

Beam loss measurements at the SPS collimator test

Stefano Redaelli, AB-OP

Based on discussions with: G. Arduini, R. Assmann, H. Braun et al.

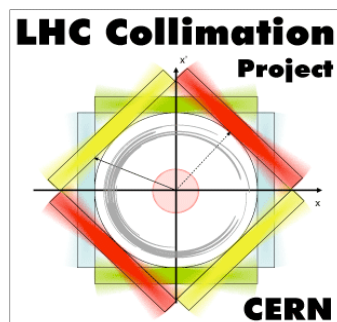
Outline

2004 measurements

What can we improve

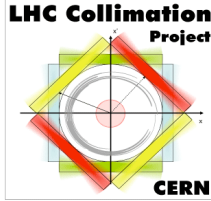
New measurements

Proposed planning for 2006





2004 beam loss measurements



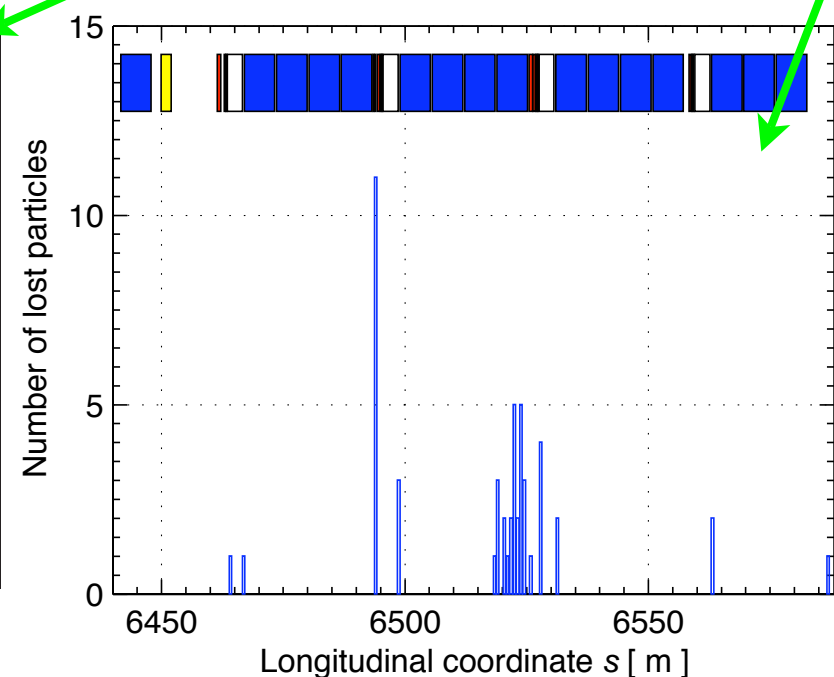
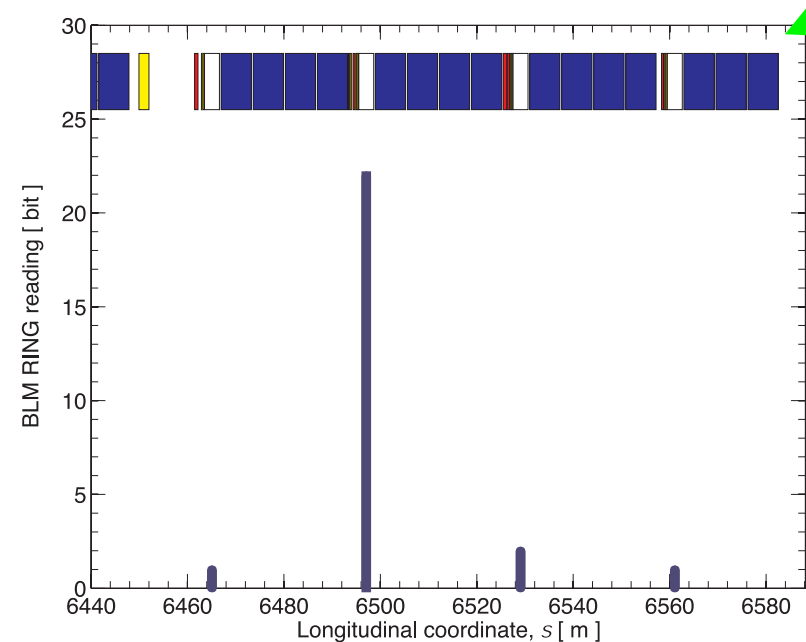
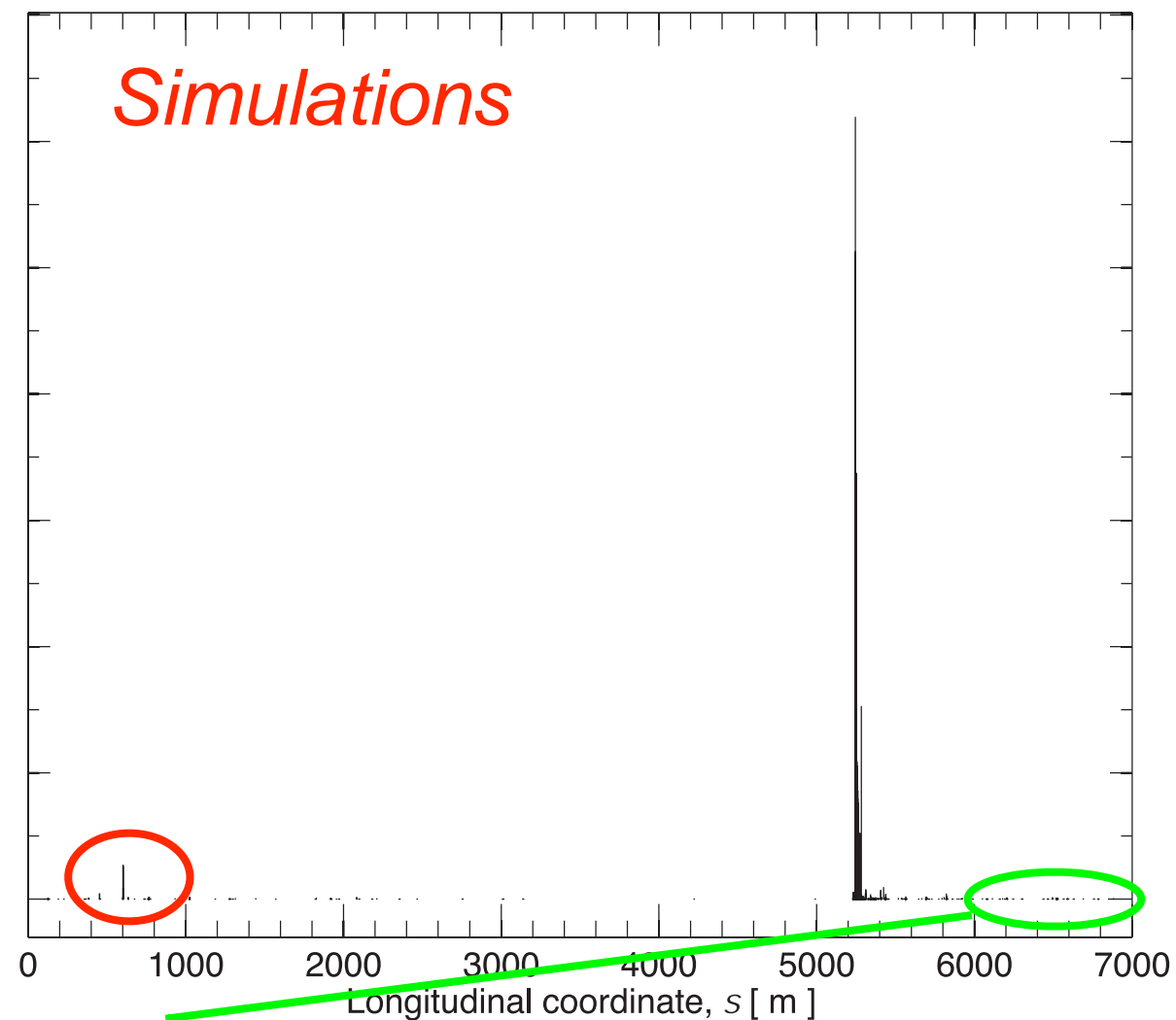
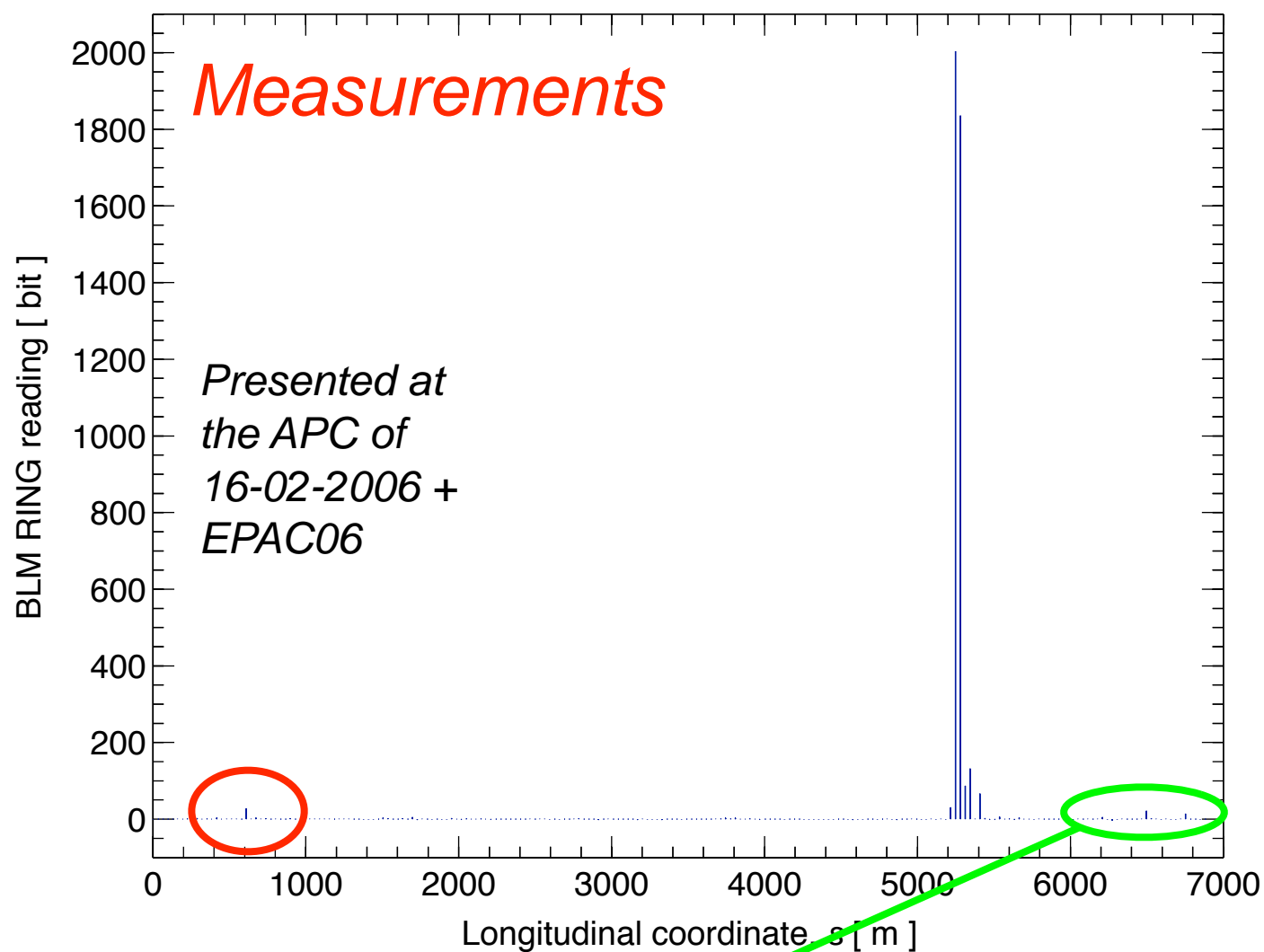
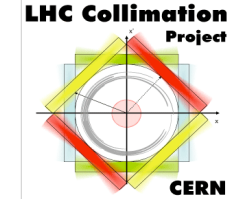
- ✓ 8 dedicated beam loss monitors (BLMs) in LSS5
 - $f_{\text{acq}} = 1 \text{ Hz}$ [see talk by M. Jonker for this year's availability]
- ✓ SPS BLRING monitors (1 per main quad. = 216 monitors)
 - 1 integrated measurement per SPS super-cycle $\approx 30 \text{ sec}$
- ✓ Beam current measurement (BCT)
 - ~Continuous measurement along the SC. $f_{\text{acq}} = 100 \text{ Hz}$

Was this enough?

What could we improve?



Benchmarking of simulations with measured losses



Good preliminary results **BUT**:

- Limited by 30 sec sampling time
- No dedicated beam-B alignment
- No dedicated emittance meas.

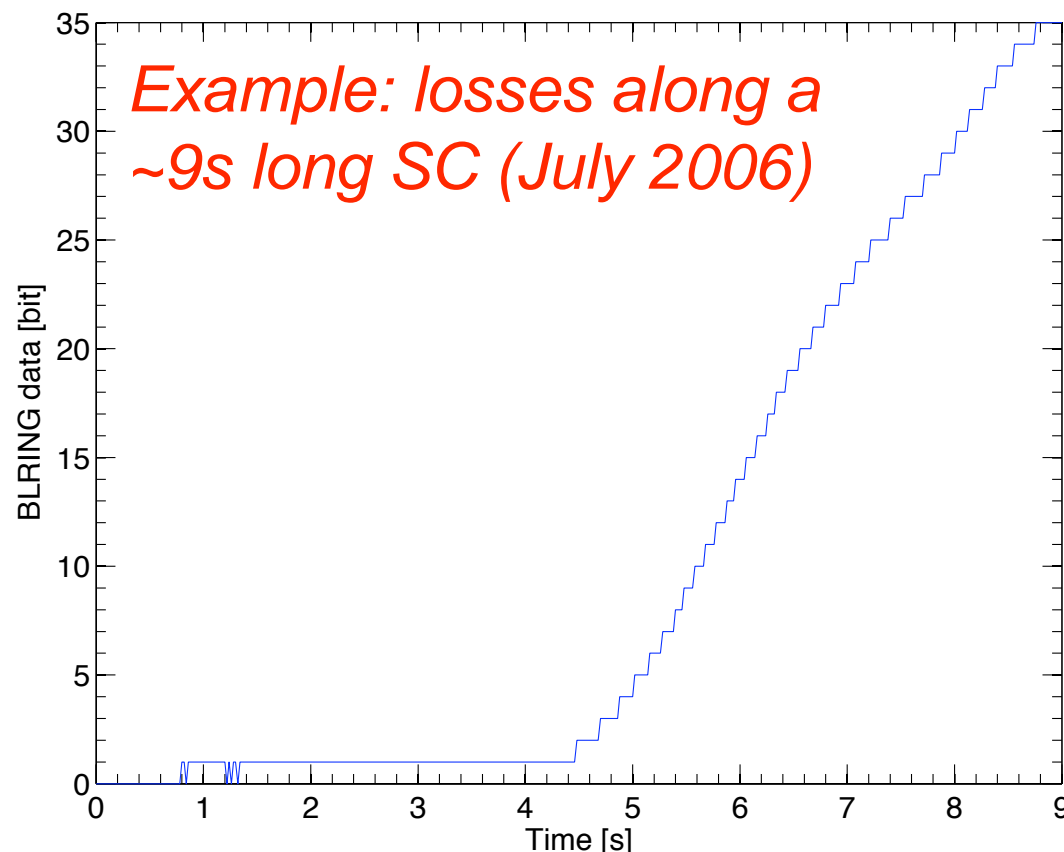
Remark: recent interest from I-collimation to participate in these measurements (B. Roderik)₃

Losses around the ring at higher f_{acq}

(Acknowledgments: F. Follin, L. Jensen)

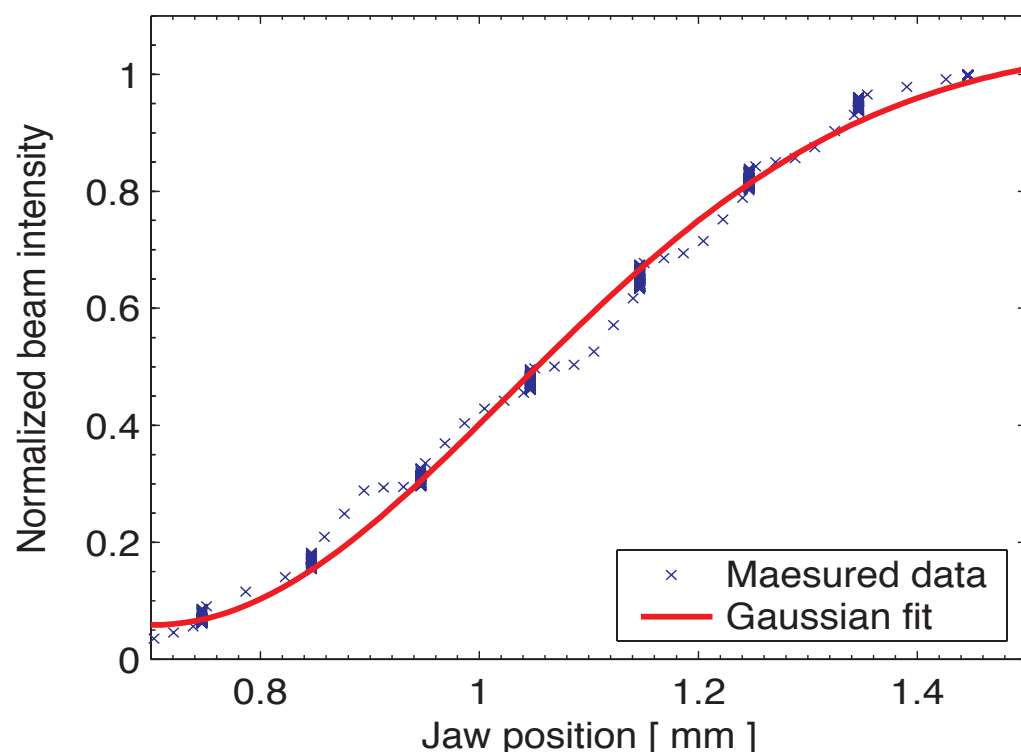
- BLRING signal of each monitor (216) is actually acquired at 50 Hz!
Integral over a super-cycle used for the fix display in CCC
- Following up our request (March 2006), F. Follin (AB-OP) updated the BL program for a **continuous data acquisition at 50 Hz!**
- New version available since July 2006 and successfully tested!
- **Issue:** Existing (working!) program is being migrated to FESA!!

New software is being written from scratch.



Follow-up required to make sure that the new program will provide the same functionality or that the old is kept alive!

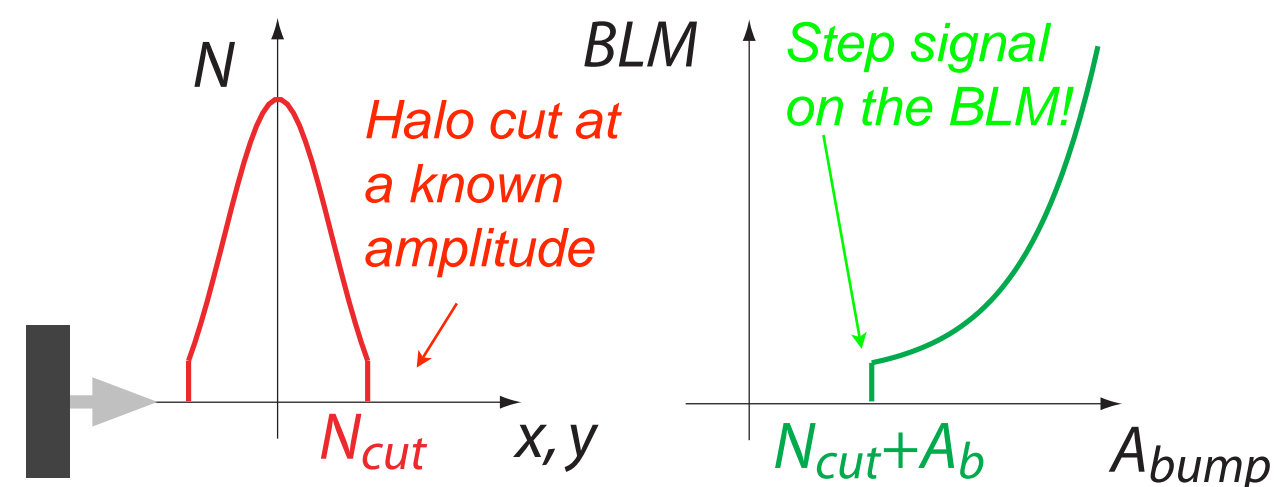
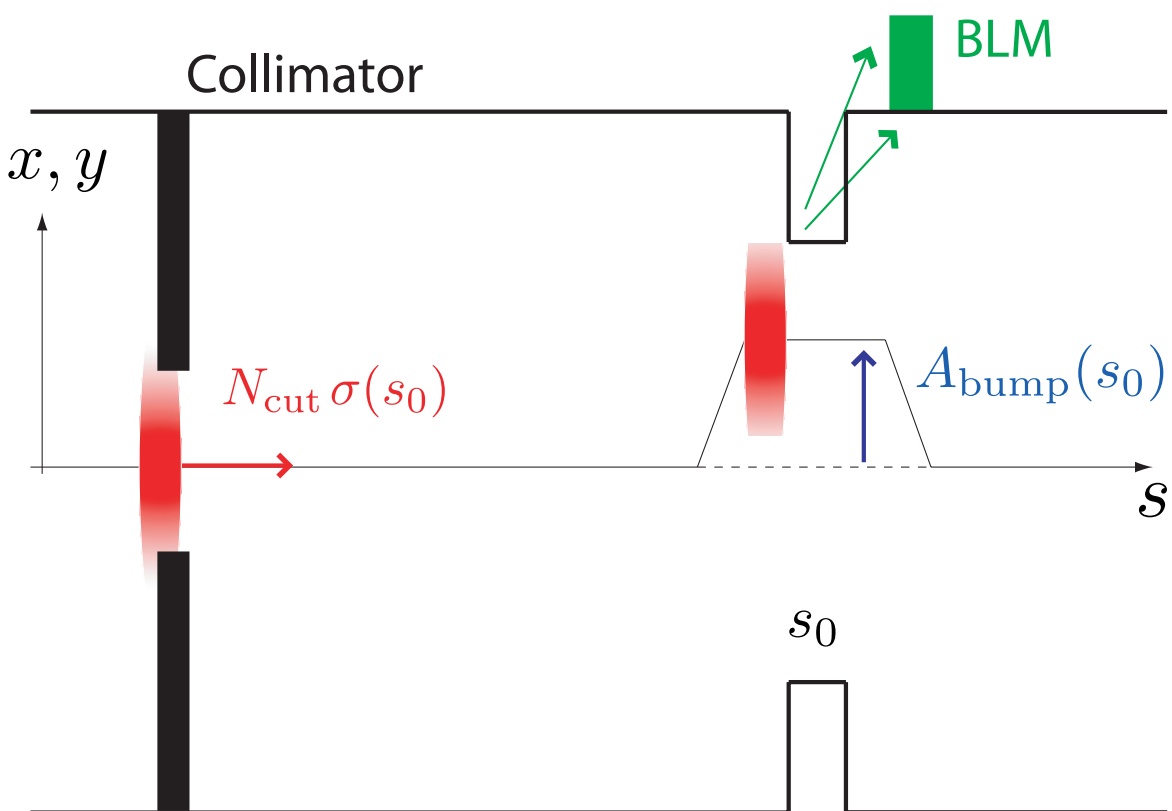
- We proposed to measure beam centre and beam sigma at the collimator with **full beam scraping** (Chamonix 2005)
- No dedicated measurements in 2004 - few data sets available
- **Beam size** from fit is in good agreement with expectations **BUT** the **beam centre** disagreed by $\sim 500\mu\text{m}$ from the standard BLM-based BB alignment! [but: BCT data were taken few hours later!!]
- We should *systematically compare* the two methods!
- Fast beam current measurements ($f_{\text{acq}}=100\text{Hz}$) are still available



Can we systematically scrape the beams with the collimator at the end of each coast?

Additional measurements (1)

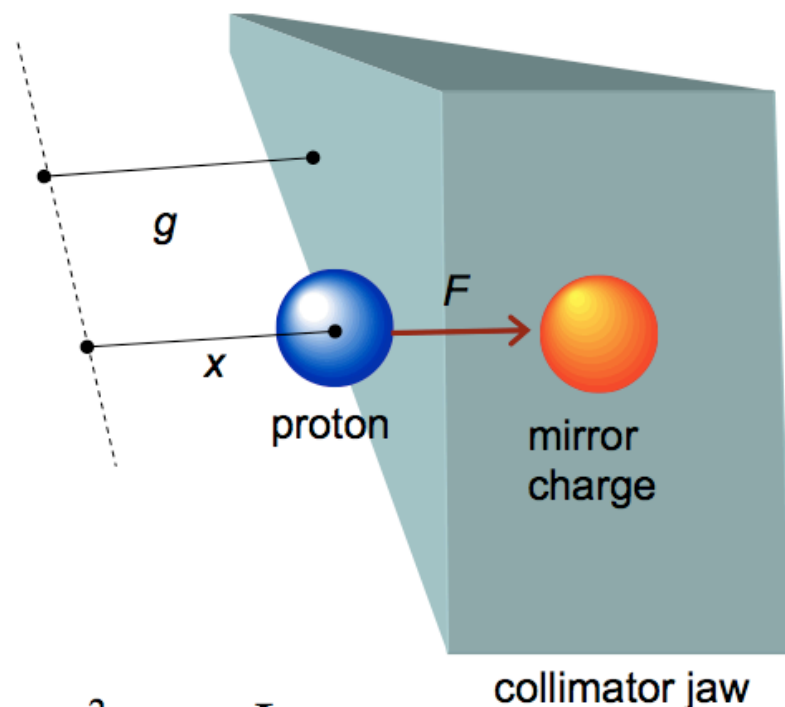
Aperture scans with scraped beams



- Measure the aperture by using *beams scraped with the collimators*
- See spike at the BLM when we touch the local bottleneck
→ Can speed up LHC commissioning!
- Try to *assess this new method* at the SPS. Candidates aperture bottlenecks (Gianluigi): TPSG, TIDH, TIDP (H limits)
- No need of additional BI!
- Need to setup time *dependent local orbit bumps* (already tried!)
- Required dedicated time $\sim 1-2$ hours (don't include BB collimator alignment!)

- Hans B.: **theoretical model** to explain the **LONG beam loss signal decay** when collimator jaw is left close to the beam core (LCWG, March 4th, 2006)
The LCWG endorsed dedicated measurements for these studies.
- Requirements: → BLM measurements for **~5min x 6** with 1 jaw close to beam
→ (parasitic) fast loss measurements when jaw moves

H. Braun, LCWG
of March 4th, 2006



$$\delta x' = \frac{e^2}{16\pi\epsilon_0 m_U c^2} \frac{Z^2}{A} \frac{L_{\text{jaw}}}{(\beta\gamma)^2 (g-x)^2}$$

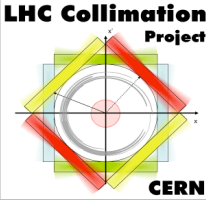
Measurements at different energies would provide a validation of the model!

~~Coast beams at 60 GeV?~~

Coast beams at injection ?



Proposed measurements - impact on planning



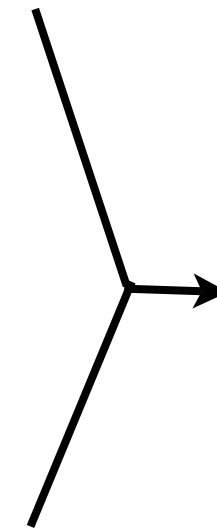
- ☑ In addition to the standard measurements, I would propose to:

Measure emittance

Cross-check the BB alignment

Acquire dedicated fast BLRING

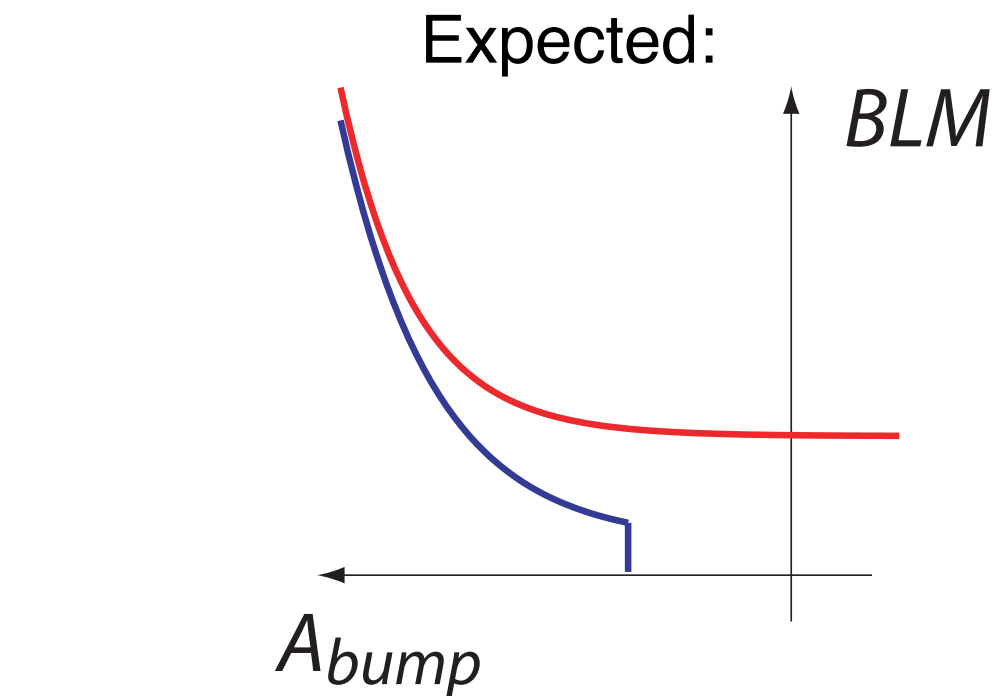
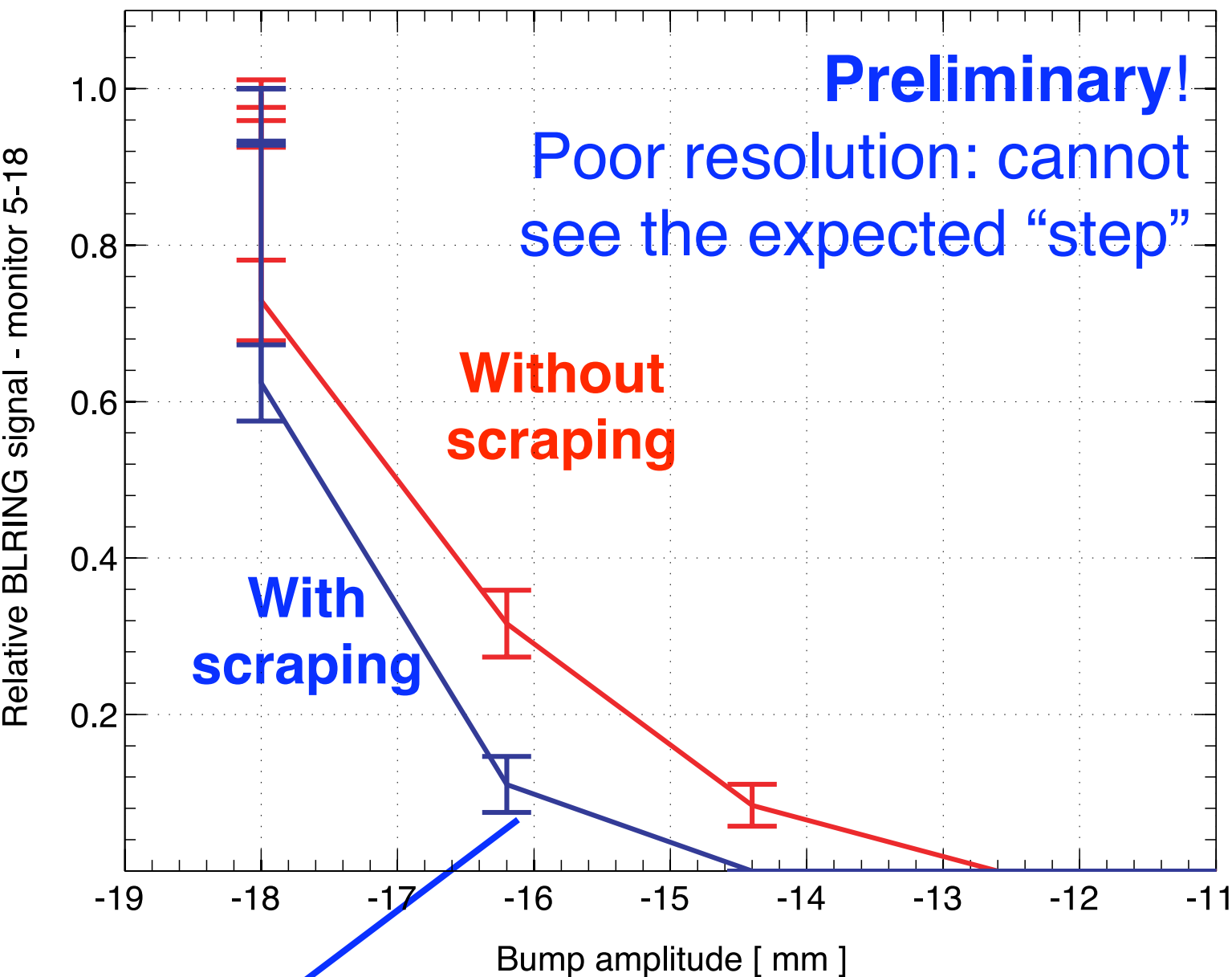
Full beam scraping



**At the end of
each coast!**

- ☑ Additional ~0.5 hours for benchmark of Hans theory
x2 if we get measurements at another energy
- ☑ Additional 1-2 hour for aperture scans with scraped beams
- ☑ No significant BI issues to perform these measurements

Preliminary aperture measurements



No scraping: don't know the distance from the beam centre

Scraping: From one step to the next, we know that we touch at 3σ !

Touch at $\sim 15-16$ mm
 Ncut $\sim 3\sigma = 12-15$ mm
 Mech. Aperture $r = 30$ mm
 Resolution: ~ 2 mm (bump too fast)
 fast rise-time to fit it within flat bottom

Good indication - not yet a proof!
More detailed tests with the LHC collimator at the SPS!