Fake trigger background simulation

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Outline

- Motivation
- SW and configuration
- Accumulated information
- Analysis, pattern recognition attempt

Motivation

- Aim of trigger is to detect the signal from real event among extremely high background (~10^{11} counts/s/FS)
- Signal filtered on several levels reducing the trigger rate
- Organized in two main levels, basing on positions and time correlations of physical events compared to background

Outline of noise reduction capability.

Level		**Rate of signals/triggers at PDM level**	**Rate of signals/triggers at FS level**
PDM level trigger	Photon trigger	~9.2×10^{8} Hz	~1.4×10^{11} Hz
	Counting trigger	~7.1×10^{5} Hz	~1.1×10^{8} Hz
	Persistency track trigger (PTT)	~7 Hz	~10^{3} Hz
PDM cluster level trigger (FS=144 PDM's)	Linear track trigger (LTT)	~6.7×10^{-4} Hz	~0.1 Hz
Expected rate of cosmic ray events		~6.7×10^{-6} Hz	~10^{-3} Hz

Motivation

- Very high statistics of simulated background needed
→ 10^5 events →10^{14} GTU's
- Impossible to simulate by ESAF:
→ 10^3 slower then used code
→ cannot be computed parallely (mem. share)
- Fast and standalone code written in C++ developed by Francseco Fenu

The code

- Trigger algorithm implemented (as in ESAF)
- One PDM simulated
- Persistency Track Trigger algorithm → 1st level → 1Hz/PDM
- Linear Track Trigger algorithm → 2nd level → 1 mHZ/PDM
- Background source → Poisson distribution of average 500 photons (m^{-2} s^{-1} sr^{-1}) = 2.1 photons/pixel/GTU
- Code fast but since to produce huge statistics has to be run in parallel (on Kosice cluster)

JEM-EUSO Kosice cluster

- Actually used and available for also for collaboration
  7*32 cores @ 2.3 Ghz; 25 TB
  upgrade in progress right now
- Fedora Core 14 1.2.5-2.fc14
  kernel 2.6.35.13-91.fc14.x86_64
  gcc 4.5.1-4
- NFS shared disk space (temporarily),
  RAID configuration in progress right now
- ROOT v32.00,
  ESAF trunk (less than 1 month),
  GEANT4 9.4

M36 Configuration

M36

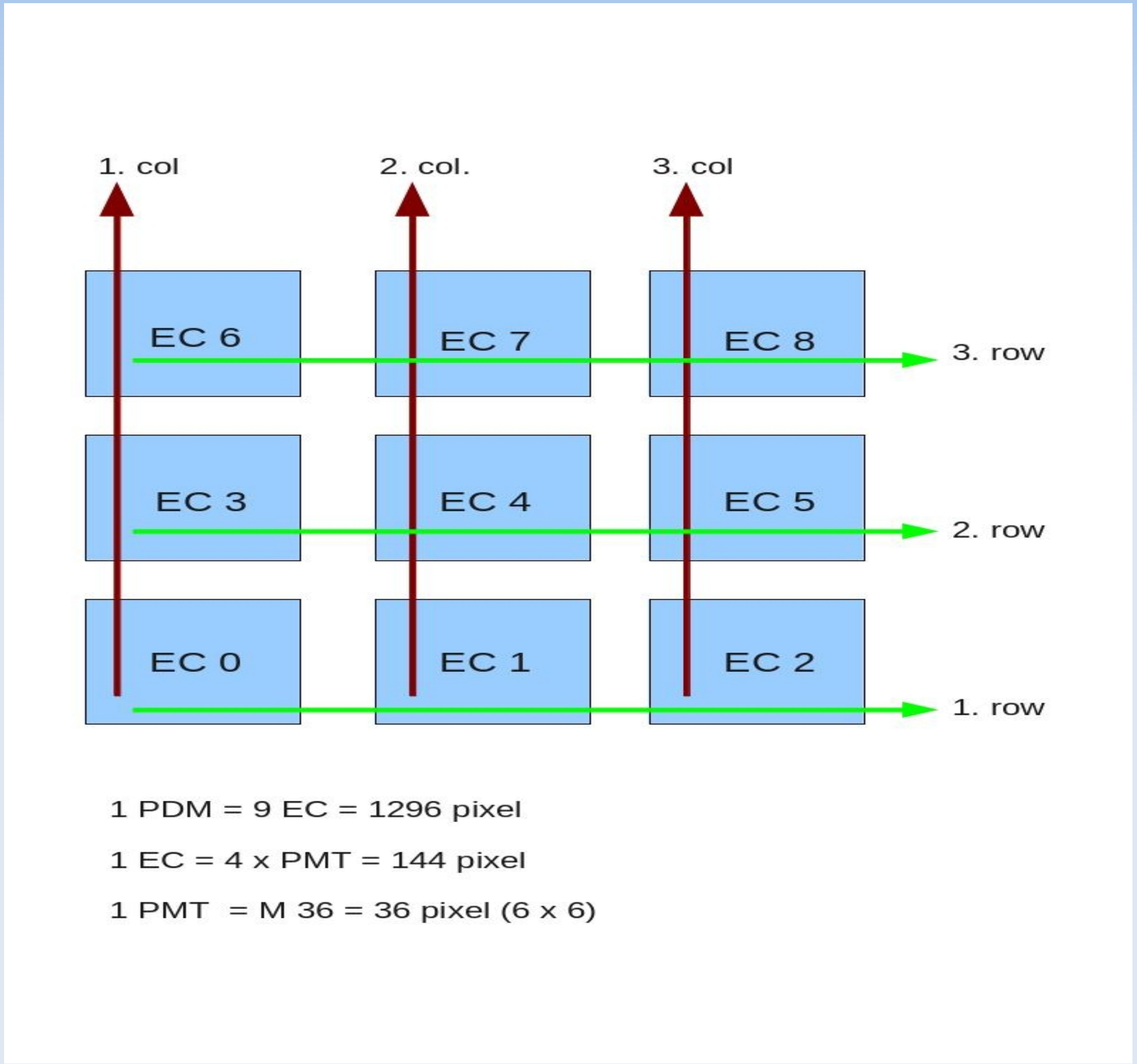
BG = 2.1 ph/pix/GTU

PTT_integr = 43

LTT integration = 145

Consecutive GTU = 5

Yellow pixel th = 4



Stored information

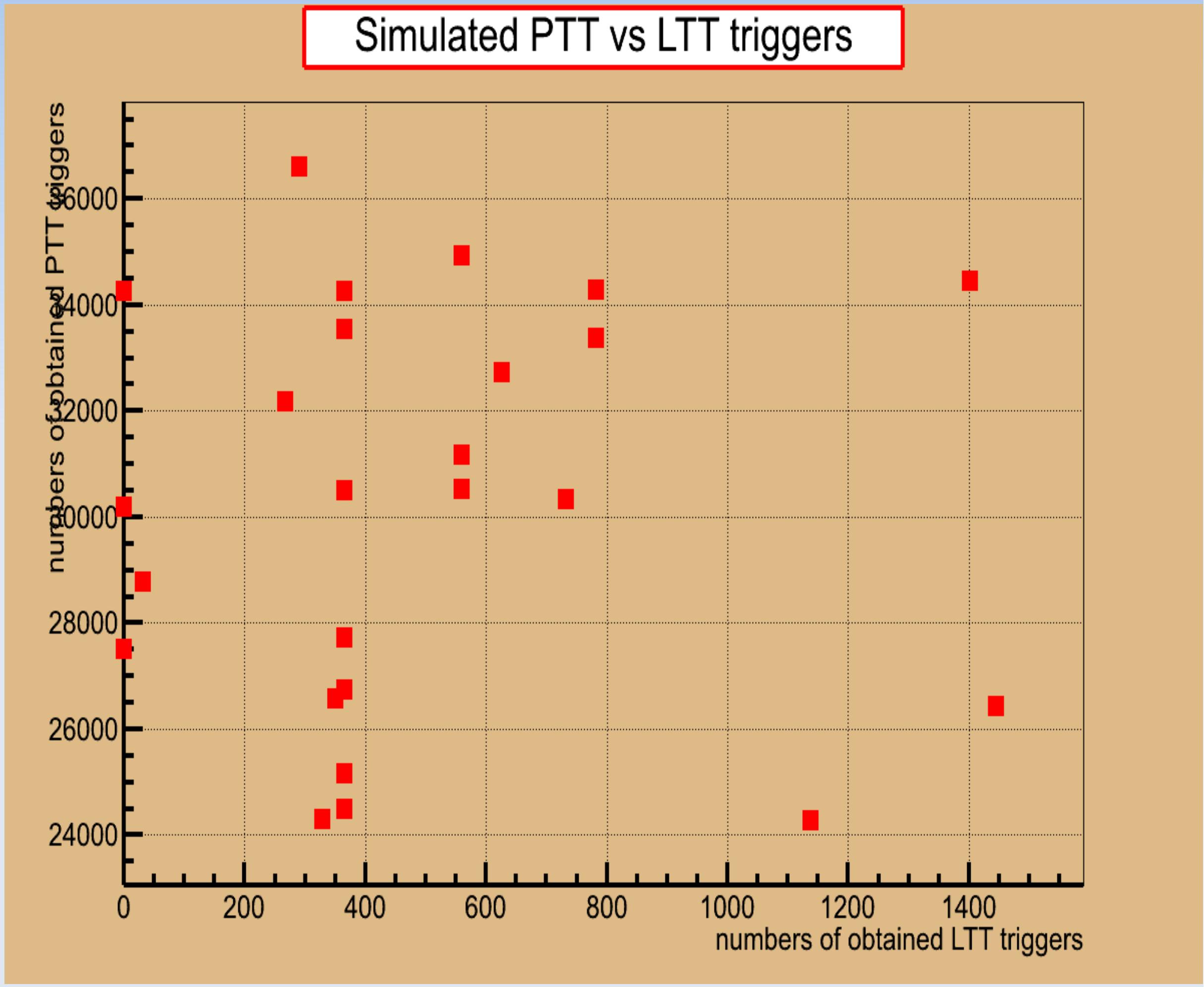
- Two files written when thresholds reached:
- PTT_SECOND_OUT → (x,y,pers, ecid,counts)

  12x12x5 =720 lines/pdm
- LTT_SECOND_OUT → (x,y,time,counts)

  36x36x31 = 40196 lines/pdm
- Information for which PPT, LTT dumped (reached threshold)
- Analysis of only pixels contributed to LTT

Present statistics - M36

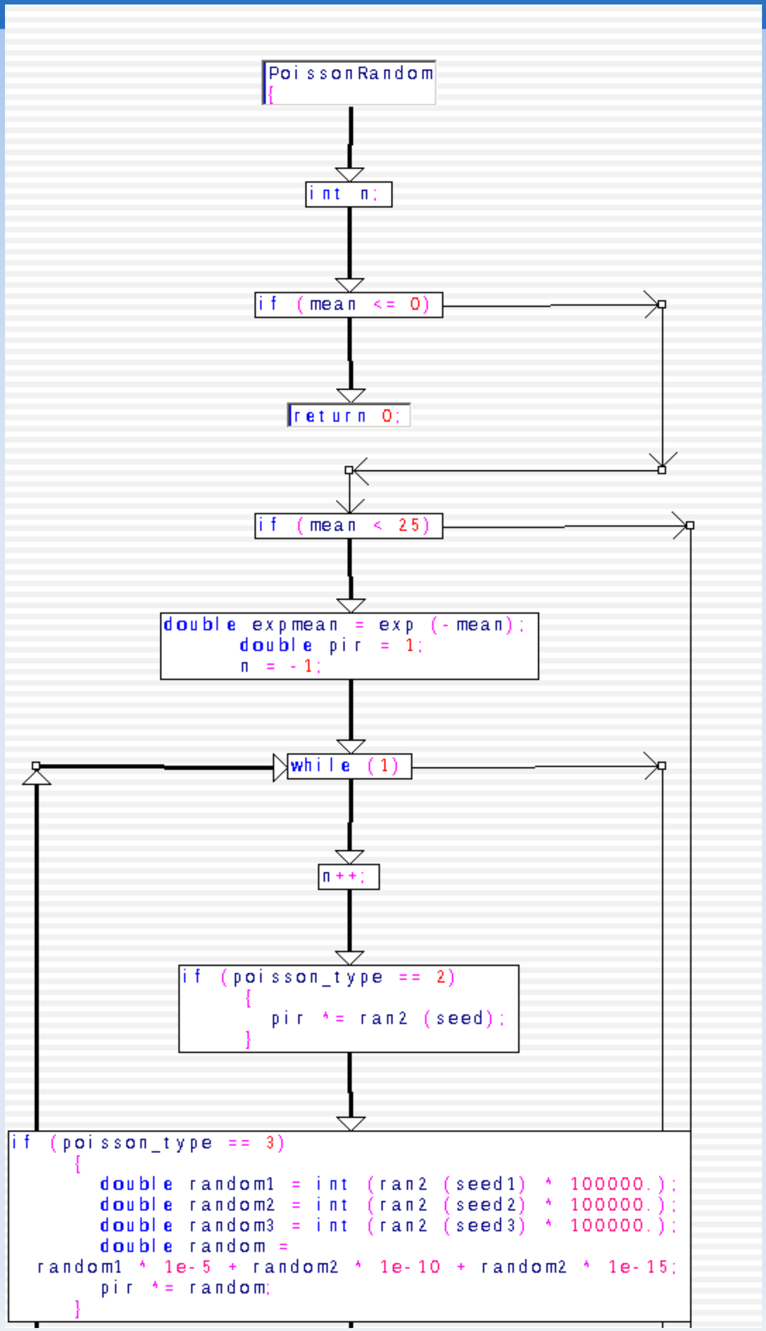
- 10^{12} GTU's
  6 weeks simulation
- 12000 LTT triggers
  → 1mHz/PDM
- 750000 PTT triggers
  → 0.1 Hz/PDM



Random number generation

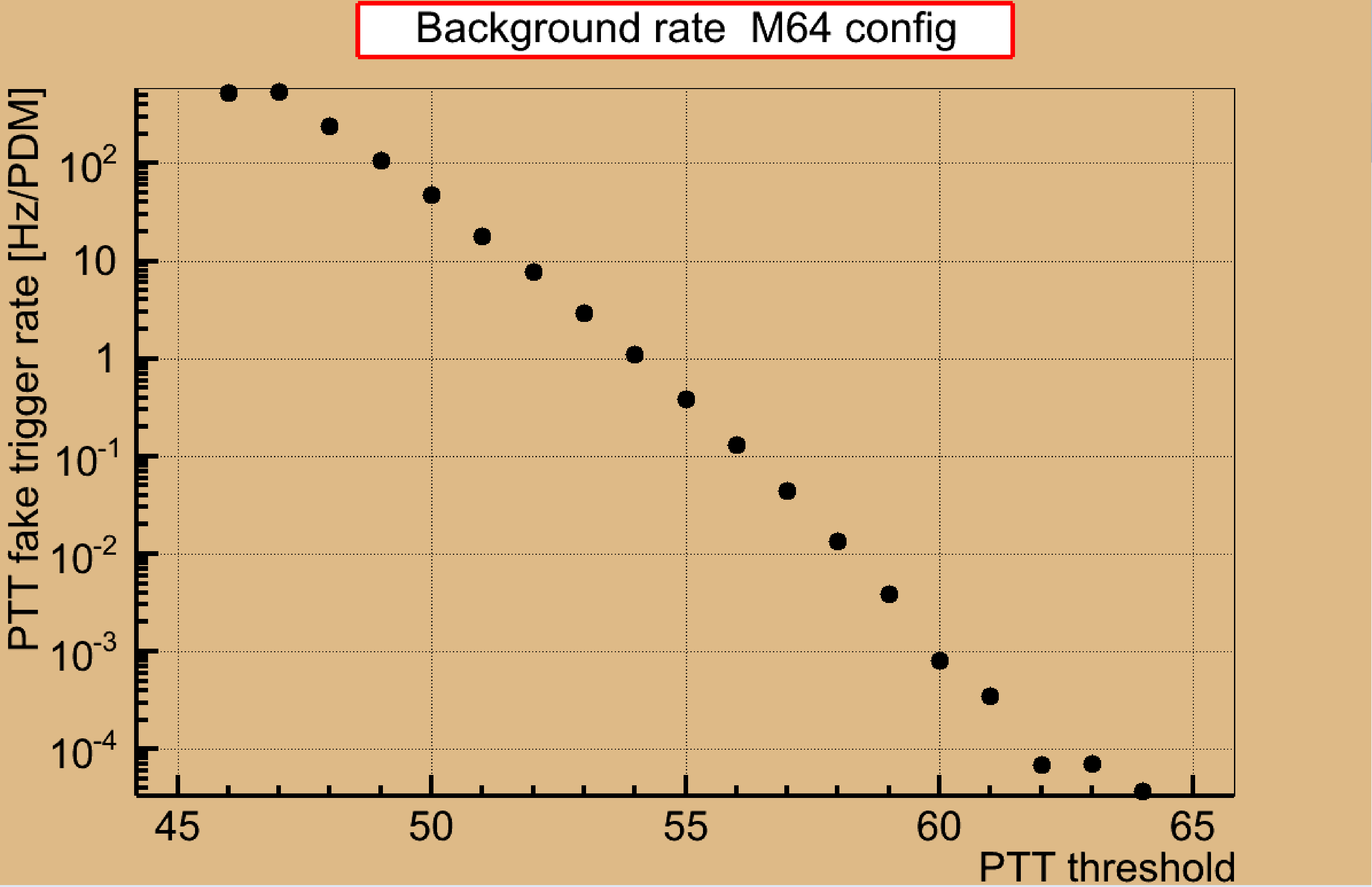
- Due to very high generated statistics possible problems with random number generation
- Previously 4 different types of rnd generation acording to predefined Poisson distributions investigated from ROOT investigated
- Folowing schema used for improving
- Check the random seeds -> succesfully follow Poisson

Random number generation

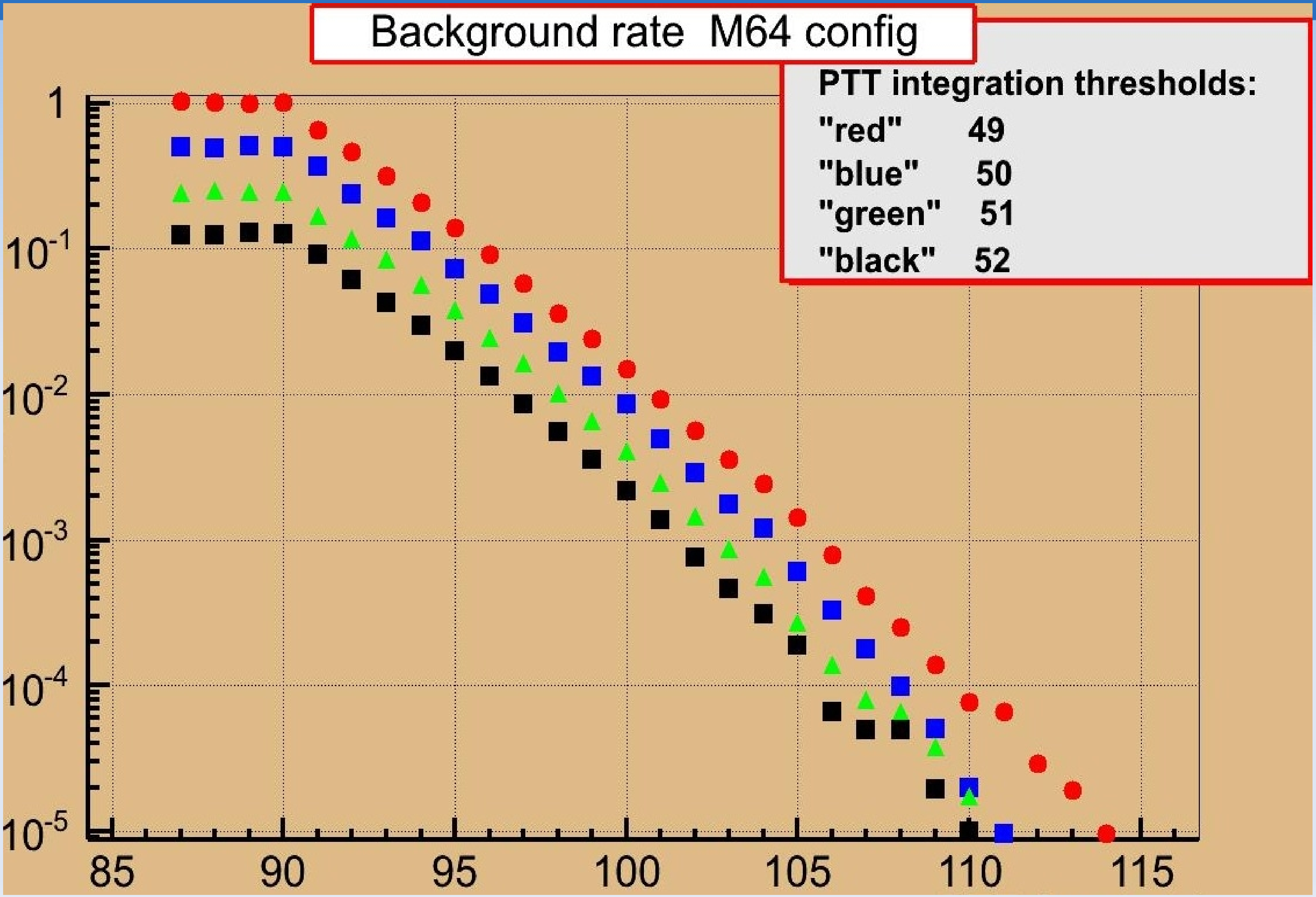


M64 config for simulations

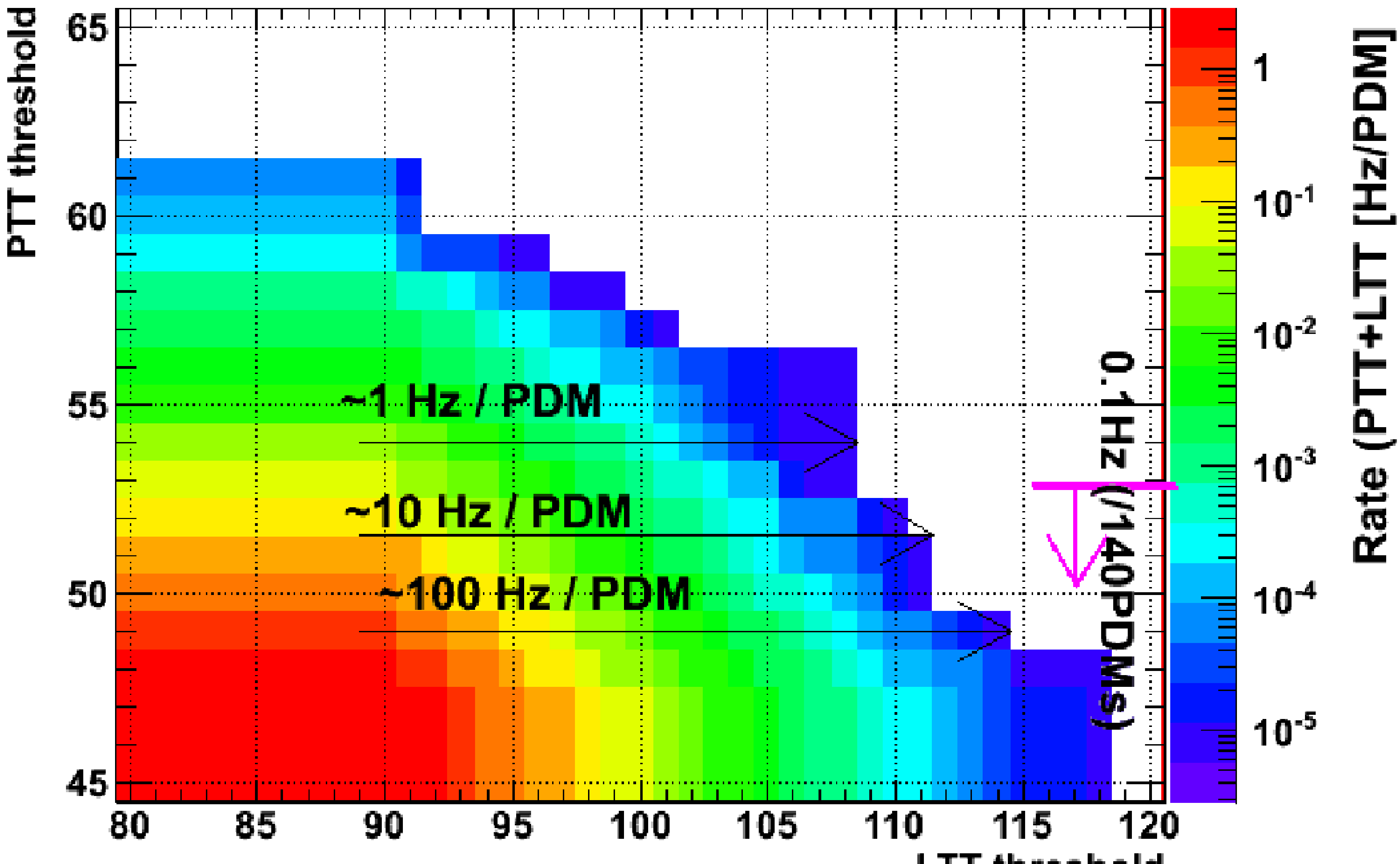
- Modification of BG
  → scaled according $(36/64)^2$
- PTT and LTT integration thresholds modification following obtained background rates for M64


Background rate M64 config
PTT fake trigger rate [Hz/PDM]
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
45
50
55
60
65
PTT threshold

LTT threshold for M64



M64 config



PTT threshold
65
60
55
50
45
80
85
90
95
100
105
110
115
120
~1 Hz / PDM
~10 Hz / PDM
~100 Hz / PDM
0.1Hz (/140PDMs)
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
Rate (PTT+LTT [Hz/PDM]

Pattern recognition

- We have started to study pattern recognition on obtained result
- 1) Adaption of RobustModule.cc code prepared by Svetlana for ESAF
- 2) Finding fake patterens inonly randomly produced noise in 8x8 matrices – new student started this work

Summary, todo

- Checked trigger rates obtained from the code compatible with expectation
- No patterns at present level o statistics
- Improved random number generation OK
- The code modified for M64 configuration and prepared to start massive simulation
- Pattern recognition of the obtained data under study