National Society of Black Engineers (NSBE)
Houston Space Chapter

Macho Mengi “Many Eyes”

NSBESAT 2 Ground-based Interferometric Telescope Research

Macho Mengi
"Many Eyes"

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Project Overview

- Introduction
- Background
- Goals and Objectives
- Project Design Concept
- Project Scope
- Funding
- Macho Mengi Project Team

  *(Roles and Responsibilities handout)
- Questions and Comments

Background

- ***NSBE's small satellites projects is for NSBE members to gain first hand experience at designing, building, and operating satellites.***

Phase I

- ***<u>NSBESAT 1:</u> Single space telescope***

Phase II

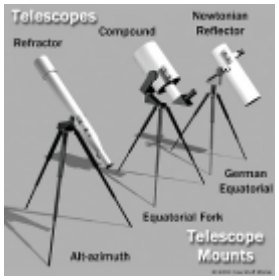
- ***<u>NSBESAT 2:</u> Formation of space telescopes that use interferometry to act as one large space telescope.***

Why space telescopes?

- Gives our Community direct access to the Space Program
  - Specifically target:
    - Communities
    - Grade Schools
    - Universities
    - Astronomers and Astrophysicist

What's so interesting about space?

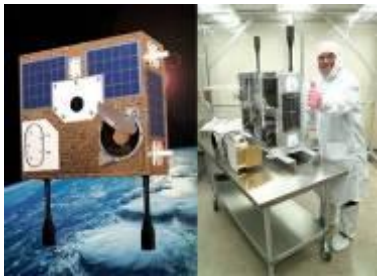
Telescope Technology



Basic Telescope

Observatory

Hubble



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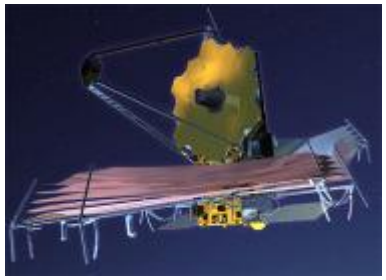
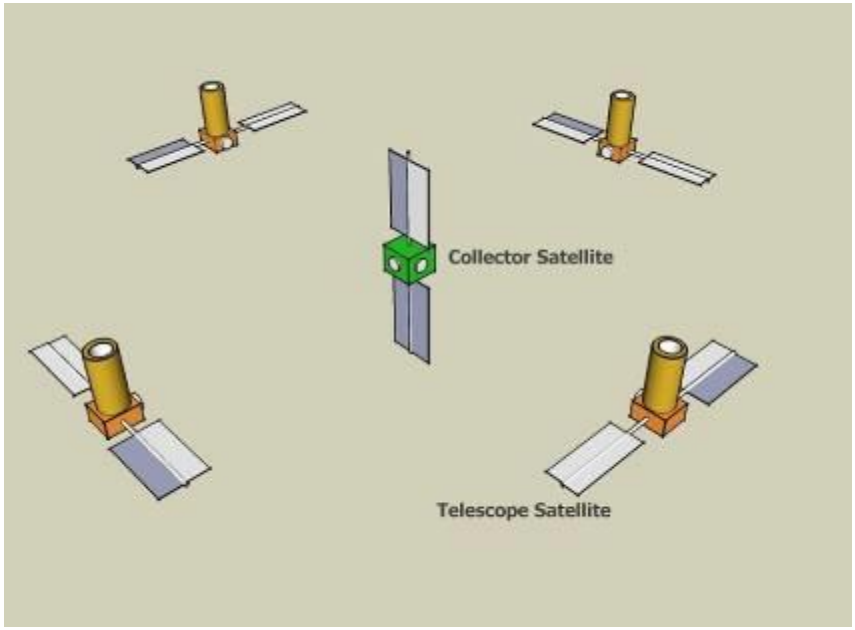
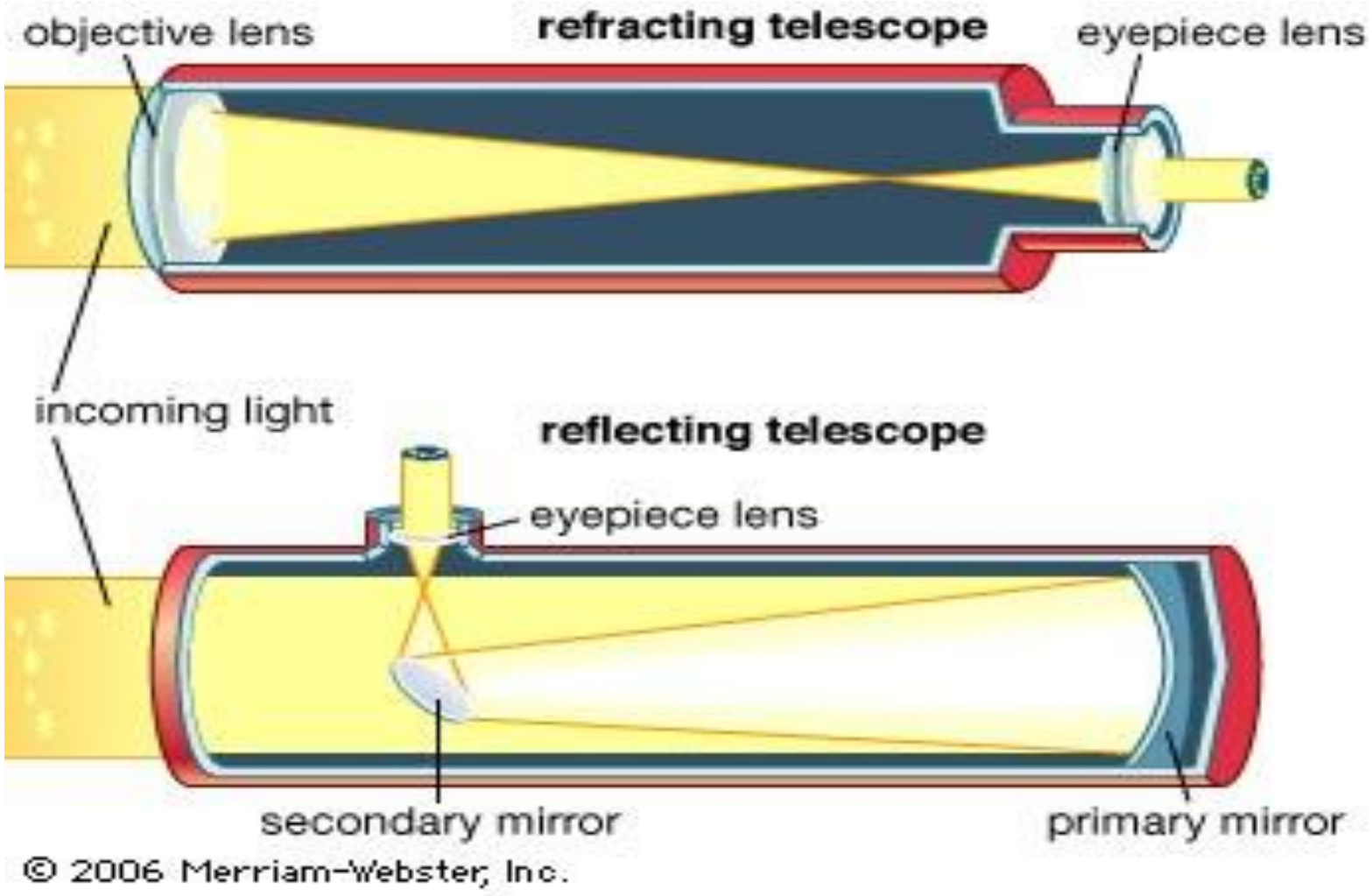


James Webb



Multi-Satellite Telescope

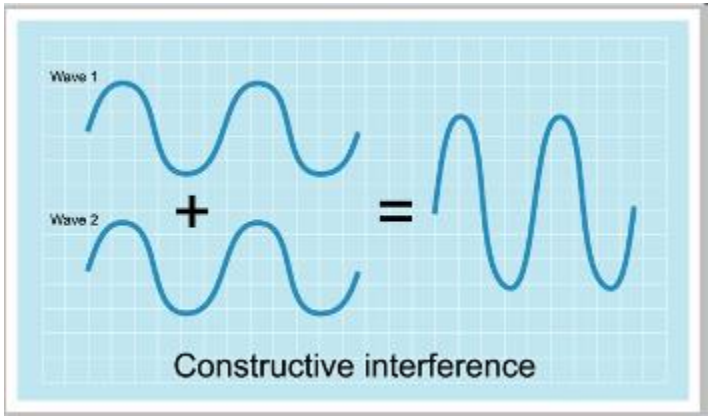
Basic Operation

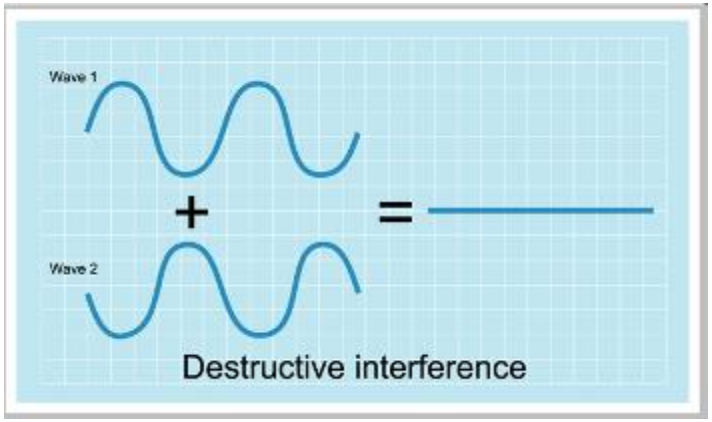


Very Large Telescope Interferometer (VLTI)

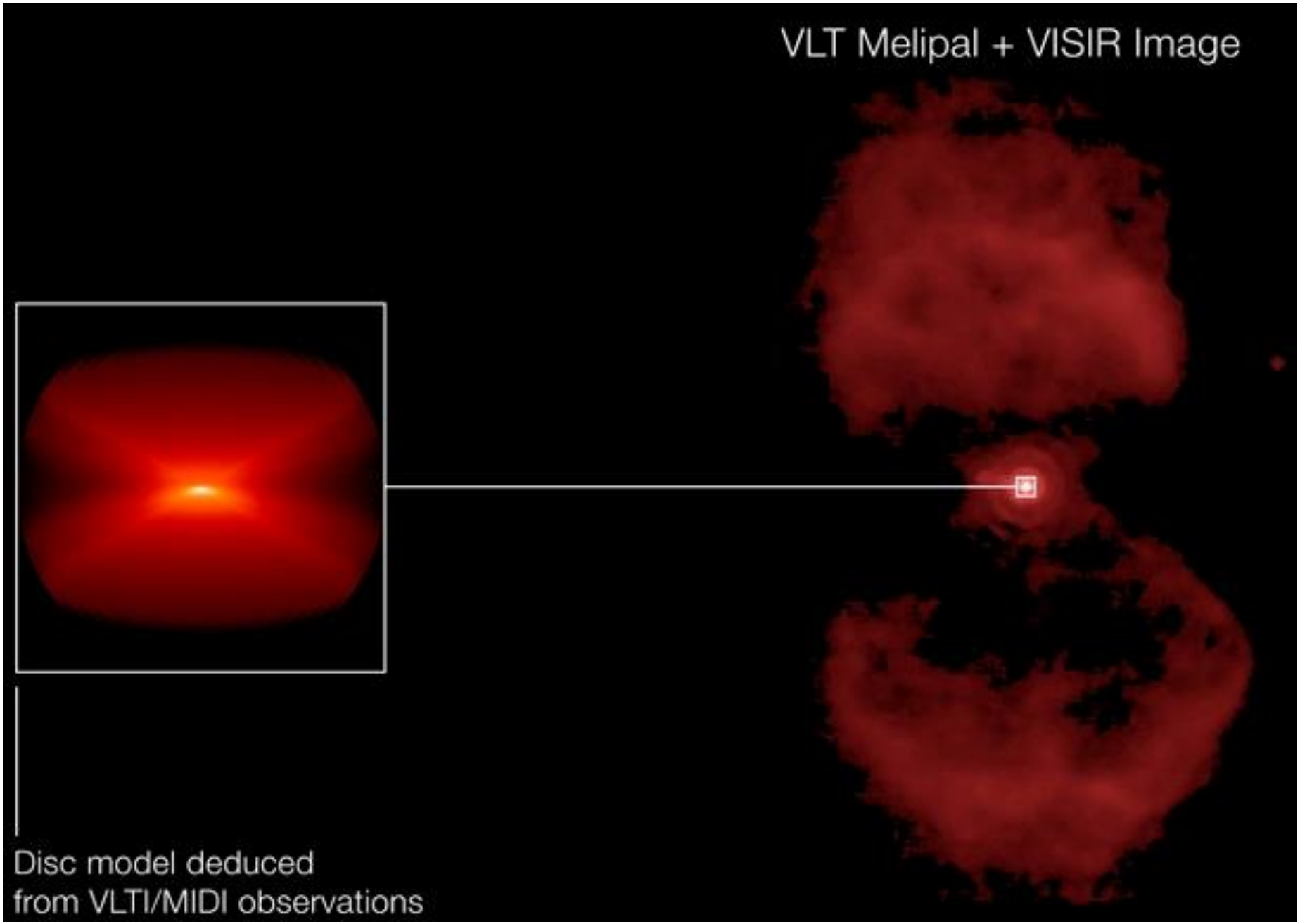
Interferometry: A technique of collecting light from several telescopes and combining them to reveal details much smaller than those visible by a single telescope.

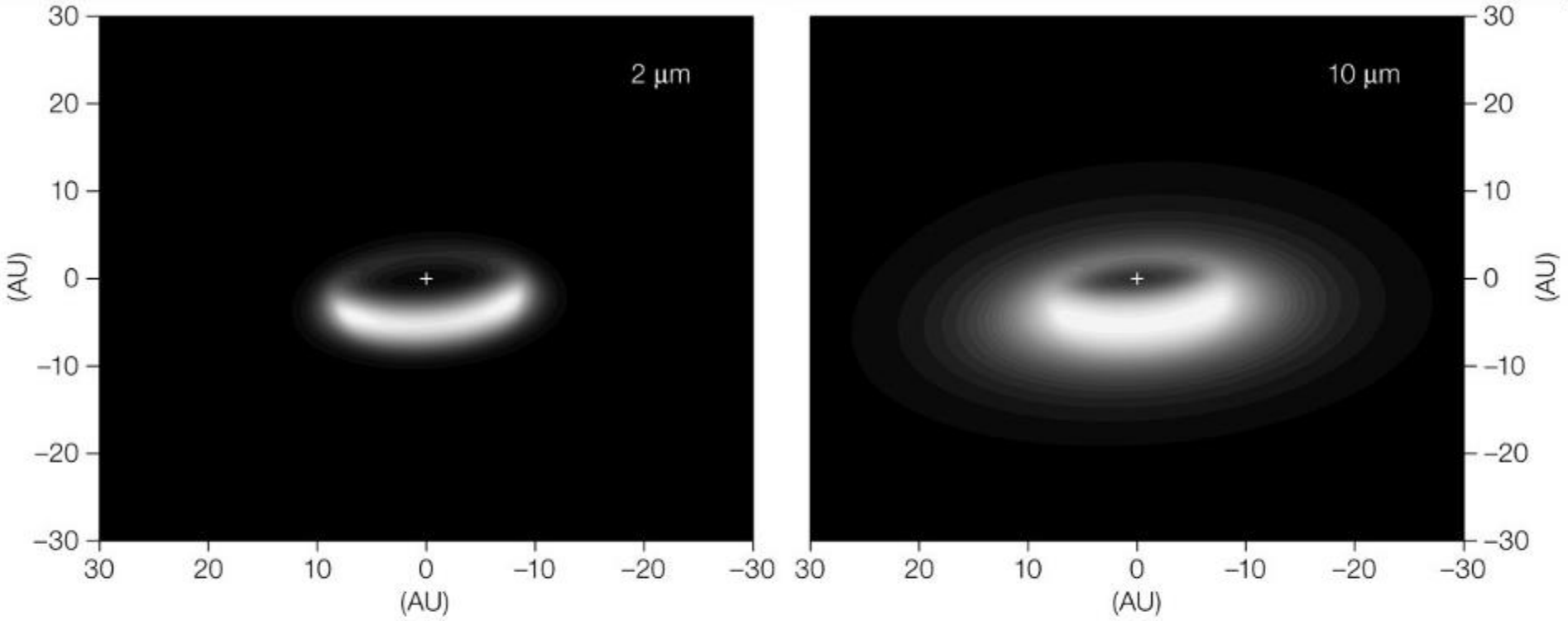
1. Light beams from each telescope, corrected for atmospheric turbulence, are brought together and combined.





2. Computers process data from light sensors to form an image similar to that which would be obtained using a larger telescope than the individual ones.


VLT Melipal + VISIR Image
Disc model deduced
from VLTI/MIDI observations



A Disc Around An Aged Star

ESO Press Photo 43/07 (27 September 2007)

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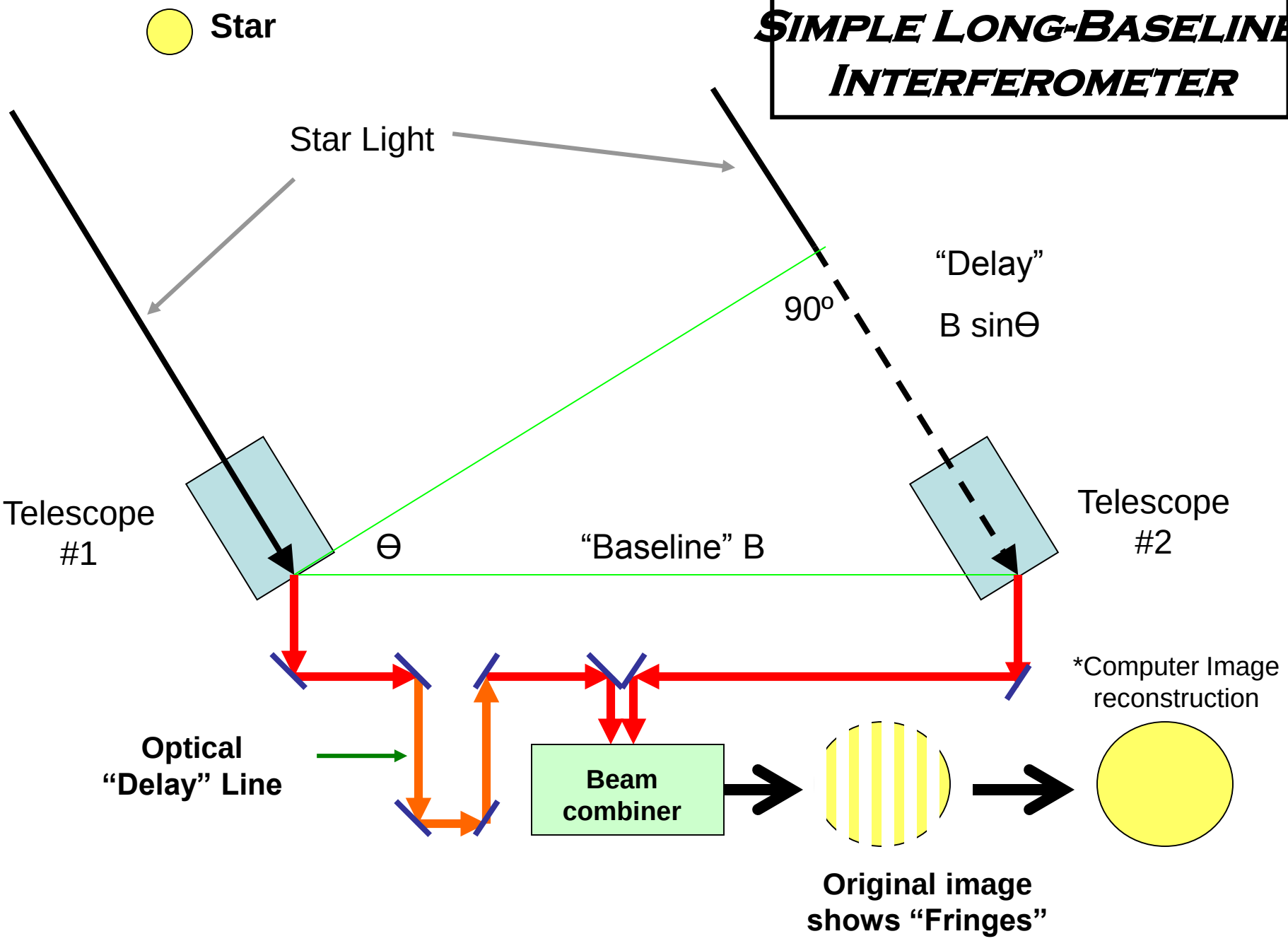
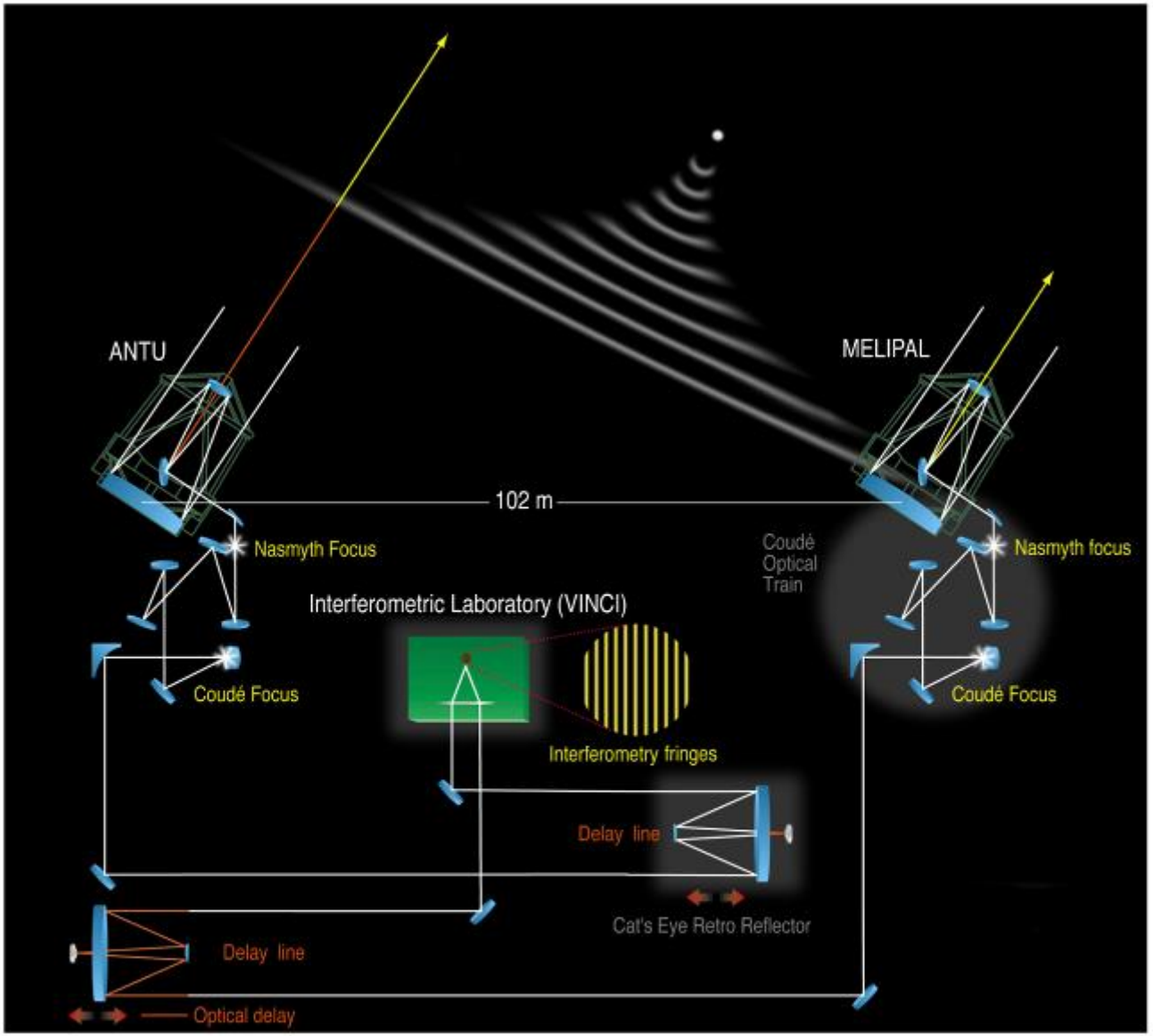
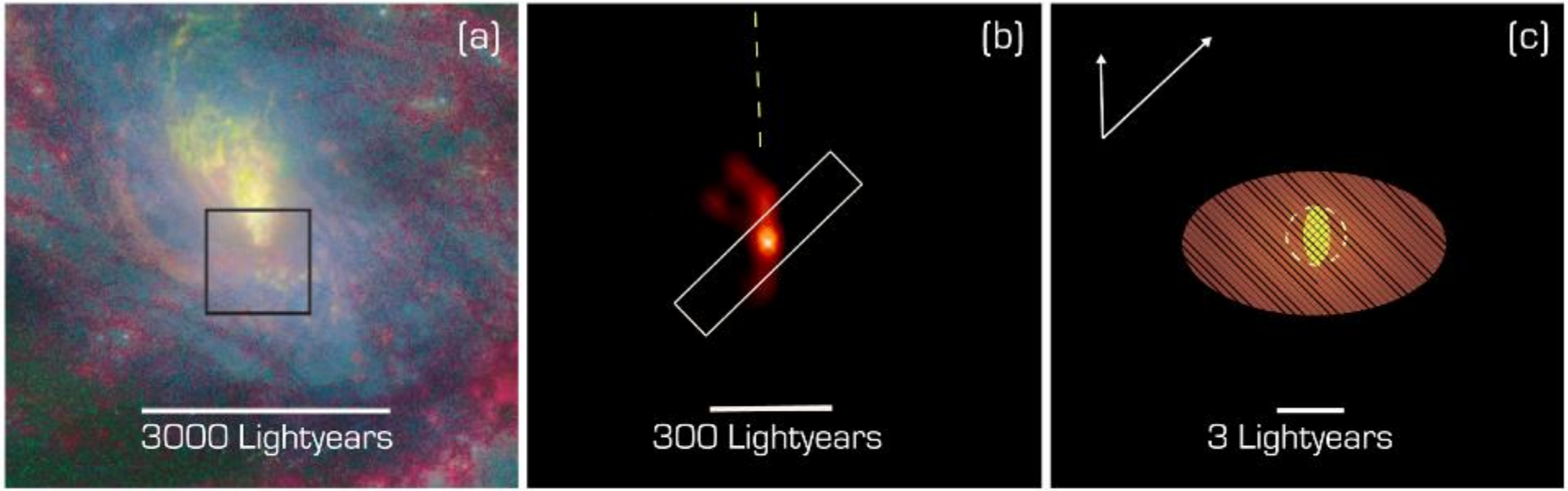
Simple Long-Baseline Interferometer





The VLT Interferometer with ANTU and MELIPAL



The Innermost Region of the Active Galaxy NGC 1068
(VLTI + MIDI)

ESO PR Photo 13/04 (5 May 2004)

© European Southern Observatory

Angular Resolution

- **Angular resolution** describes the resolving power of any image-forming device (optical or radio telescope, microscopes, cameras, or an eye).
- The term resolution or minimum resolvable distance is the minimum distance between distinguishable objects in an image.

The angular resolution *R* can usually be approximated by:

Single telescope case

$$R = \frac{\lambda}{D}.$$

Telescope array case

$$R = \frac{\lambda}{B}.$$

λ = wavelength of the observed radiation
D = diameter of the telescope's mirror or lens.
B = length of separation of the telescopes in the array (baseline).

Angular Resolution

(Calculated examples)

Wavelength: 580 nm - yellow light

Diameter/ Baseline (m)	R (arcsecond)		
1	0.120		
1.8	0.066	**VLTI**	Auxiliary telescope
2.4	0.050	Hubble	
8	0.015	**VLTI**	Main telescope
100	0.0012	COAST	Cambridge Optical Aperture Synthesis Telescope
200	0.00060	**VLTI**	Interferometer
640	0.00019	SUSI	Sydney University Stellar Interferometer
1609	0.000074	**<--- 1 Mile**	

.001 arcsecond -- Equivalent to resolving a target 2 meters (6.6 ft) across at the distance between the Earth and Moon.

Project Goals and Objectives

⇒ **Our primary goal: Have a minimum of three NSBE members with the necessary experience to become subject matter experts to contribute with the development of NSBESAT 2.**

- **Our objective: Have a complete and working small ground-based interferometric telescope to be used as a "proof of concept prototype" and training tool for NSBESAT 2.**

Project Design Concept

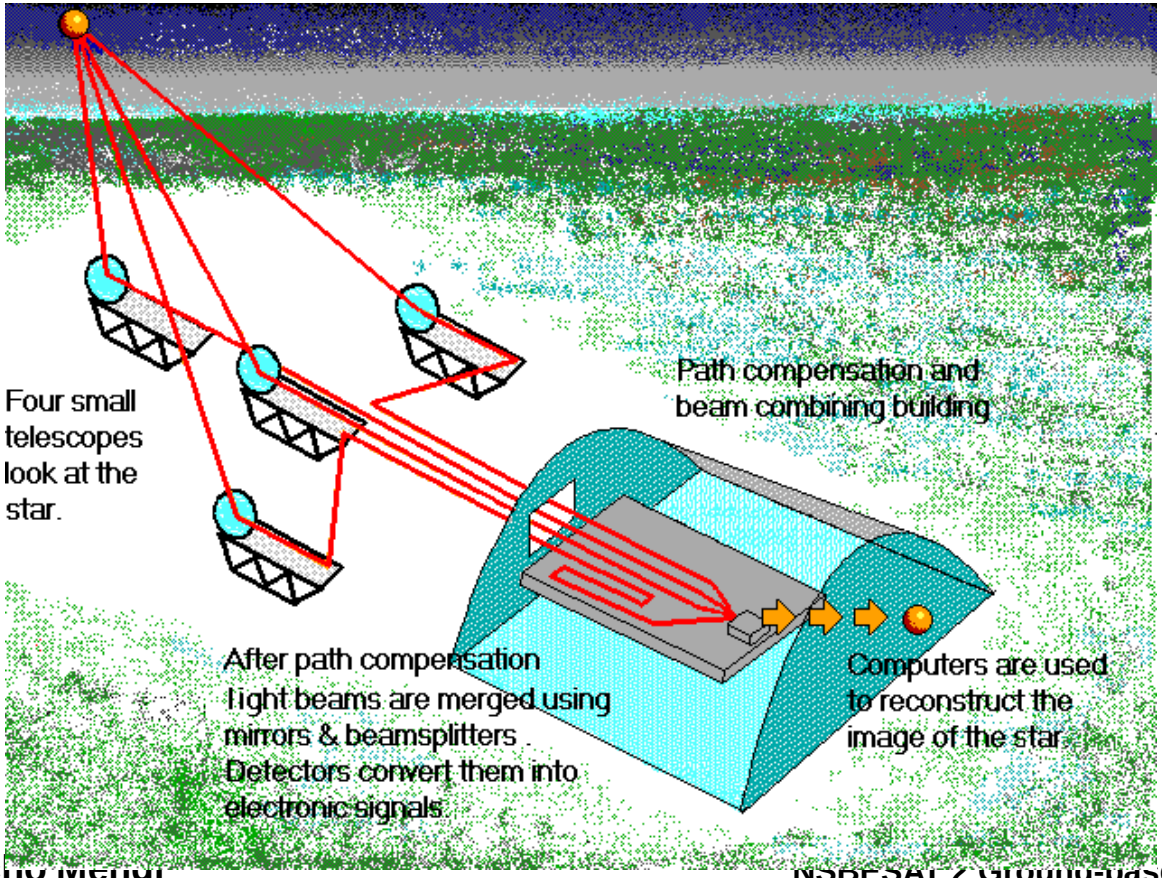
Macho Mengi

Requirements:

- Four reflective telescopes
- Transportable
- Moveable baselines and formations
- Stable
- Configured for visible light

Design:

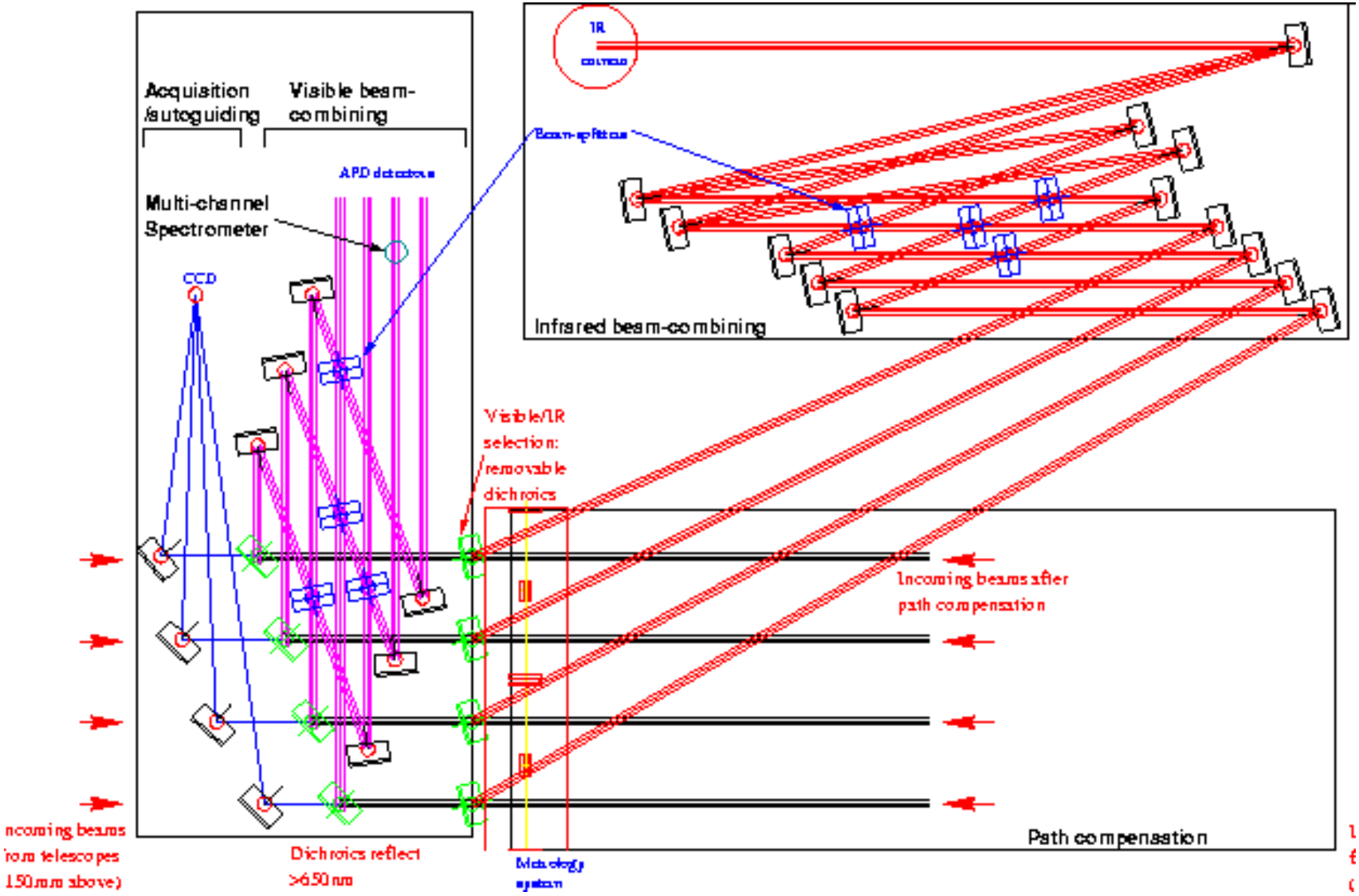
- Similar to COAST interferometer

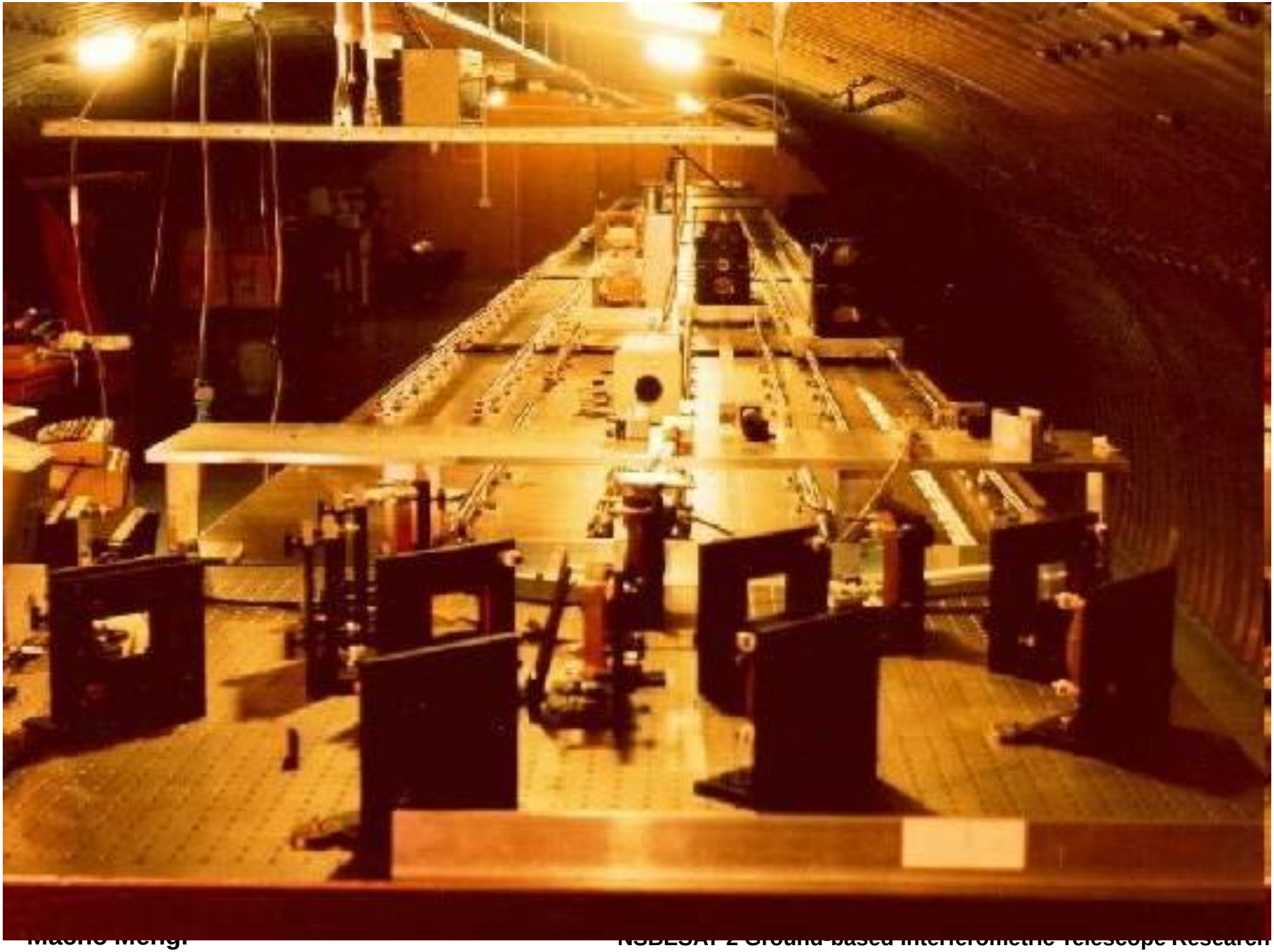


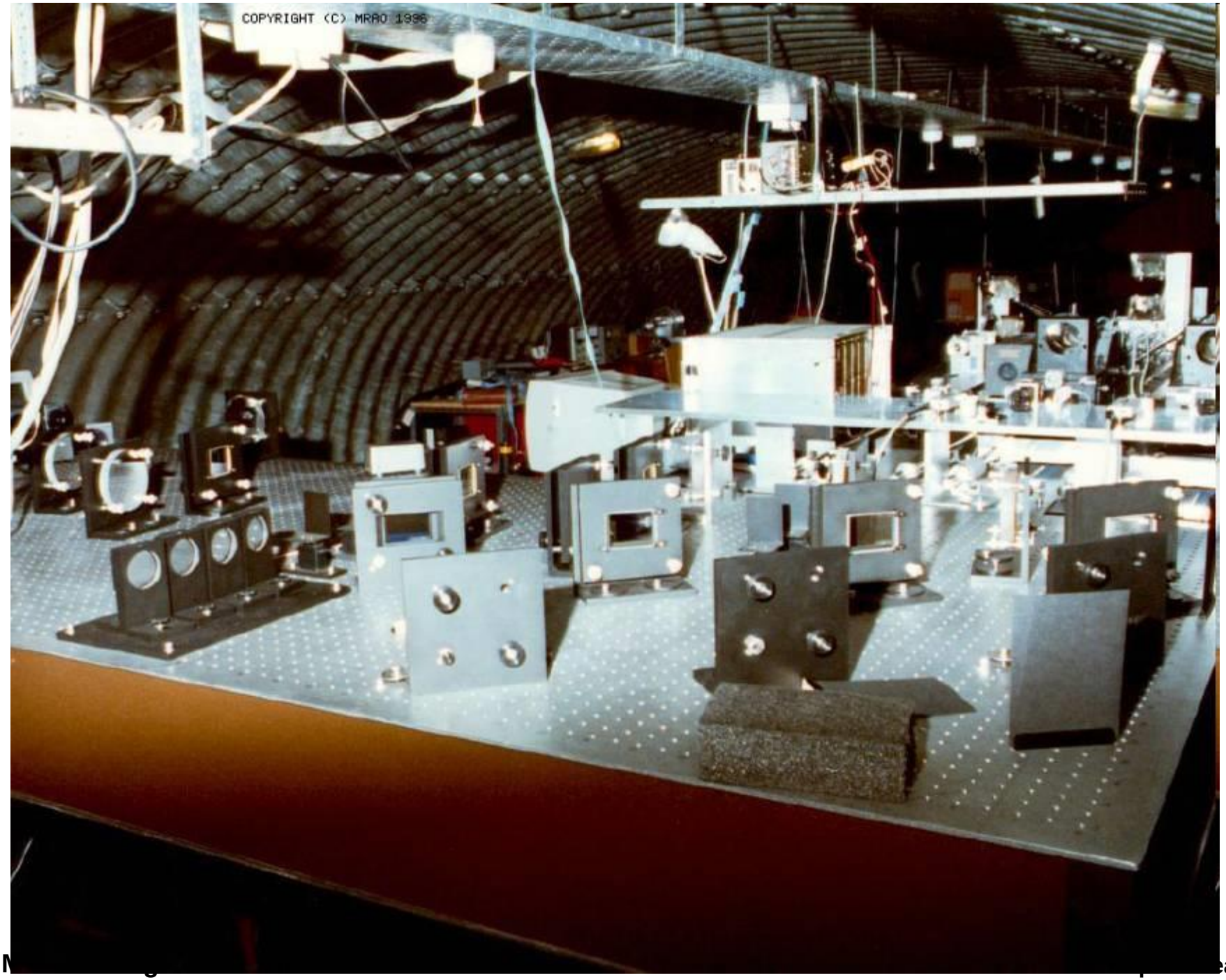
COAST Interferometer Testbed Univ. of Cambridge

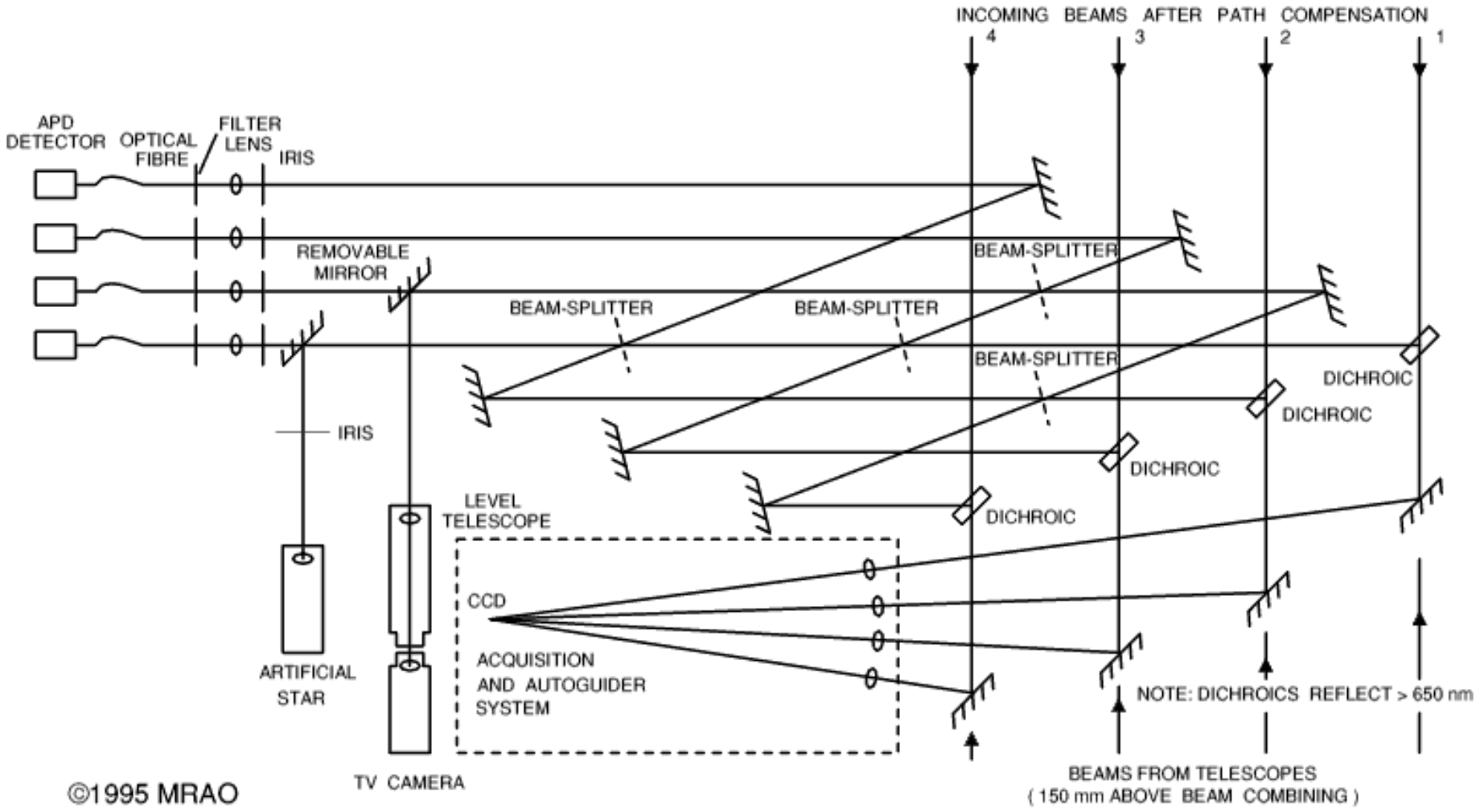
Built 1988

COAST Beam Combining Table

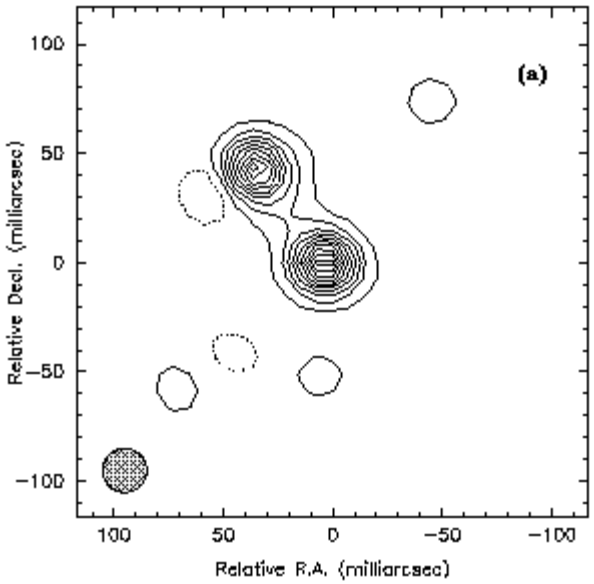


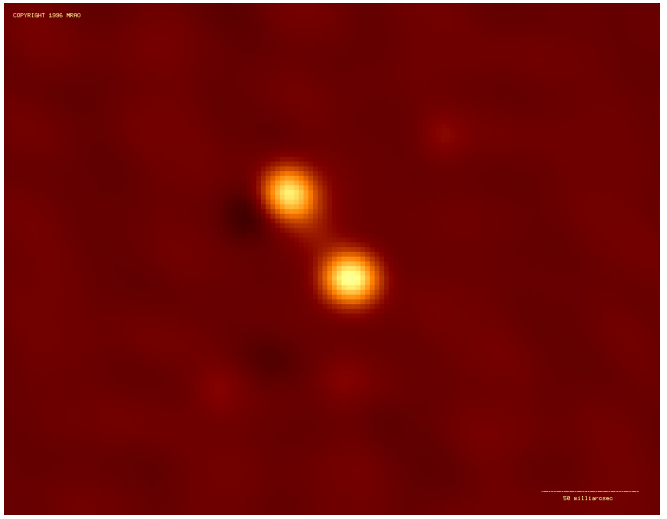


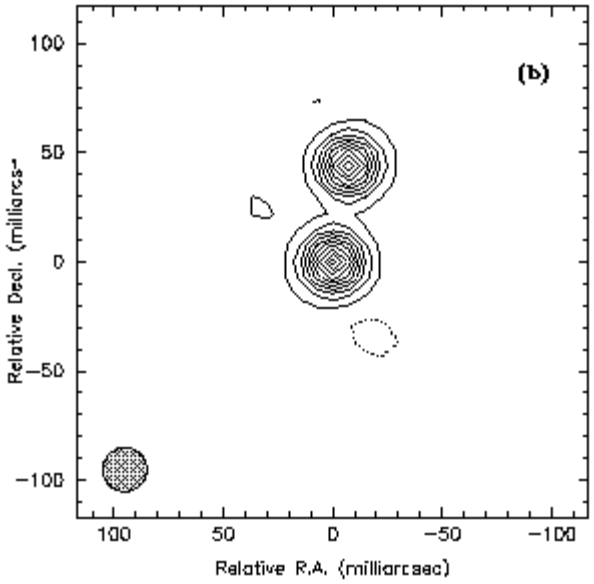

COPYRIGHT (C) MRAO 1996



BEAM COMBINING TABLE







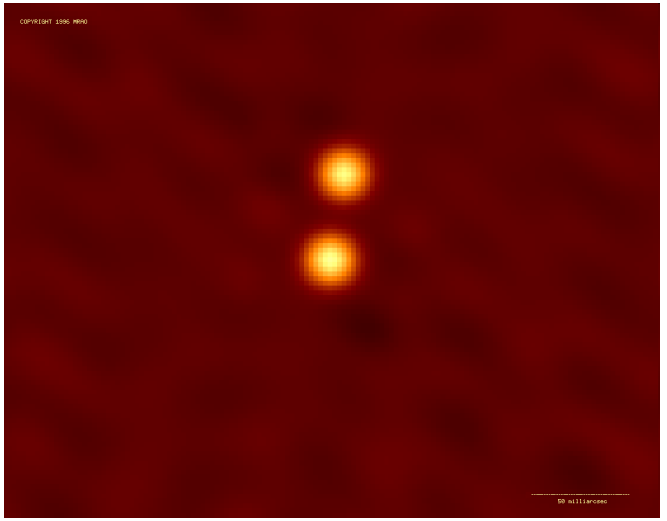
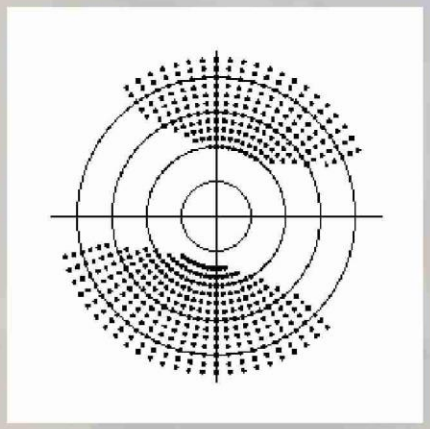
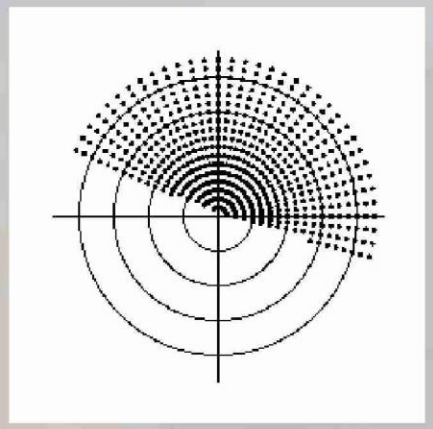
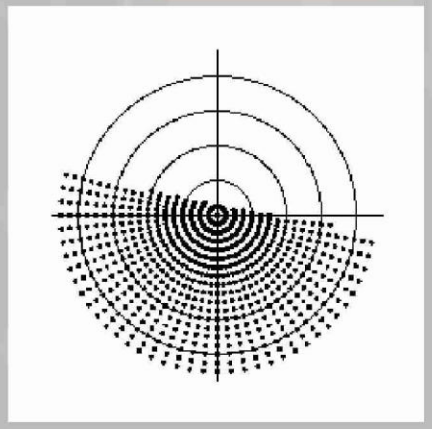


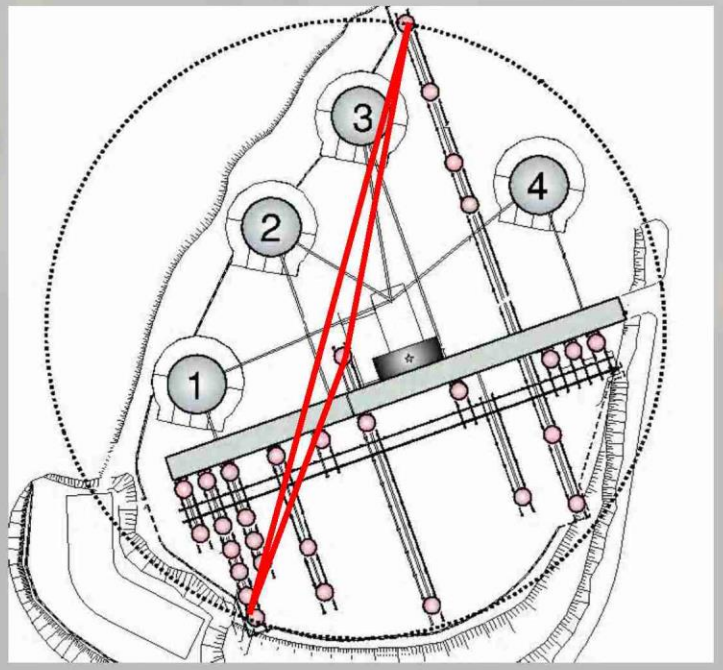
Image reconstructions of Capella, from
data obtained on the nights of the 13th (a) and 28th (b) September 1995.

DL restriction on ATs









Project Scope

Project Includes
Designing, building and operating a ground-based interferometric telescope
Training NSBE members on use of interferometric telescopes
Comparison between interferometric and non-interferometric telescopes

Project Excludes
Astronomy research – although aspects of astronomy will be learned this particular project is an engineering and physics research project.
NSBESAT 1 and 2 satellite design

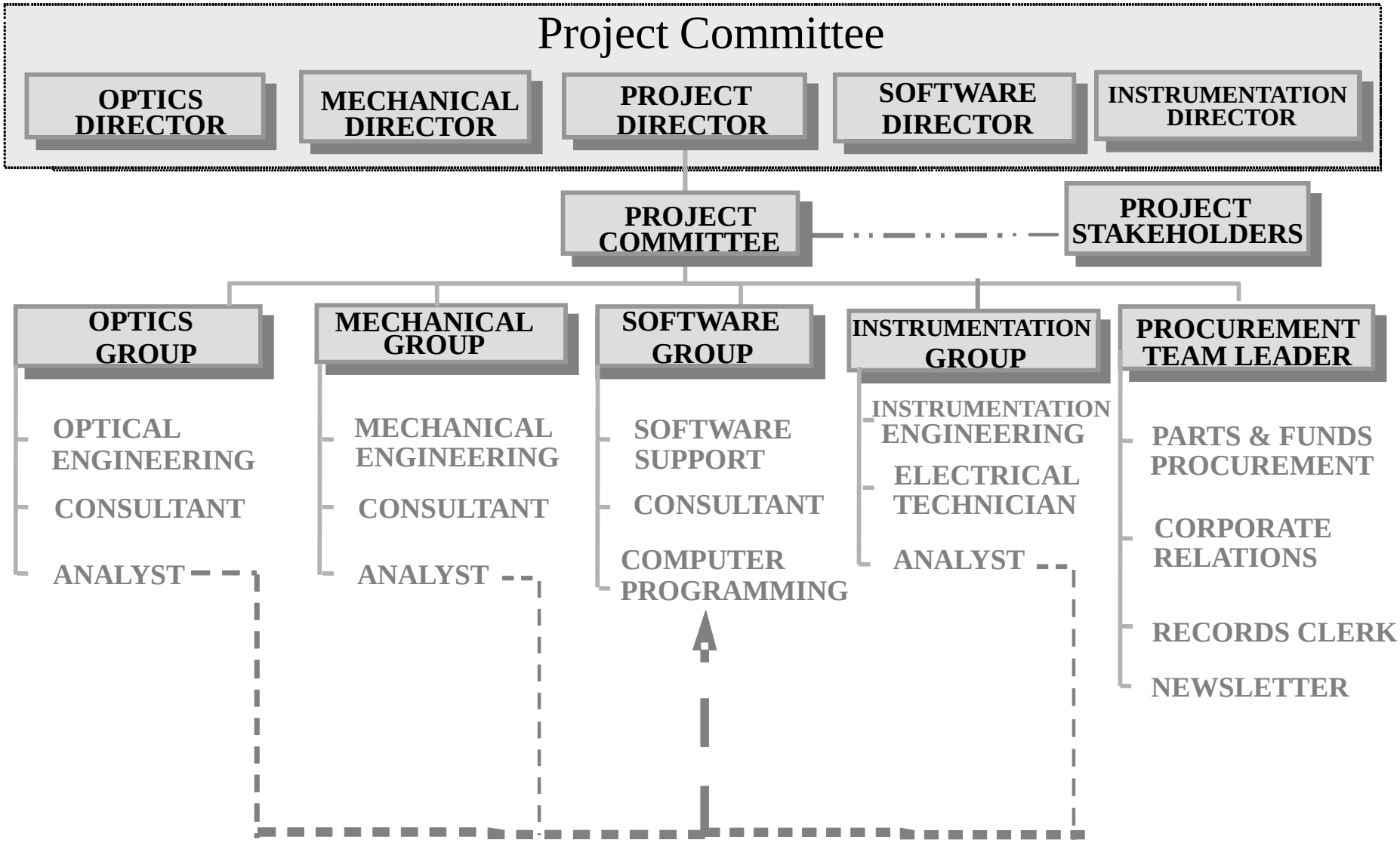
Funding

- ⇒ Funding Authority for this project shall be in accordance with the existing chapter bylaws of the NSBE Houston Space Chapter.
- The bulk of our financing should come from corporate sponsors, donors, and federal grants.
- Once we have a better idea of our design and specifications - <u>receiving donated equipment</u> would be our best bet.

Funding
Donated Equipment

- Key Philosophy: "Linking Needs with Benefits"
- We are not looking for "junk", but sometimes companies are willing to donate some of their latest products for key benefits:
  - Free Advertising at Major Events
  - Tax write-offs: NSBE HSC is a 501(c) non-profit organization
  - Free testing:
    - The process can be as simple as reporting to them how well their product performed under real world conditions.
- Companies may be more willing to donate components out of their manufactured surplus rather than giving cash.
- The value of donated components may far exceed whatever they would have given in actual dollars.

Macho Mengi Project Team



*See Handout for Roles and Responsibilities

Macho Mengi Team

- **Kevin Calvin:**
  - **Optics Director**
- **Chemuttaai Lang'at:**
  - **Mechanical engineer**
- **Darnell Cowan:**
  - **Acting Mechanical Director**
- **Dr. Robert Howard:**
  - **Consultant**
- **Michael McCullar:**
  - **Project Director**

Visit NSBE's Houston Space Chapter Homepage:

http://www.nsbe-hsc.org

Questions?