Results of the Test Beam 2004

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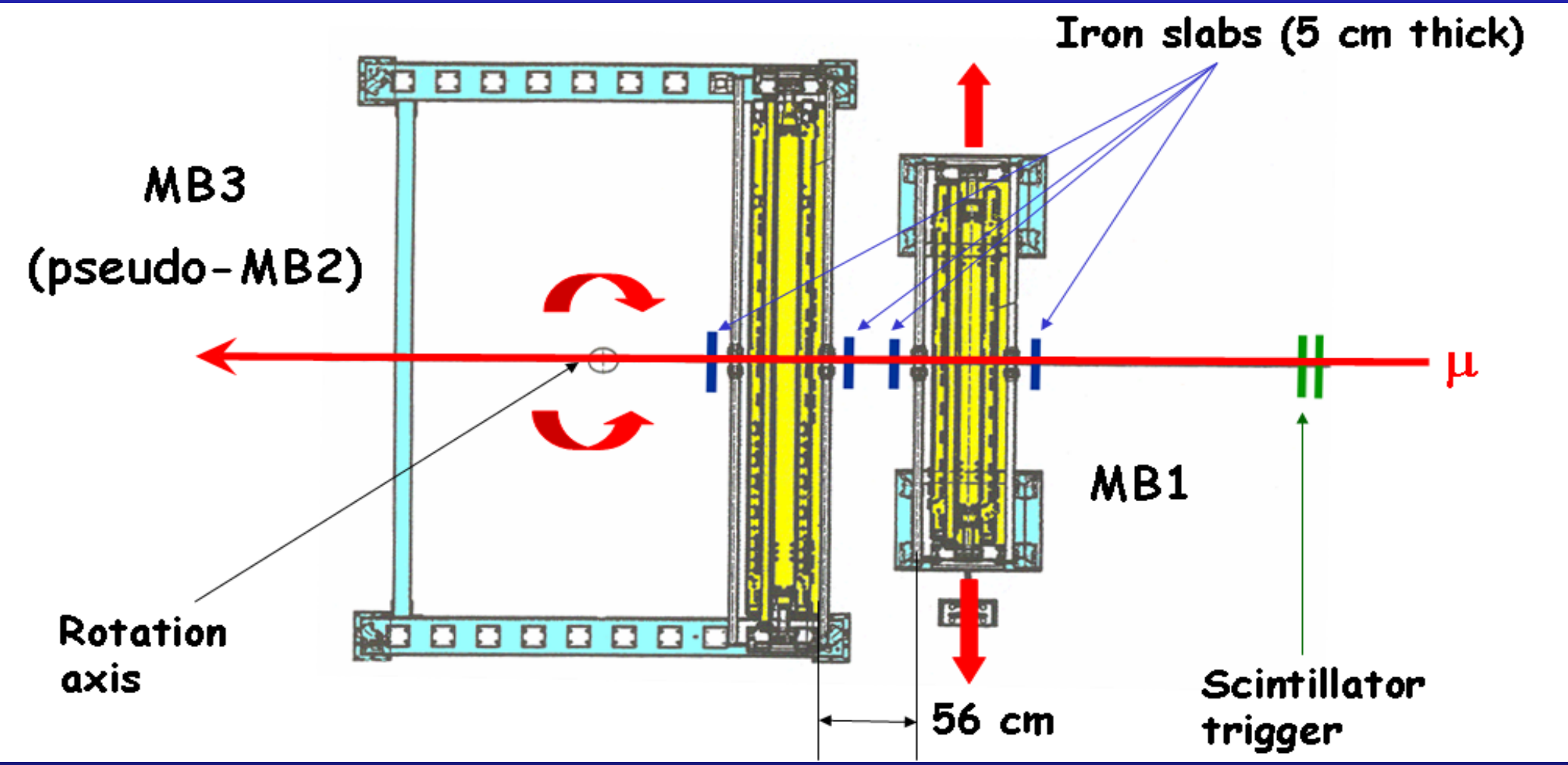
Slides by PL Zotto, presented by E.Conti
CERN, CMS week March 2005

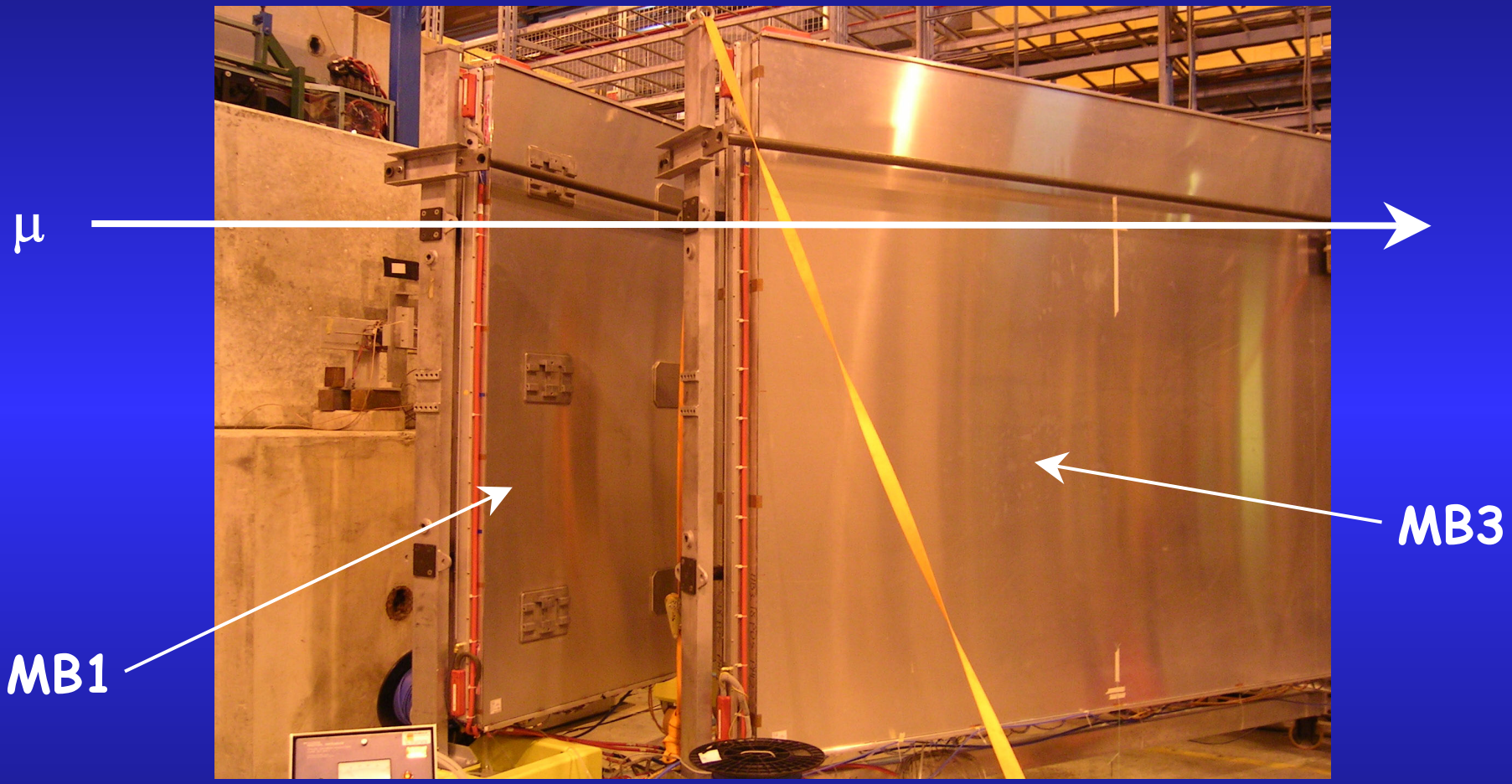
Goals

- **MAIN GOAL**: test of the trigger chain up to DTTF and test of DTTF
- Verify some points left from test beam 2003, namely, BTI default configuration, calculation of TRACO tables with inclusion of the station offset
- Verify bit BTI-offset in TRACO
- Test with e.m. background (showers)
- Verify synchronization algorithm

Experimental set-up



Experimental area



Data collection

- Scan in angle (0,±10,±20,±30 deg)
- Scan in position
- Scan in energy at 0° (30,50,100,150,300 GeV)
- Scan in clock phase *(to be analyzed)*

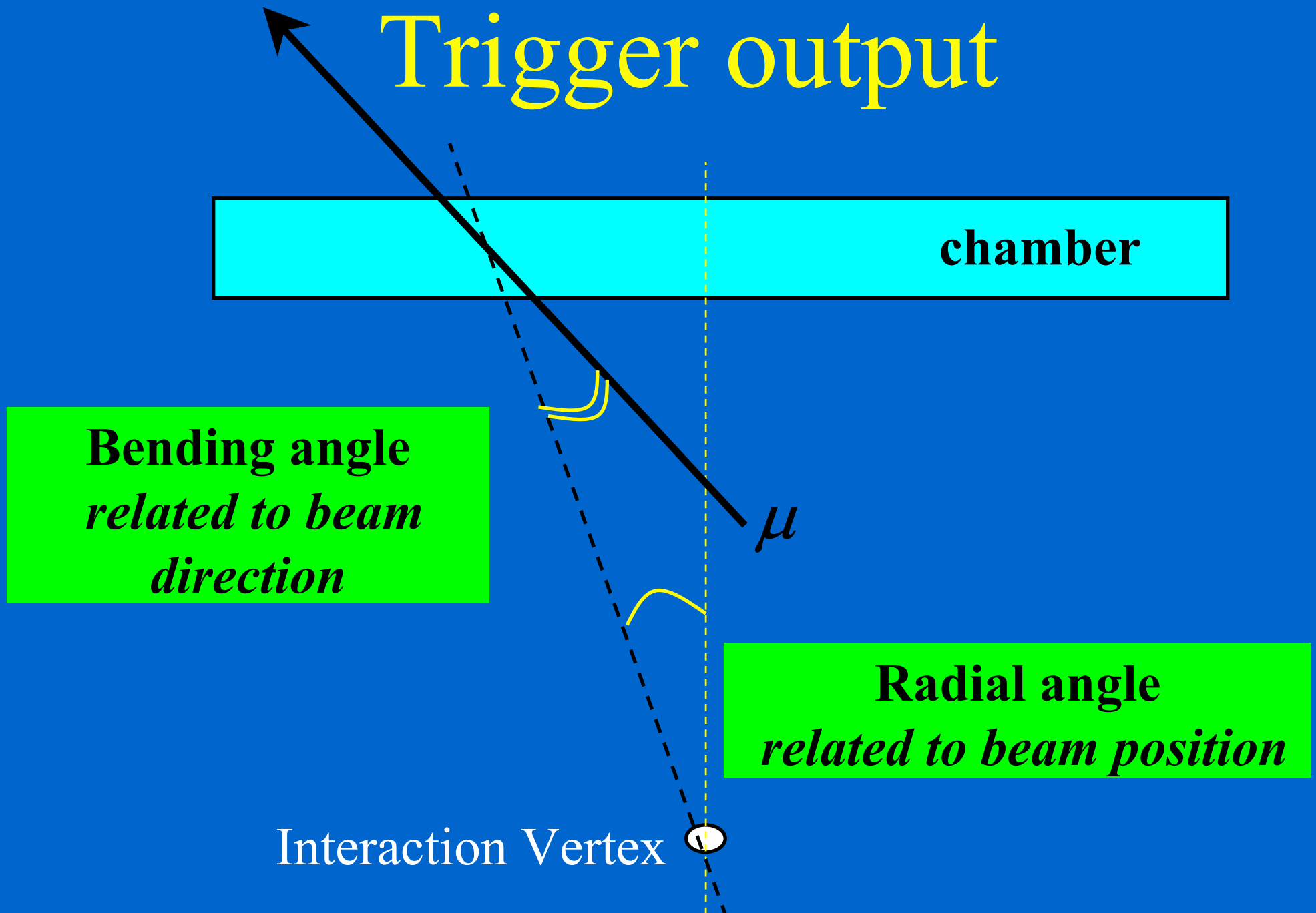
Here we report only the results for SINGLE muon

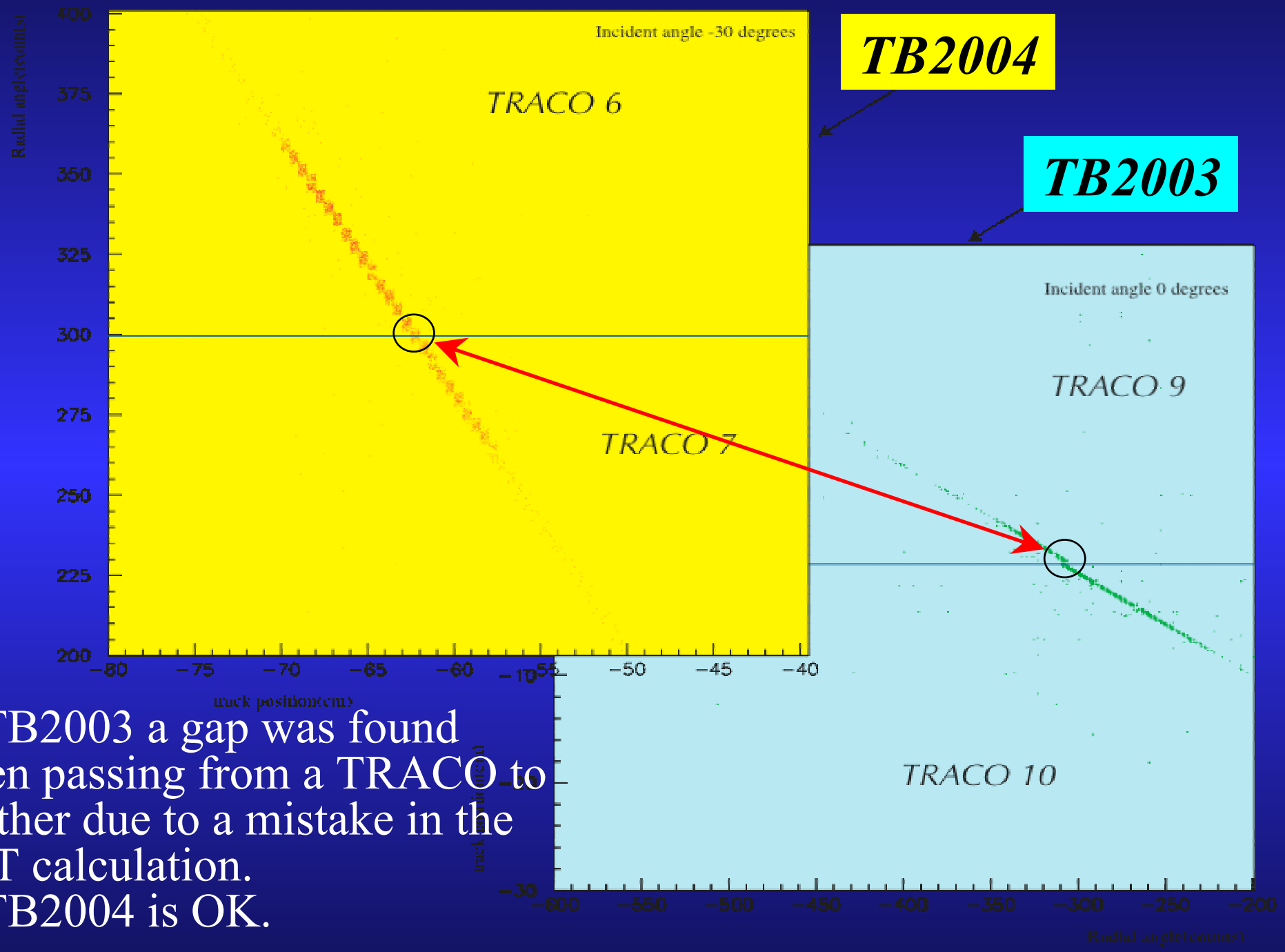
Selection

- Cuts for the definition of the SINGLE muon are done on MB1 – for the analysis of MB3 data – or as control on MB3, for the analysis of MB1 data :
  - $\leq$ 2 hits out-of-time
  - $\leq$ 6 hits in SL Theta
  - $\leq$ 6 hits in al least one SL Phi

- Some problems:
  - Because of a bad FEB we can reconstruct tracks at x > -45cm only for runs from 2607 to 2697 in MB3.
  - No way to reconstruct tracks for run > 2735 because of a TDC configuration error (see M.Cruz talk Dec2004).
  - Theta trigger data have been eliminated in SC because no enough lines in the PU.

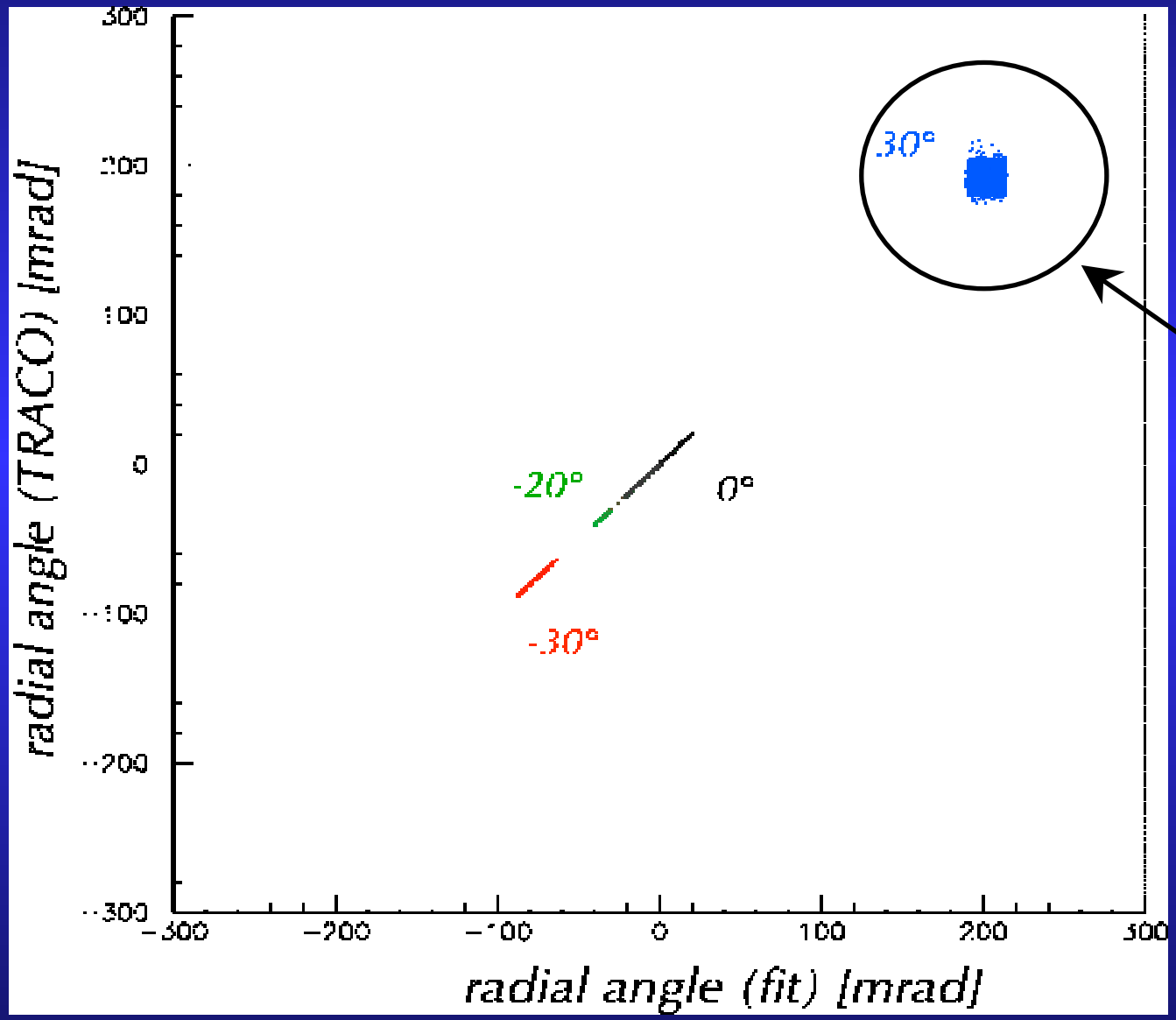
Trigger output





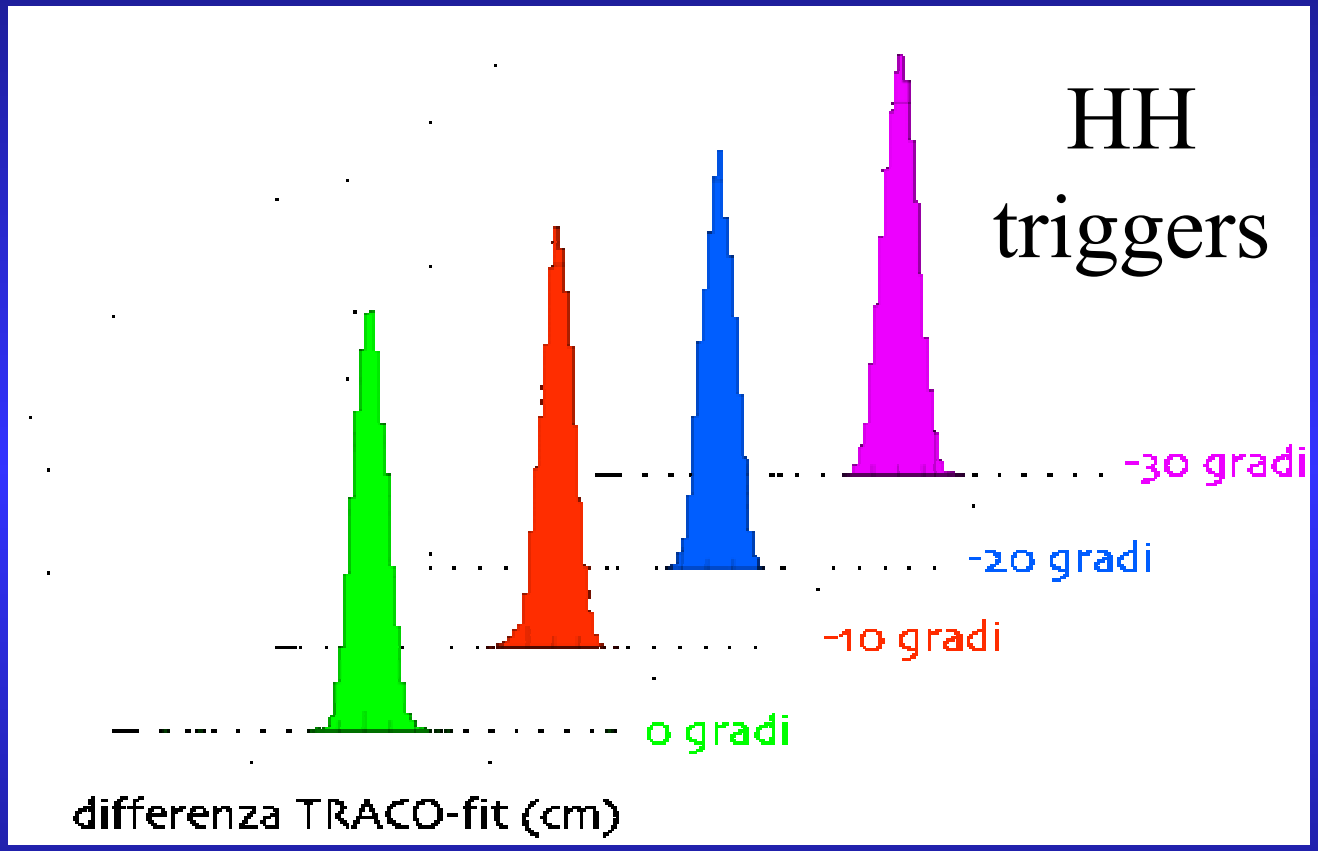
- In TB2003 a gap was found when passing from a TRACO to another due to a mistake in the LUT calculation.
- In TB2004 is OK.

Correlation TRACO-TDC: Radial angle



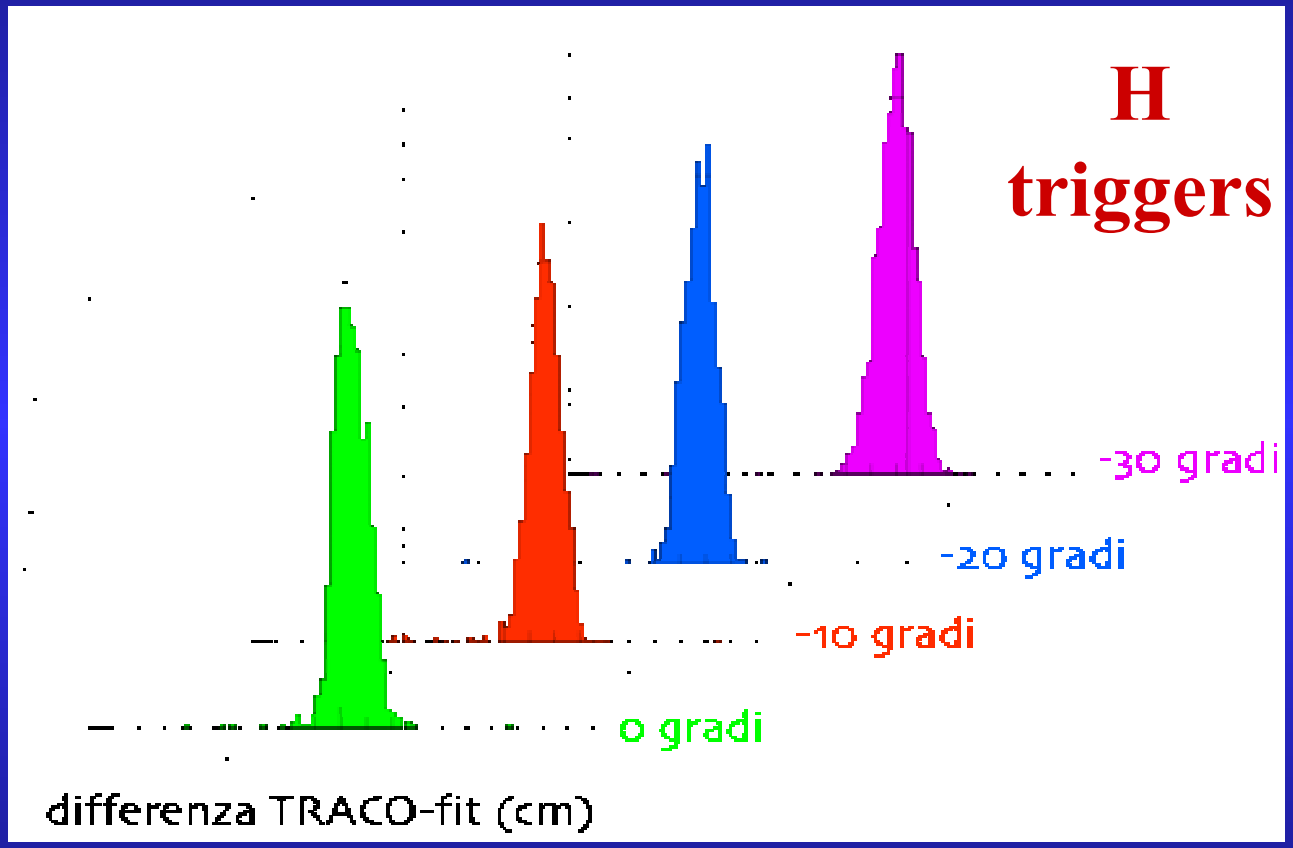
Problem of TDC configuration

Radial angle resolution



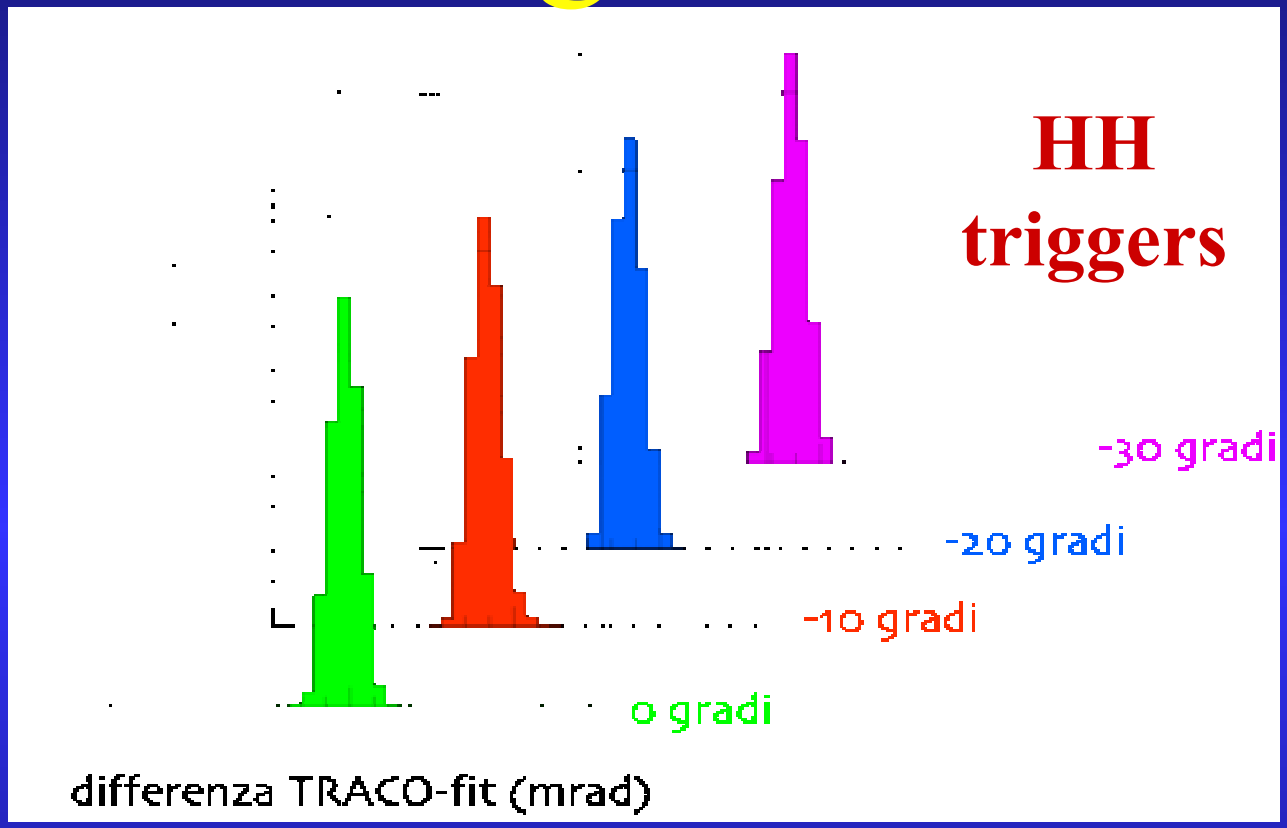
Distribution variance is between 800 and 650 μm
There is a systematic of about 700 μm every 10 deg

Radial angle resolution



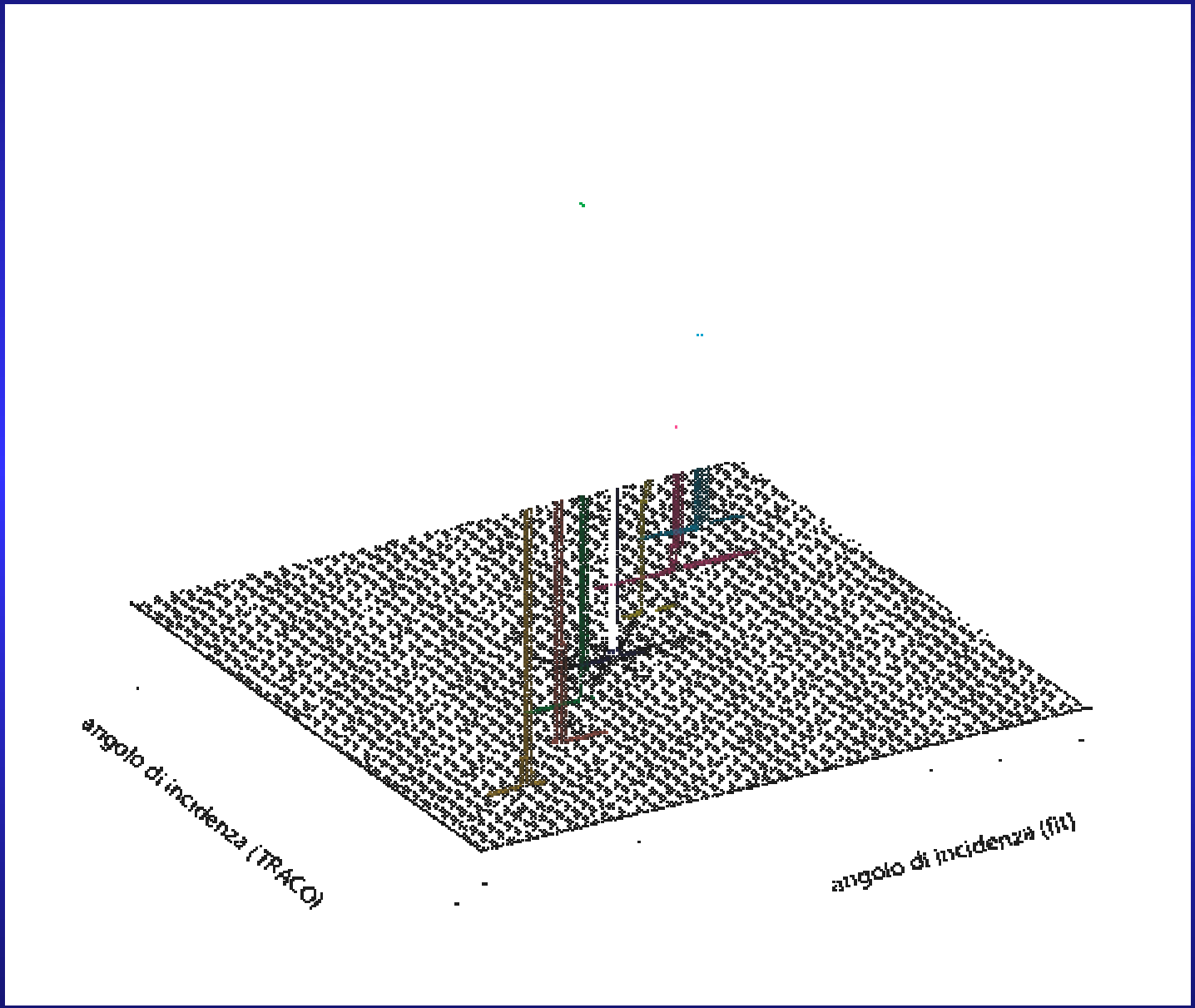
- Results identical for all trigger types

Radial angle resolution

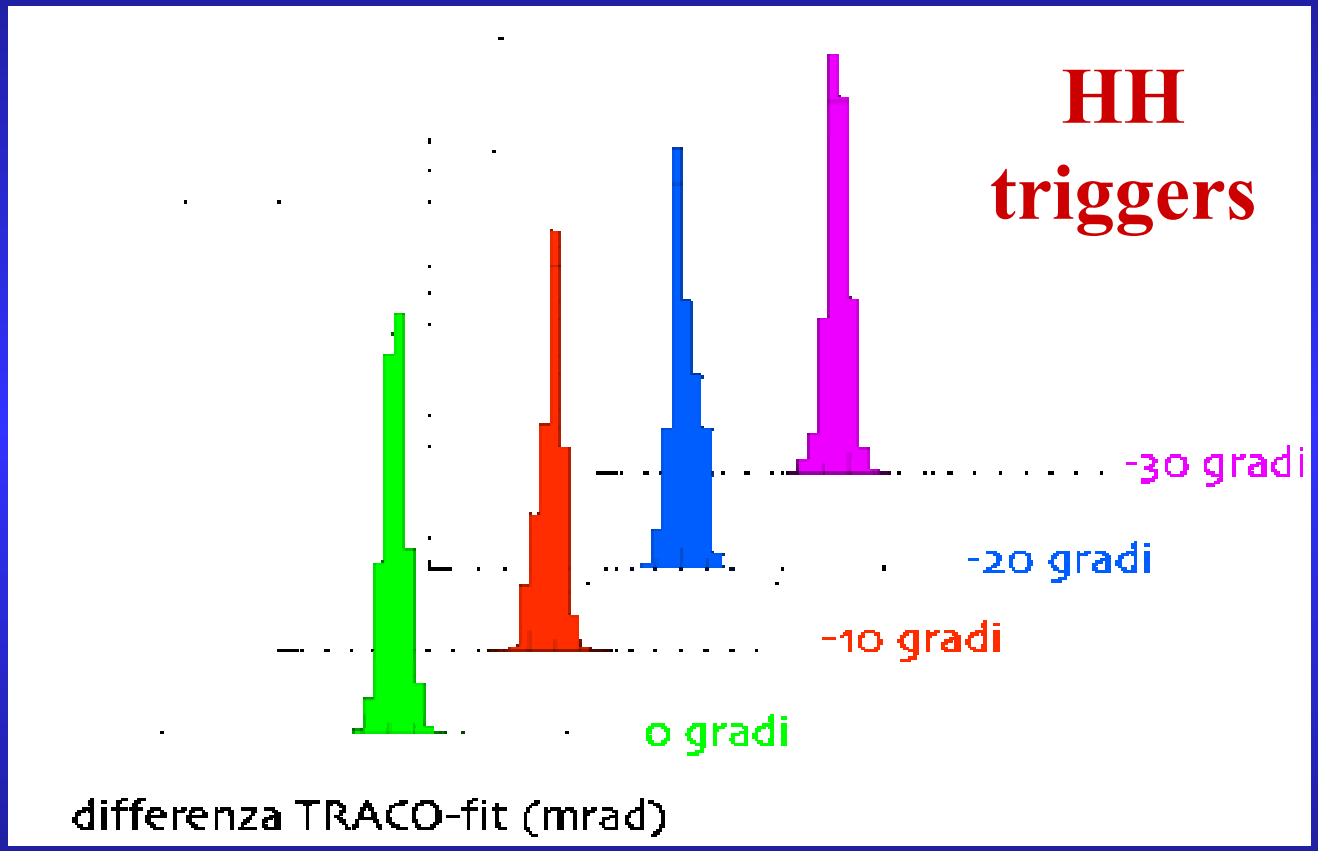


- In angular units, the variance is about 150 μrad.
- The systematic is about 250 μrad (except at 0 deg), independent from angle.
- Probably it is an uncertainty in the absolute reference system.

Correlation TRACO-TDC: Bending angle



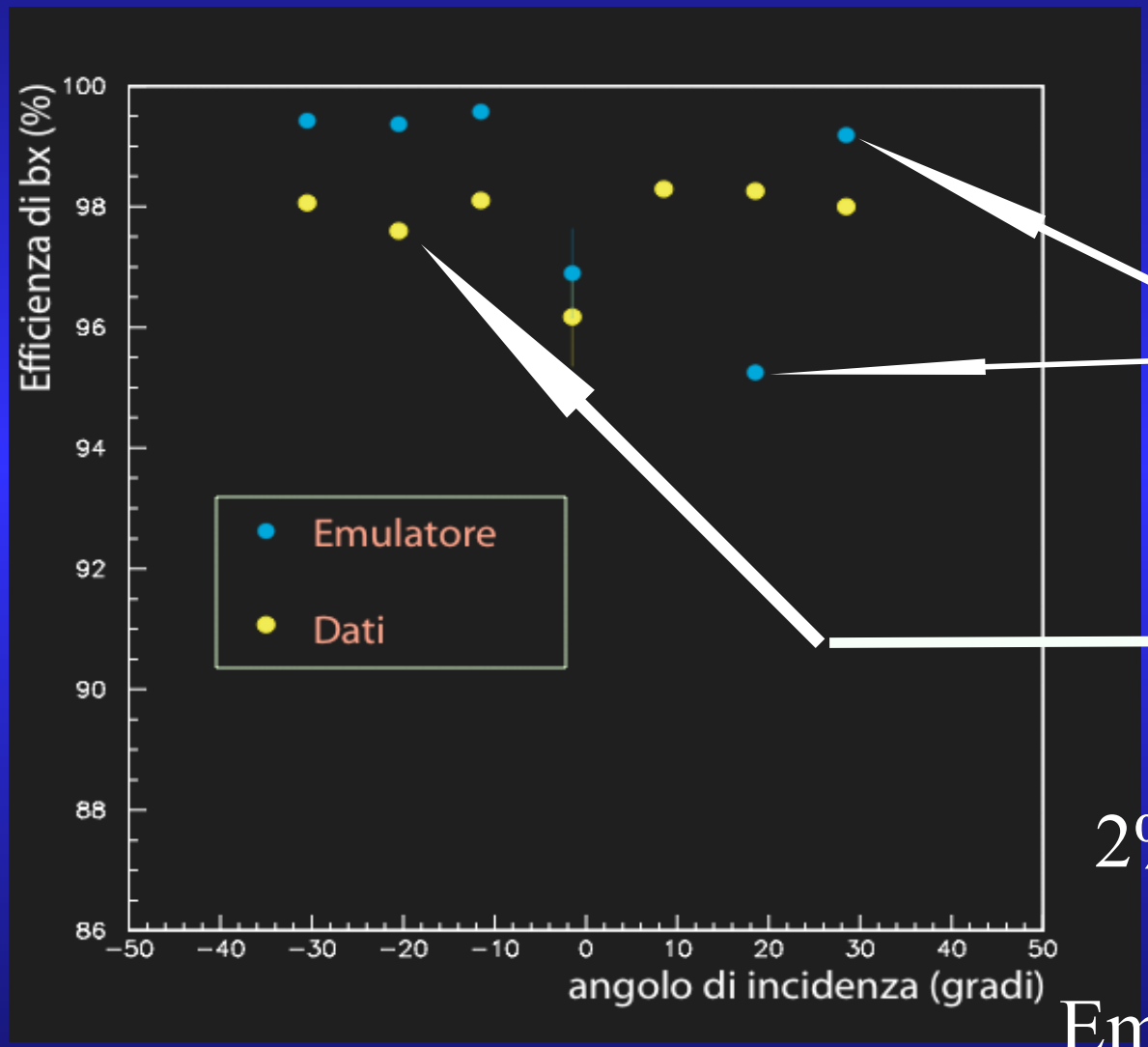
Bending angle resolution



Variance is about 2-3 mrad

For uncorrelated triggers, variance is 30 mrad

BX identification efficiency

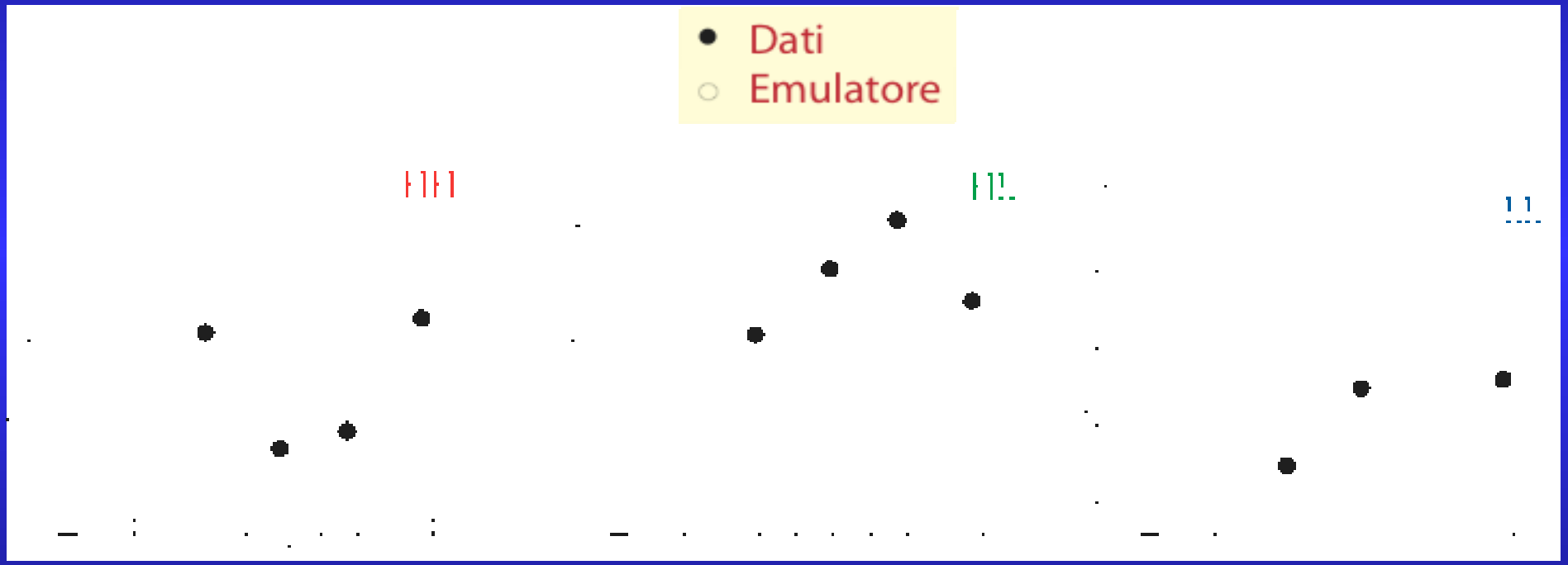


Wrong TDC configuration

Bad FEB

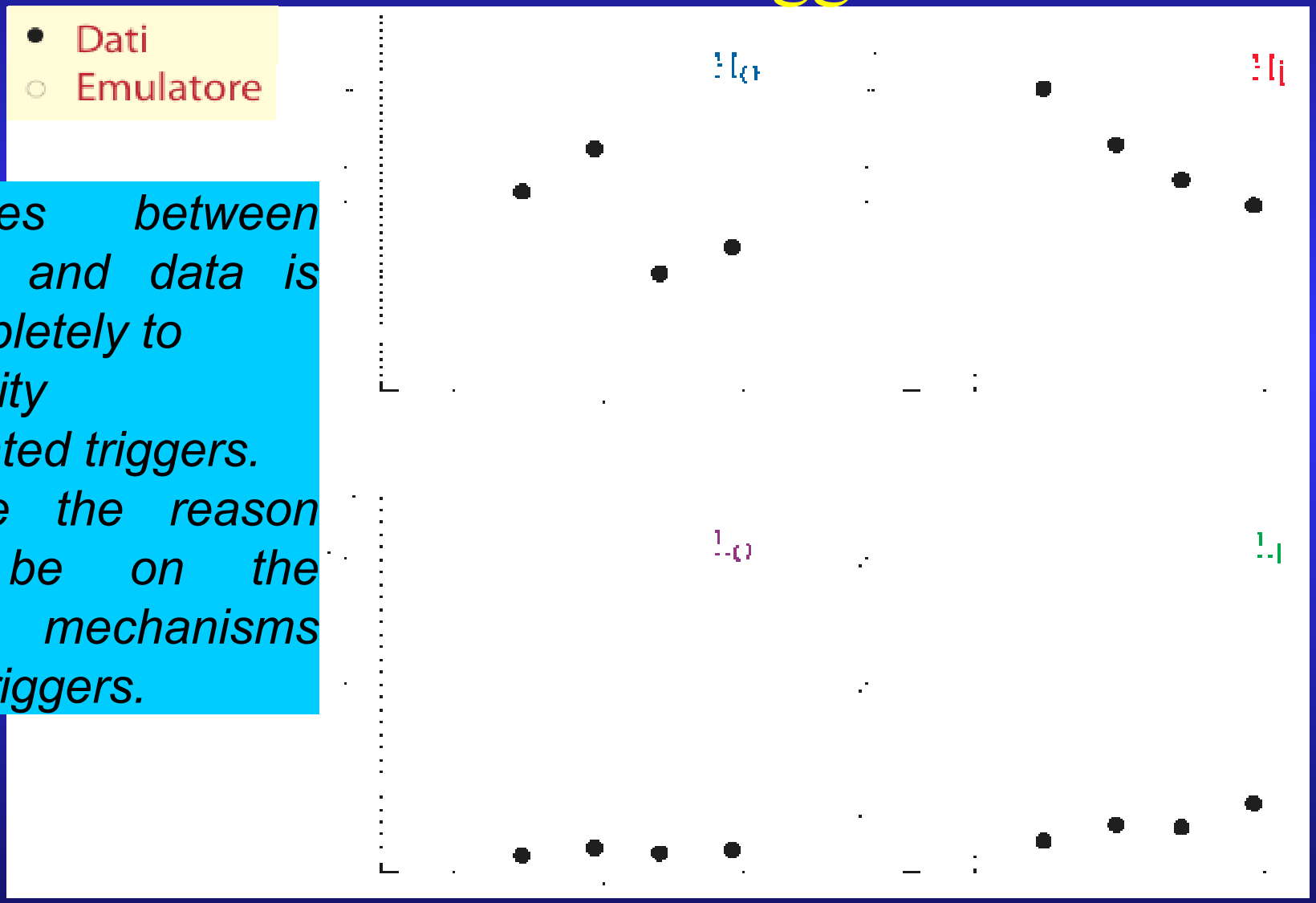
2% difference between emulator and data. Emulator result is similar to TB2003.

Data-emul. comparison: *correlated* triggers



Correlated triggers are OK

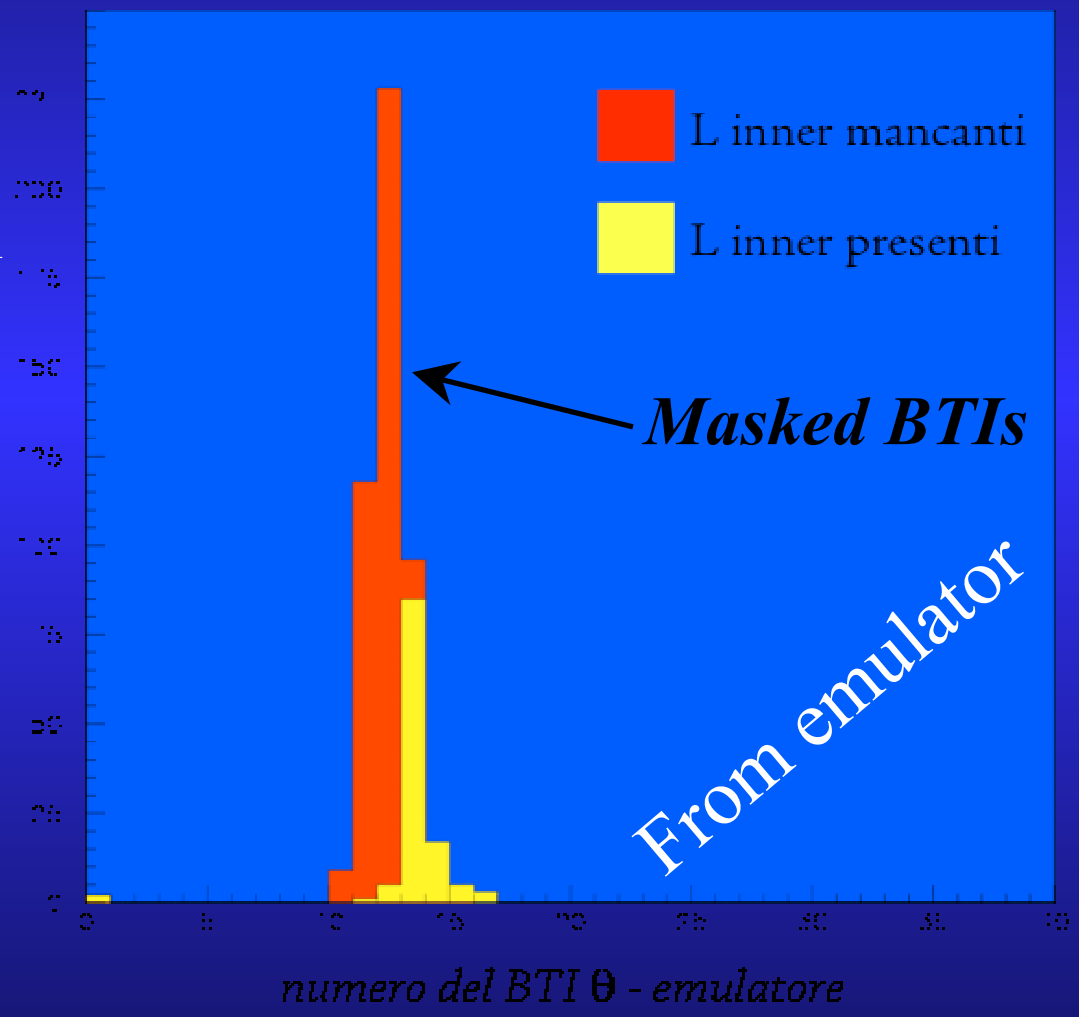
Emulator-data comparison: *uncorrelated* triggers



Differences between emulator and data is due completely to Low-quality uncorrelated triggers. Therefore the reason should be on the rejection mechanisms of such triggers.

Theta Triggers

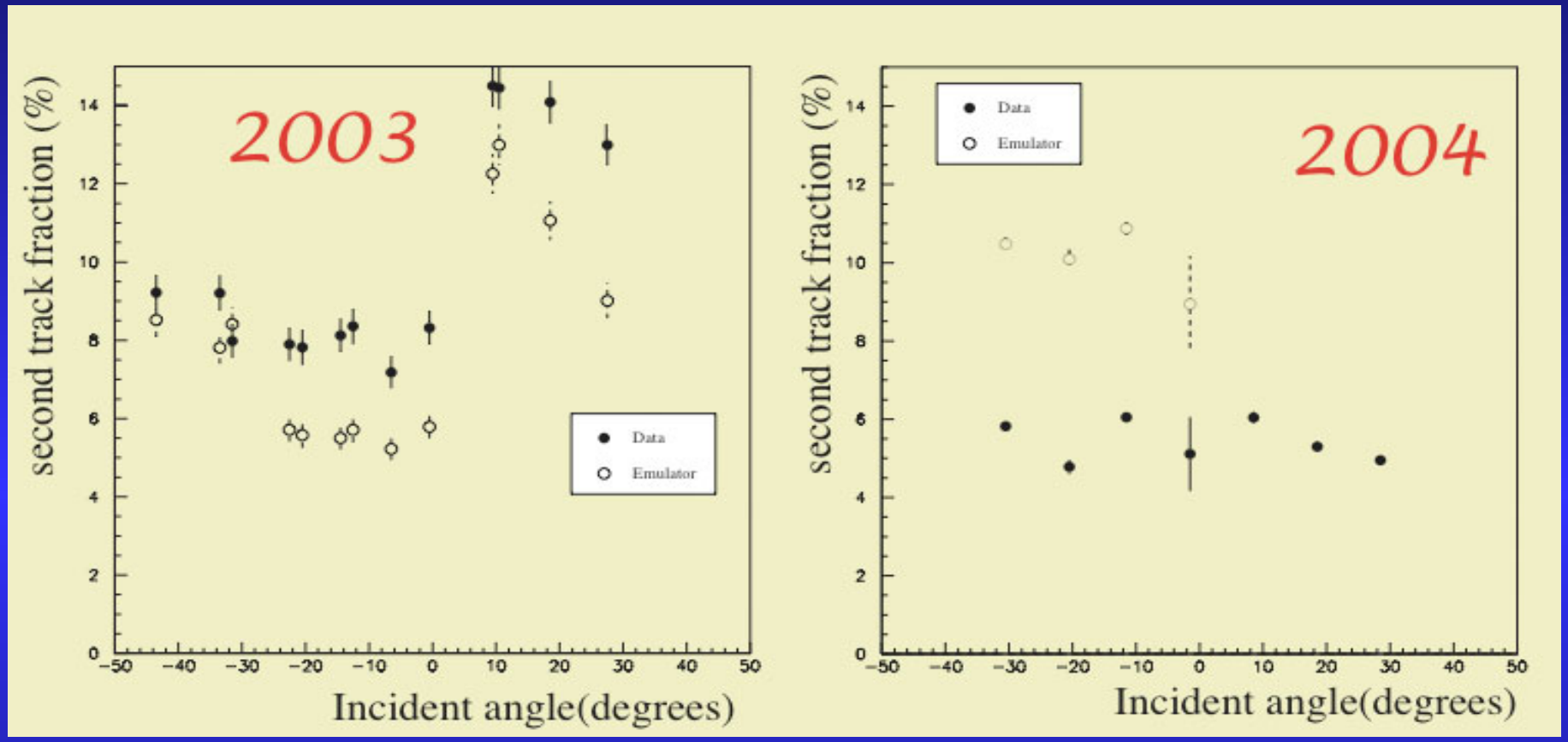
Theta Trigger bits are used to validate Low-quality uncorrelated triggers.
There is a correlation between missing triggers and BTI Theta which should validate the trigger.
Correlation can be seen using the emulator, since Theta trigger bits could not been recorded.
Because of a configuration error, some Theta BTI were MASKED !



Emulator

- The emulator has not been modified to include the masked BTI channels. All BTI inputs are ON. Therefore in the following the emulation results are systematically better than the data.

Second tracks

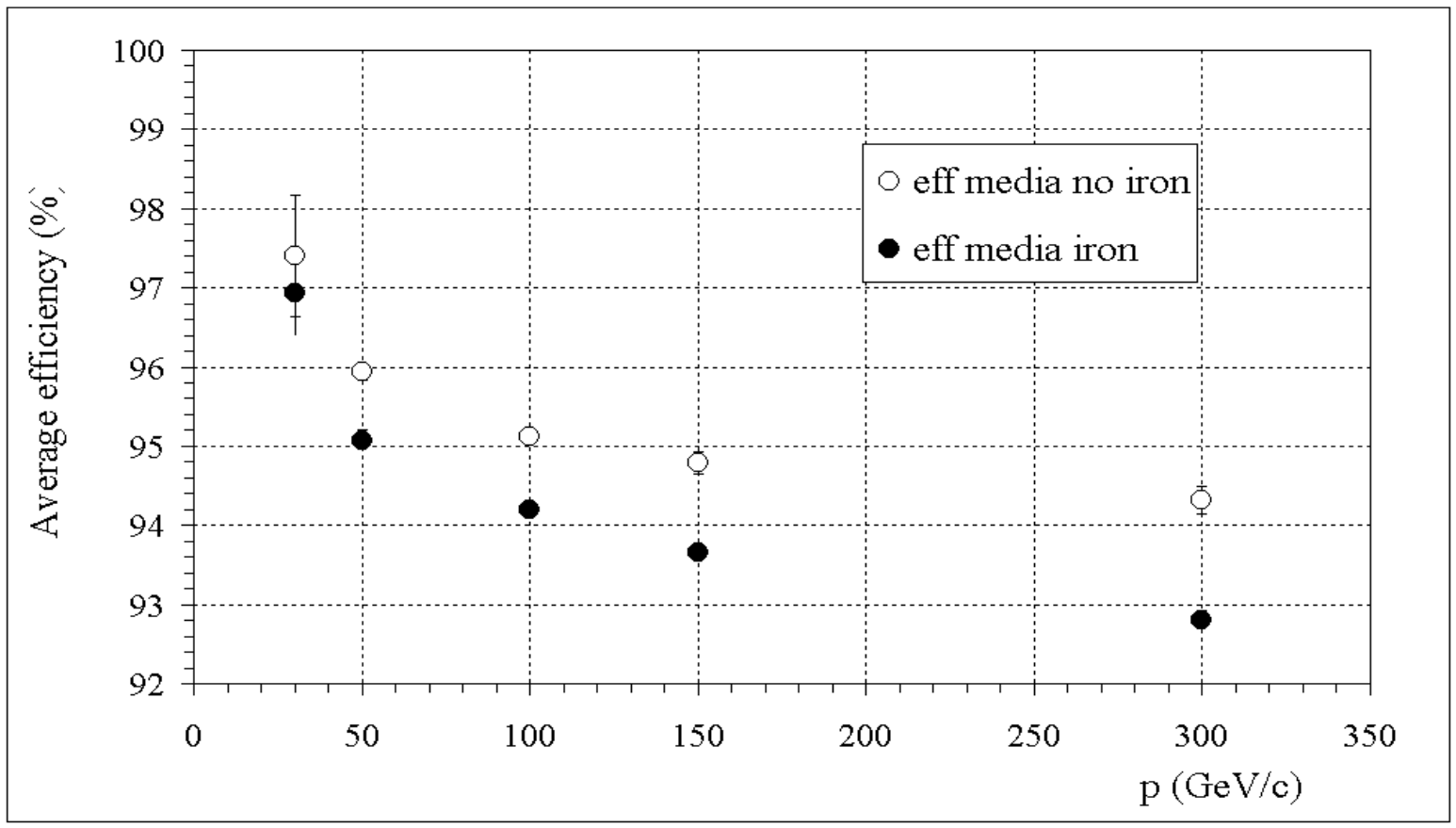


- **Differently from TB2003 data, in TB2004 data the fraction of second tracks is symmetric => it was a wrong configuration.**
- **Difference between emulator and data still due to the missing Theta BTI infos (masked BTI inputs), since most missing triggers are uncorrelated L.**

Trigger efficiency & noise vs. energy

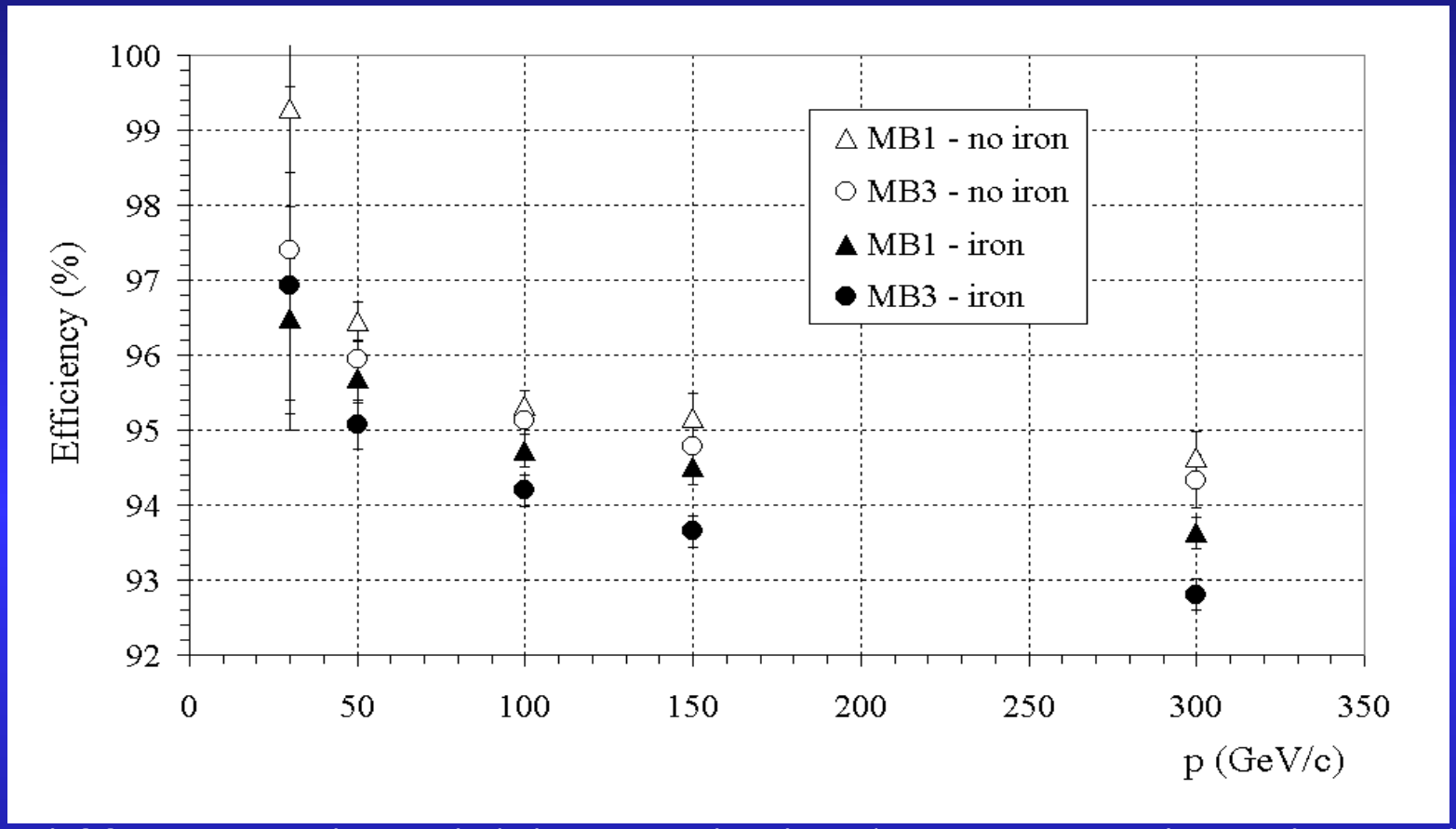
- Comparison MB1 - MB3
- Comparison w/ iron – w/out ferro
- Comparison data - emulator

Efficiency – MB3 data



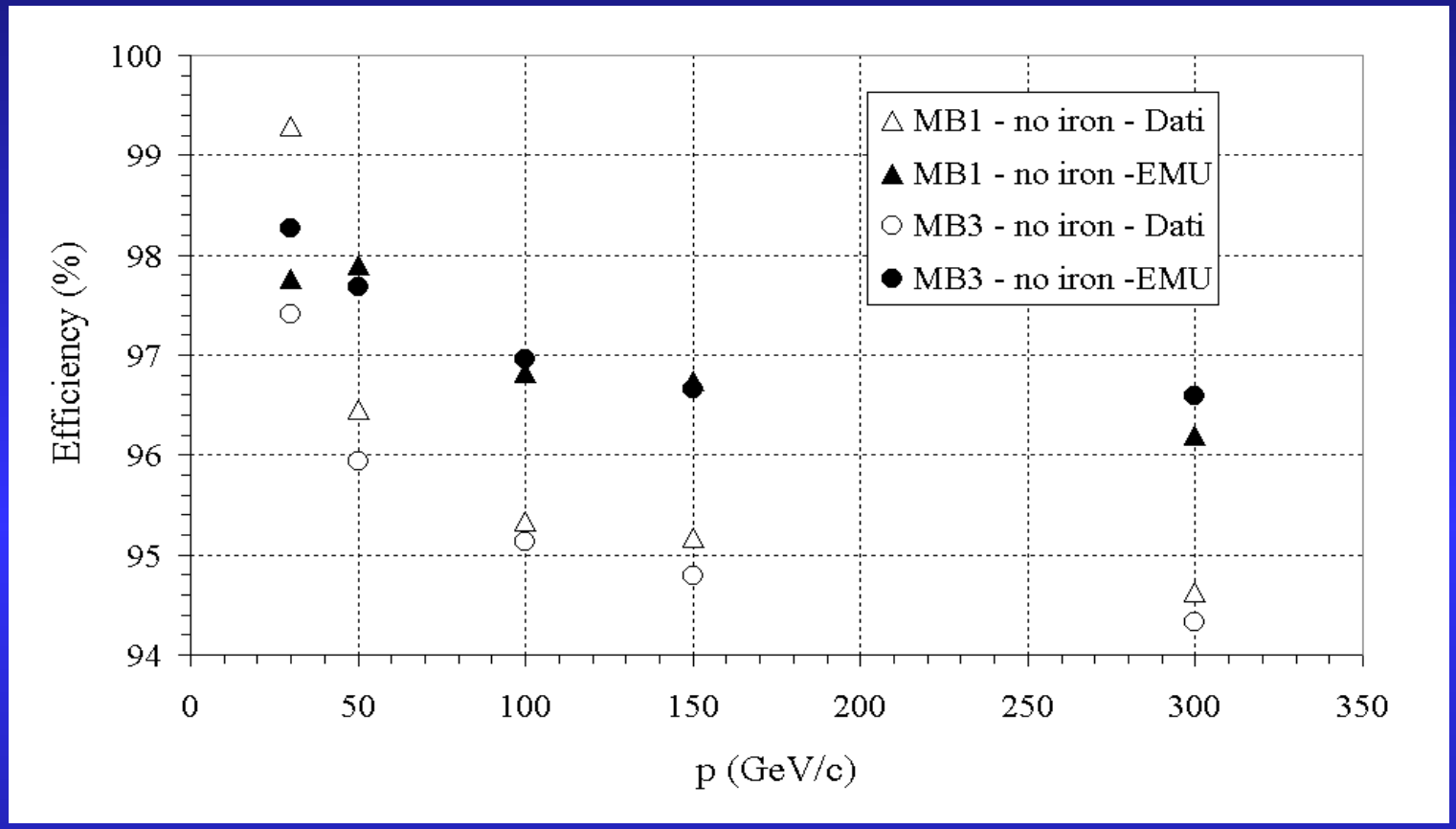
- Also w/out iron there is a dependence on beam energy.
- Efficiency falls by about 2.5% from 50 to 300 GeV.
- Iron introduces another 1-1.5% loss.

Efficiency – Comparison MB1-MB3 data



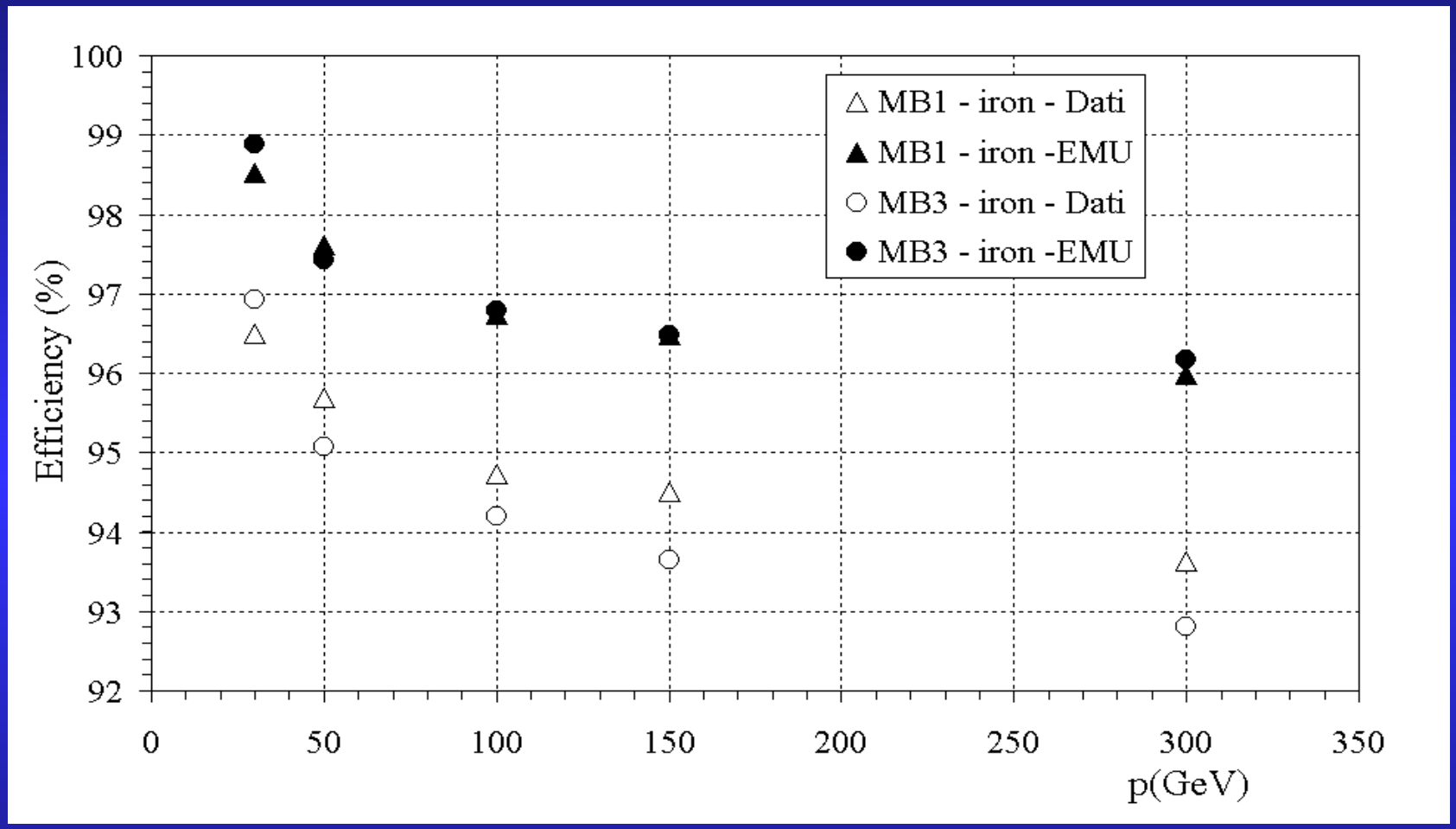
- Difference is within statistical errors w/out iron, but evident with iron.
- MB1 more efficient than MB3. Part of the shower generated in MB1 crosses the iron ?

Efficiency – Comparison data-emul. w/out iron



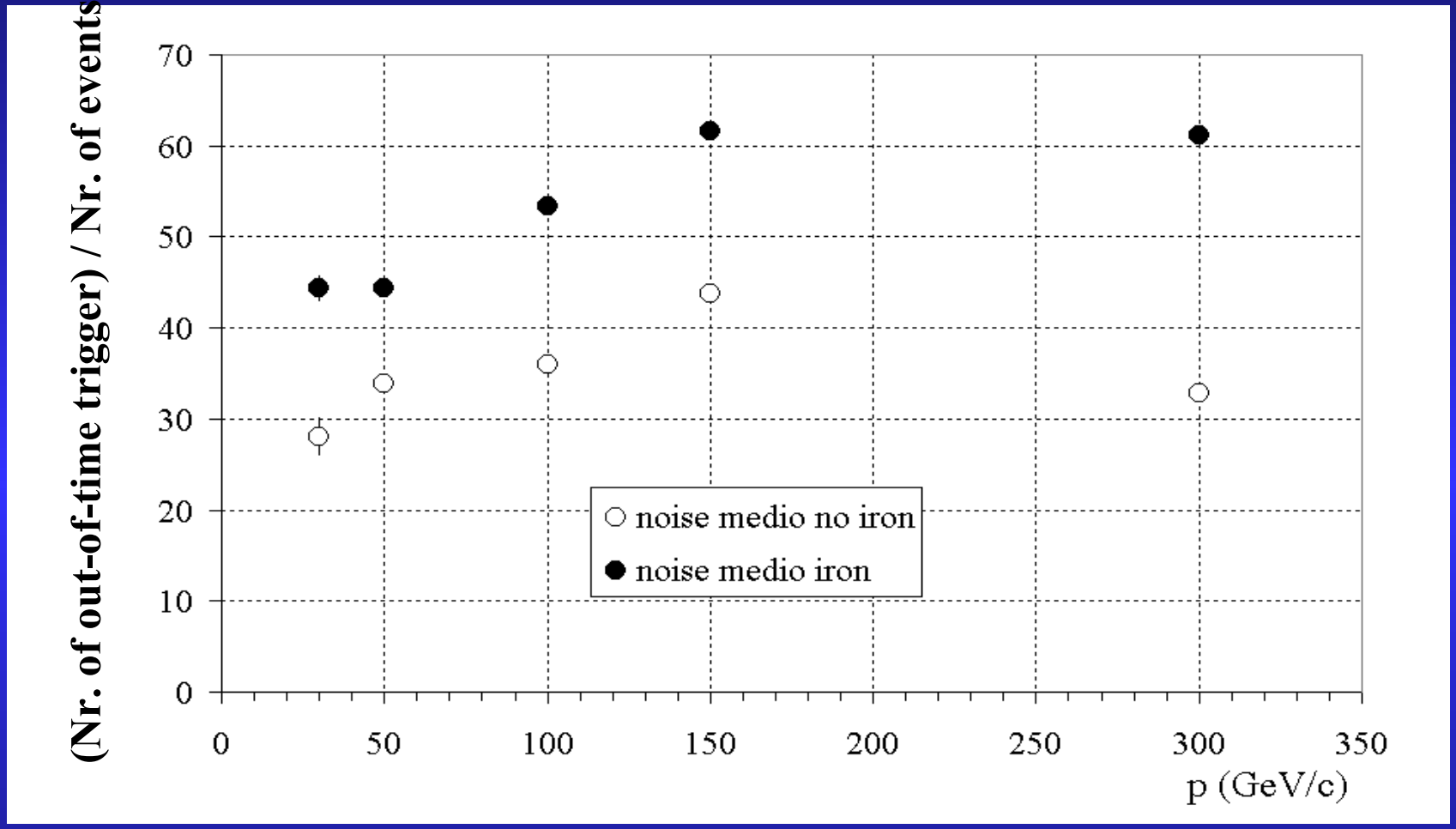
- Difference emulator-data shows the contribution of uncorrelated L triggers, which is approximately constant with energy.

Efficiency – Comparison data-emul. with iron



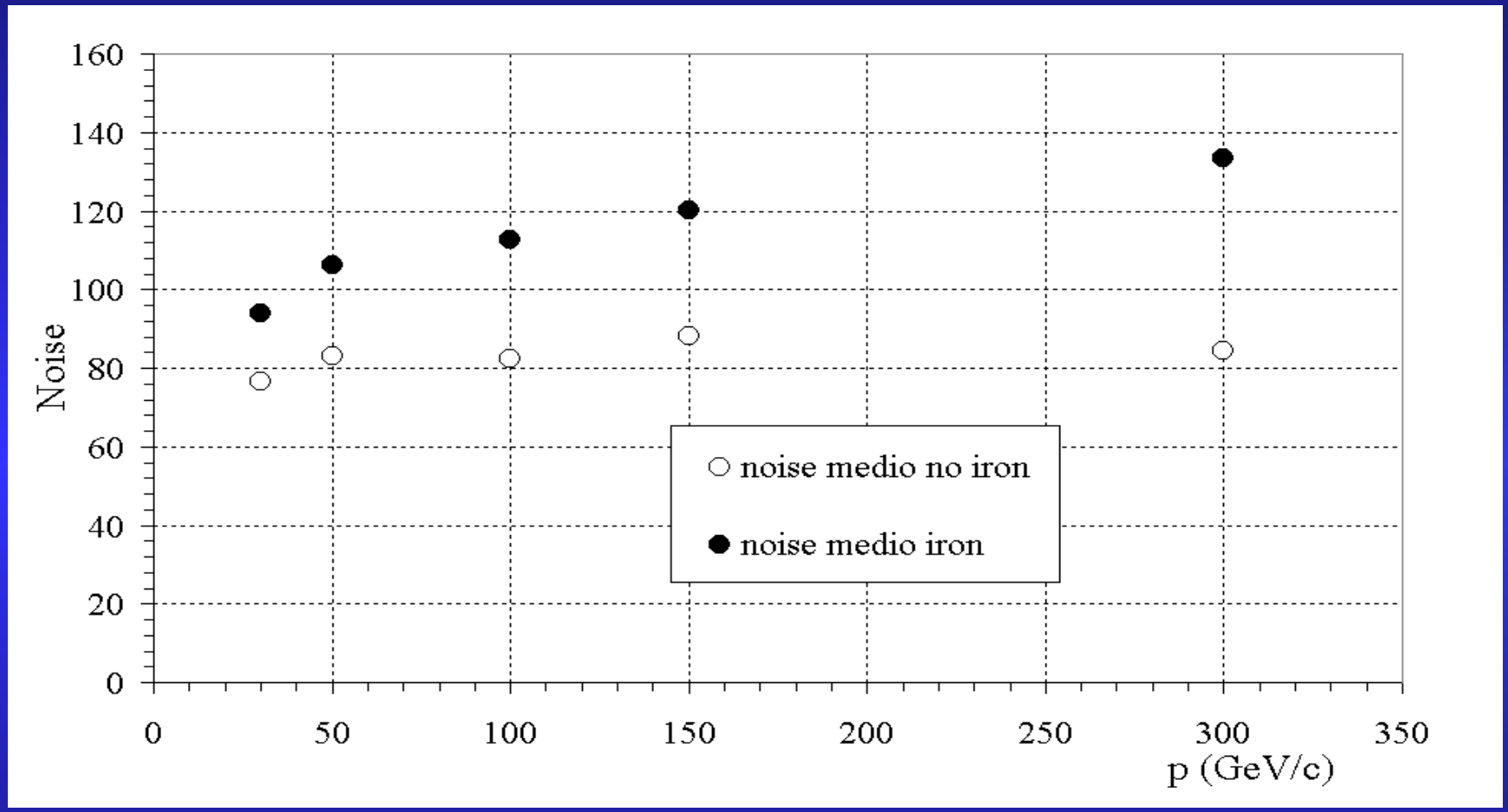
- Difference MB1-MB3 in data with iron is not reproduced by emul. Probably it is geometrical effect (beam does not impinge in the same vertical position)

Noise – MB3 data



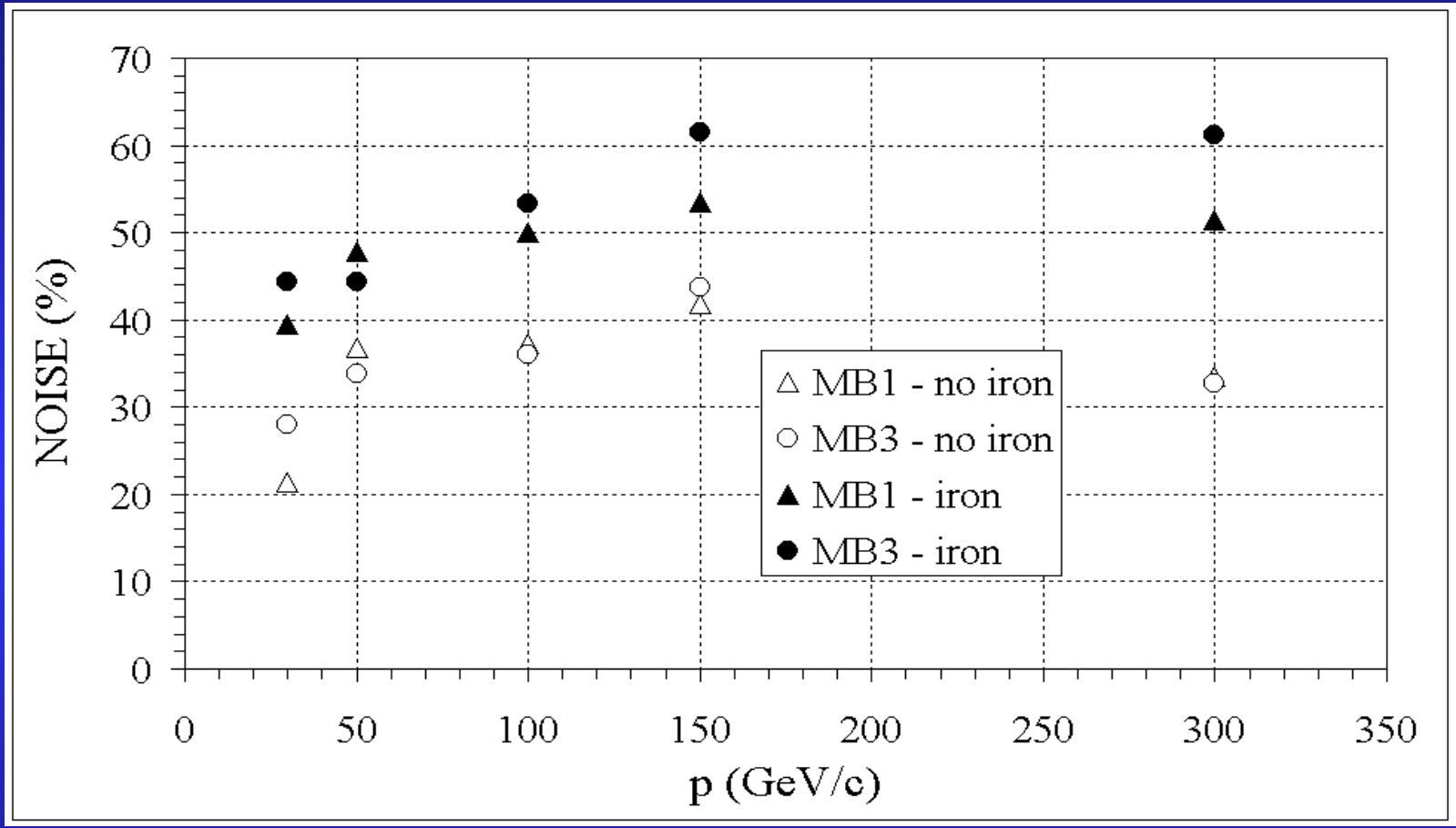
- **Noise = out-of-time triggers (triggers in wrong BX)**
- The loss at 300 GeV is apparent, due only to the wrong Theta BTI configuration.

Noise – MB3 emulator



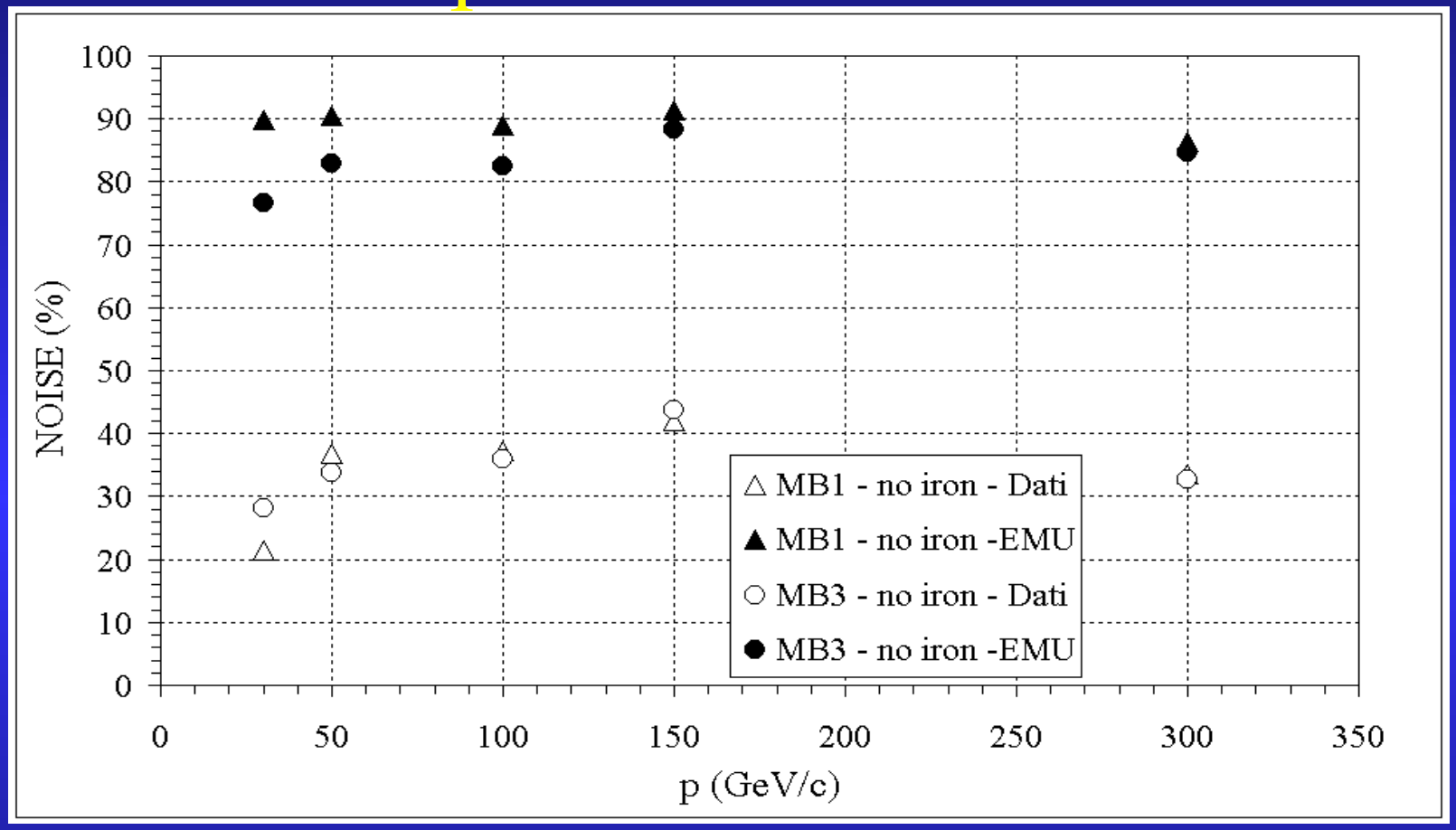
- W/OUT iron, out-of-time triggers constant with energy.
- WITH iron, noise increase with energy, consistently with em. showering

Noise – Comparison MB1-MB3 data



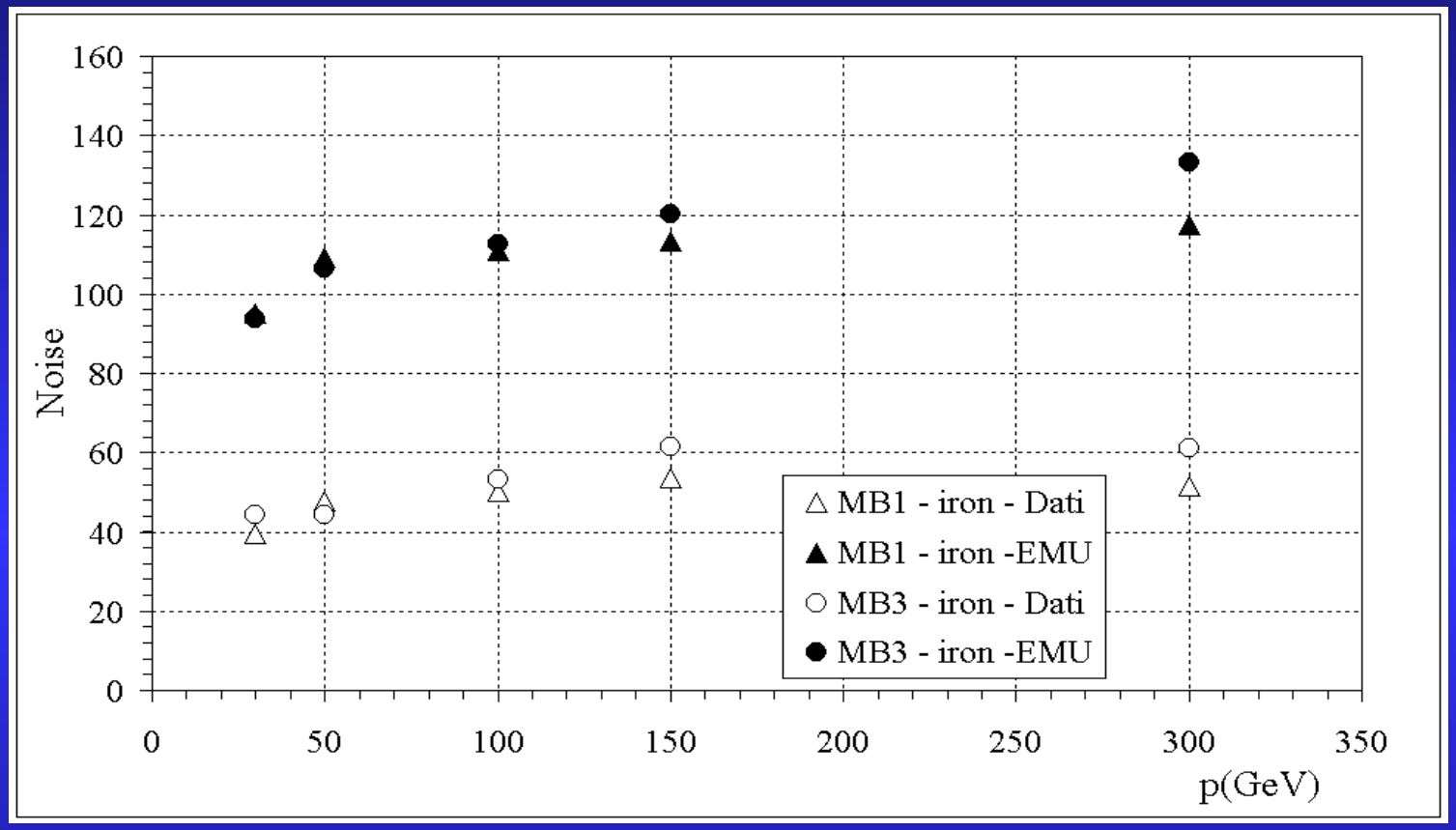
- W/out iron, MB1 and MB3 have some noise.
- With iron, MB3 noiser than MB1

Noise – Comparison data-emulator w/out iron



- Noise levels for MB1 and MB3 are similar, about constant with energy.
- In emulation, noise is about double because ALL uncorrelated L triggers are considered.

Noise – Comparison data-emul. with iron



- Again, in emulation, noise is about double because ALL uncorrelated L triggers are considered.
- A dependence on energy appears.
- MB3 is slightly noiser than MB1 because it is downstream.