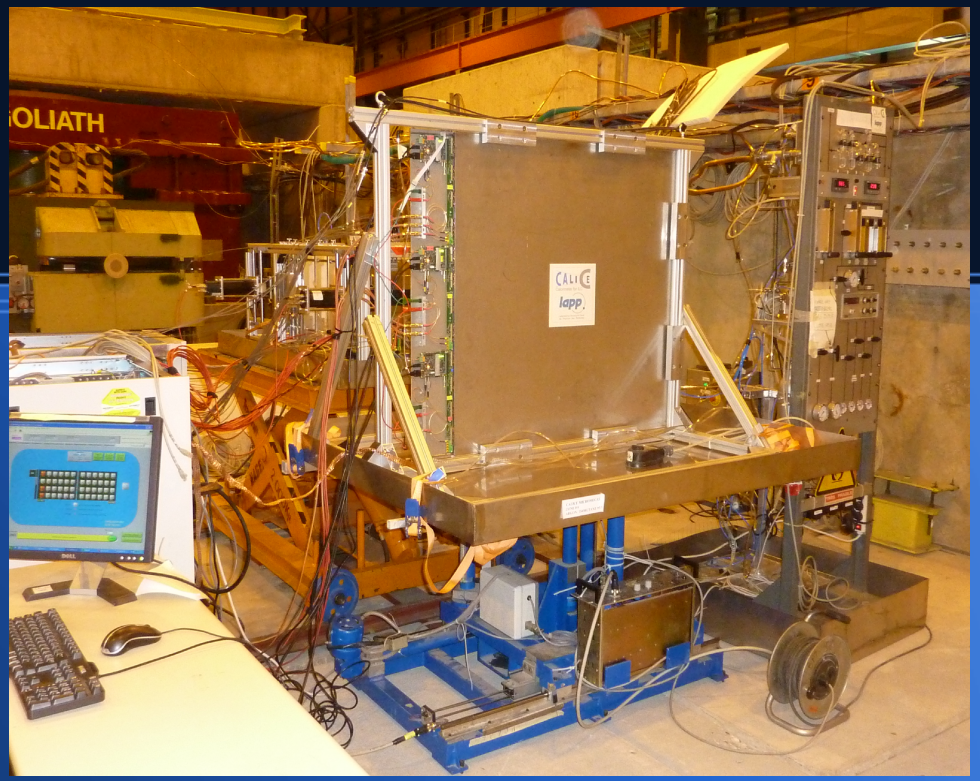
M2 chamber TB data analysis

- Setup
- Thresholds
- Time-stamping
- Noise rate
- Event selection
- Efficiency and multiplicity

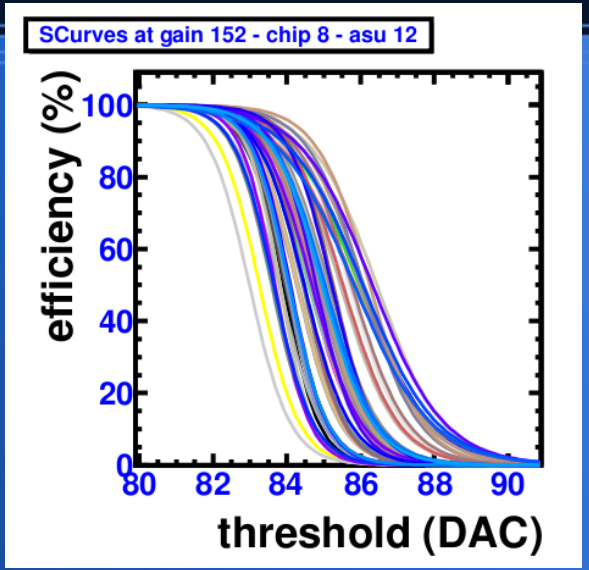
Setup

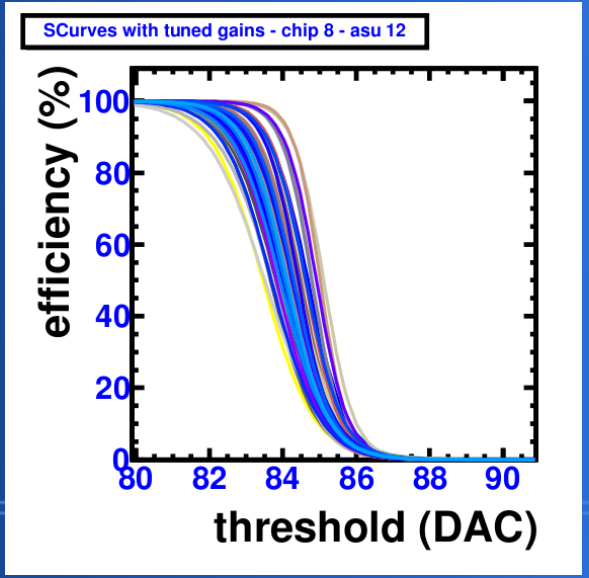


- Beam
  - SPS/H4, 150 GeV/c muons
  - not more than 1 kHz used (also pion run)
- Detectors
  - telescope with 4 Gassiplex chambers
  - 1 m2 chamber downstream of telescope
  - 3 scintillators
- DAQ
  - CAEN ADC/sequencer VME module and LabView Centaure
  - DIF (synchronized with CCC) and Labview (C. Drancourt)
  - Trigger obeys BUSY and READY signal logic
    → common event numbering for off-line reco.
- Rates
  - Beam and trigger < 1 kHz

Thresholds

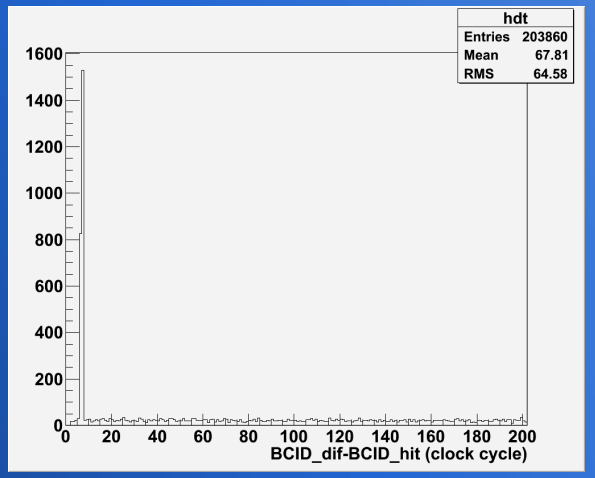
- Electronic threshold
  - Common to the 64 channels of a chip
  - Individual thresholds depend on relative position of global threshold to S-curve inflexion point
- SCurves parameters depends on preamp. gain
  - SLAB 1&2 equipped with HR2
    - Can not change gain (SC errors)
    - High thresholds (> 10 fC)
  - SLAB 3 (ASU 12) equipped with HR2b
    - Squeeze Scurve together to reduce thresholds
    - Low thresholds (3 fC)
- Procedure of Scurve end-point equalization performed 4 times during TB
- Thanks to accurate time-stamping (next slide), noise can be tolerated to a certain extend

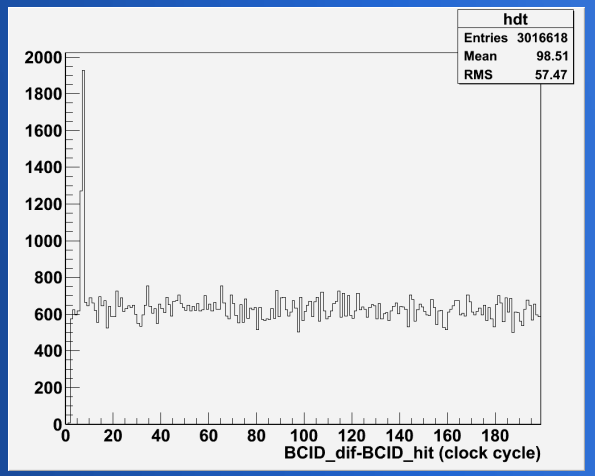




Time-stamping

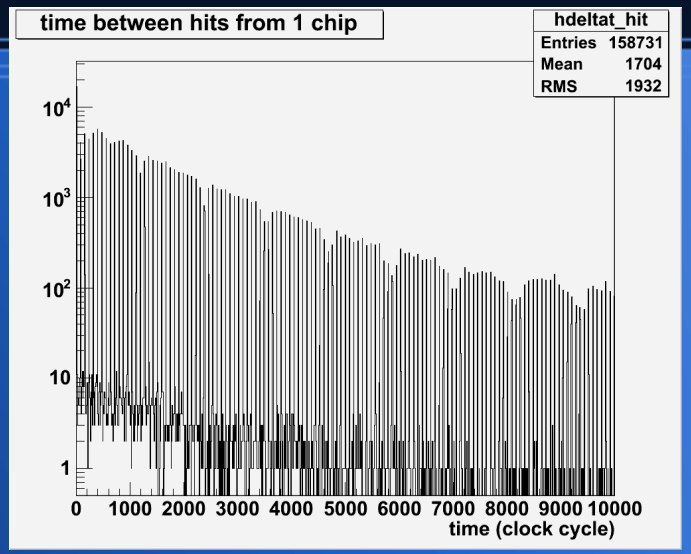
- Time-stamping with 200 ns precision (~ILC BX fq.)
- Upon a pulse over threshold (hit)
  - Chip content & BCID_hit written to memory
  - 127 event depth, memory resets at 128
- After a readout of the chip memory content (trigger)
  - Time of readout, BCID_abs (48 bits)
  - Time of readout, BCID_dif (24 bits)
  - Time of hits, BCID_hit (24 bits)
- If readout upon trigger, pulse not above threshold yet
  - Delay of 1 us between PM signals and readout
- So hits from triggering particles have:
  - BCID_dif - BCID_hit ~ 5 clock cycles (1 us)

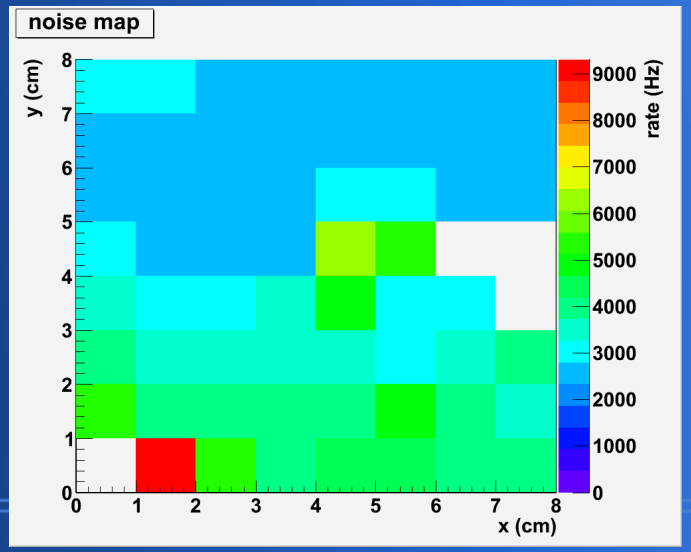




Noise rate

- Noise rate depends on thresholds and varies from channel to channel
- Measured, for each readout and chip, as the time between write in memory
  - Structure with 16 us period (62.5 kHz)
- In typical working conditions
  - S/N ratio > 100
  - Noise rate ~ 1 kHz
  - Noise hit probability/chip < 1 % after time cut on BCID



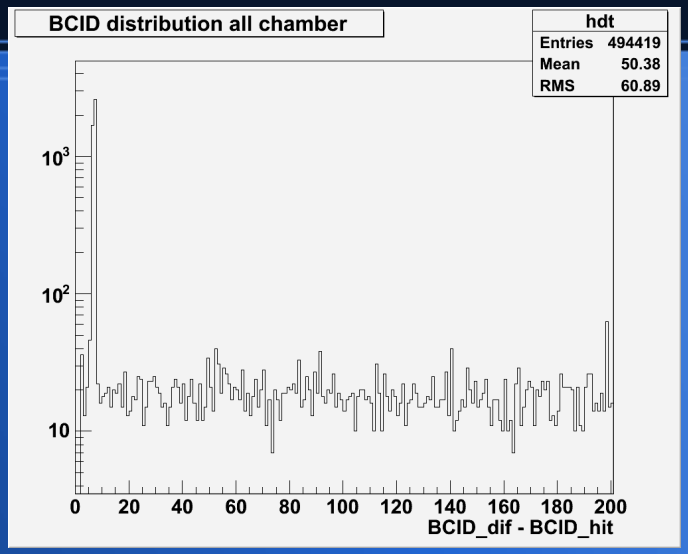


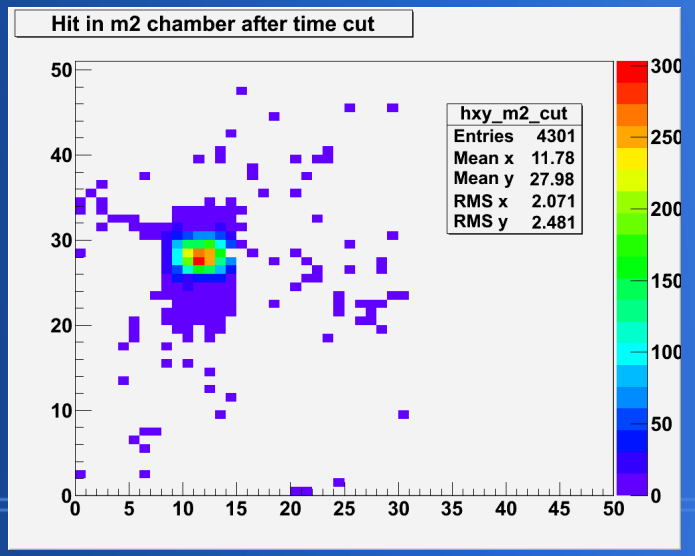
Event selection

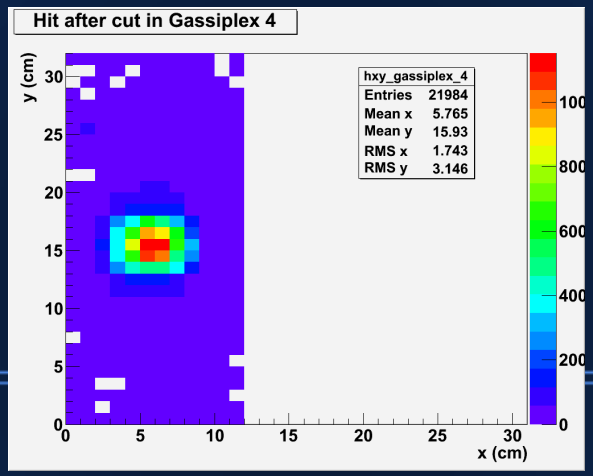
- Efficiency and multiplicity measurement
  - Look for hit around expected pad
- Use telescope to determine expected position
  - Not very precise (same pad size)
  - Tracks should be as straight as possible
- Event selection
  - Single aligned hits in at least 3 Gassiplex chambers
- Expected pad (x1,y1) for a track @ (x0,y0) in telescope:
  - Maximum of beam profile for straight tracks passing through (x0,y0)
- Search hits in 3x3, 5x5, 7x7 region around (x1,y1)

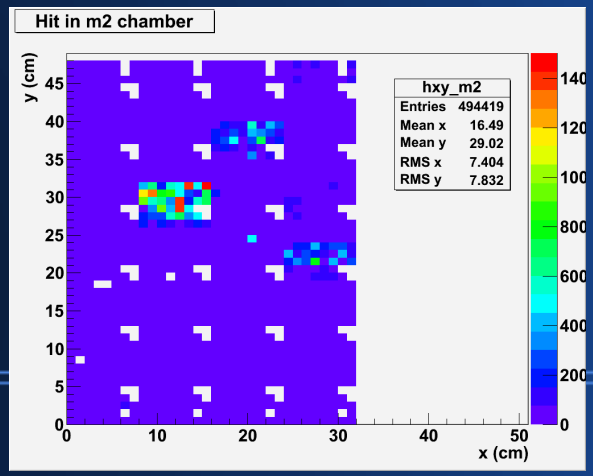
Run studied sofar

- 420 V, gas gain of 15000, highest used in TB
  - Muon beam at 200 Hz
  - Directed at the center of a chip of ASU 12
- 4261 hits in time, noise contamination of 40 hits
  - S/N = 106 for all chip
  - Average noise hit probability of 1 % for full chip of 0.02 % for a single channel
- 20000 events → reduced by half when selecting straight tracks in telescope



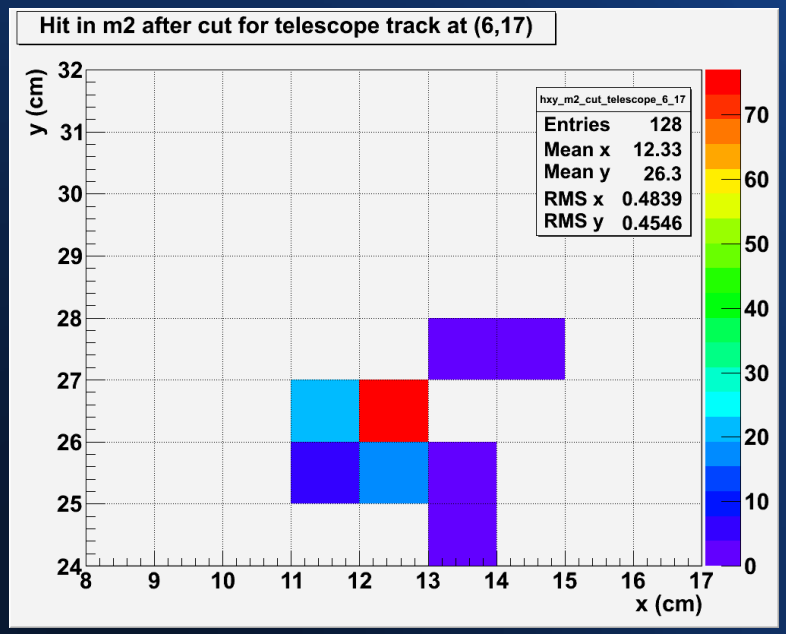


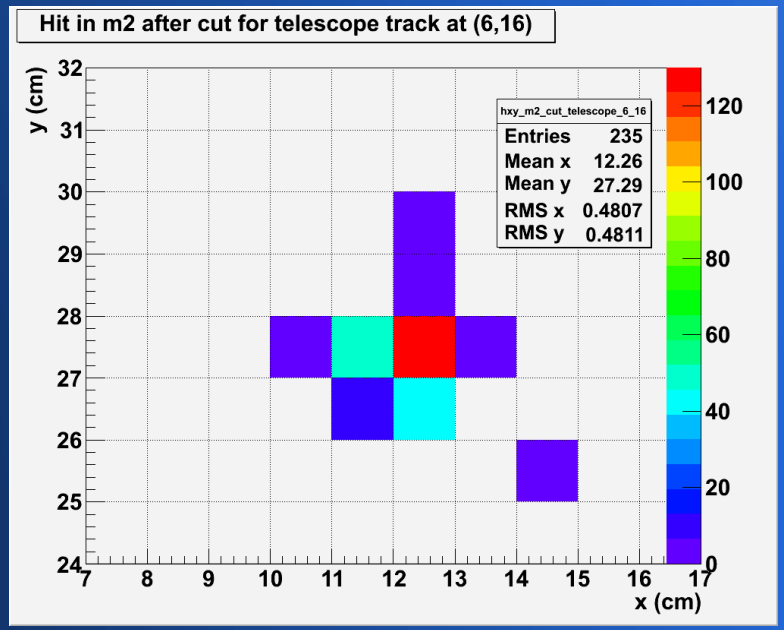




Regions of search

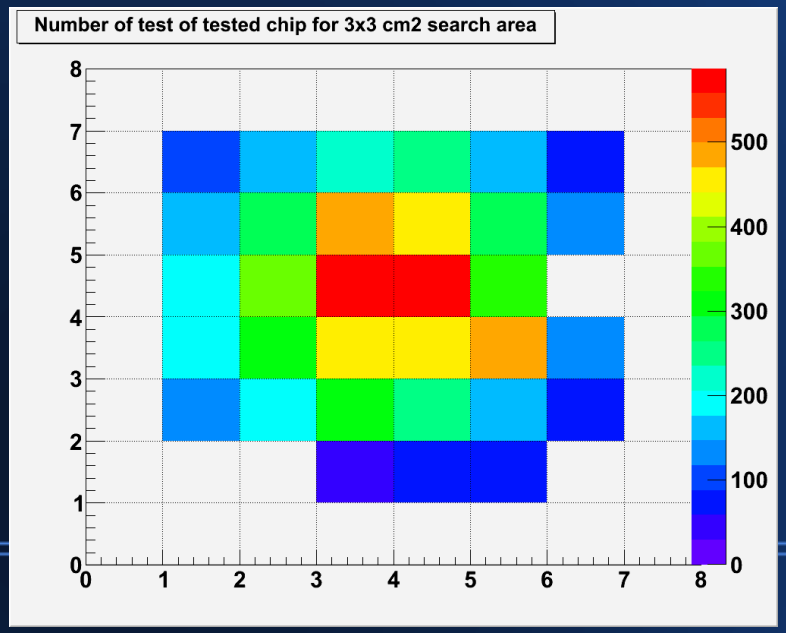
- The hit profile in m2 chamber of straight track traversing the telescope in a given pad is contained in a 3x3 pad region
  → Performance map of m2 possible

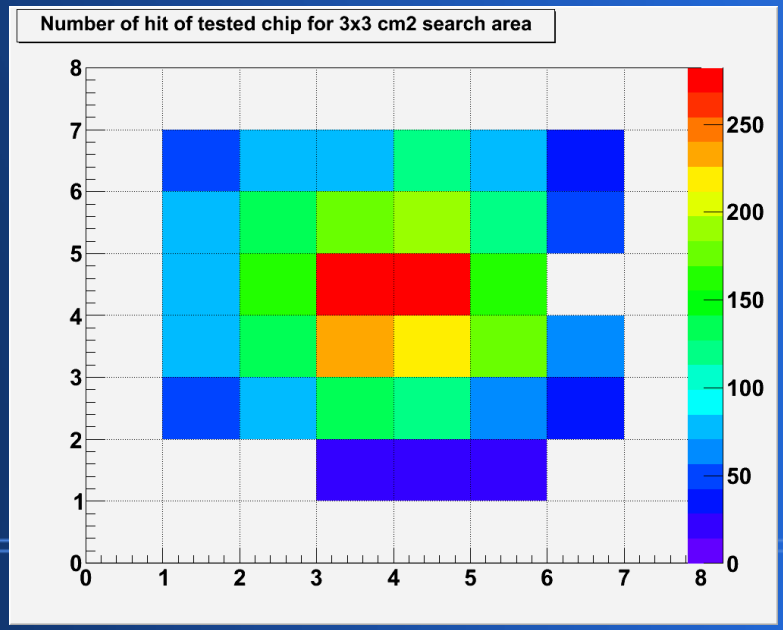




Preliminary results

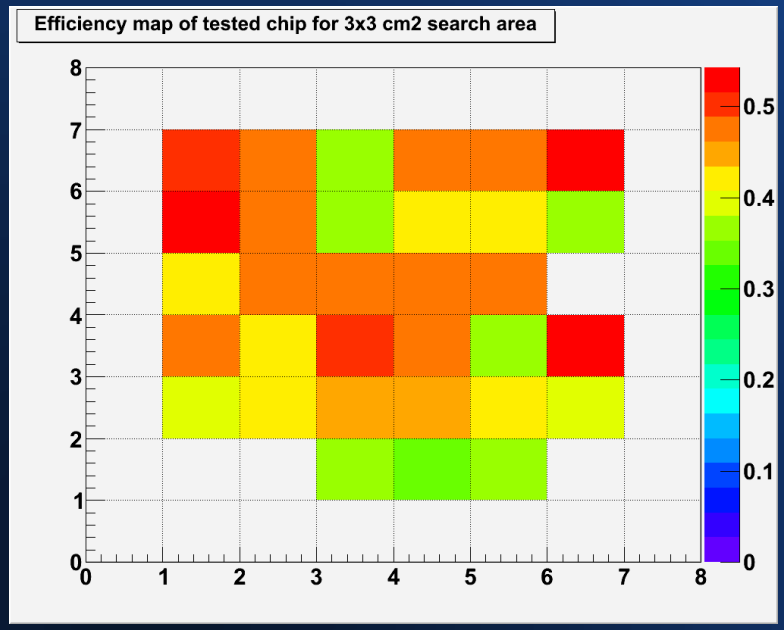
- For each region of search
  - Record the number of time it is tested, Ntest
  - Record the number of time it has at least 1 hit inside, Nhot
  - Record the number of hits inside, Nhit
- Efficiency = Nhot/Ntest
- Multiplicity = Average of Nhit distribution

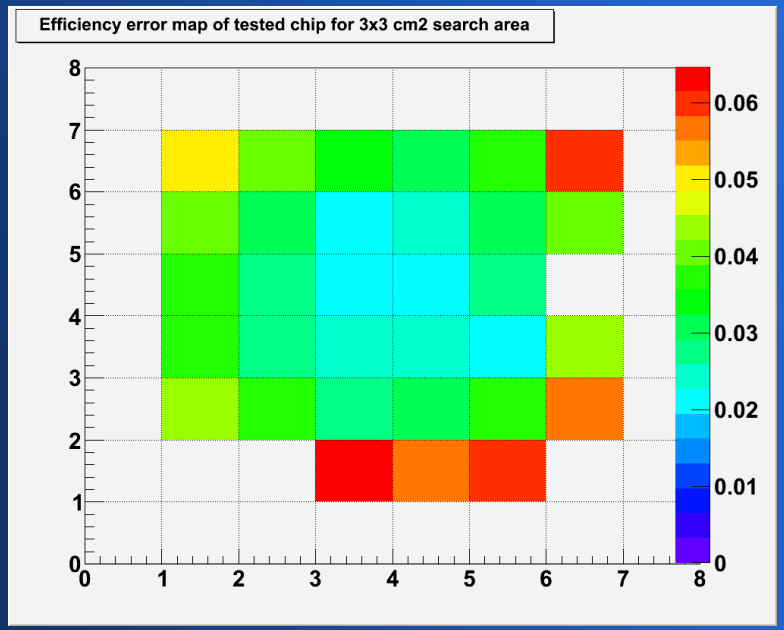




Performance

- Average efficiency over chip of 44.2 %
- Multiplicity of 1.06





```
Search area = 3 x 3 cm2

  number of track looked for in m2              = 8114
  number of track (at least 1 hit) found in m2 = 3589
     efficiency (ratio of found over searched) = 44.2322 %
     multiplicity (average found hits)          = 1.05545


Search area = 5 x 5 cm2

  number of track looked for in m2              = 8114
  number of track (at least 1 hit) found in m2 = 3599
     efficiency (ratio of found over searched) = 44.3554 %
     multiplicity (average found hits)          = 1.06252


Search area = 7 x 7 cm2

  number of track looked for in m2              = 8114
  number of track (at least 1 hit) found in m2 = 3601
     efficiency (ratio of found over searched) = 44.3801 %
     multiplicity (average found hits)          = 1.06582


Search area = 9 x 9 cm2

  number of track looked for in m2              = 8114
  number of track (at least 1 hit) found in m2 = 3605
     efficiency (ratio of found over searched) = 44.4294 %
     multiplicity (average found hits)          = 1.06796
```

Next steps

- Use all statistics
- Uniformity studies, run on different chips
- High voltage studies (sparks, performances)
- Pion/muon runs comparison
- Channel to channel threshold determination
- Pressure and temperature effects

...