Evolution of the Auger FD design (very briefly)

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PIERRE AUGER PROJECT DESIGN REPORT

(First Edition)

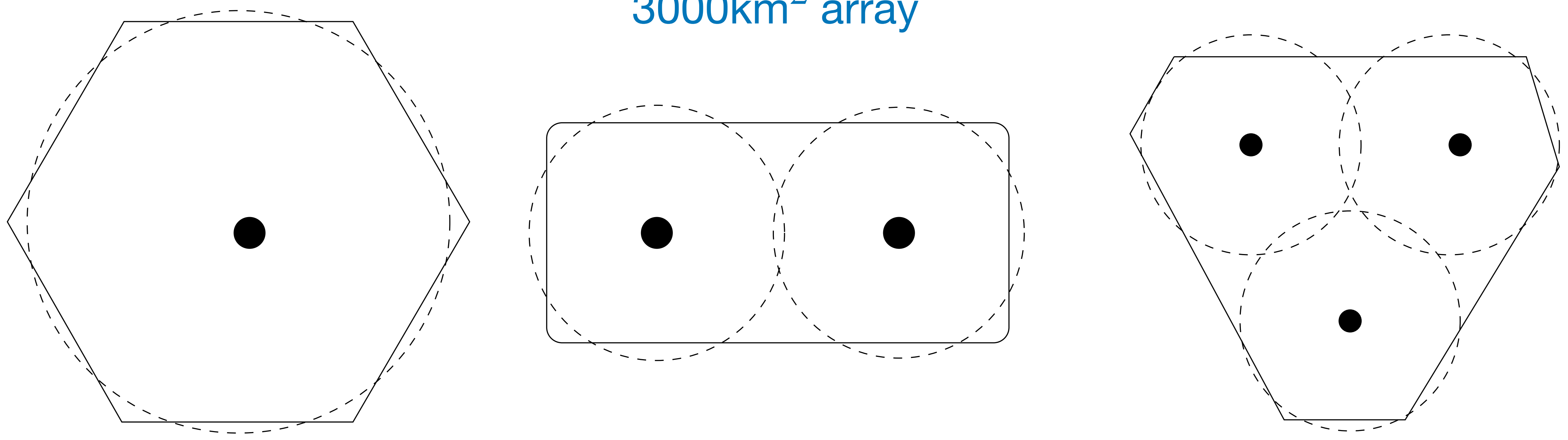
The Auger Collaboration

October 31st 1995

(Just before site selection)

- Hybrid already decided in 1993.
  (as was the elevation range of 30 degrees (HiRes).)
- Stereo was not a priority (should it have been?) because hybrid geometry was very good. Didn't enter into optimisation.

$3000 km^2$ array



Cyclops　　Mastercard　　Superman

$$S/N \sim \sqrt{\frac{A}{\Omega}}\,\frac{1}{R^2}\,exp(-R/\xi).$$

i.e. maximise S/N with big mirrors and small pixels.

- Optimisation for first Design Report
  - based on required S/N and cost of mirrors/pixels/electronics/site preparation.
  - assumed good knowledge of atmosphere.

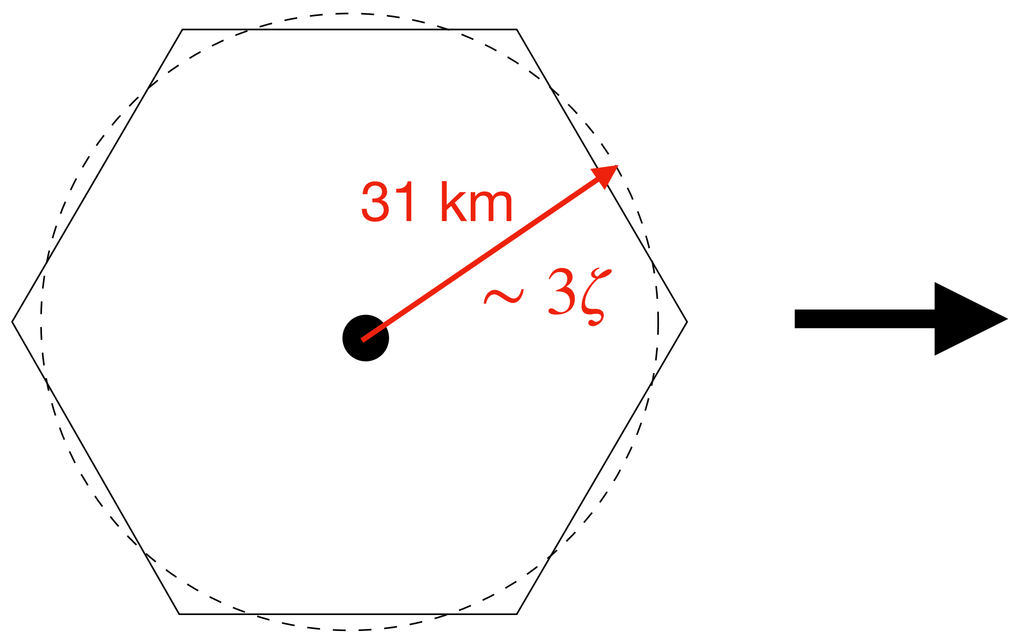
- Optimum $N_{site} < 1.5$ → "Cyclops 3000" was the reference design
  - 48 telescopes, 4.4m diameter mirrors
  - 15x15 deg camera, 1 deg pixels
  - 10,800 channels

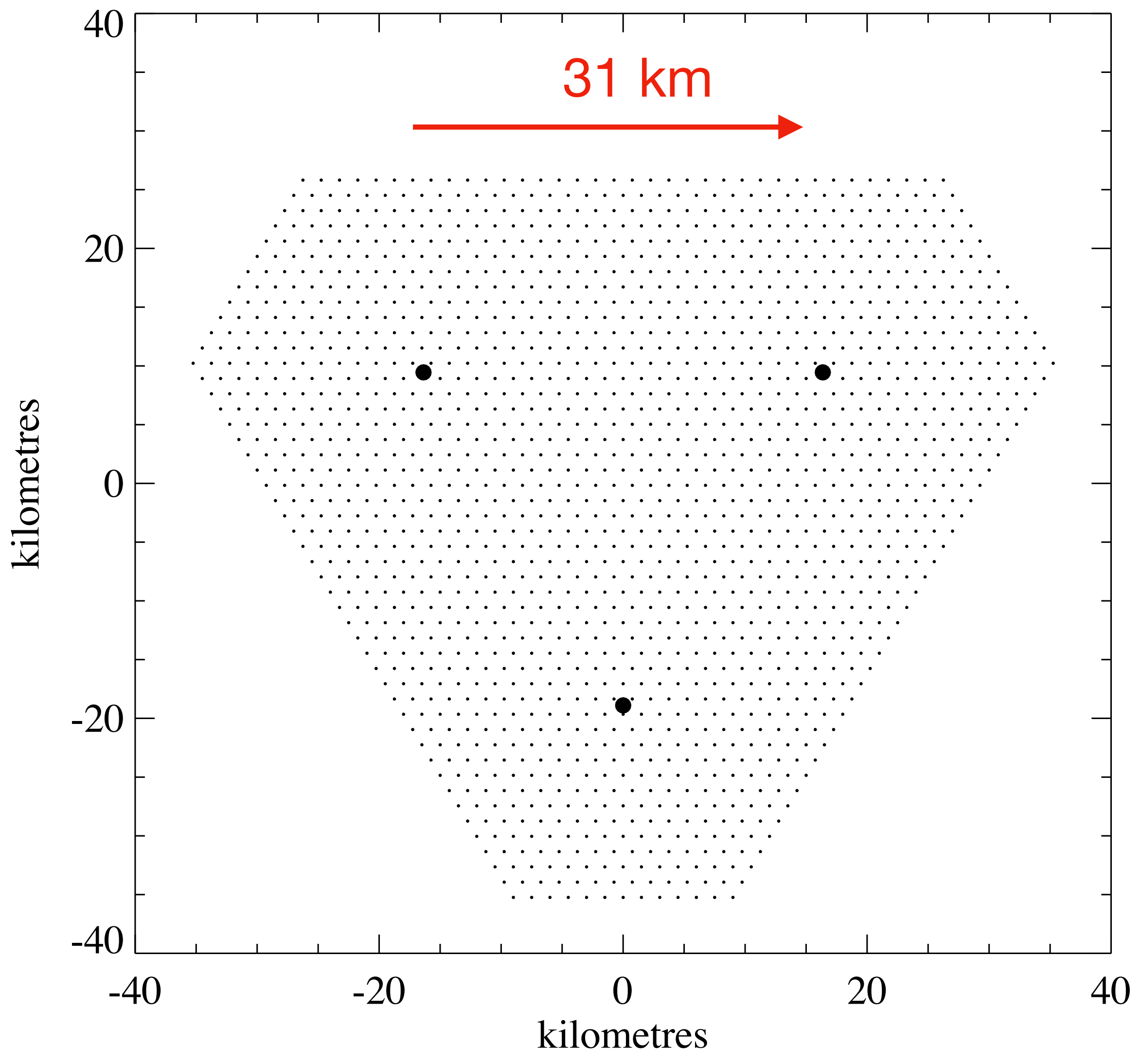
THE PIERRE AUGER OBSERVATORY DESIGN REPORT

Second Edition

The Auger Collaboration

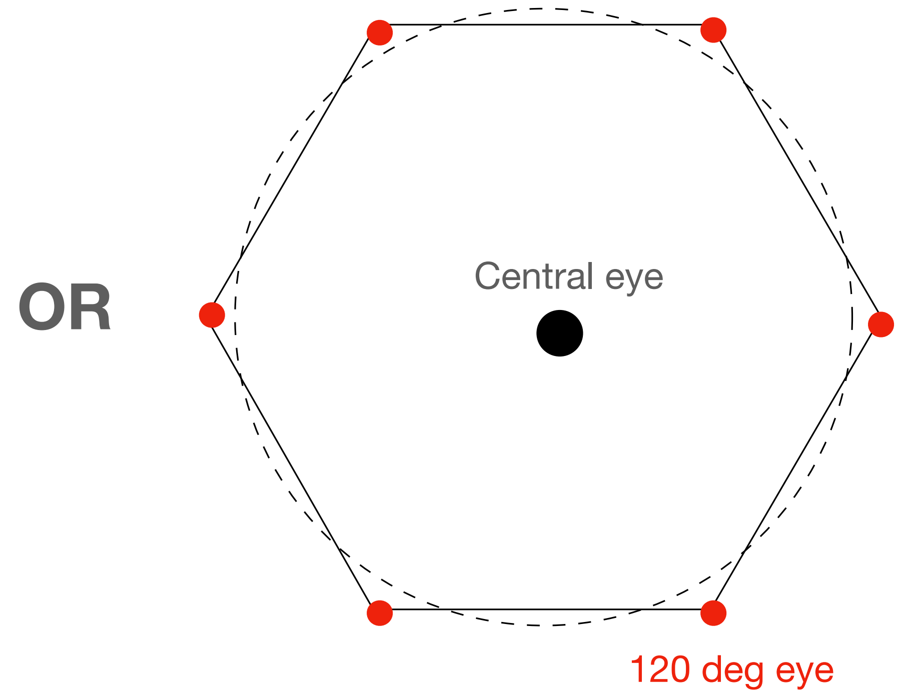
14 March 1997





“Superman”

OR



“Hexagon”

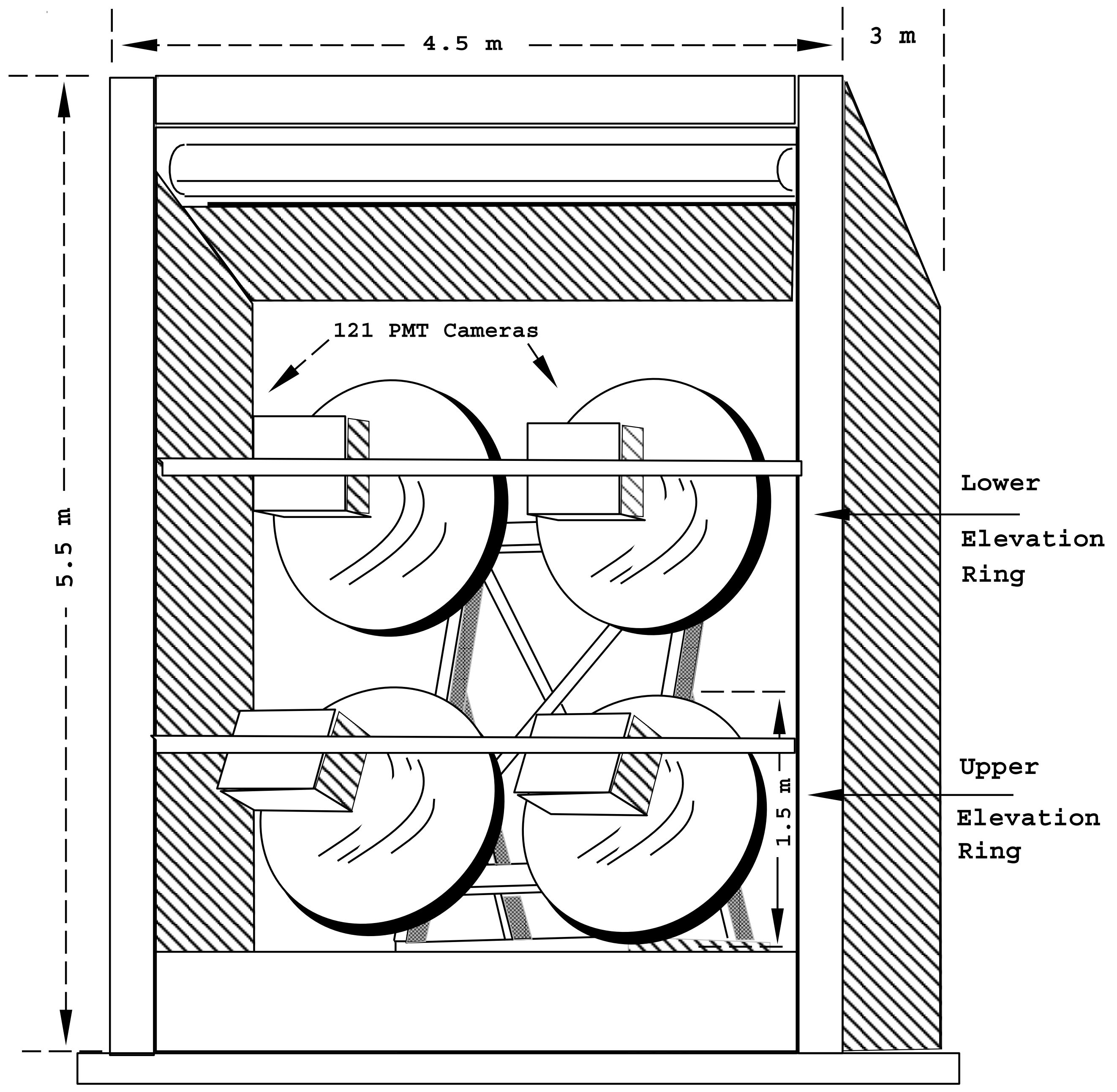
- We weren’t confident of knowing the atmosphere well enough for Cyclops

- Superman and Hexagon used less “far-sighted” telescopes, very similar performance for either design

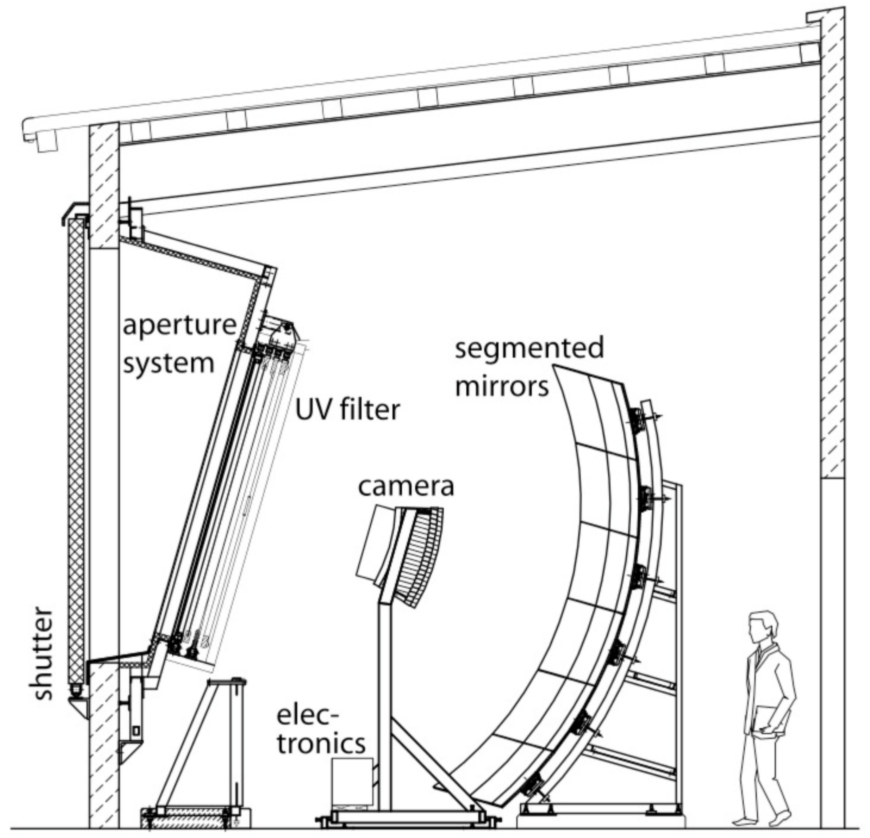
- 1.5° pixels. $16^\circ \times 14^\circ$ camera.
  1.5m dia. mirrors
  135 telescopes
  16,335 channels

- Bigger pixels - good, fewer boundary crossings (but sufficient for SDP)

- Hardware cost somewhat more expensive than one far-sighted Cyclops eye

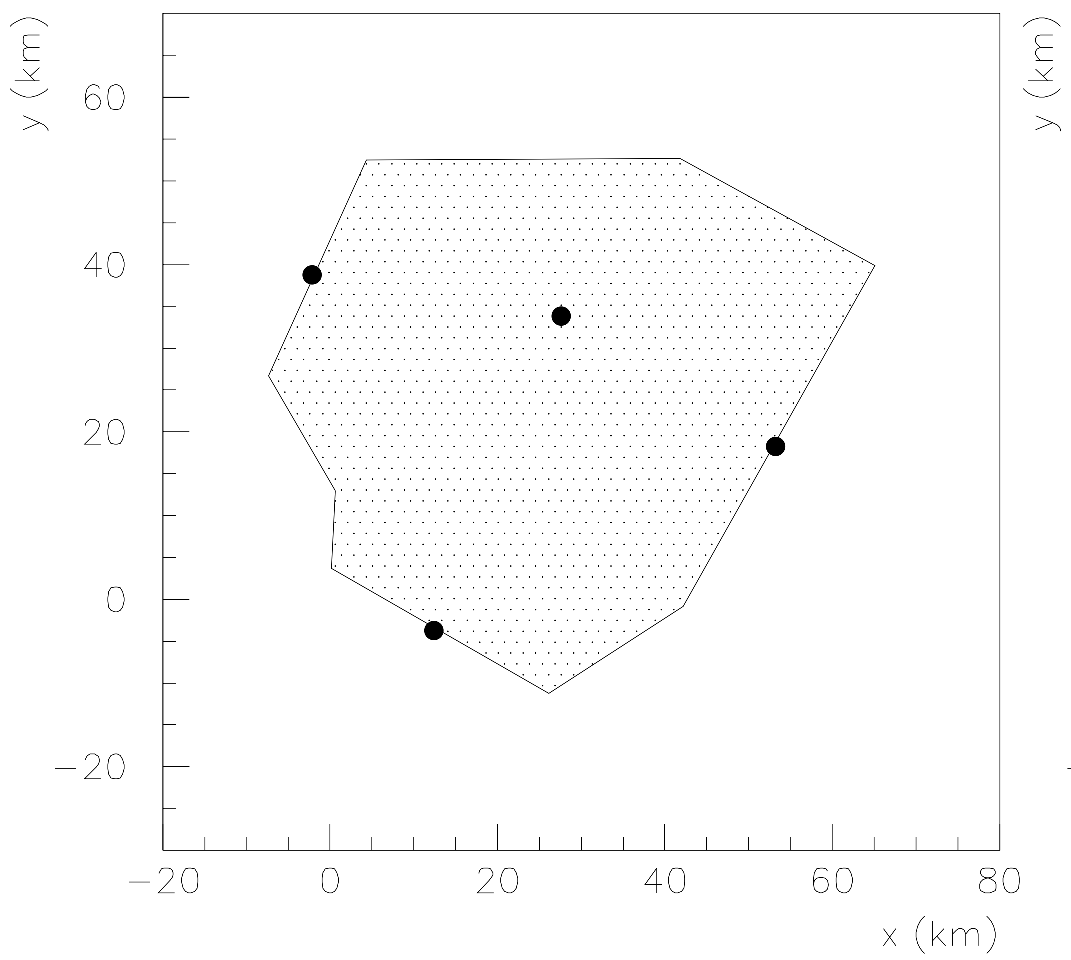


Evolution of design 1998-2000

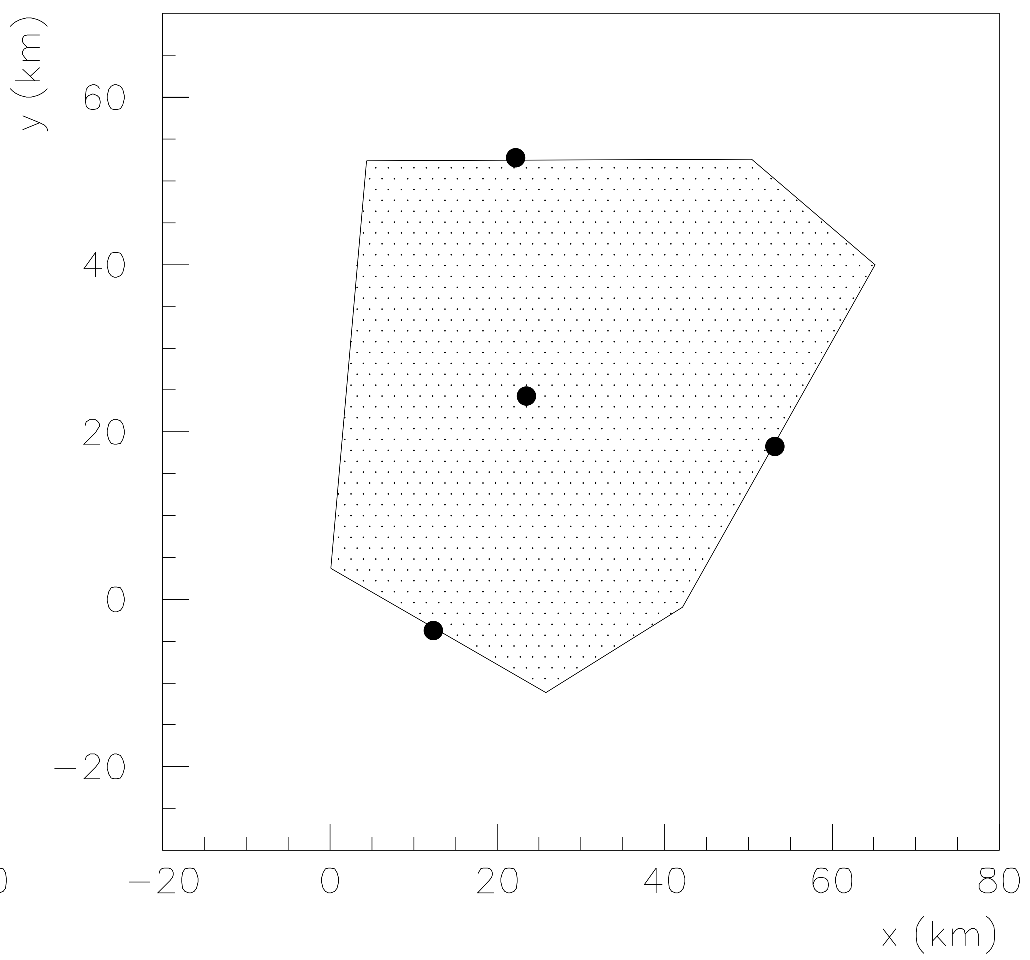


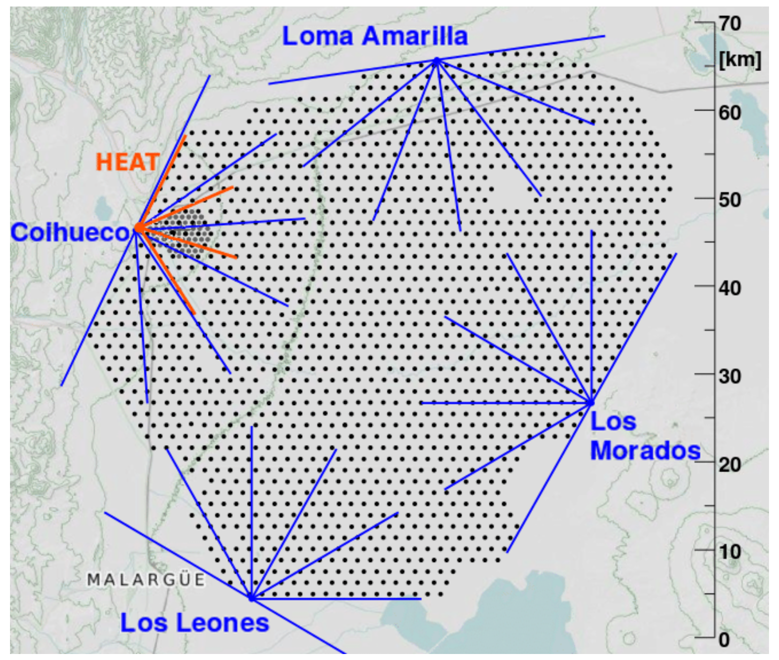
- Major innovation - Schmidt optics (incl. corrector “ring”) (Puebla group)
  - reduces coma aberration, all pixels are “equal”
  - $30^\circ \times 30^\circ$ camera FOV, reduce telescopes by 4x
  - not a cost-saver, since mirrors have to be ~4x larger
  - but great for data quality!

Coihueco option



Puntilla (a.k.a. Loma Amarilla) option





- A real site: attempting to take advantage of elevated positions for the FDs
  - elevation minimises the problem with aerosol boundary layer, fog
- But no obvious position for “central” FD
- We settled on 4 elevated sites each with 180° FOV, saving money (24 vs 30 telescopes) but sacrificing some stereo aperture (sad in retrospect)
- This ensured that FD cost < 50% of Observatory cost. Also, the lack of an elevated central position was problematic.

Omitted: “Plan B” (1996), similar idea to FAST and CRAFFT
Dual mirrors (1996), bigger pixels, two mirrors per telescope, offset FOVs