

Design an IACT for VHE gamma-rays

ACME Online Course

Guidelines to Design an IACT

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OUTLINE of the Course

- Support Material
- Guidelines to design an Imaging Air Cherenkov Telescope
 - Read the Support material
 - Step by step instructions
 - i. Science case selection
 - ii. Telescope dimensions and site selection
 - iii. Telescope structure
 - iv. Reflective surface
 - v. Camera dimension and housing
 - vi. Camera photosensors
 - vii. Camera electronics
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 - ix. Readout and storage
 - Ask for advice: [Use ACME ticketing System](#)

Read Support Material

- The support material is not for memorising it but it is recommended to go through it before following the step by step instructions.
- It should be used to get a basic background on the different elements of a telescope as instrument.
- Examples appearing in the support material are just examples, not models to follow.
- Whatever is not clear in the support material can be ignored, looked for or asked ([ACME ticketing system](#)). All options are valid.
- The support material is support material to have some background while following the step by step instructions

Step by step instructions

- We will be following this guidelines (more or less) during the online hands-on session.
- The aim is that you build a IACT Telescope based on argued decisions.
- If you want to go through it before the hands-on session, feel free to do it. If you have some kind of design or questions, feel free to ask them through the [ACME ticketing system](#) or directly to [Oscar Blanch](#)

Image Air Cherenkov Telescope

Quite some of them have already been built

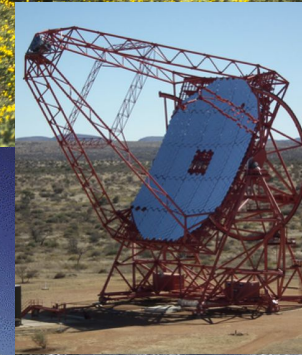
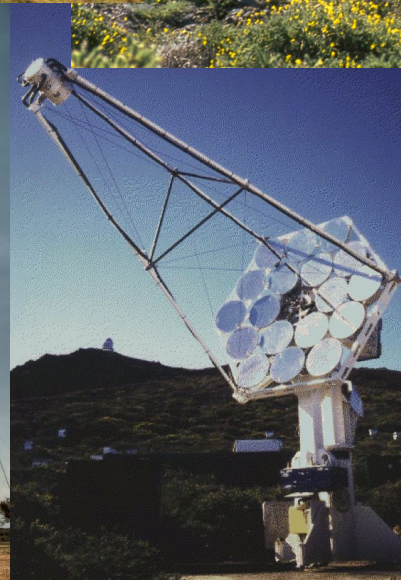
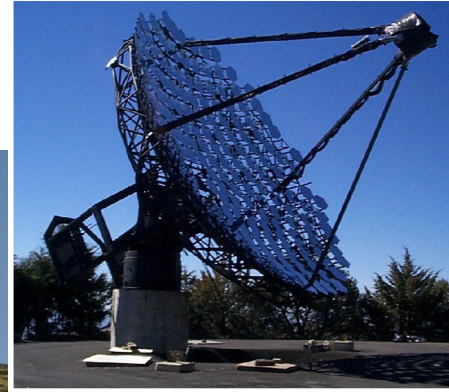
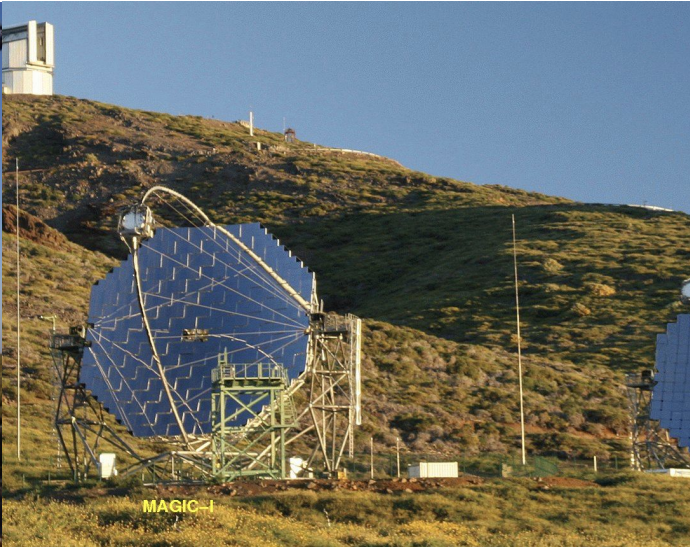


Image Air Cherenkov Telescope

- In terms of hardware instrumentation, the IACTs can be divided in three parts:
 - Structure
 - Reflective Surface
 - Camera
- This does not fully contain all that is needed to have them operative, some other elements are:
 - Auxiliary Systems
 - Readout and storage



Science case selection

- The science cases for VHE gamma-rays are quite diverse: [CTAO Science cases](#).
- What you actually want to study with YOUR telescope may have an impact on the characteristics of the IACT that you need.
- Give a thought on which Science cases you would like to study, which does not need to be unique. It could even be as many as possible.
- Try to list what it/they will require for your telescope in terms of:
 - Angular resolution
 - Energy ranger and resolution
 - Sensitivity
 - Size of the FoV
 - Reaction time
- This requirement will be key to decide what you want to build (together with budget!)

Telescope Dimension and Site Selection

- The dimension of the telescope is a big driver of the overall design as well as for the cost.
- Choose the size of YOUR telescope. Unfortunately you do not have the budget to built different sizes as it happened with [CTAO telescopes](#). Sorry!
- You also need to think where to install the telescope, or more precisely the conditions that the site needs to fulfill (light contamination, height, connectivity, weather, ...)

Telescope Structure

- The structure needs to handle the rest of the elements but it is also responsible to point the telescope where ever we need to point it
- Is the F/D of the structure relevant? Why? Which one will you choose?
- Which type of mount do you want to use?
- Material, colour, ...

Reflective Surface

- The reflective surface may have different shapes, which one do you want? Which one are you going to build?
- Is it a single mirror or many mirrors? Which shape?
- Do you need to have something to adapt its shape or modify its orientation?
- Any consideration about its reflectivity in terms of wavelength?
- Some environmental protection?

Camera Dimension and Housing

- Which are the dimensions of your camera, both angular and actual dimensions?
- How is it protected from the external environment? Does it have any internal environment control?
- Which is the shape?
- Does it has any protection against sun during the day?
- Can you access the internal elements easily?

Camera Photosensors

- What type of photosensors are you planning to use?
- How many photosensor are you using?
- Which shape do the photosensors have? And which dimension?
- Do photosensors cover full camera area? Is there something that makes the sensitive area larger than the photosensor area?
- Do you collect also light coming from reflexions not in the reflective area of the telescope?
- Do they have some protections against high illumination?

Camera Electronics

- Are you recording the signal from the photosensors continuously? At which sampling rate?
- Do you need a system to decide when the signal from the photosensors is worth scientifically?
- Any trick to increase the dynamic range?
- Do you need to condition the signal from the photosensors? Where?
- Are you planning any testing system?

Auxiliary Systems

- Does your telescope need other elements beyond the structure, the reflective surface and the camera?
- Any thing related to calibration?
- Are you planning testing and verification mechanism?
- What about safety? For both the instrument and people.
- Any need to monitor the atmosphere and weather conditions?

Readout and Storage

- What are you planning to do with the signal recorded from the photosensors?
- Where do you store it?
- How do you bring it to the storing place?
- From where does it need to be accessed for scientific exploitation?

Ask for advice

- For any question, doubt, thought while following the step by step instructions or after the on-line session, do not hesitate to ask.
- But ...
 - do not look for the best design, look for your design with your own choices.
 - do not expect answers when you ask, you will most likely get more questions.

Please use the [ACME ticketing system](#)