Update on Background Simulations

LCU

Yngve Inntjore Levinsen
CERN and Univ. of Oslo

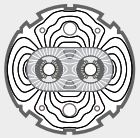
Helmut Burkhardt
CERN

18. May, 2010

Overview

- New beam-gas simulations
- IR Cross Talk simulations
- First look at data from LHC

Overview

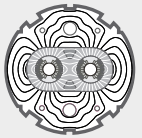


http://cern.ch/project-LHC-bkg-sim/

- $7\ \mathrm{TeV}$ and $3.5\ \mathrm{TeV}$ beam-gas simulations for both beams available.
- **Simulation of IR Cross Talk for both beams at 3.5 TeV available.**
- Links to other related projects and information.

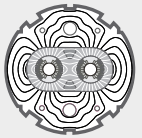
CERN

New optics for background studies



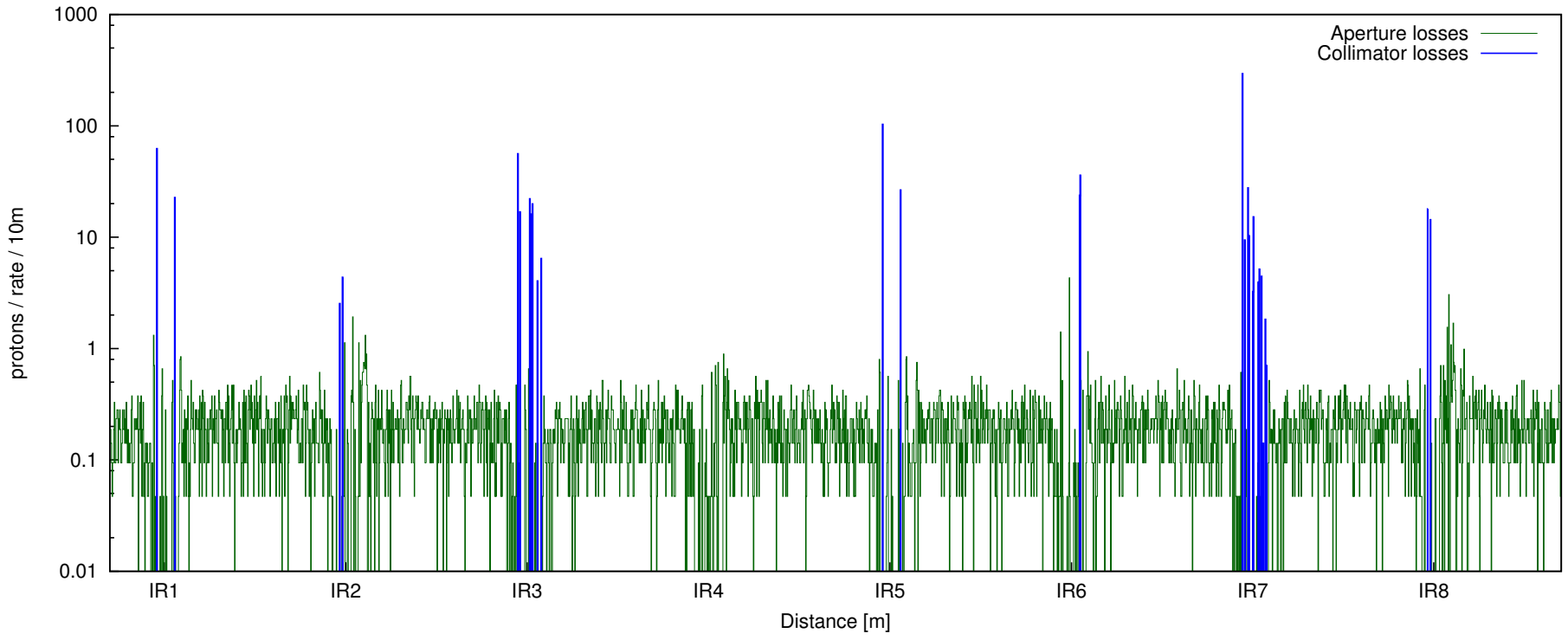
- After LBS meeting, was requested to update “benchmark parameters” for background simulations at 3.5 TeV.
- LHCb: **3m -> 2m**
- ALICE: **10m -> 2m**
- Background related studies for off-centred collisions in ALICE?
- Full list of parameters on the web page.

Beam-gas simulations



- $\beta^* = 2$ m in ATLAS/CMS, 3 m in LHCb, 10 m in ALICE.
- Rates normalized to 9E10 protons/bunch and 156 bunches/beam.
- Simulations predicts loss rates (maps) and lifetime from beam-gas component.

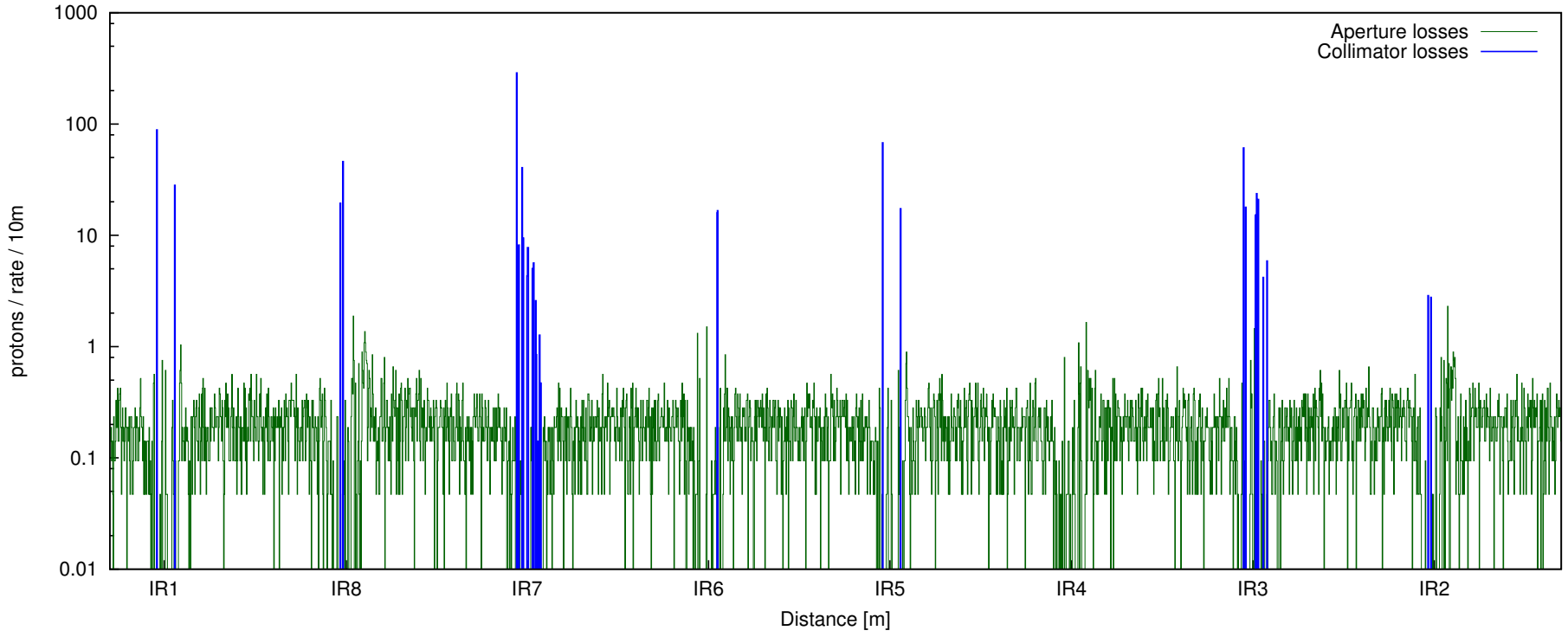
Beam-gas simulations



Beam 1

(Excluded protons with off momentum above 15 %)

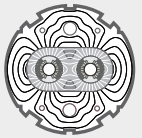
Beam-gas simulations



Beam 2

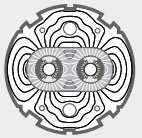
(Excluded protons with off momentum above 15 %)

Beam-gas simulations



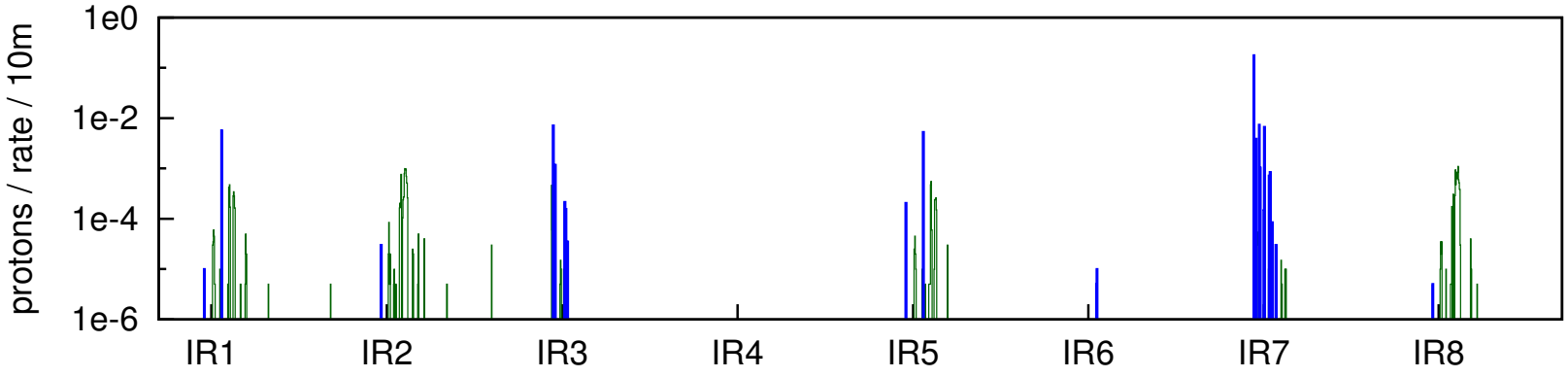
- Luminosity / beam-gas ratio is expected to:
  - Stay constant with increased number of bunches.
  - Increase linearly with increased bunch intensity.
  - Increase with energy for E $<$ 5 TeV.
- Lifetime at 3.5 TeV estimated to approximately 10^5 h (order of magnitude).
- 3.5 TeV -> 7 TeV beam energy: Beam-gas lifetime 10^5 h -> 10^3 h
- Experiments are capable of distinguishing local beam-gas events from other background sources due to it's particular signature (e.g. high charged hadron multiplicity, presence in beam–empty events..).
- Beam-gas is not expected to impose problems at 3.5 TeV.

IR Cross Talk Simulations



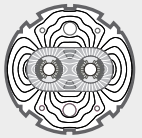
- For IR cross talk simulations, the same framework as for beam-gas has been used.
- Without crossing angle, signal from all four insertions can be simulated at once. Otherwise IR by IR.
- DPMJET again used for event generation, Lorentz boost from crossing angle directly incorporated in DPMJET.

IR Cross Talk Simulations



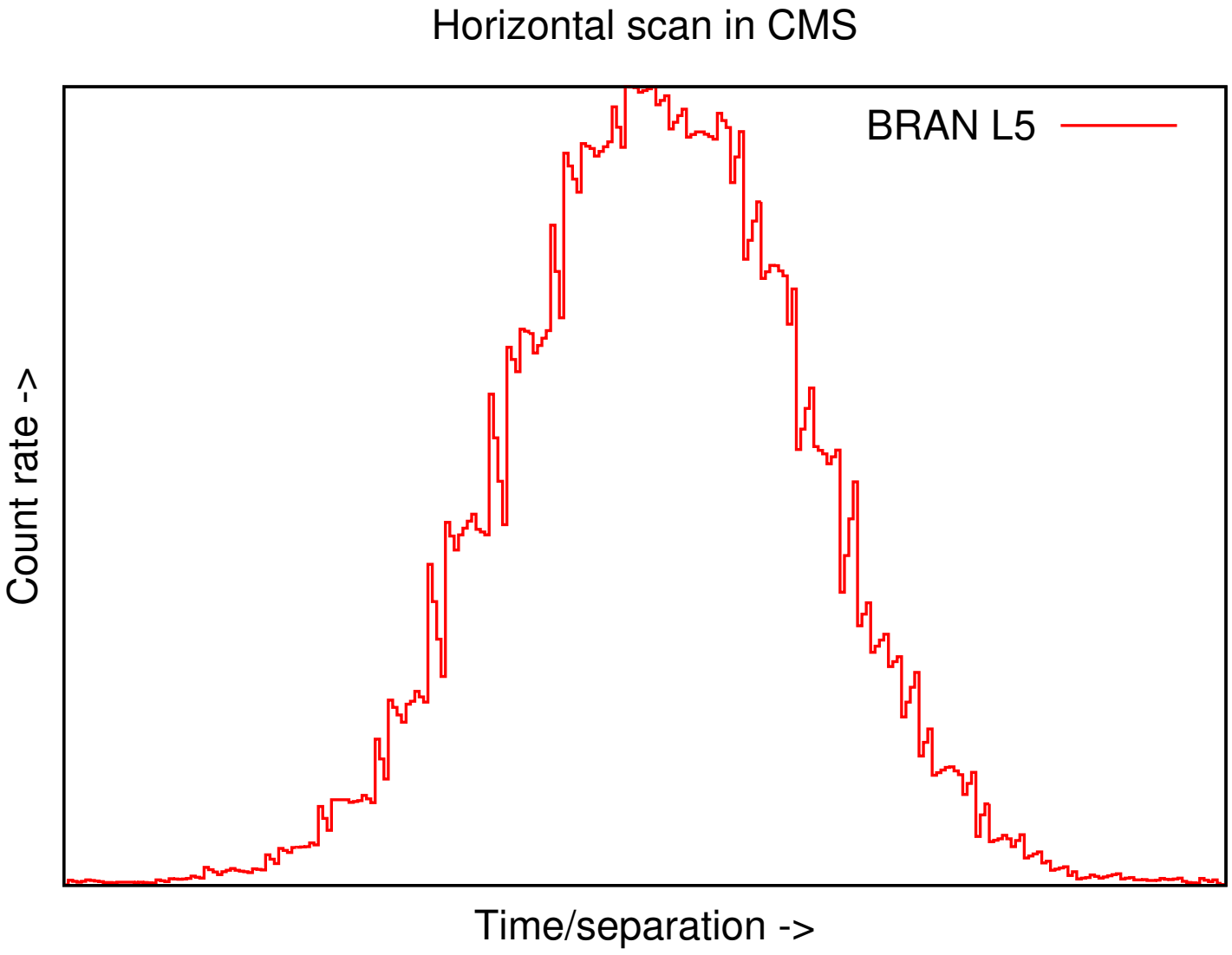
All TCT's at 12.8σ, 2 m β^* in all IR's, beam 1 (and bad thin lens optics..).
Multiply y-axis by the sum of the interaction rate in all four experiments (remember to use total cross section, not just inelastic..).

Attempts to observe IR cross talk

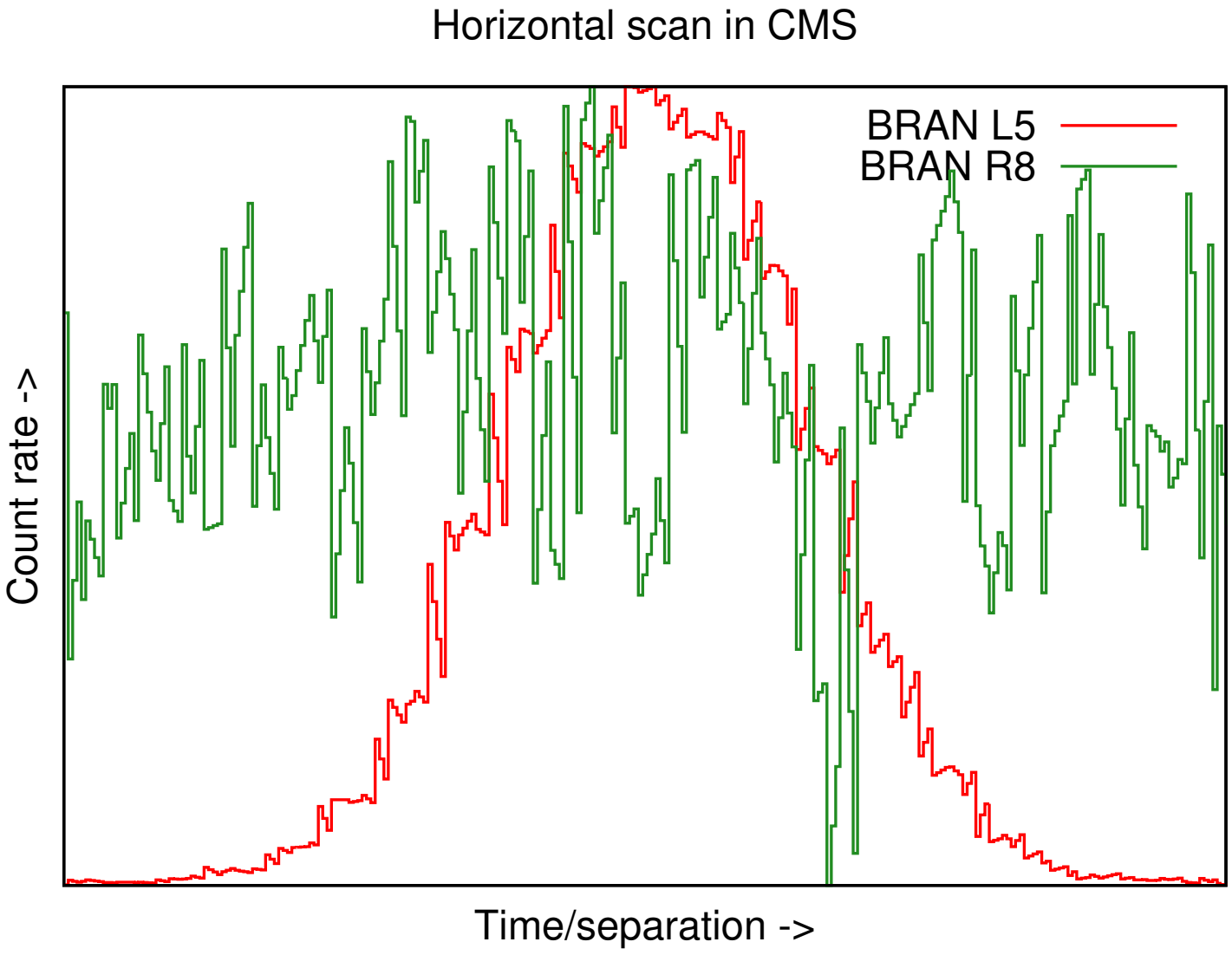


IR cross talk mainly adds to the normal halo (in addition to local losses downstream of the insertions), hence difficult to disentangle.
Difference in background signal as a function of luminosity in other exp. could be credited to IR cross talk.
Expect to need higher intensity in order to observe anything.
Approach: Try to correlate calibration scans (long lumiscans) to different BLM's and similar signals.

Attempts to observe IR cross talk



Attempts to observe IR cross talk

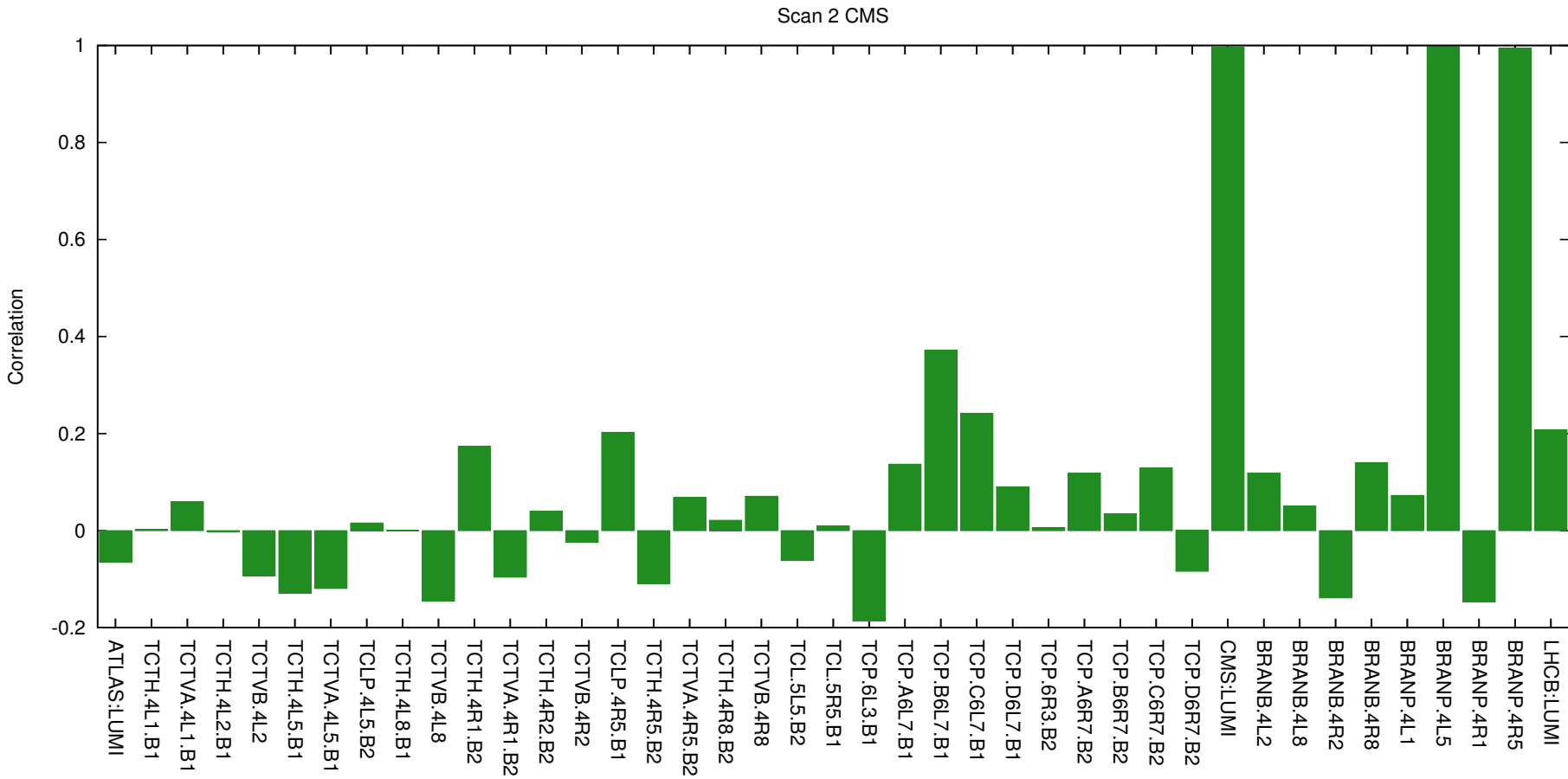


Attempts to observe IR cross talk

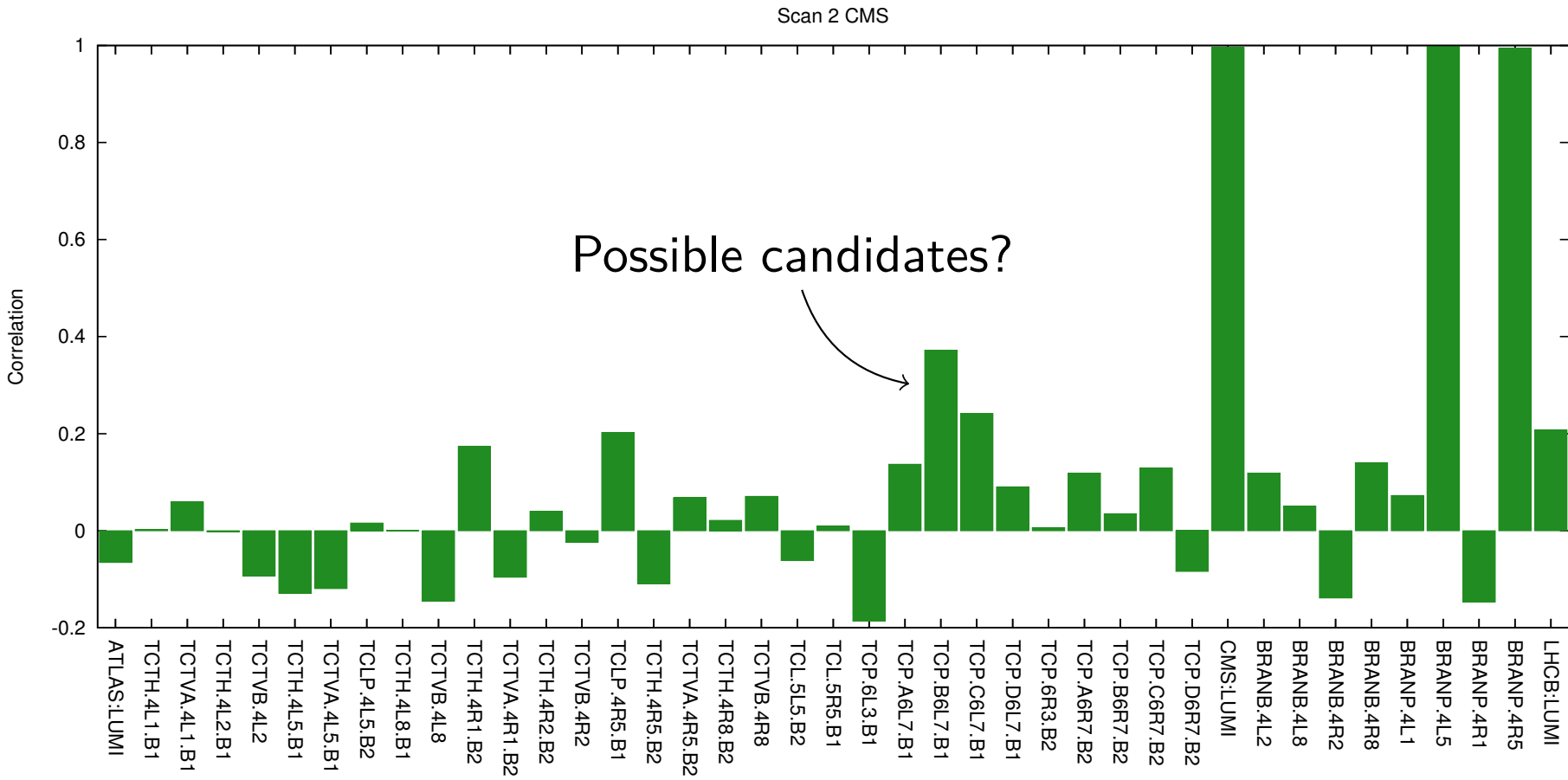
$$Cor(X, Y) = \frac{Cov(X,Y)}{\sigma_X \sigma_Y}$$
$$\text{Cor(BRAN L5, BRAN R8)} = \mathbf{0.14}$$

- A single number that gives a quick idea if there is anything worth investigating..
- Repeat for all signals that might have a correlation...

Attempts to observe IR cross talk

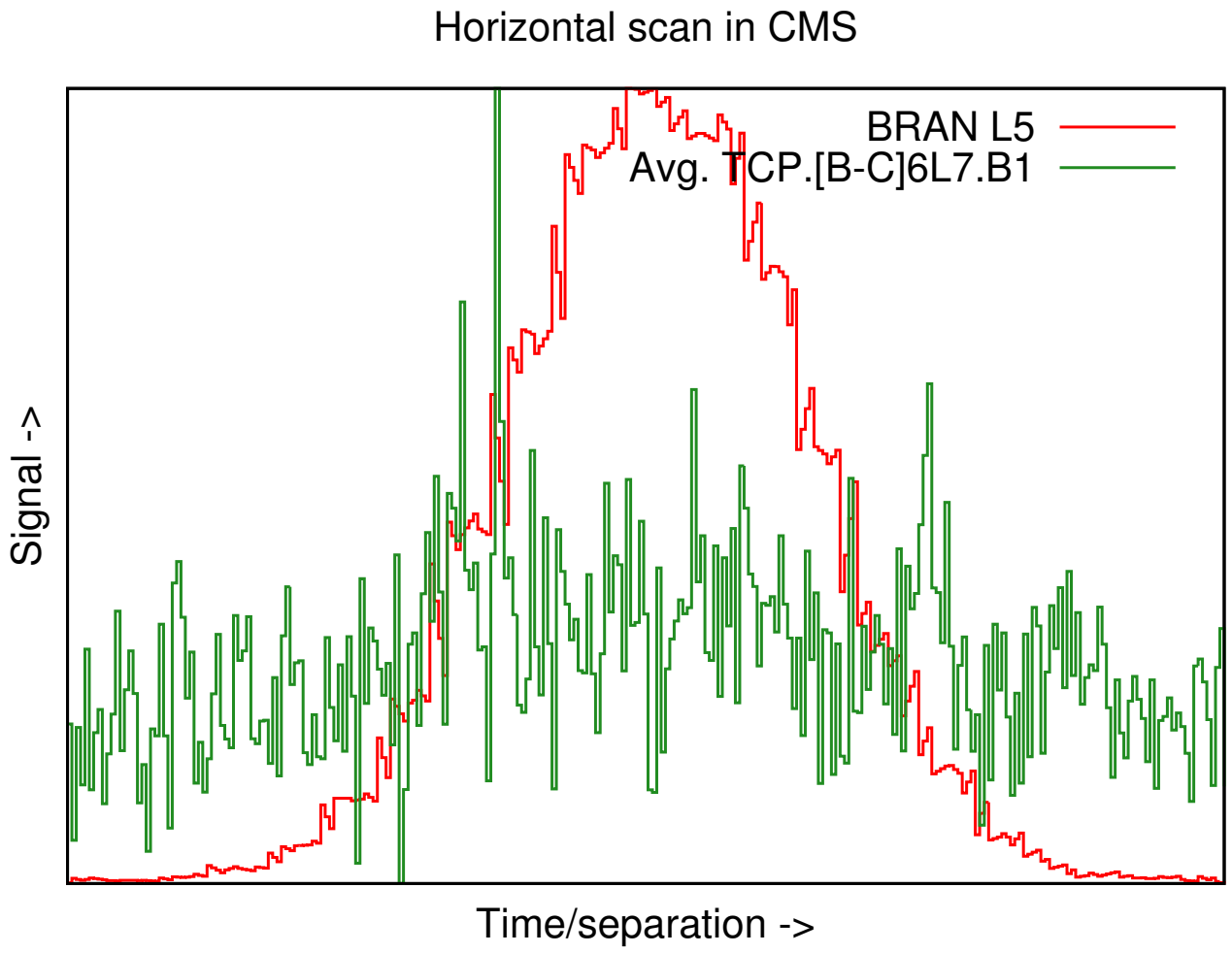


Attempts to observe IR cross talk

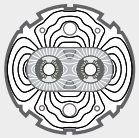


Attempts to observe IR cross talk

Very weak correlation, could be many things...



Summary



- Beam-gas simulations in sixtrack are available for several configurations
- IR cross talk simulations started
- Some early investigations on data from LHC started, suggestions are welcome!
- `http://cern.ch/project-LHC-bkg-sim/`
- `http://cern.ch/LBS/`

CERN