IRF introduction

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What is an instrument response function

An instrument response function (IRF) describes how the instrument and reconstruction changes the physical properties of real photon into the reconstructed properties of that photon.

- Total instrument response $R(E_R, p_R | E_T, p_T)$ allows going from *True* quantities to *Reco*nstructed quantities
- Conversion critical for comparing theoretical models with measurements
- Precision measurements not possible without IRFs

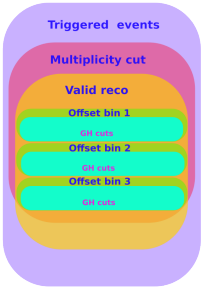
'ctapipe-make-irfs' is tool being developed to produce IRFs for DataPipe

- uses 'pyIRF' for much of the actual IRF related work
- first prototype is now being validated against reference script

Generating IRFs

IRFs are generated by reconstructing Monte Carlo events and keeping track of where in energy and space the reconstructed events end up relative their true position

- The central operation in the generation is creation of histograms
- Big source of errors is not properly selecting events when filling histograms
- Second big challenge is how to handle low count bins



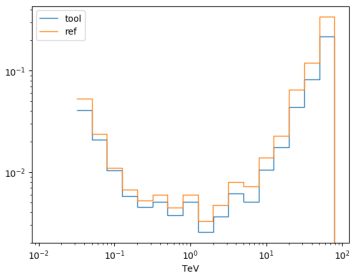
Generating IRFs

IRFs are generated by reconstructing Monte Carlo events and keeping track of where in energy and they end up relative their true position

- Typically the total response $R(\cdot)$ is factorised into three parts
  - Effective area: efficient of detection, affects absolute flux level
  - Point spread function: spatial reconstruction errors
  - Energy migration: energy reconstruction errors

Current status

Comparison with reference script shows good agreement on many quantities



- Differential sensitivity still some small differences

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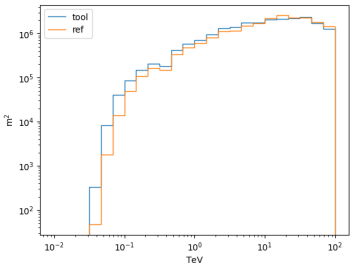

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- Effective area similar disagreements

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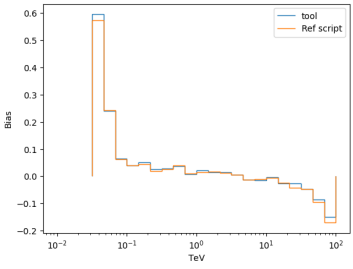

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- Energy resolution excellent agreement

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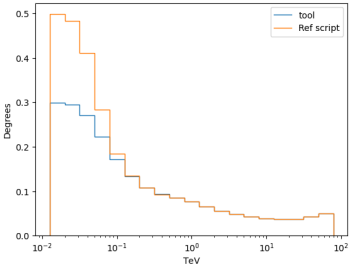

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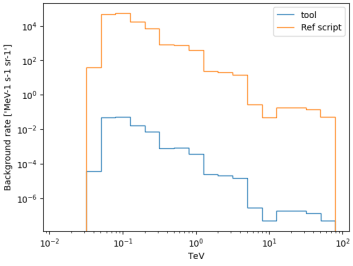

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- Effective area similar disagreements
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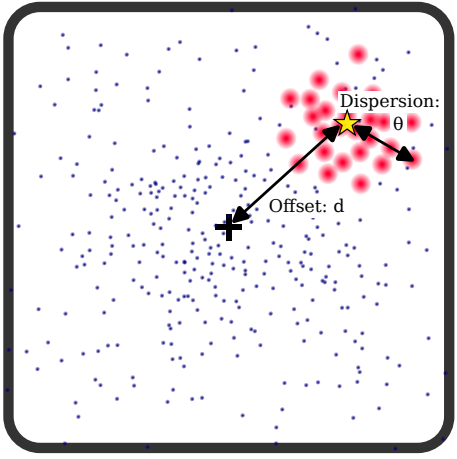
- PSF still shows big difference at low energy
- Background rate seems offset by constant

End

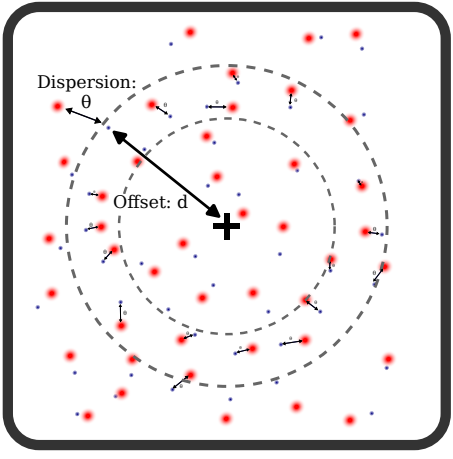
Thank you for your attention

Coordinate systems

Coordinates with real data



Coordinates with simulations



What is an Instrument response function

- Typically the total response $R(\cdots)$ is factorised into three parts
  - Effective area A_{eff}: efficient of detection, affects absolute flux level
  - Point spread function PSF: spatial reconstruction errors
  - Energy migration M: energy reconstruction errors
- The function R takes the true energy E_T, time t, and sky position p and returns their reconstructed versions $\hat{E}$ and $\hat{p}$.