

# Observation tailored instrument response functions for the MAGIC telescopes

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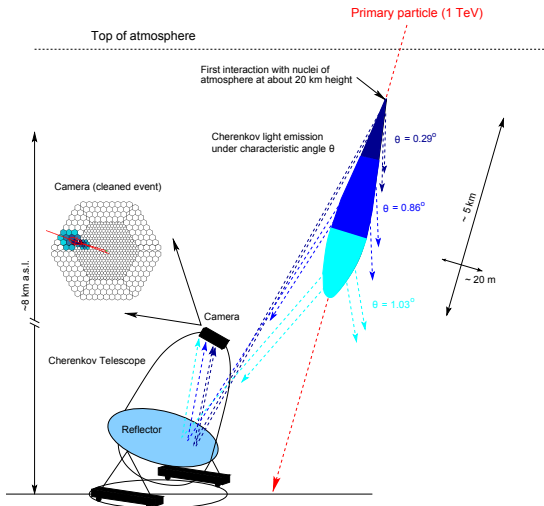


# Counting events - Signal & Background

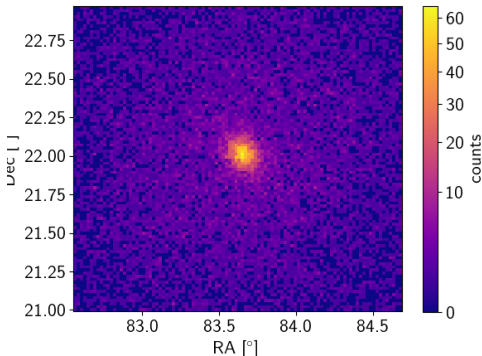


R. Wagner

# Counting events - Signal & Background



## Why are IRFs important?



▶ Cherenkov telescopes are background dominated

⇒ background estimate

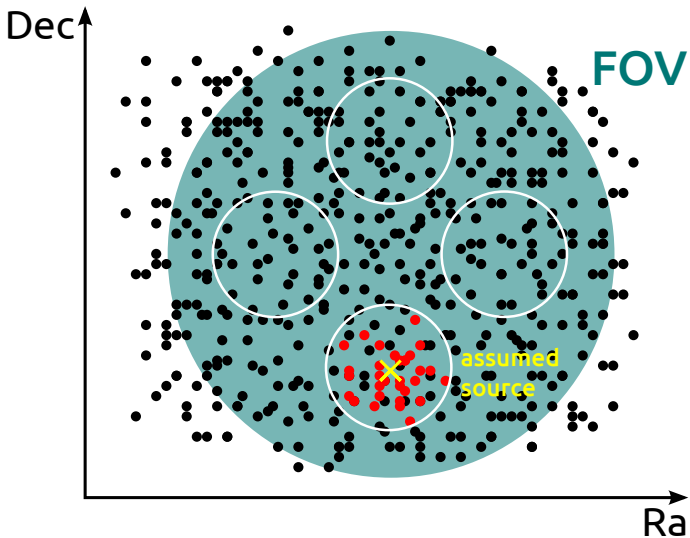
▶ resolution of instrument important to judge structures

⇒ need to know PSF

▶ want to our map in physical quantities

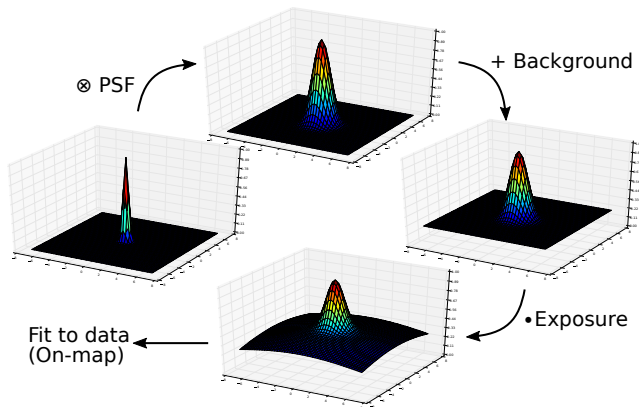
⇒ need to know exposure

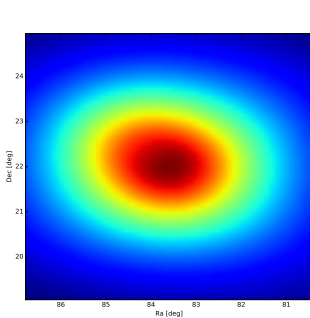
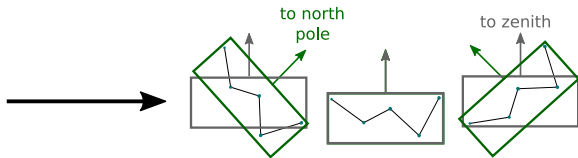
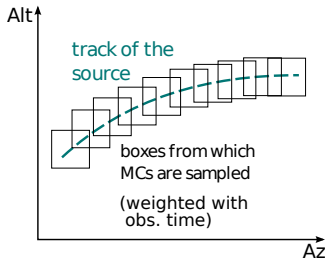
## Counting events - Signal & Background



# Likelihood approach

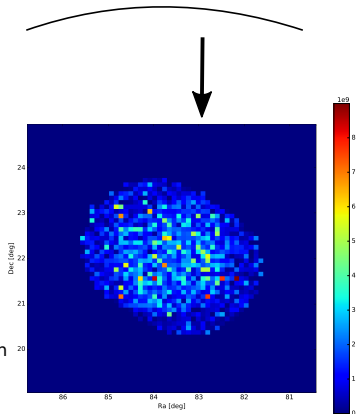
- ▶ approach used by Chandra (Sherpa), Fermi-LAT (glike) and proposed for CTA (ctools)
- ▶ radial symmetry is assumed (1D)

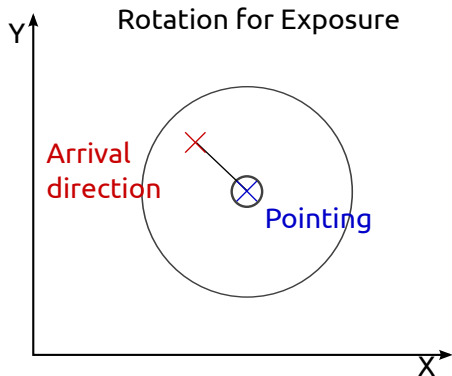
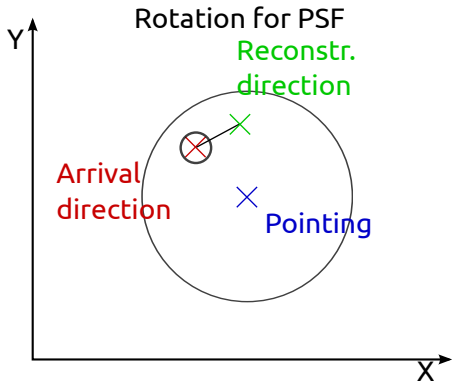




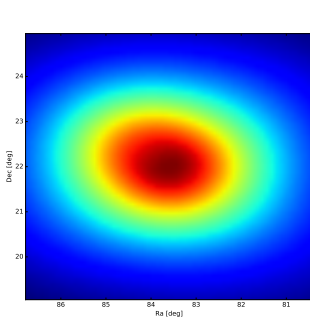
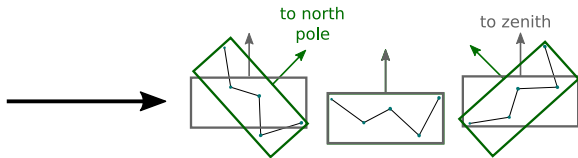
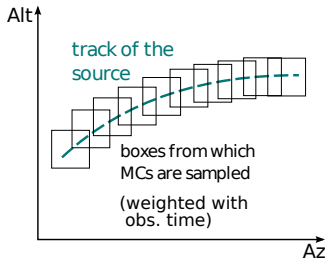
Fit Raw Map

Functions:  
PSF - King  
Exposure - mod. 2D Gaussian



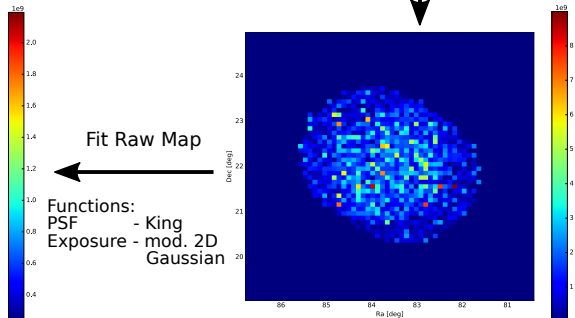




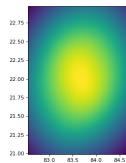
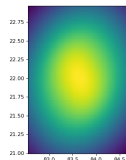
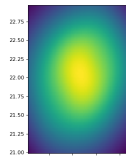
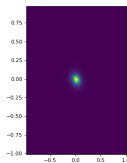
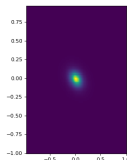
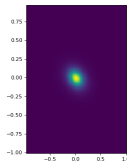
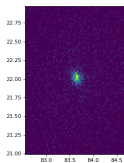
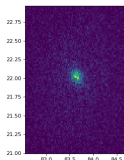
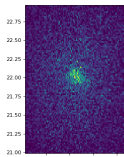
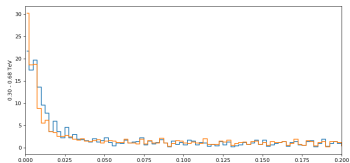
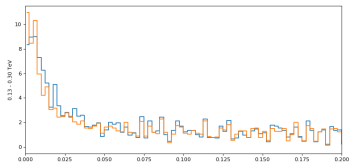
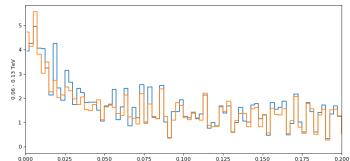


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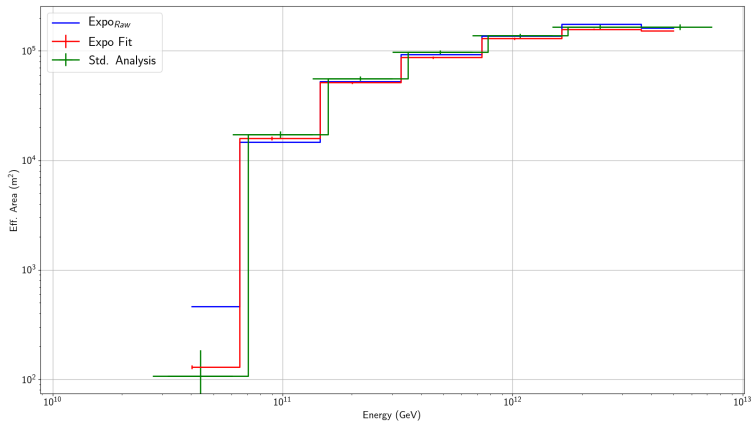
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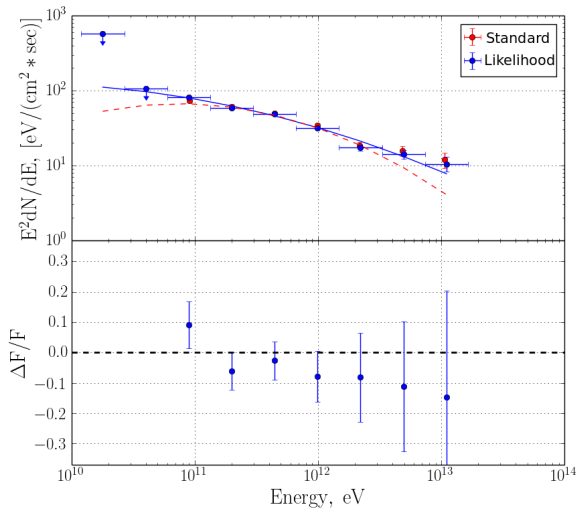
# PSF + Exposure vs. On - Crab WS



# Comparison Std. Analysis with Exposure



# Comparison Std. Analysis with Exposure



## Summary

- ▶ Instrument response function are crucial
- ▶ MC based approach allows IRFs in 2D
- ▶ methods expands analysis opportunities in  $\gamma$ -ray astronomy

Thank you for your attention!

## Poisson likelihood

### What to fit?

$$\ln L = \sum_{ij} n_{ij} \ln(\theta_{ij}) - \sum_{ij} \theta_{ij} - \sum \ln(n_{ij}!)$$

with measured counts  $n$  in bin  $(i, j)$  and expected value of  $\theta_{ij}$ .

### Likelihood ratio test

$$T_s = -2 (\ln L_0 - \ln L_1)$$

$$\sim \chi_n^2 \text{ distributed (Wilk's theorem)}$$

following idea from Fermi-LAT/EGRET: Mattox et al. ApJ 1996 461 396M

# PSF off-axis

