Spike ID with chi2

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definitions
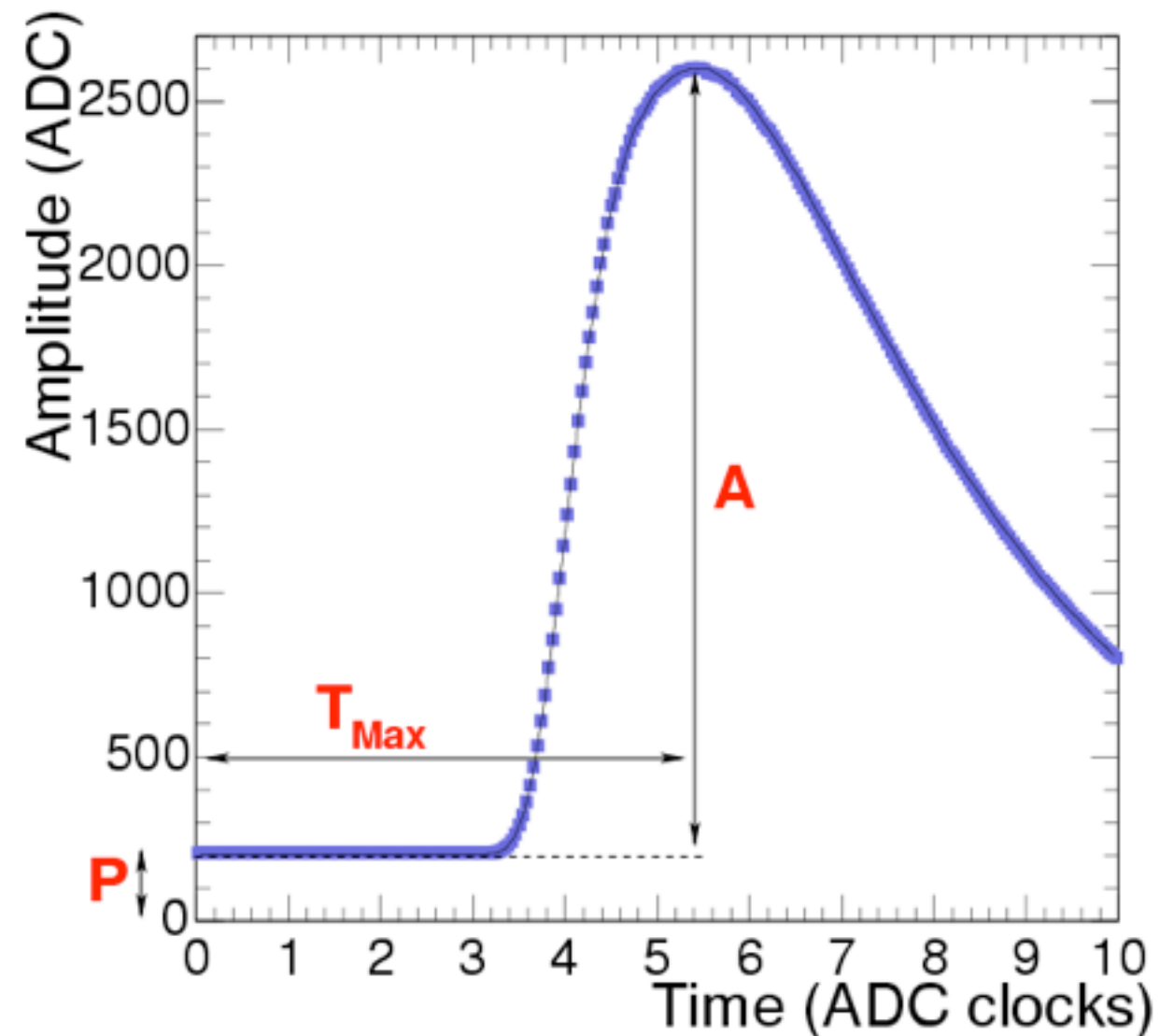
$\chi 2 = \Sigma (R_i/\delta R_i)^2$
where $R_i = (S_i - Af_i - P)$

here the default TB shape
was used to estimate chi2
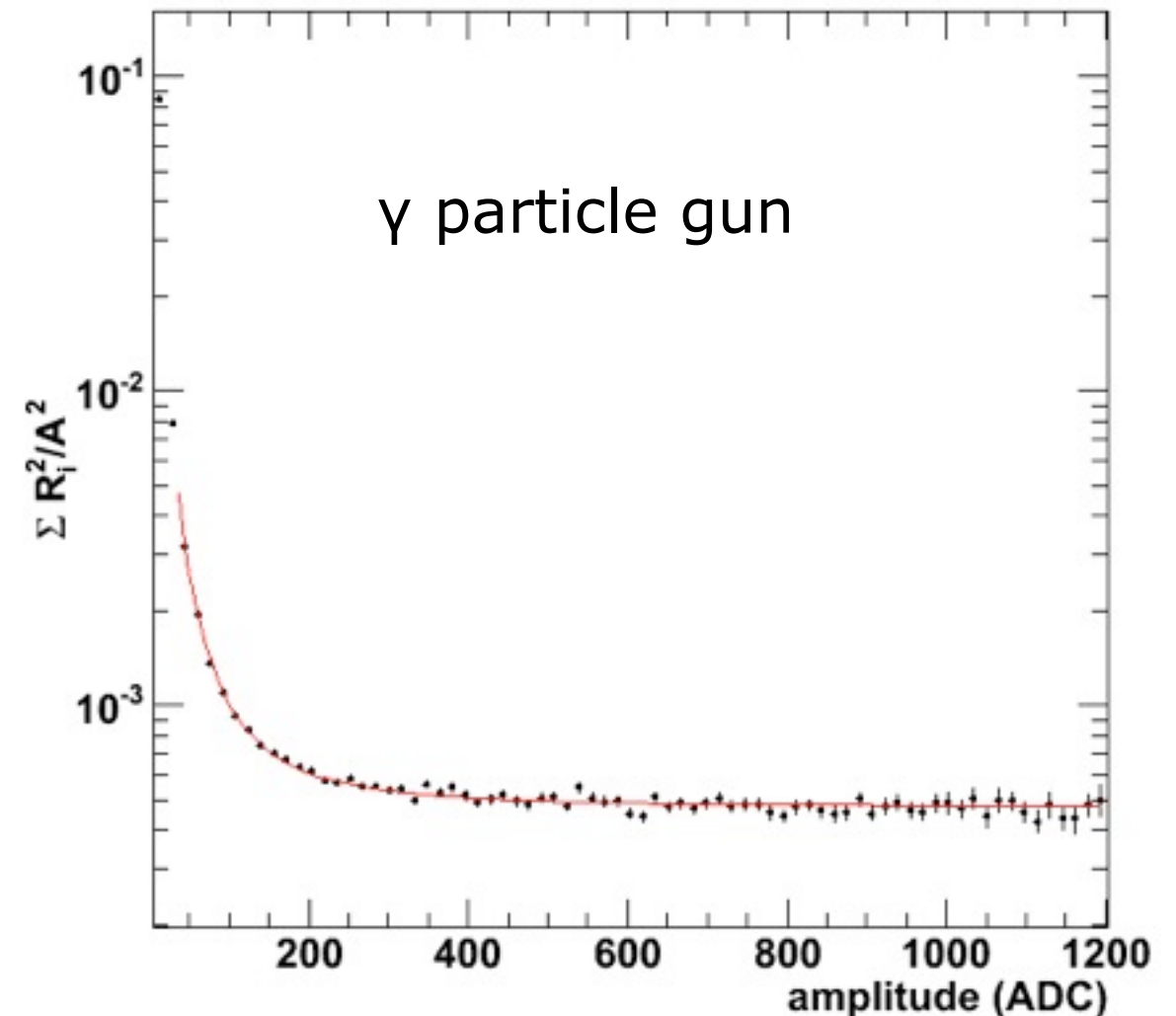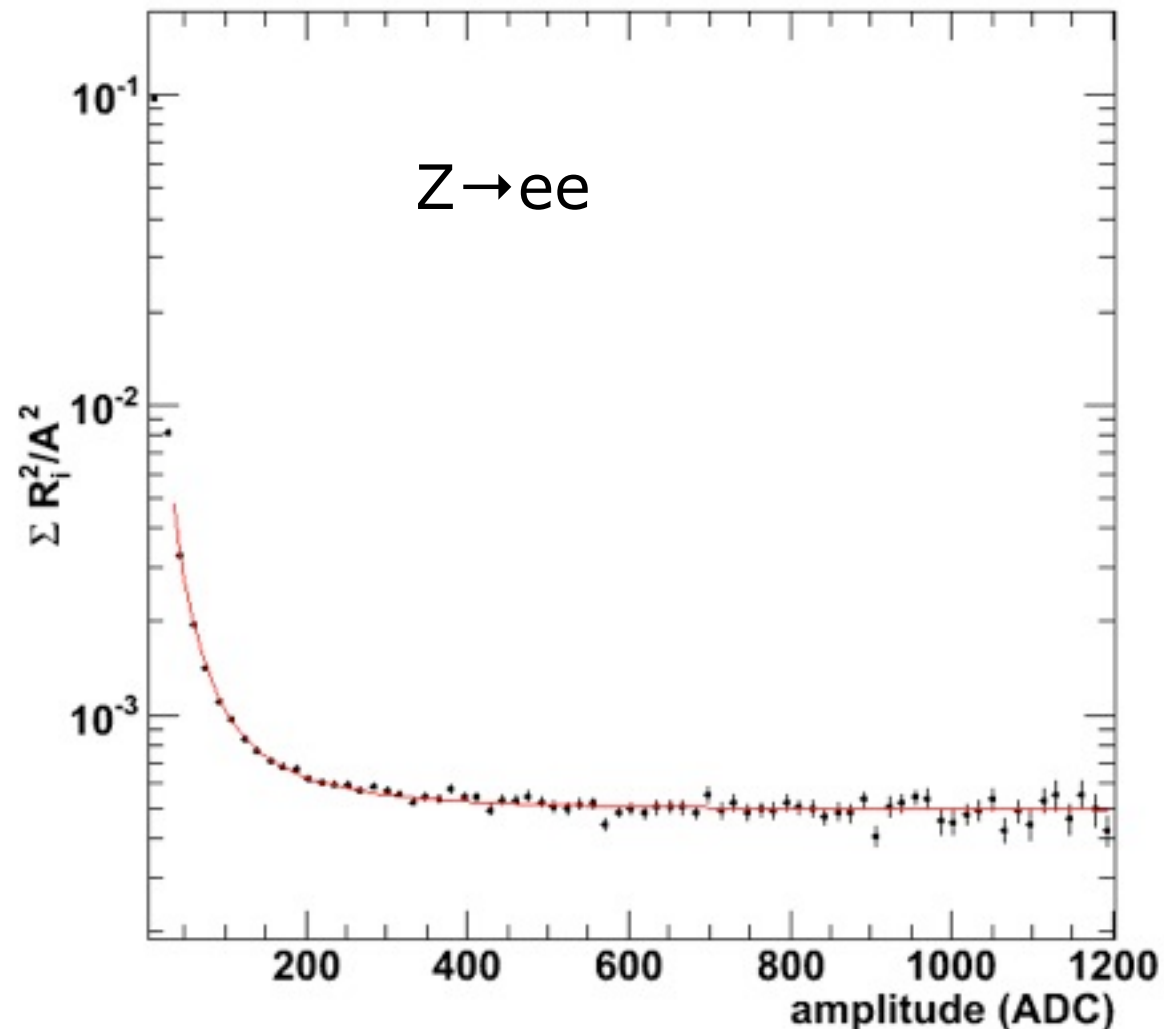
$\delta R_i^2 \sim pedRMS^2 + (A\delta f_i)^2$

δf_i =systematic error
on the shape,
A=amplitude,
P=pedestal

- model the residuals: $<\Sigma R_i^2> = N^2 + C^2A^2$

- Noise term related to correlated noise and pedestal fluctuations

- Constant term related to the error on the shape

chi2's constant and noise in MC

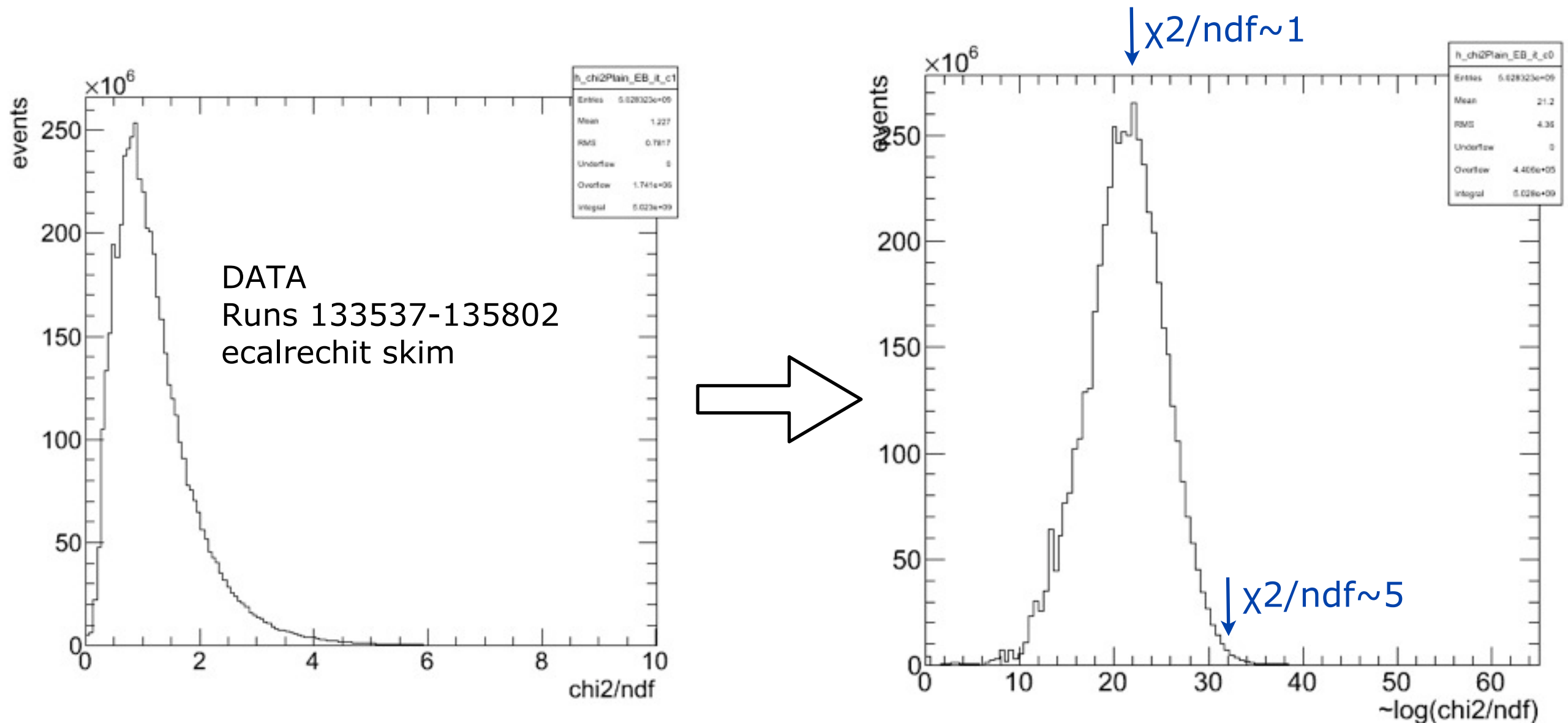## estimate N,C from $\Sigma R_i^2 / A^2$ distribution

Z→ee

γ particle gun

$$y = N^2/x^2 + C^2$$
$$N = 2.3 \text{ (ADC)}$$
$$C = 2.2 \times 10^{-2}$$

MC process independent parameters

C is dominated by the time alignment of the generated pulses in MC

define chi2/ndf = $\Sigma R_i^2/(N^2 + C^2 A^2)$

chi2 mapping convention

DATA
Runs 133537-135802
ecalrechit skim
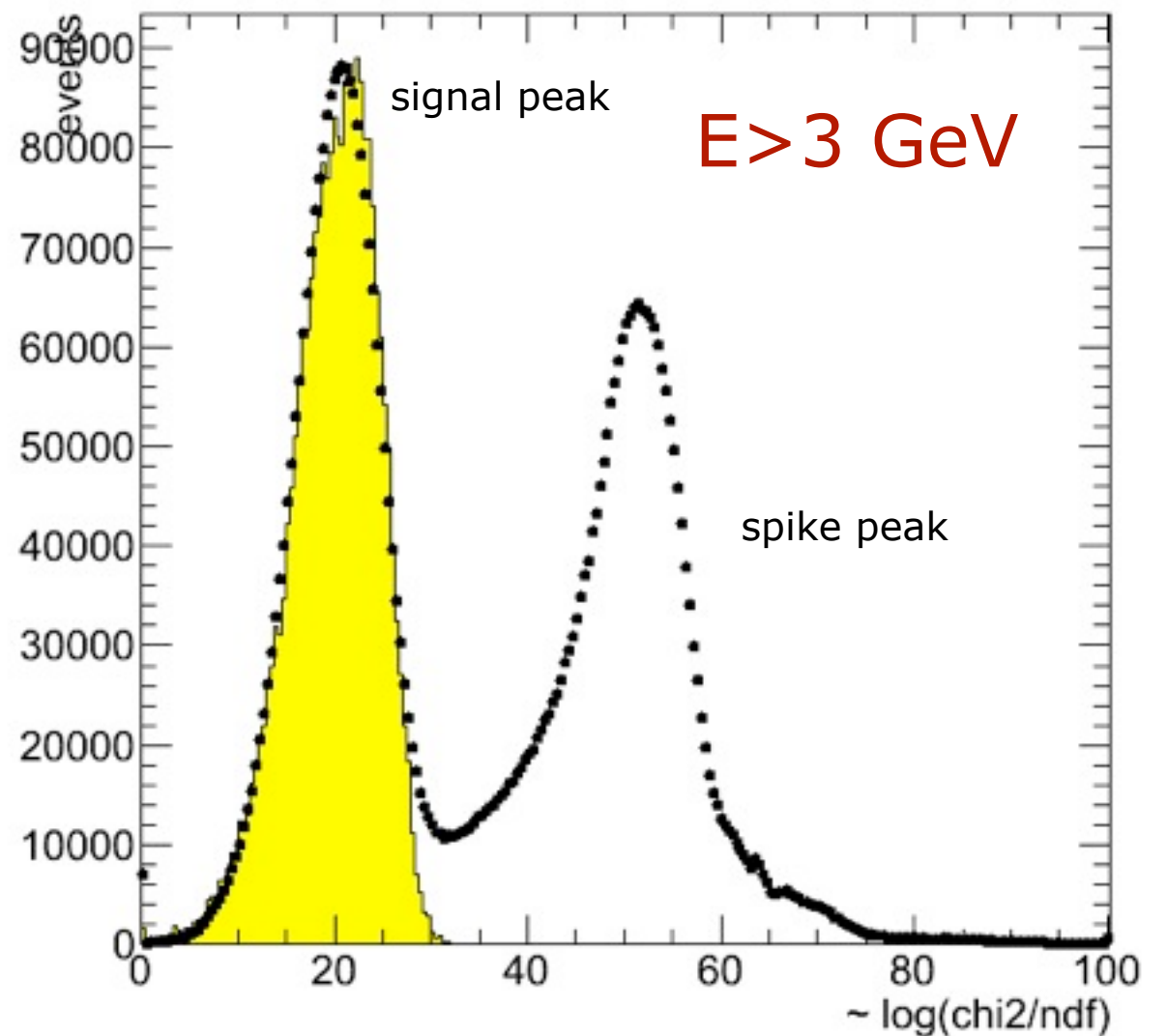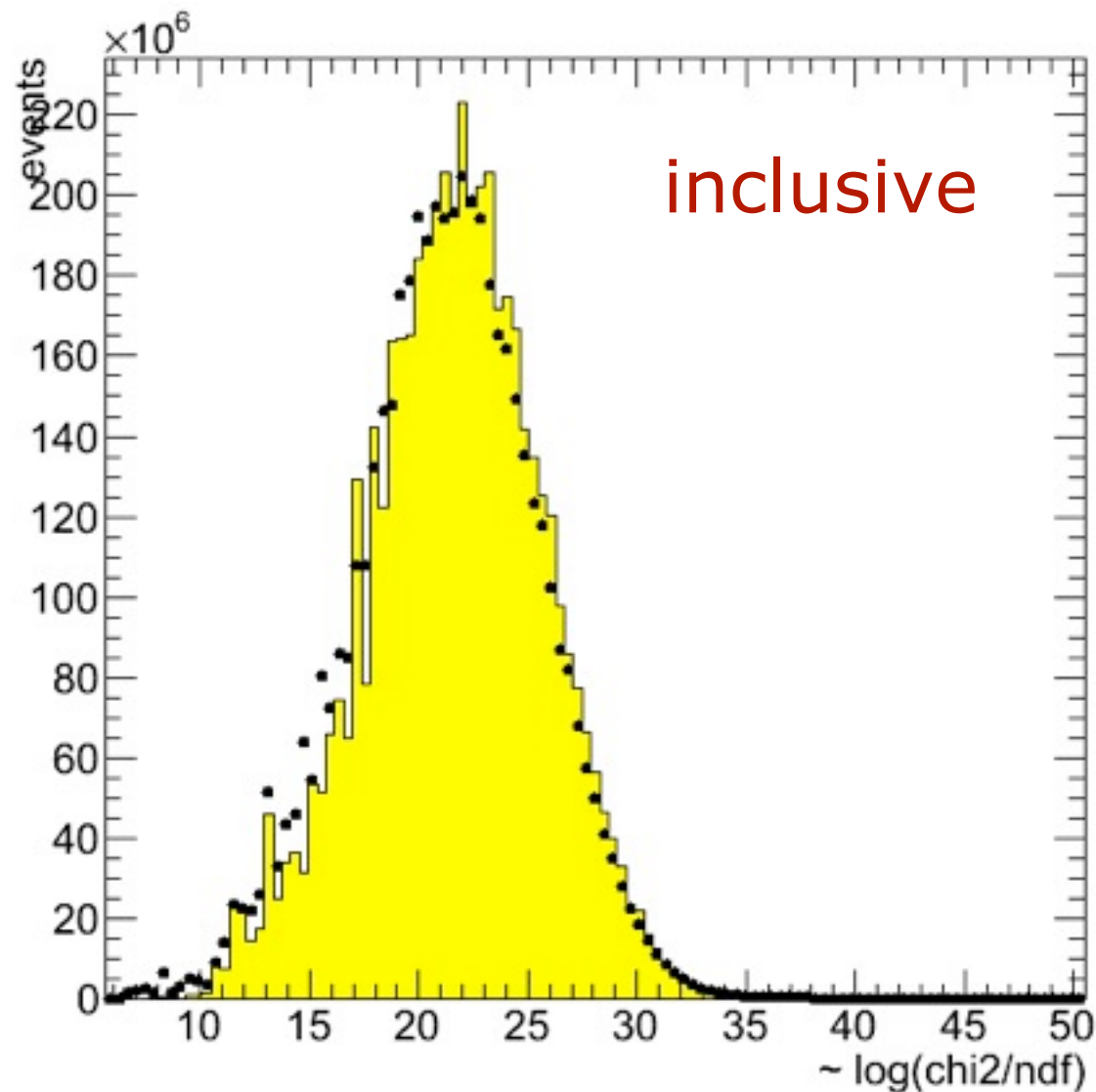
- convenient to use the log(chi2/ndf) instead of the chi2 [1]
- calibRechit preserves space in bits for the 0-64 range
- 7[3+log(chi2/ndf)] better exploits available space
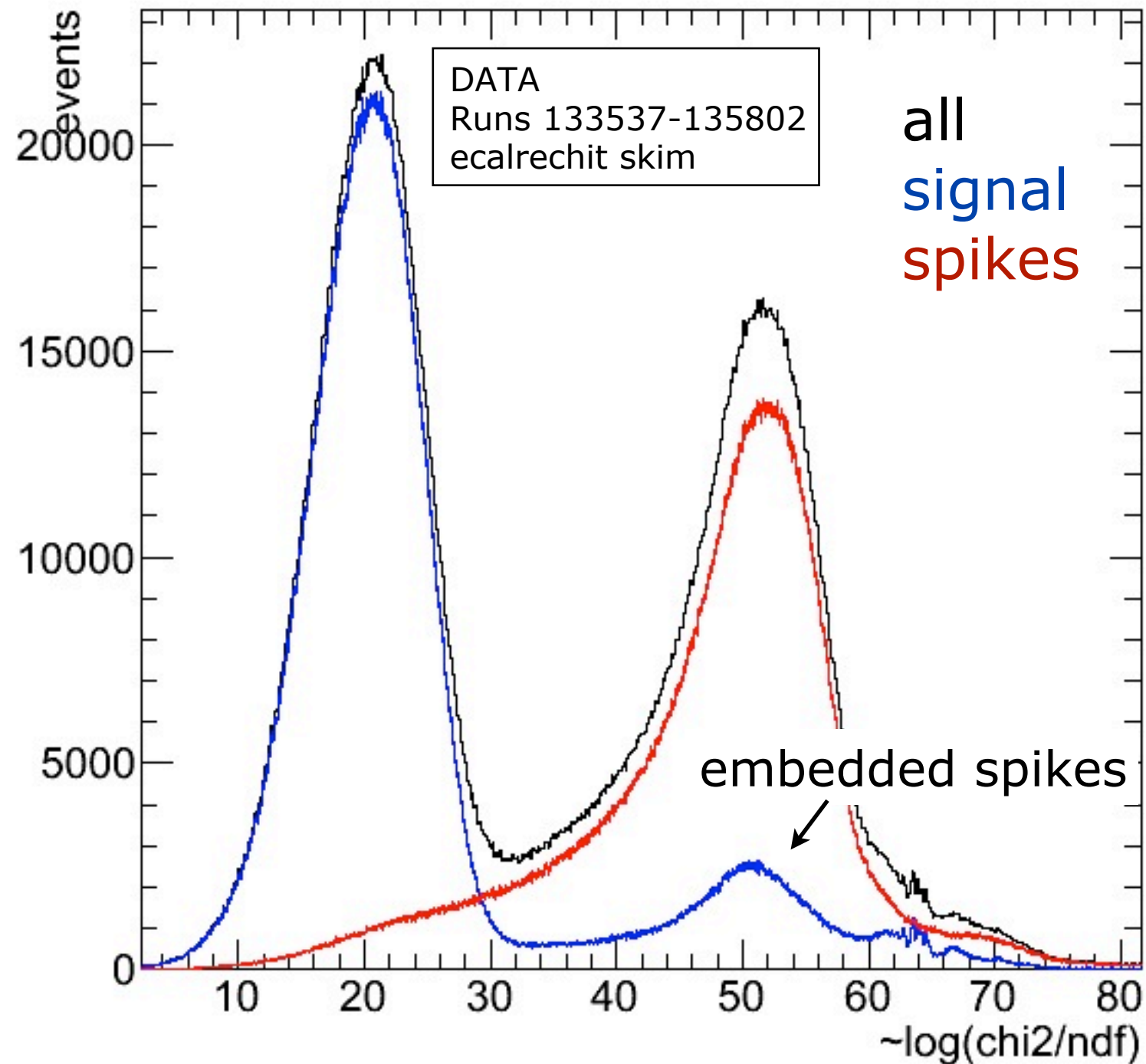
[1] thanks to A.Ledovskoy for the suggestion

DATA vs MC

MC seems to describe roughly the data, more studies are on the way

embedded spikes

only hits with E>3 GeV


signal = SwissCross<0.95

spikes = SwissCross>0.95

out-of-time chi2

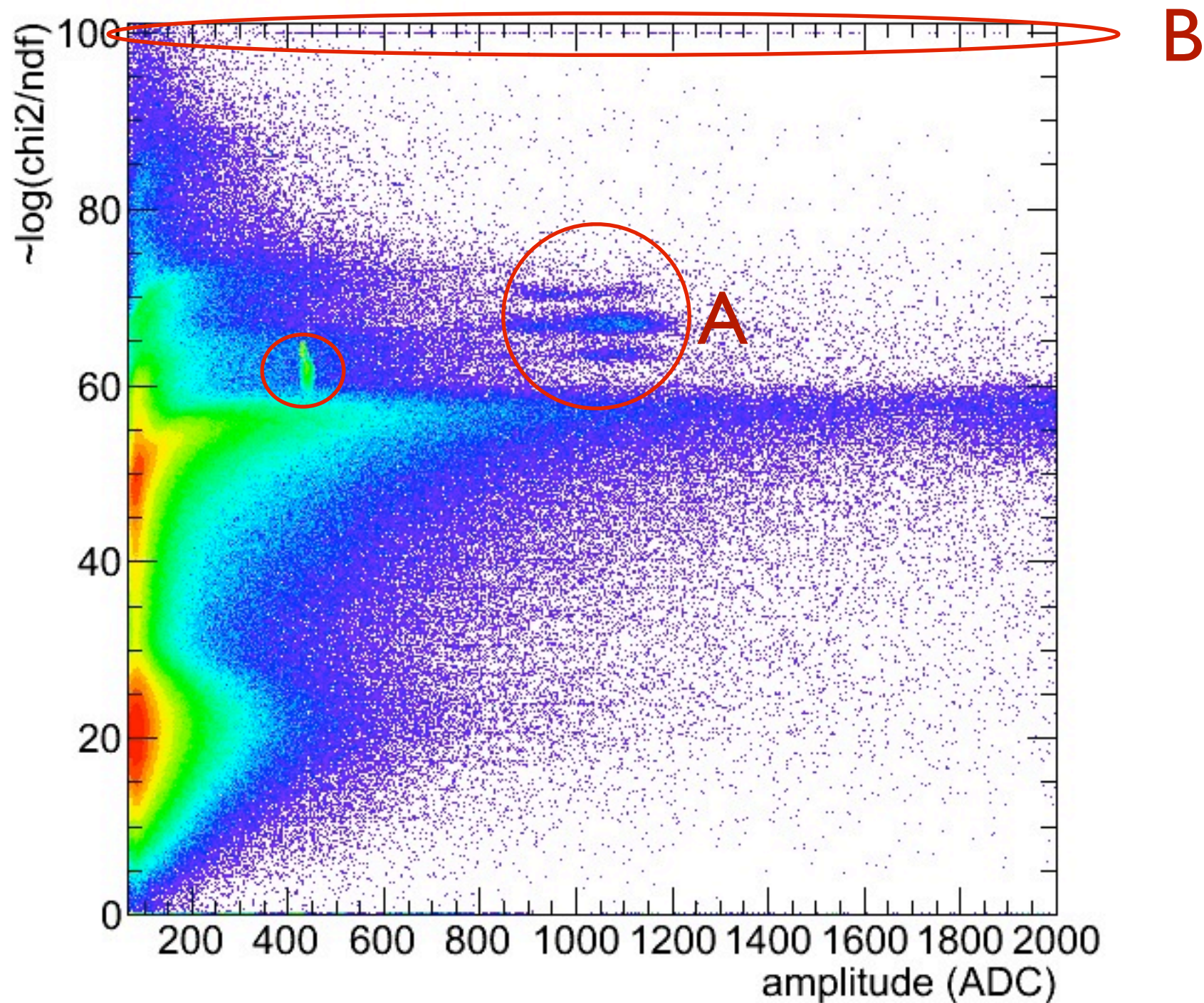out-of-time chi2 benefits from the amplitude **and time** reconstruction provided by Ratio method

time is used to align the pulse shape event by event

Did not yet tune N,C for out-of-time chi2, used the defaults from the fixed time chi2

E>3 GeV

once commissioned could be used for suppressing spikes in exotica searches
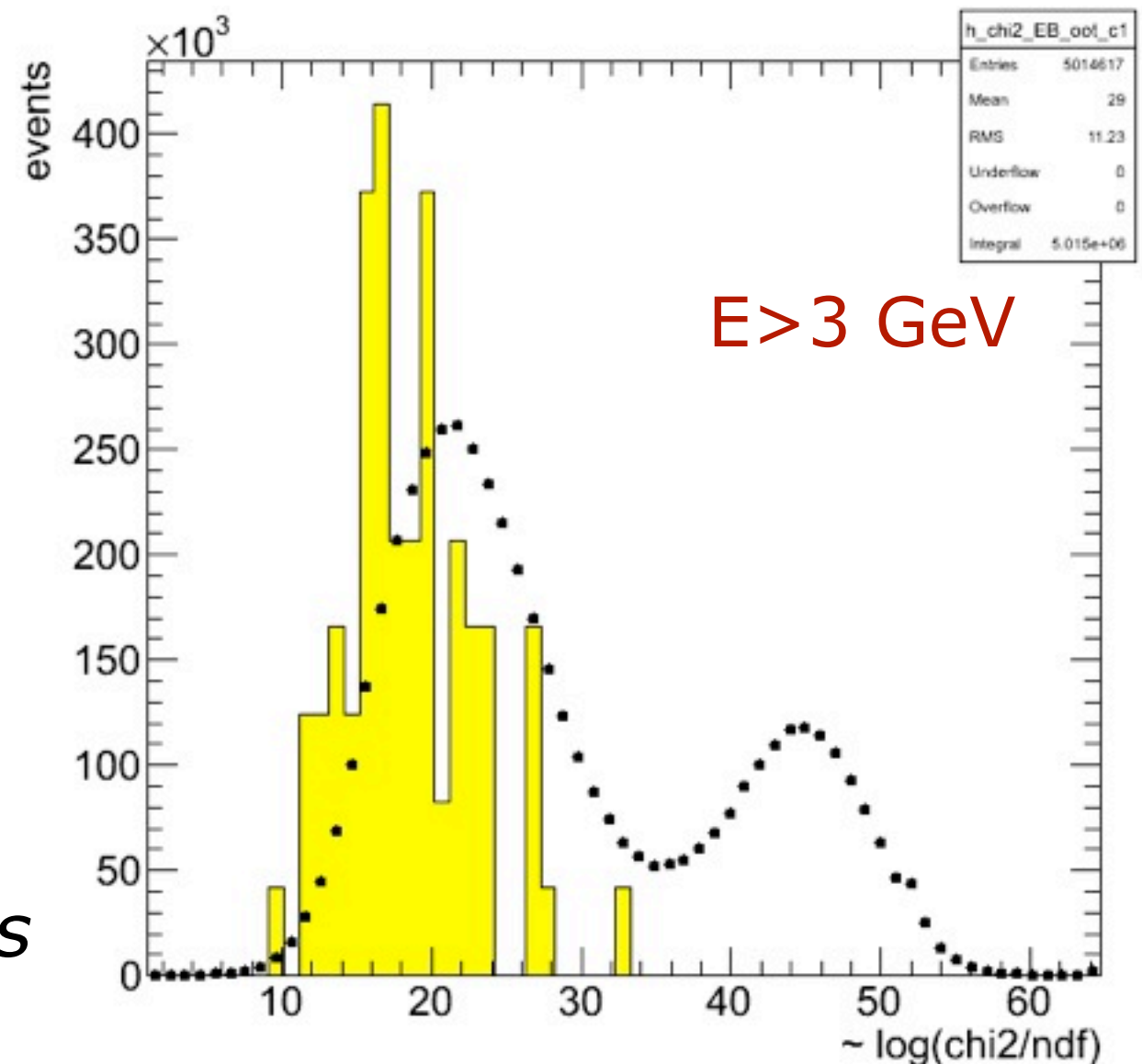
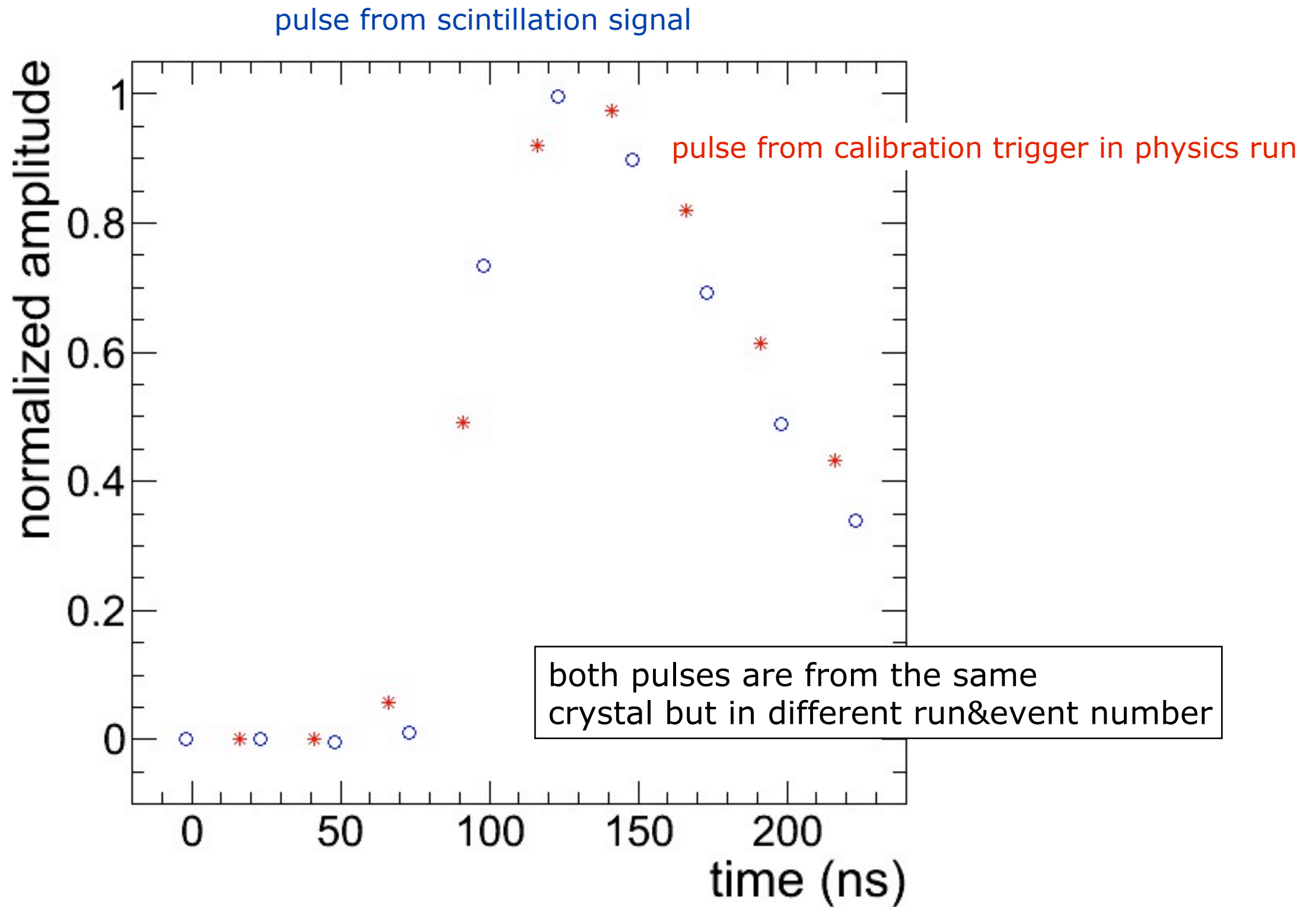# chi2 vs amplitude

structures pop out, usually some calibration sequence or other hardware problems

dynamic flagging

pulse from scintillation signal

pulse from calibration trigger in physics run

both pulses are from the same
crystal but in different run&event number

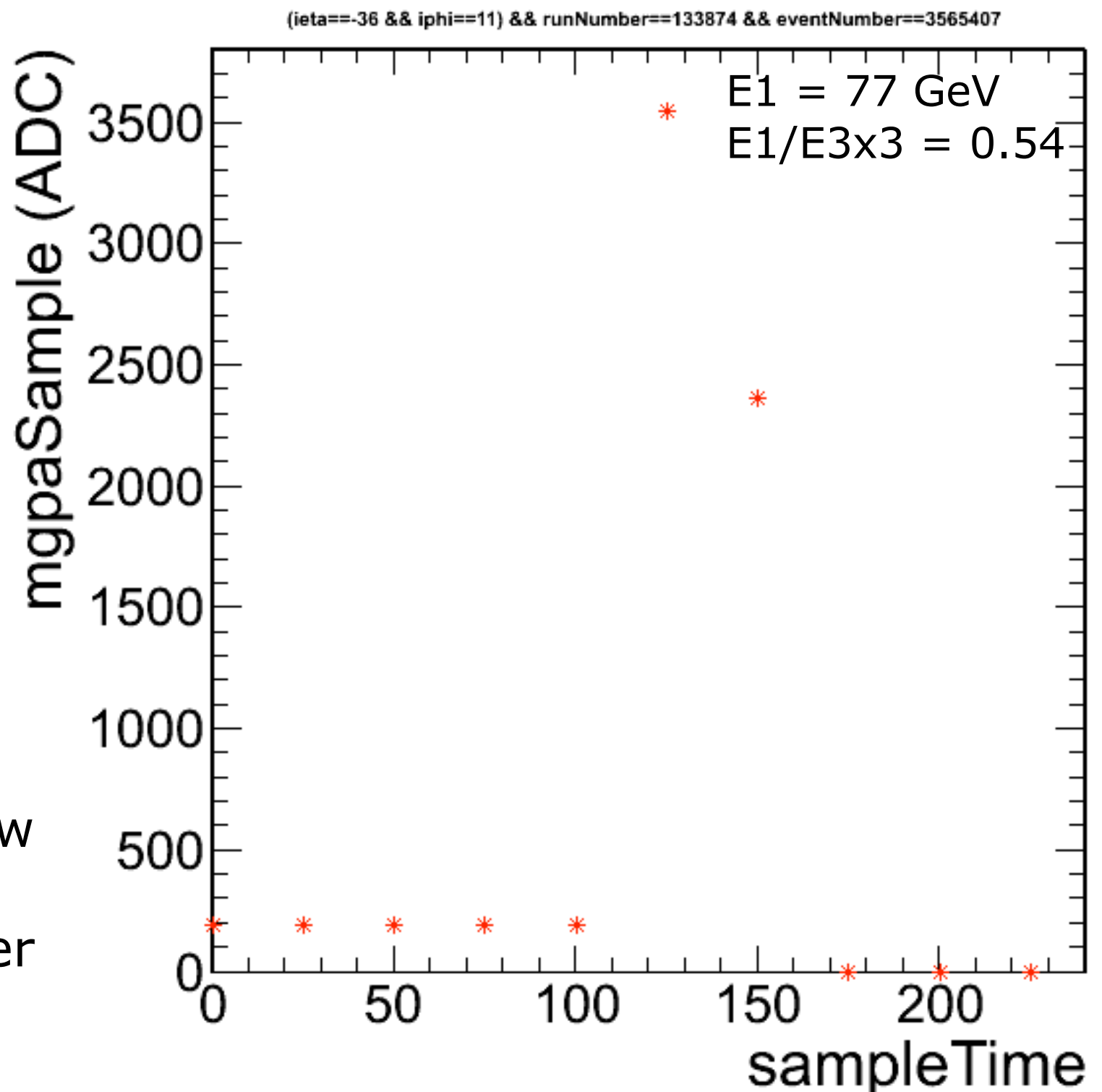test pulse sequences, produce a peak in the chi2 distributions

example digis from a crazy case

notice the last 3 digis
are 0 ADC

channel has low E1/E3x3,
**will pass the
topological spike cut**

channels in the same
tower gave such patterns
during a run and then
went back to normal

initially spotted as a peak
in the chi2 distribution, now
a protection is developed
for rechits were the number
of non-zero digis !=10

(ieta==-36 && iphi==11) && runNumber==133874 && eventNumber==3565407

E1 = 77 GeV
E1/E3x3 = 0.54

mgpaSample (ADC) vs *sampleTime*

probably nobody noticed the problem to exclude this run range, though the optimum is dynamically flag such rechits

conclusions

- C,N parameters are useful to tune the chi2

- fixed time chi2 looks OK

- out-of-time chi2 needs calibration

- chi2 is not only useful for spike-ID

- chi2 adds **information** in the data

- do we want to update chi2 in CVS ?

backup: chi2 vs swiss cross