Array Calibration:
An Introduction

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cta
cherenkov telescope array

Array Calibration

Array calibration group tasked with development of strategy for the array as a whole, including all telescope types and high level data

Requirements for calibration accuracy are much stronger than current instruments

Need to adapt calibration methods used in current instruments to CTA and develop entirely new techniques to meet these requirements
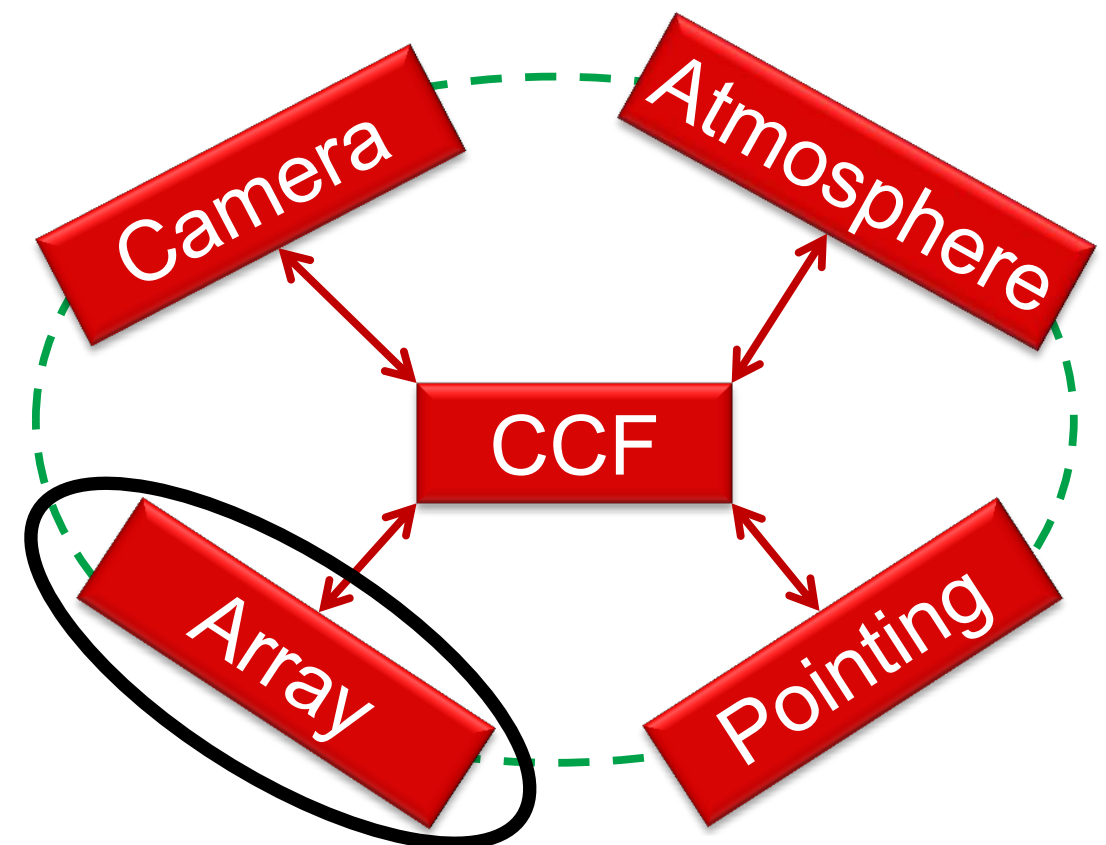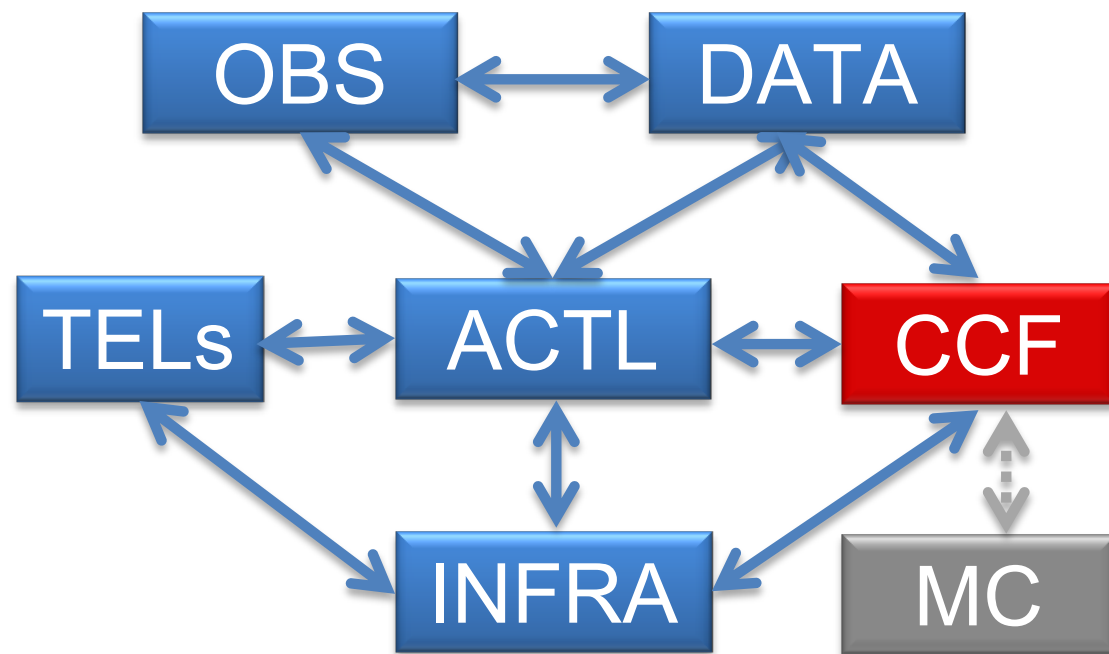
Where is array level calibration applied?

Most array calibration methods concentrate on calibrating the absolute light throughput of individual telescopes

Could be achieved both by using regular data products or specialised equipment

Produce a correction factor for each individual telescope which can be applied either to the telescope energy estimate of image amplitude

Array calibration should also check the total performance of the array IRFs at the highest level

Effective area, energy reconstruction, PSF etc…

This could either be as a correction factor, or that the MC simulations being produced represent the array performance correctly

Lets have a look at some methods…

Calibration Techniques

Method	Co-ordinator	Summary	Status
Calibration using muon rings	**Cettina Maccarone & Markus Gaug**	Muons provide standard light source in camera, MC expectation of muons compared to data	Proven on current instruments, currently being tested on MC of CTA telescopes
Inter calibration using cosmic ray events	**Alison Mitchell/ Dan Parsons**	Compare light yield of gamma-like cosmic ray events, should be equal at the same core distance	Tests made with current generation telescopes, paper complete of CTA tests
Calibration using satellite data	**Dan Parsons**	Compare reconstructed spectra of "standard candle" sources to satellite data	Test studies underway…

Calibration Techniques

Method	Co-ordinator	Summary	Status
Cherenkov Transparency Coefficient	**Raquel de los Reyes**	Transparency coefficient should be the same for all telescopes. Can be used for inter calibration	CTC proven on HESS data. Calibration tests on CTA data underway
Octocopter	**Anthony Brown & Felix Werner**	Fly calibrated light source above the array, calibrate throughput of several telescopes at once	Proven on Auger FD, tests underway for CTA
Illuminator	**Alberto Segreto**	Calibrated light source to attach to individual telescopes, calibrate total throughput	Not tested on any current instruments. CTA tests underway

Future

We will see in the following talks we have many promising calibration strategies under development

Some are proven by current instruments and just need adaptation, others are more novel and require a little more development

We need to tie these together into a coherent analysis strategy
    Choose a single primary method and use others as checks
    Or, try to combine them somehow

Array calibration should produce a telescope wise calibration coefficient and potentially array-wise values also

Level at which these values are applied needs to be determined:
    In the case of run wise simulations, apply directly to simulations
    Otherwise apply to IRFs

Interfaces with the DATA work package are crucially important to decide this