All-aluminum mirrors from the INFN-Padova group

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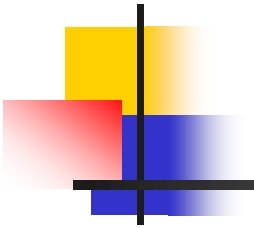
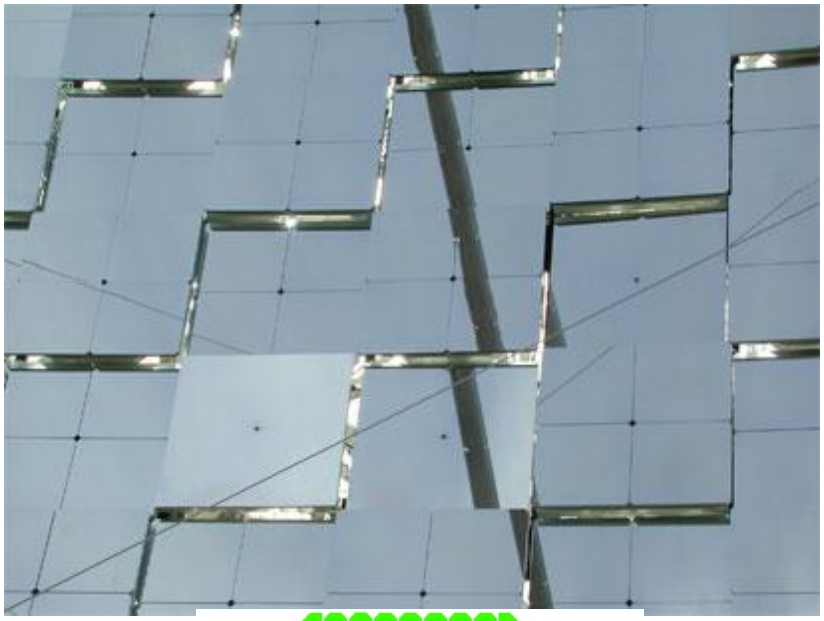
MAGIC
Major Atmospheric Gamma Imaging Cerenkov Telescope

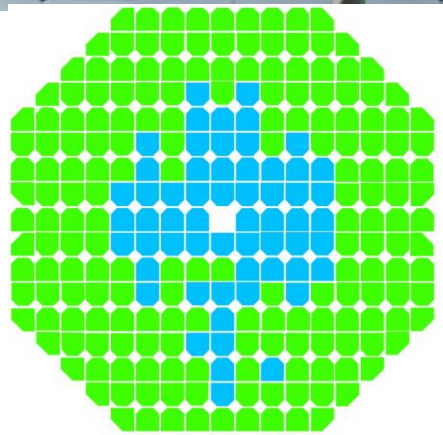


Overview

- The Reflector
- MAGIC I mirrors
- MAGIC II mirrors
- Prospects for CTA

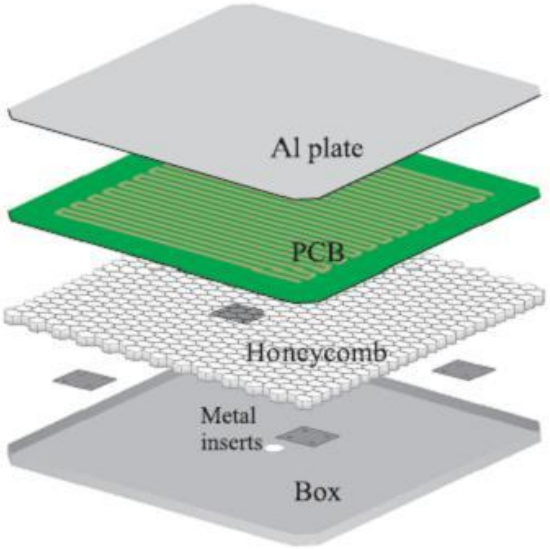
The Reflector Parabola





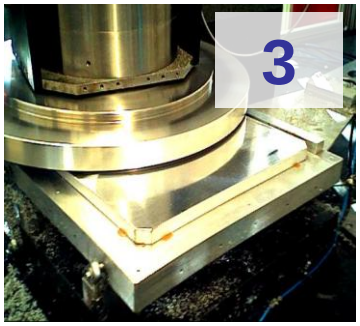
- The MAGIC reflector has a parabolic profile f=17m
  - To maintain temporal information
  - f/d ~1 (>1 decreases aberrations)
  - Larger ever built (by now!)
- Tesselated surface of mirrors tiles
  - 236 m2
  - 964 mirrors 0.5 x 0.5 m2
  - Panels of 4 and 3 mirrors grouped
  - Inter-alignment of mirrors into panels
  - Each panel is controlled by AMC
- Chess-boarding was necessary

MAGIC I mirrors



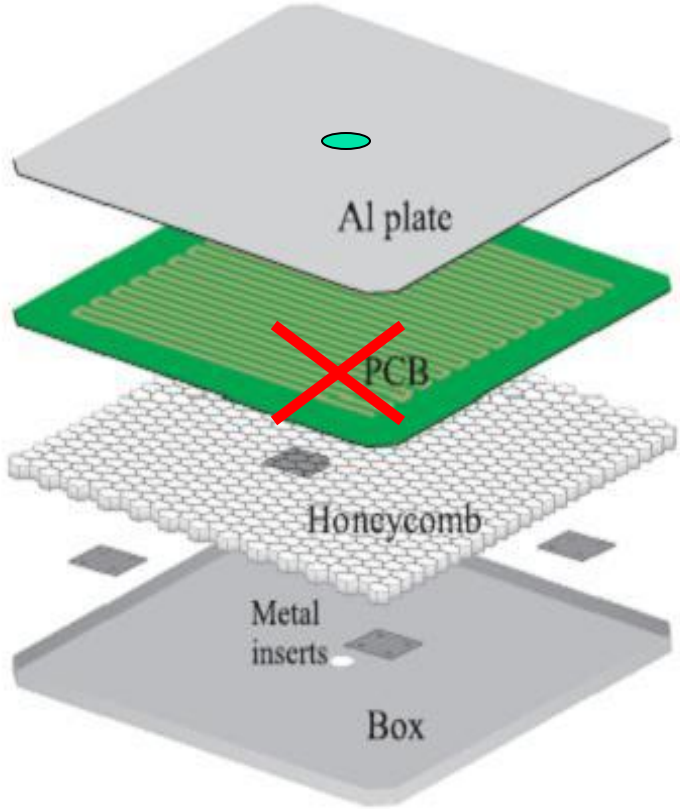
- Full aluminum sandwich
  - Upper Al plate
  - PCB heater
  - Honeycomb 30mm
  - Al-box
- Characteristics
  - Spot PSF 10mm @ 17m
  - 3 kg per mirror + 20 panel = ~32 kg per m^2
- Main problem: insulation
  - Foam is entering and condensating
  - Main holes on skin perimeter

Mirrors - production

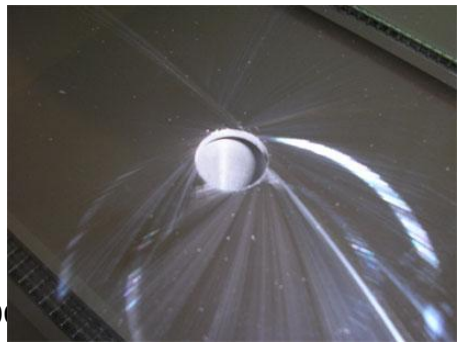


- Requirements
  - Good optical quality
  - Light-weight
  - Resistance to adverse atmospheric conditions
  - Spherical shape and focal according to final position in the reflector
- All-aluminium mirrors sandwich structure
  - Al - Skin [AlMgSi0.5, width= 3mm]
  - Al - Hexcell [60mm width, microholes]
  - Al - box
- Assembling technique
  - Structural aeronautic glue 3M™ AF163-2K
  - Use of pre-shaped al-mould
  - Curing in autoclave
    - 4 bar pressure
    - 120º temperature
- Diamond milling of the surface
  - Fly-cutter technique
  - Roughness of 3-5nm
- Quartz layer (Si-O-C) evaporation of 100nm

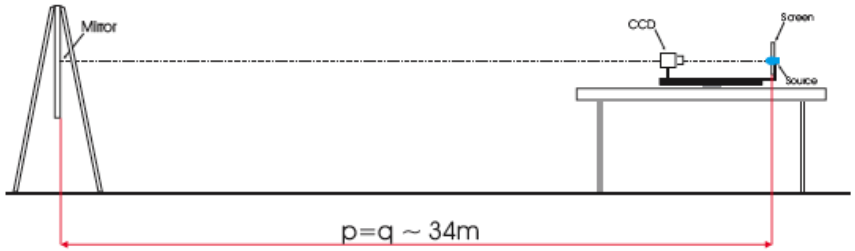
MAGIC II mirrors

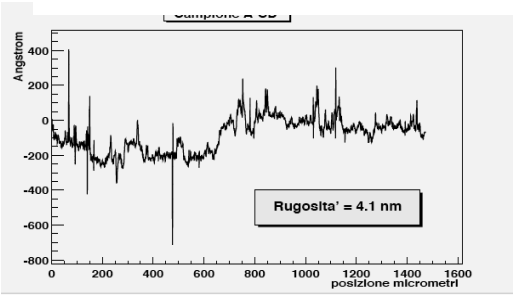


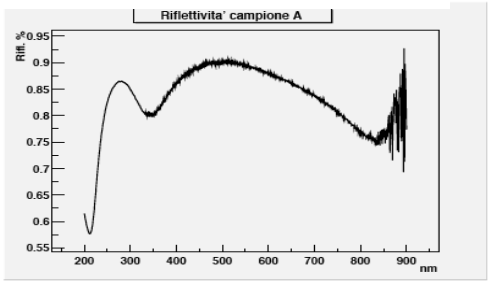
- Area increased to $1m^2$
  - Easier production
  - No need for inter-alignment into panels
  - Less weight (32 -> 18kg)
  - Less expensive?
- Design:
  - Basically an extension of MI-upgraded mirrors
  - Increased width (60mm) resulted in an increased rigidity and better performance
  - Hole in the centre for laser housing

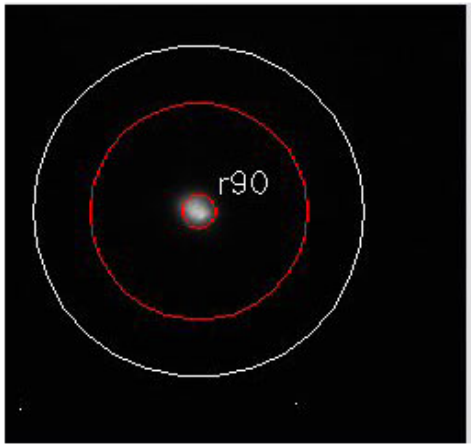


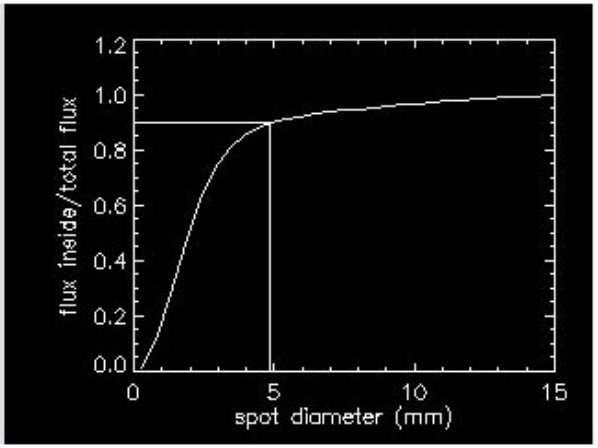
Mirrors - properties





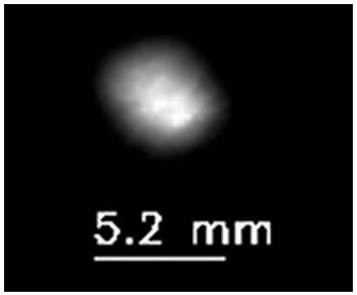




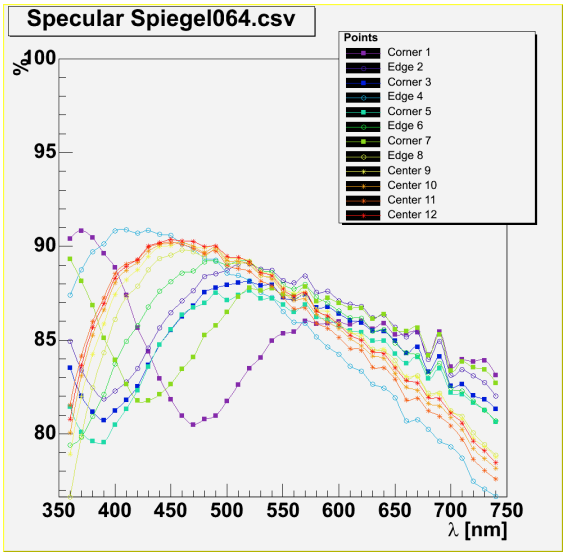


- The different radius is obtained with different setup of the fly-cutter diamond-milling machine
- Tests & Measurements:
  - ✓ Radius of curvature
  - ✓ Point Spread Function
  - ✓ Reflectivity vs wavelength
  - ✓ Water tightness
  - ✓ Mechanical stresses
  - ✓ Focal vs temperature

MII mirror properties

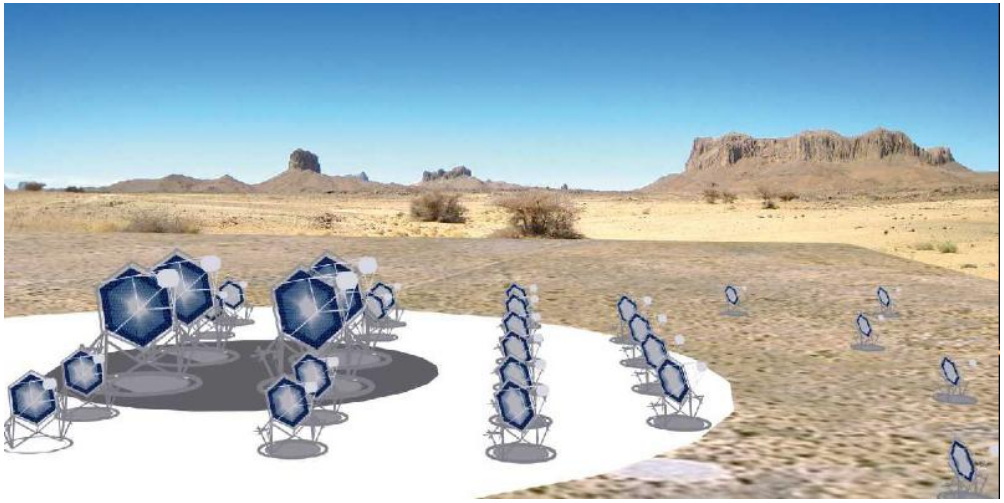


- Extremely good PSF=5mm @ 17m
  - 1/5 of the pixel
  - Best mirrors ever built
- Good insulation
- Reflectivity:
  - Average focussed reflectivity ~85% depending on position
  - Measuring diffuse light is difficult
  - Need of measuring total reflectivity

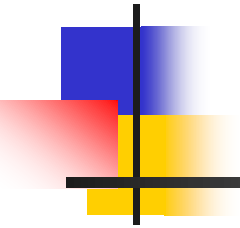


Prospects for CTA

- Improve design
  - Better water tightness
  - Easier mounting system
  - Reduce costs
  - No major designing needed
- Possibilities
  - Aspherical mirrors
  - Large mirrors easy to go
- Advantages
  - High optical quality
  - Extremely high environmental ruggedness (basically not reflectivity degradation in 5 years)
- Drawbacks
  - Costs (3keuro/m^2)
  - Slow production (1-2/day)



- Activities so far
  - Contact with companies
  - (Lack of money so far to start prototyping)



Thanks for the attention and sorry for not being there!