Monte Carlo studies for the trigger of CTA

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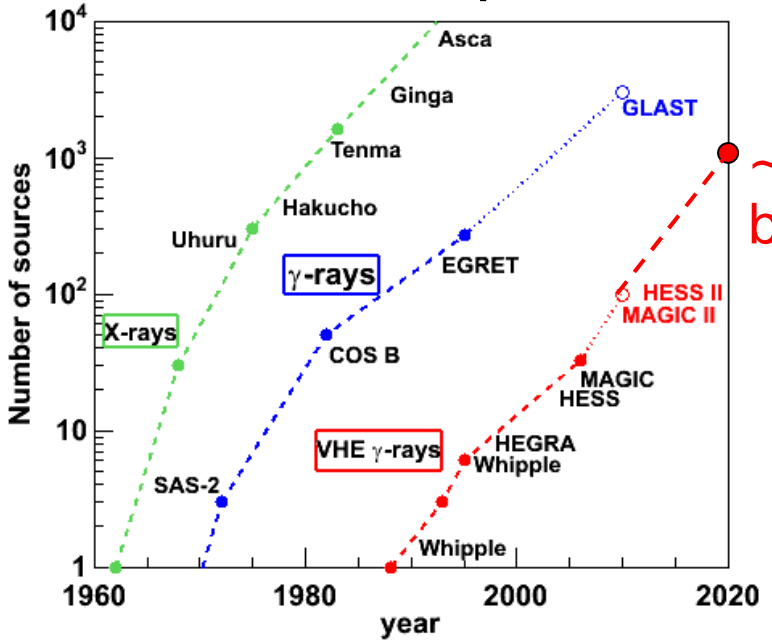
Cherenkov Telescope Array

Present IACT experiments

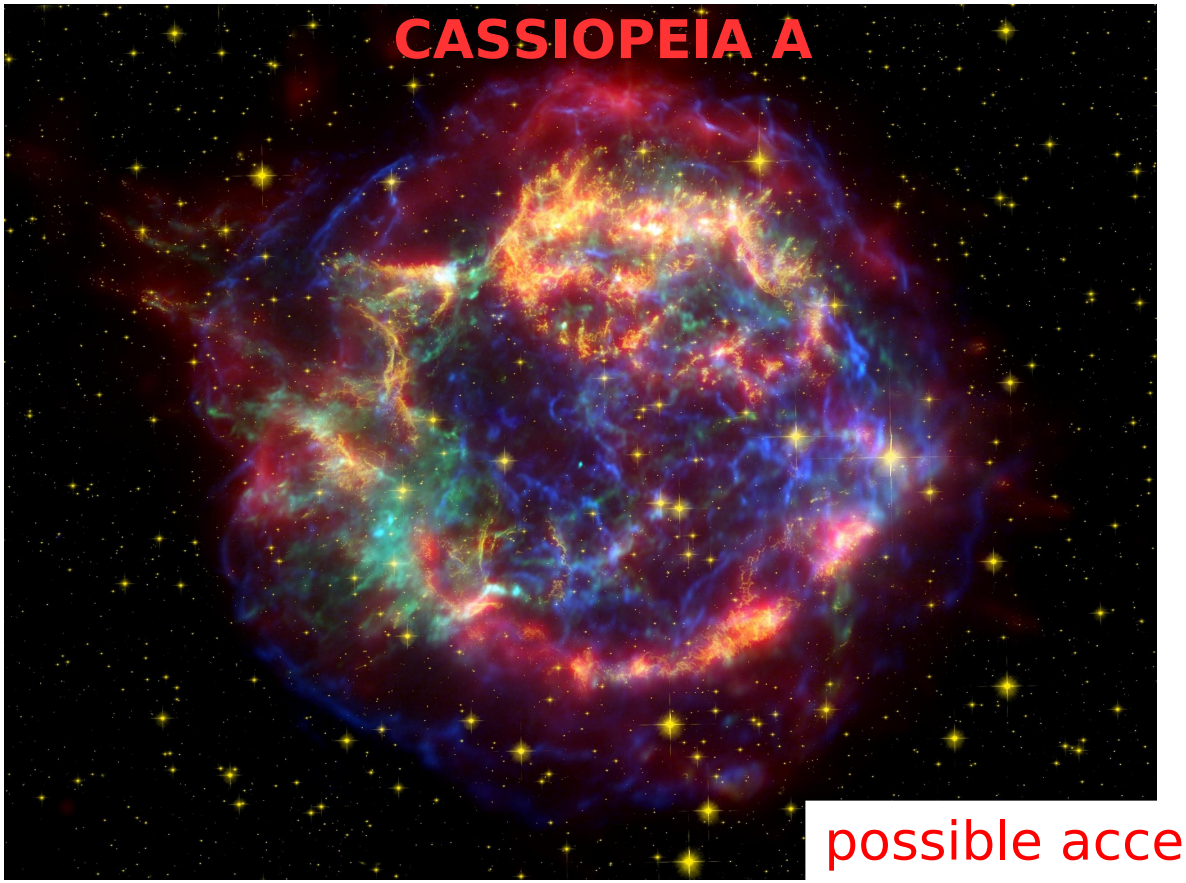
CTA physics goals

- Further investigate the non-thermal universe:
  - more statistics to known sources (reobservation)
  - ~1000 new sources / new kind of sources

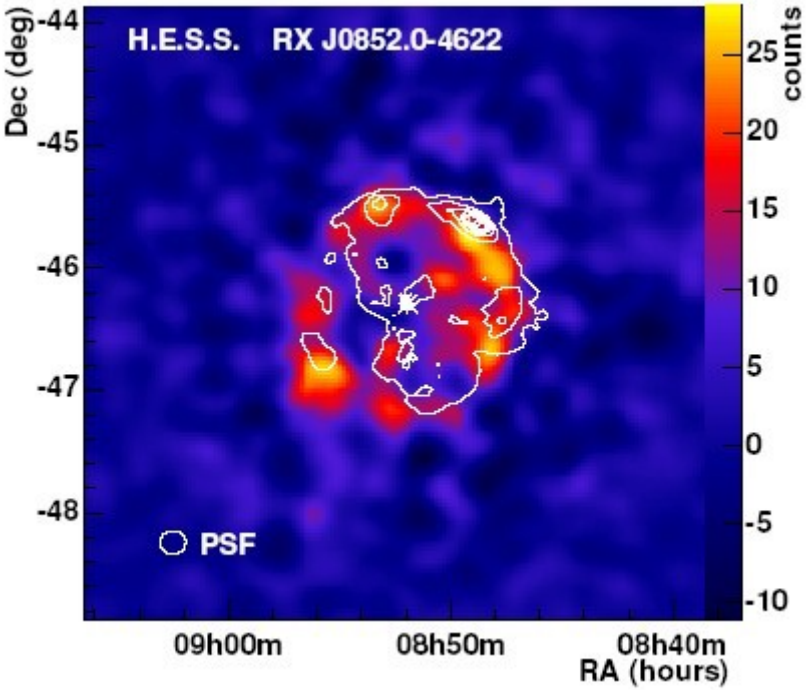


CTA physics goals

- More statistics for population studies
- E.g: Shell-type SNR in VHE range ~ 5



VELA JUNIOR

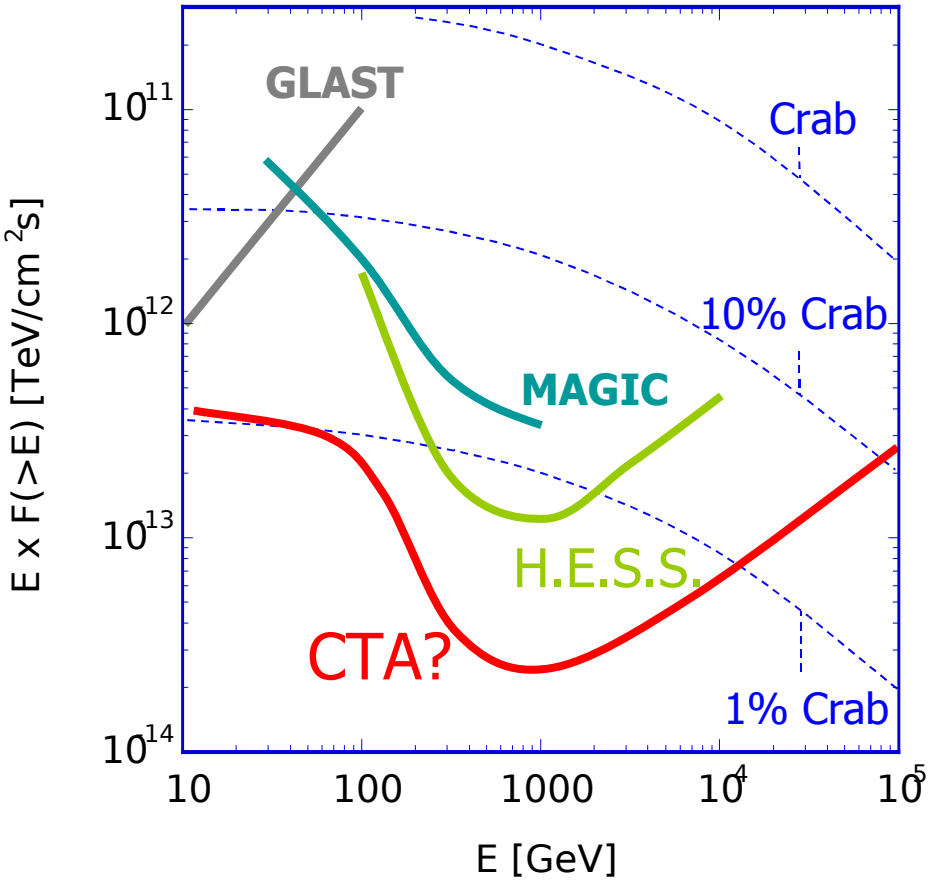


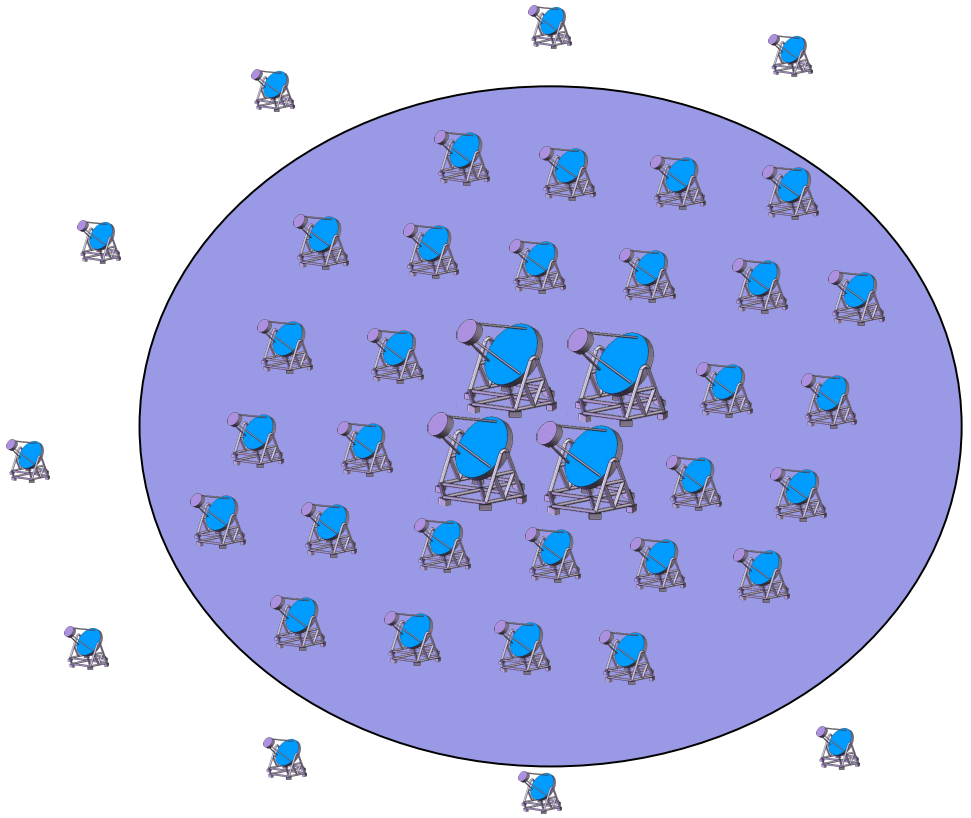
possible accelerators of galactic CR

Cherenkov Telescope Array

- Next generation of IACT experiments
  - Energy range: ~10 GeV – 100 TeV
  - Big effective area
  - Angular resolution: 5-10 times better (HESS: 0.1°)
  - Sensitivity: ~mCrab flux

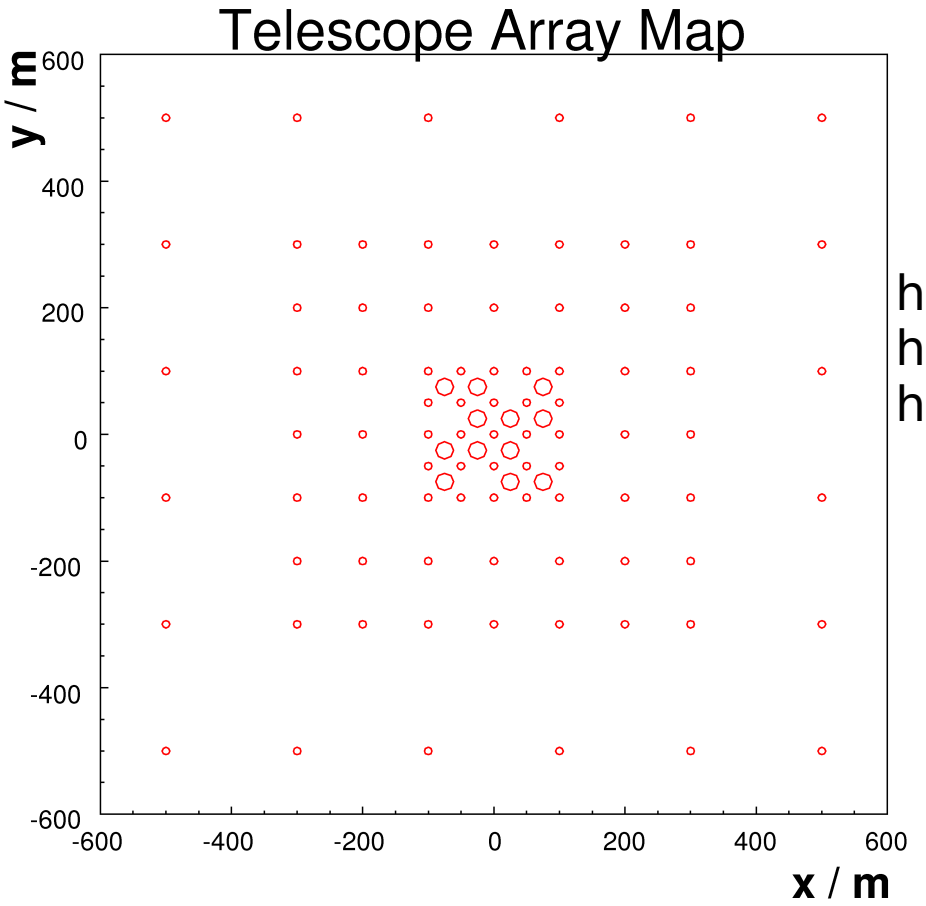
Cherenkov Telescope Array





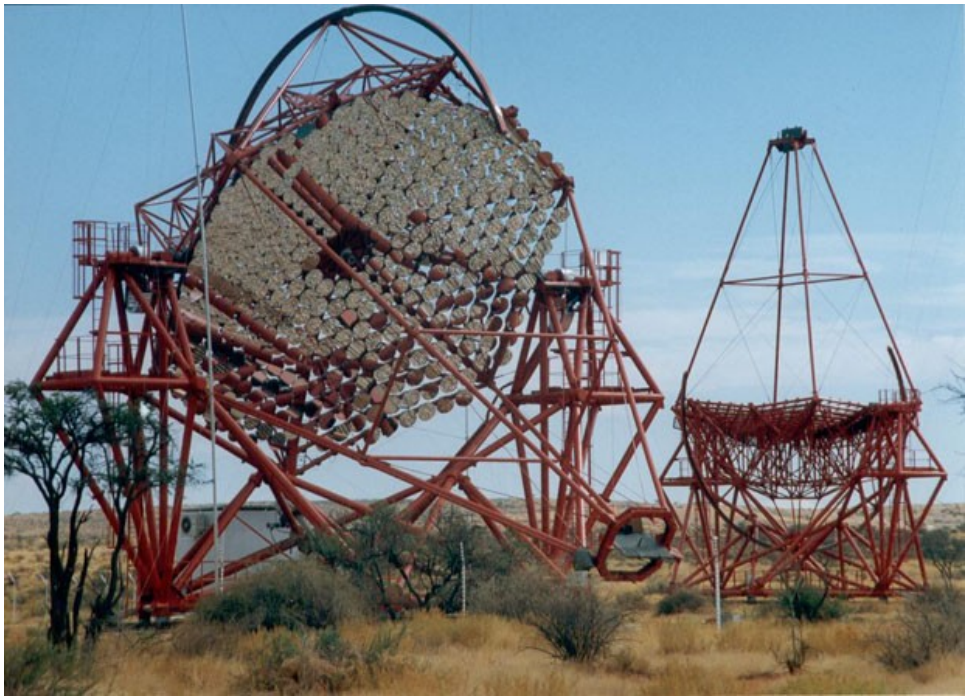
Trigger studies

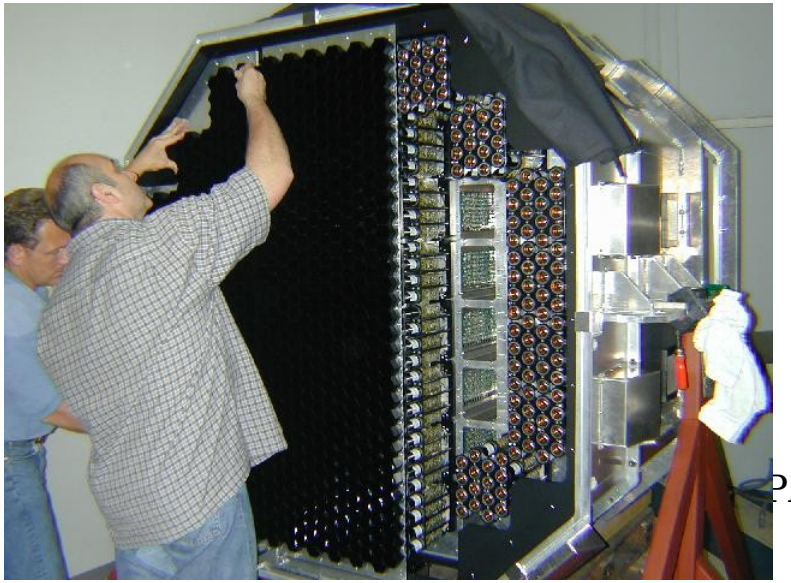
CTA 97: telescope array



how big is the trigger rate?
how many telescopes are triggered?
how big is the data flow?

CTA 97: cameras



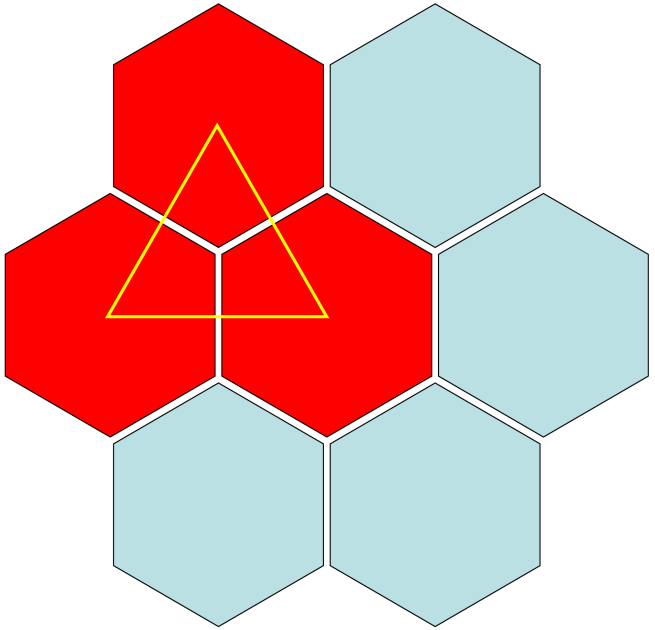


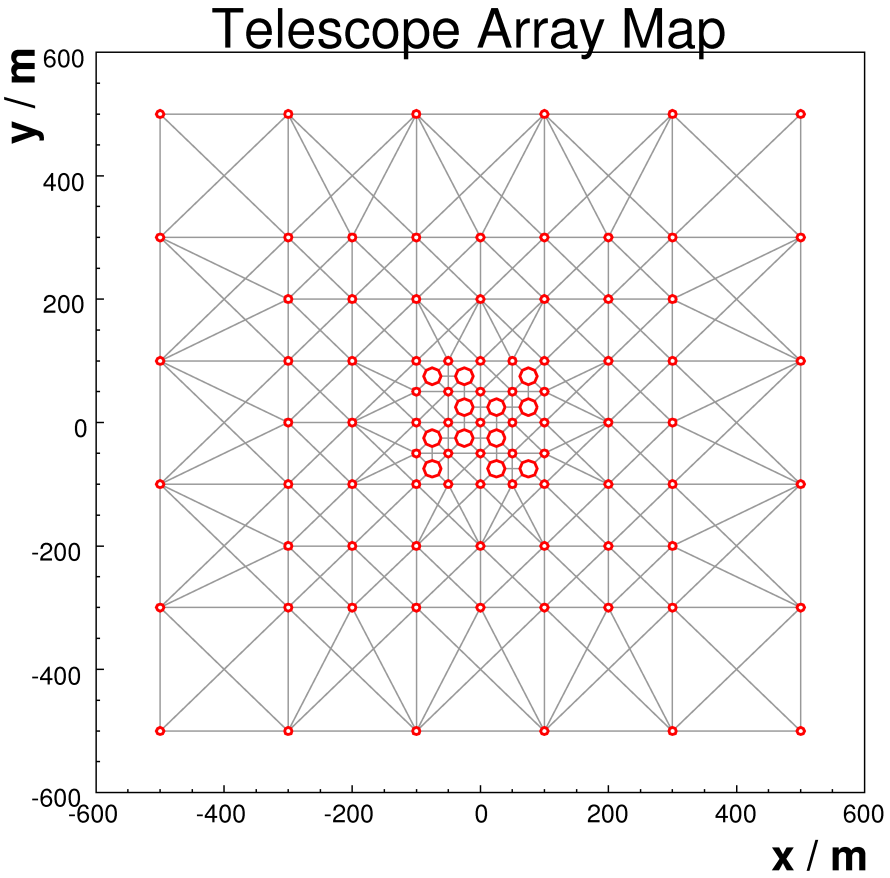
CTA cameras

big telescopes (32m)	small telescopes (8m)
3m diameter	2m diameter
4093 pixel	1735 pixel
5° FoV diameter	7° FoV diameter

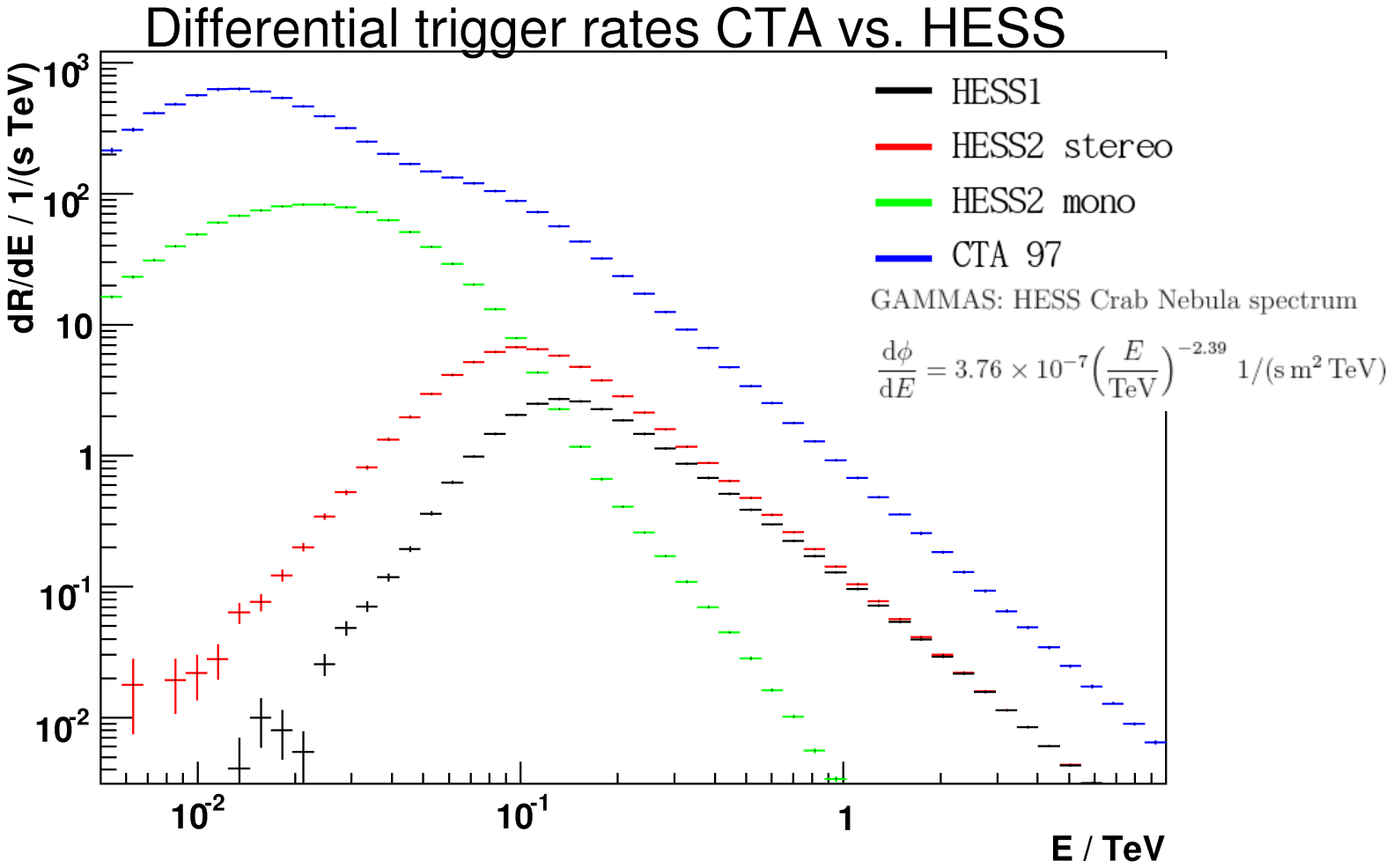
Simulated trigger condition

- Level 1: 3 pixel above 4 p.e. (Smartpixel)
- Level 2: at least 2 neighbouring telescopes





Differential trigger rates



Trigger rates

- CTA 97
  - Energy threshold: 13.4 GeV
  - Gamma rate (Crab): 31 Hz
  - Proton rate: 30 kHz
- HESS 2
  - Energy threshold: 25 GeV (mono)
    95 GeV (stereo)
  - Gamma rate (Crab): 5.5 Hz
  - Proton rate: 1.8 kHz

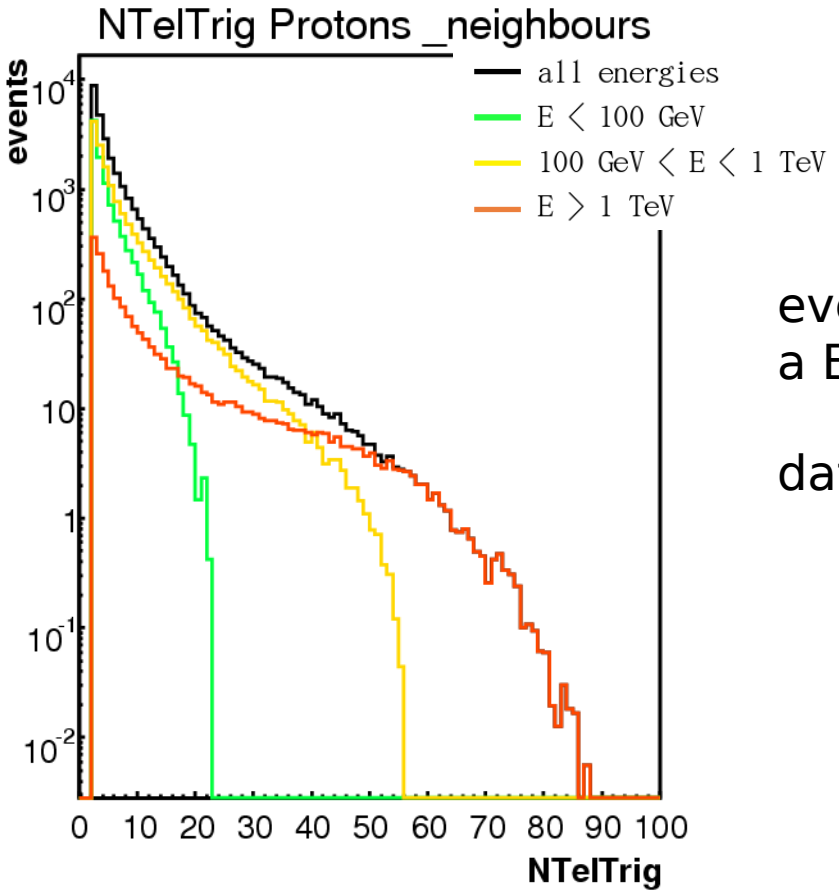
GAMMAS: HESS Crab Nebula spectrum

$$\frac{\mathrm{d}\phi}{\mathrm{d}E} = 3.76 \times 10^{-7} \left(\frac{E}{\mathrm{TeV}}\right)^{-2.39} 1/(\mathrm{s\,m^2\,TeV})$$

PROTONS: BESS spectrum

$$\frac{\mathrm{d}\phi}{\mathrm{d}E} = 0.099 \frac{(E\,[\mathrm{TeV}])^{-2.70}}{1 + (0.004/E\,[\mathrm{TeV}])^{1.75}} 1/(\mathrm{s\,sr\,m^2\,TeV})$$

Triggered telescopes



events weighted to represent a $E^{-2.7}$ spectrum

data equivalent to 7.5s

- Mean number of triggered telescopes per event: 5 (protons)

Disk space

- Rate for all stereo events ~30 kHz
- Mean number of telescopes to read ~5 tels/ev
- 1 event: 30 Bytes/pixel (waveform digitalization), ~3000 pix/tel

- 440 kBytes/ev ⟷ ~13 GB/s read out

Conclusions / outlook

- CTA will give precise and sensitive measurements over a wide energy range
- Strategies to reduce the trigger rate
- Topology of the trigger: how many trigger boxes?