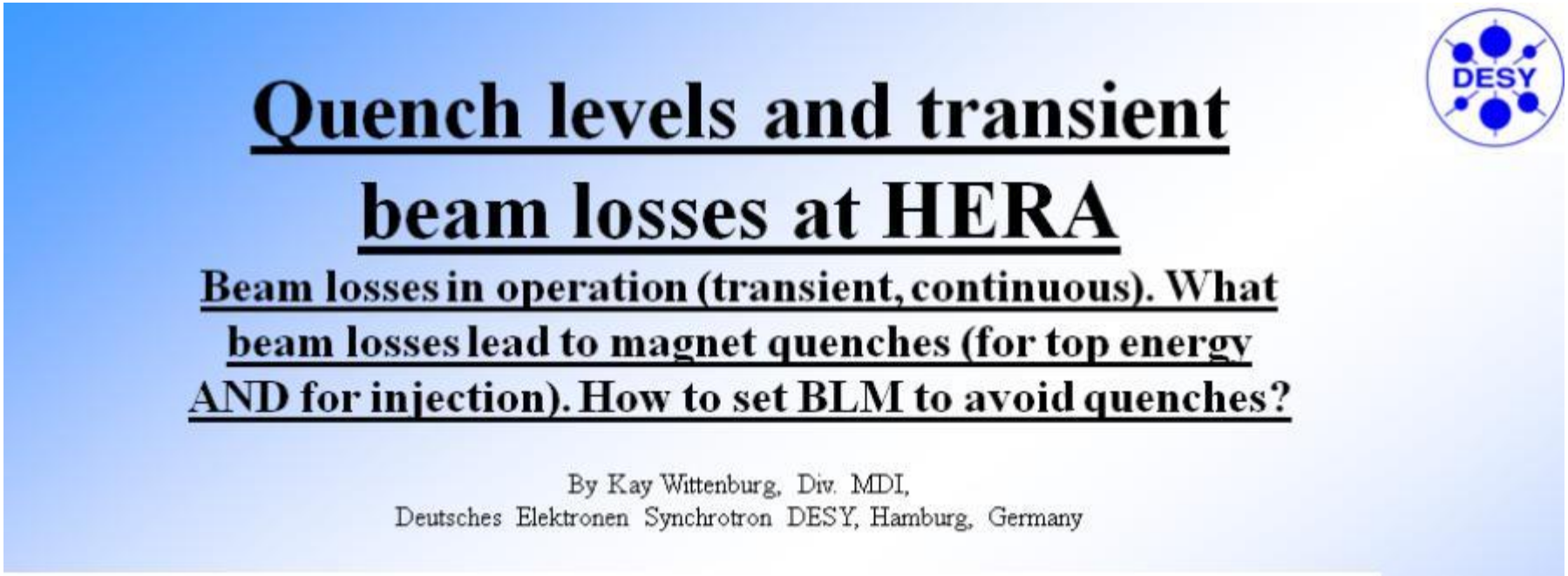


Figure 4: Categorization of Tevatron magnet quenches. Data between October 2007 and March 2011.

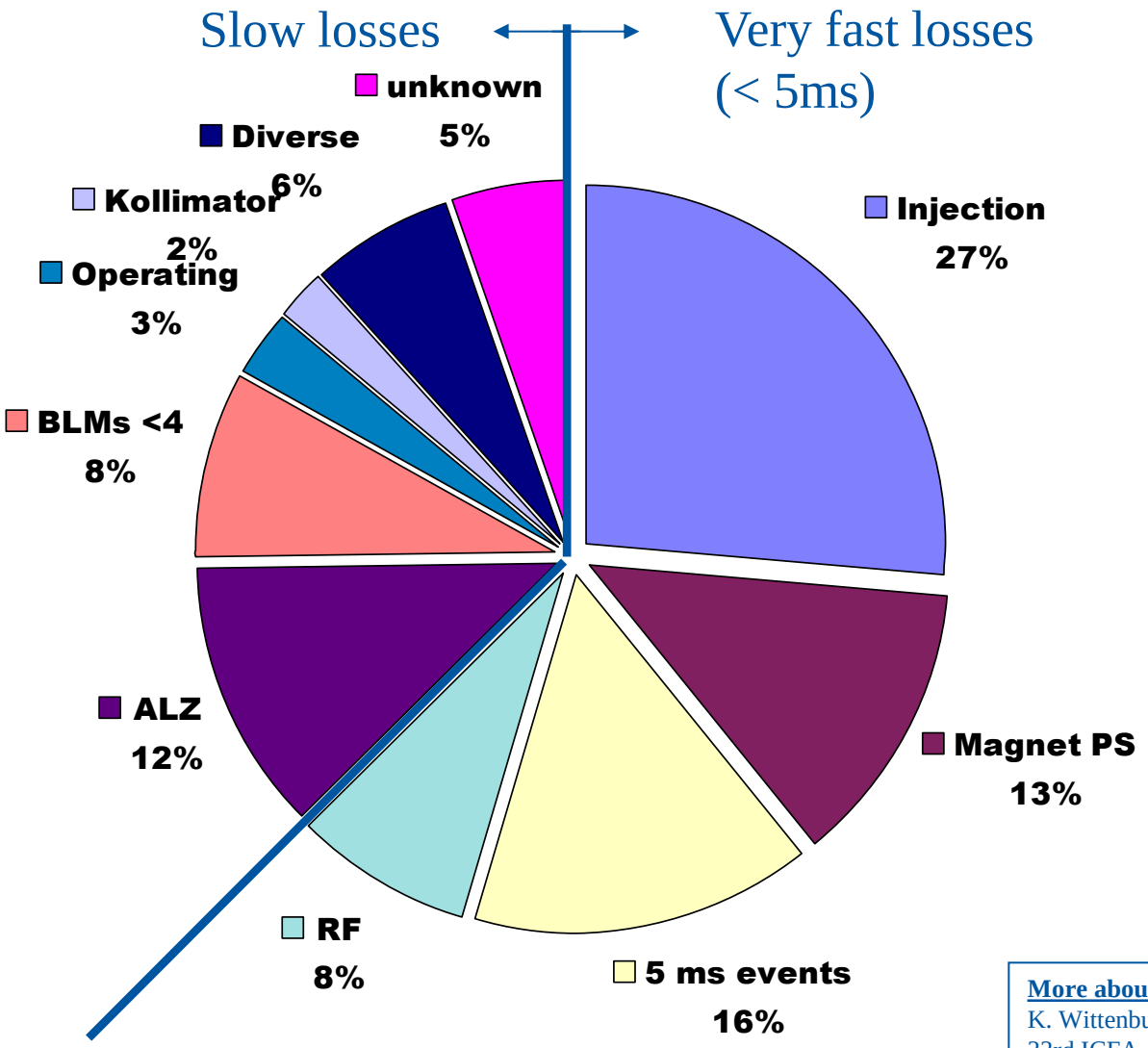
- 32 quenches during 120s step during β* squeeze from 1.5 m to 0.28 m and change of helical orbits shape – reduction of beams separation from 6 to 2σ
- Loss of antiprotons requires lengthy replenishment – significant loss of lumi
- 2010 – introduction of collimation at top energy (in IRs), reduction of losses to experiments and beam-induced quenches

HERA



- 33rd ICFA ADVANCED BEAM DYNAMICS WORKSHOP ON HIGH INTENSITY & HIGH BRIGHTNESS HADRON BEAMS, 2004, Bensheim, Germany
- K. Wittenburg, presentation at CARE AMT workshop on Beam generated heat deposition and quench levels for LHC magnets, CERN, March 2005

Beam loss induced Quenches 1994 - 2004



Σ = 200 Quenches

More about failures:
K. Wittenburg (DESY): Beam loss & machine protection
33rd ICFA ADVANCED BEAM DYNAMICS WORKSHOP on
HIGH INTENSITY & HIGH BRIGHTNESS HADRON BEAMS
Bensheim, Germany

Note: A quench in HERA is not a disaster. It takes typ. 1-2 h to recover from cryogenic

HERA

- 64% of beam loss induced quenches due to losses faster than 5.2 ms
  - Injection errors
  - Power converter and RF trips
- 35% of beam loss induced quenches due to long losses
  - Technical problems with BLM system
  - **Very localized losses** – unwanted local beam bumps or magnets after collimators or longitudinal beam instabilities (high-dispersion zone)

Summary

1. Quench-provoking losses in Tevatron – mainly during squeeze due to:
   - Lack of collimation at flat-top
   - Beam-beam instabilities
   - In LHC we have them as well (up to 4% loss of intensity)
2. Large amount of beam-induced quenches in HERA occurred in timescale shorter than BLM system resolution – difficult fault analysis!
3. Longer losses could be very localized and were tracked to technical problem of BLM and Collimation system and longitudinal instabilities.
4. LHC has learn the lesson and is basically immune to problems specific to Tevatron and HERA, but has its own problems.

Extra slides

www.cern.ch