A contribution to the history of the *Very Large Telescope* Interferometer

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Ten Years of VLTI : from First fringes to Core Science

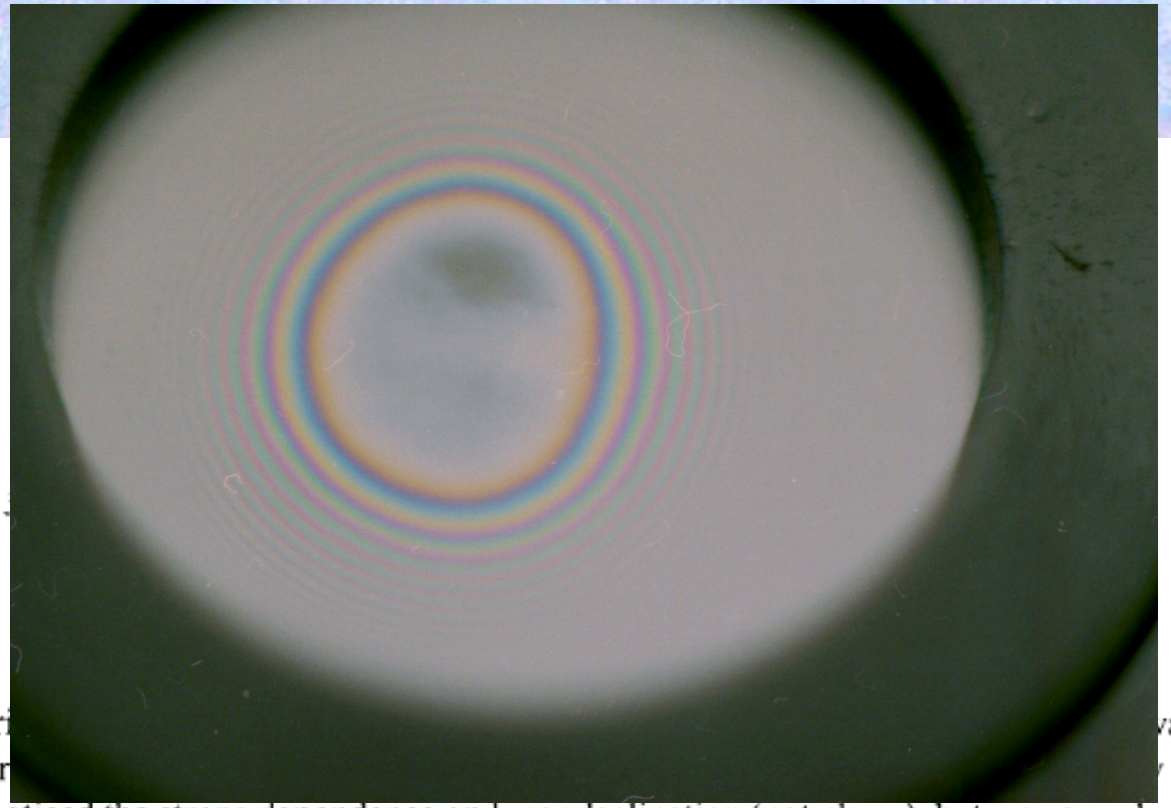
European Southern Observatory, Garching,Oct 24-27, 2011

1. Back in the past
2. 1970s : the revival of optical interferometry ;
3. 1977-1987 Birth of the VLTI : political ;
4. 1977-1987 Birth of the VLTI : scientific ;
5. After the 1987 VLT decision ;
6. Looking at the future.

1. Back in the past

The tides in the Gulf of Tonkin

Francis Davenport, 1678-1684



A descri vard
time for (in
1684) noticed the strong dependence on lunar declination (not phase), but was over-hasty in trying to reduce the varying amplitudes to a simple rule. Newton proposed a mechanism for the absence of the half-daily tide, but admitted that further observations were required to confirm it. Another explanation was made by Euler in 1740. The exact site of the original observations is obscure but is here identified through Dampier's *Voyages*. The subsequent history of prediction practice is briefly summarized, and attention is drawn to a recent computer model of the South China Sea that belatedly solves all the outstanding problems.

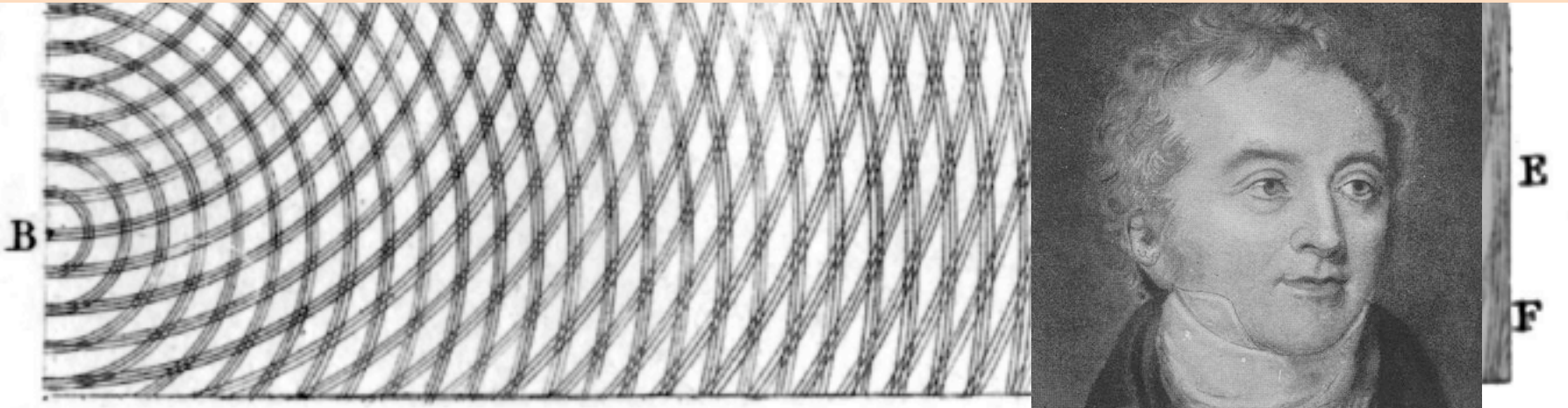
Notes. Rec. R. Soc. London, 57, 135-142, 2003

Two slits…perhaps the single most influential experiment in modern physics.

Fig. 267.

*…But the general law, by which all these appearances are governed, may be easily deduced from the **interference** of two coincident undulations, which either cooperate, or destroy each other…*

Young T. (1802) A syllabus of lectures on natural & experimental philosophy.



Thomas Young (1773-1829) by Sir Thomas Lawrence

Young, T. 1804 Experiments and calculations relative to physical optics. *Phil. Trans. R. Soc.Lond.* **94**, 1–16.

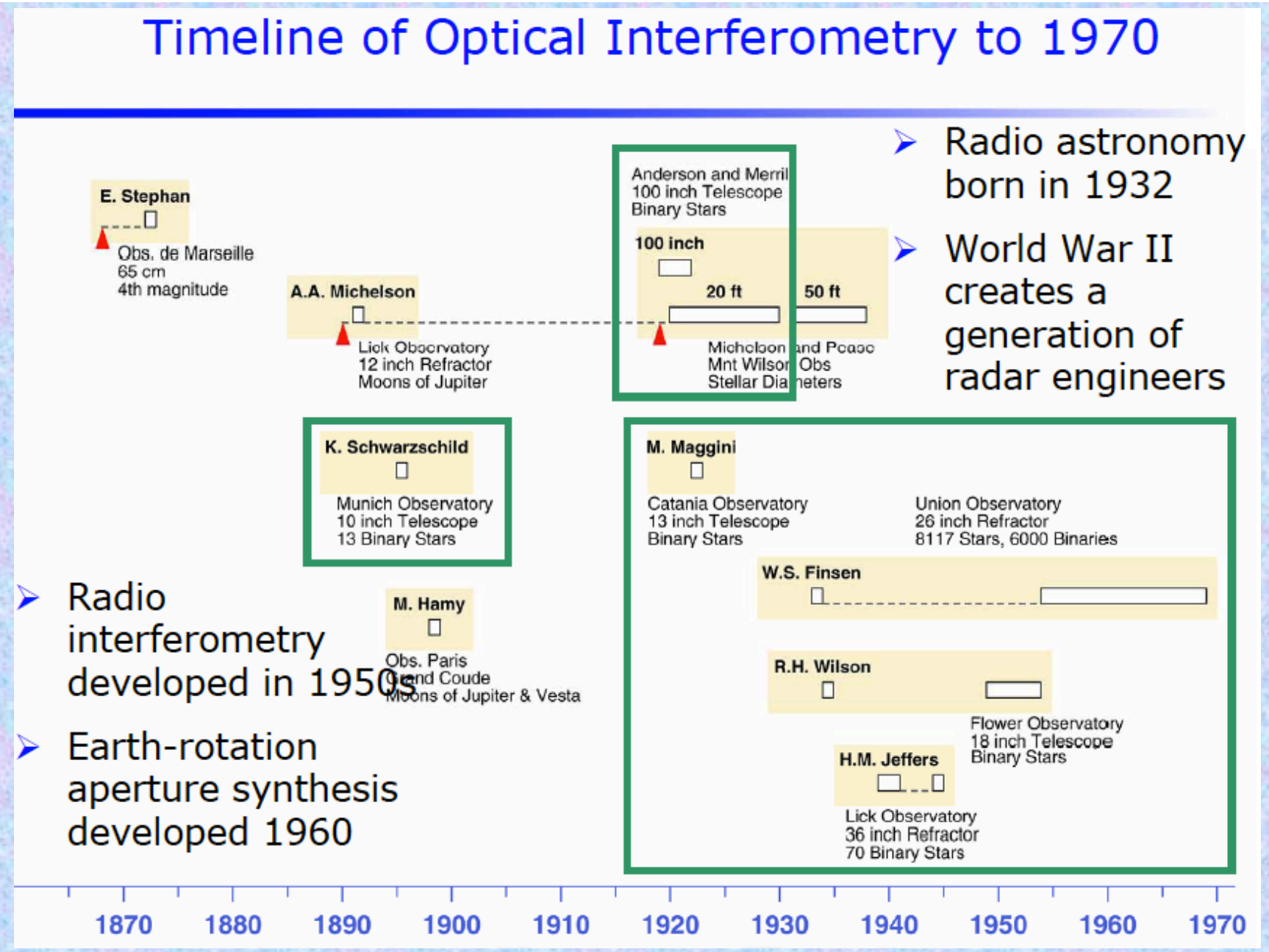
Hippolyte Fizeau (1868)
Edouard Stephan(1874), Albert Michelson (1890)

ASTRONOMIE. — *Sur les franges d'interférence observées avec de grands instruments dirigés sur Sirius et sur plusieurs autres étoiles; conséquences qui peuvent en résulter, relativement au diamètre angulaire de ces astres.* Extrait d'une Lettre de M. STEPHAN à M. Fizeau.

« ... Dans le cours d'un Rapport sur le prix Bordin, inséré au tome LXVI des *Comptes rendus*, vous vous exprimiez ainsi :

« Il existe, pour la plupart des phénomènes d'interférence, tels que les franges d'Young, celles des miroirs de Fresnel, et celles qui donnent lieu à la scintillation d'après Arago, une relation remarquable et nécessaire entre la dimension des franges et celles de la source lumineuse; en sorte que les franges, d'une ténuité extrême, ne peuvent prendre naissance que lorsque la source lumineuse n'a plus que des dimensions angulaires presque insensibles; d'où, pour le dire en passant, il est peut-être permis d'espérer qu'en s'appuyant sur ce principe et en formant, par exemple, au moyen de deux larges fentes très-écartées, des franges d'interférence au foyer des grands instruments destinés à observer les étoiles, il deviendra possible d'obtenir quelques données nouvelles sur les diamètres angulaires de ces astres. »

Timeline of Optical Interferometry to 1970



- Radio astronomy born in 1932
- World War II creates a generation of radar engineers
- Radio interferometry developed in 1950s
- Earth-rotation aperture synthesis developed 1960

From Lawson P (2006), *Optical Interferometry Motivation & History*, Michelson Summer Workshop, Pasadena

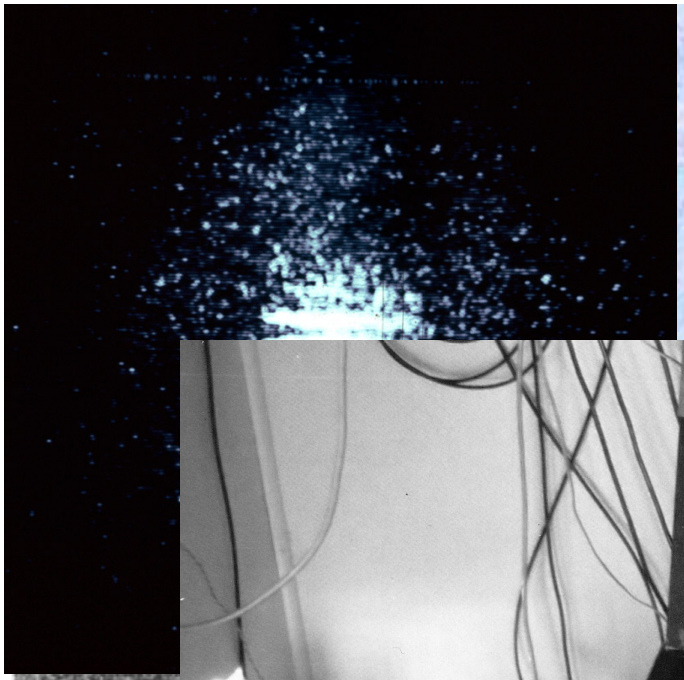
2. 1970s : The revival of optical interferometry

In the wake of *speckle interferometry (1970)*

Antoine Labeyrie (age 29), 1972

Speckle Interferometry can be extrapolated to the case of a synthetic telescope consisting of several large telescopes. Assuming that two large telescopes are located 50 or 100m apart at some observatory site, the method consists of bringing together the two coudé beams into some central station and superposing the images of the star. ....This approach to long baseline stellar interferometry is presently under test at Meudon observatory, using a pair of 25cm telescopes spaced by 15 meters. There are strong indications that it is indeed feasible and constitutes the ultimate solution for ground-based stellar interferometers. Medium sized telescopes can and will certainly be built for this purpose, pending the construction of synthetic telescopes in space. However, the largest general purpose telescopes are invaluable for this application in which photon noise is a major limitation. .... It is therefore suggested that interferometer-compatible designs be adopted for those future large telescopes which are still in the planning stage.

"*Speckle interferometer for 0.02" stellar resolution*", Labeyrie, A., 1972, in Auxiliary Instrumentation for Large Telescopes, ESO/CERN conference, 389-393



Interféromètre à deux télescopes I2T
Nice, August 1974
Fringes on Vega, 12 m baseline
Antoine Labeyrie

3. 1977-1987 : The birth of the VLTI : political

December 1977 : the ESO Geneva Conference

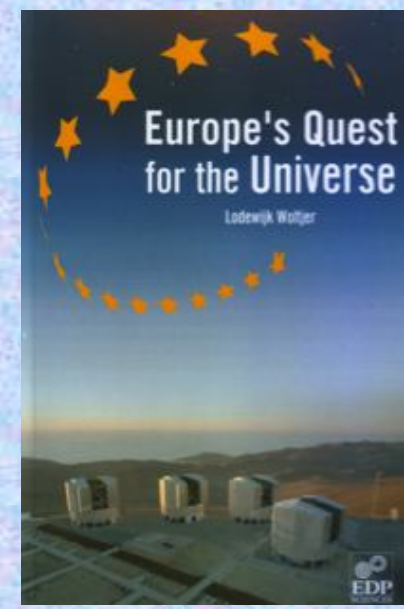
Optical telescopes of the future

•*« …I have concentrated here exclusively on the benefits for optical studies of a large collecting area…Concerning spatial resolution, it seems clear that there is no point in trying to compete with Space Telescope in the range 0.1'' to 1''. For smaller sizes, ground-based arrays might offer interesting possibilities. »*

(L. Woltjer, in Conference Proceedings, 1978)

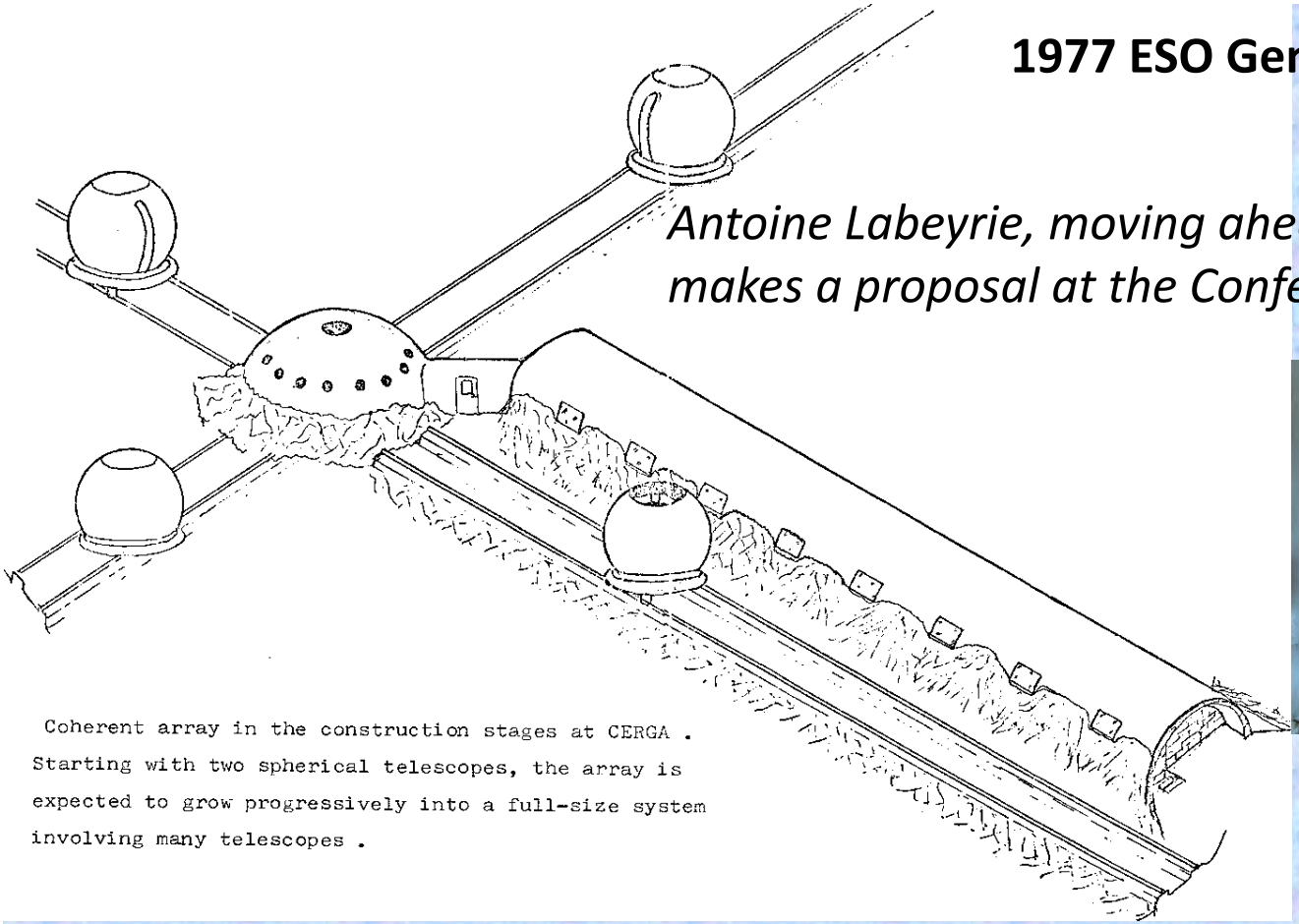
« Immediatly after the Conference, I asked our technical staff to make a first study of three options :
one 16-m telescope and arrays of four 8-m and sixteen 4-m telescopes.

(L. Woltjer, in Europe's Quest for the Universe, 2006)



1977 ESO Geneva Conference

Antoine Labeyrie, moving ahead at Cerga, makes a proposal at the Conference…



Coherent array in the construction stages at CERGA . Starting with two spherical telescopes, the array is expected to grow progressively into a full-size system involving many telescopes .

…while R. Hanbury-Brown is doubtful

indeed it might reach our "ideal" limiting magnitude of +9 or +10. Furthermore it looks, at first sight, as though it might be cheaper to build. However, we have serious doubts about its accuracy in the presence of atmospheric scintillation and also about its performance at long baselines.

1977 ESO Geneva Conference

Harold Babcock insists on seeing but does not mention Adaptive Optics… despite his fundamental paper on AO in PASP 1953 !

…while G. Bourdet presents a developing AO system…

The limited resolution of large ground-based telescopes from atmospheric turbulence shows the great interest of post detection image processing. Nevertheless, another possible and very efficient technique for improving the quality of atmospheric turbulence limited image forming instruments, is the real time phase control system. This has been first suggested for astronomical applications by Babcock [1] in 1953. During the last five years several phase control devices have been set up [4], essentially with the purpose of driving of high power laser

..and H. van der Laan expresses scepticism

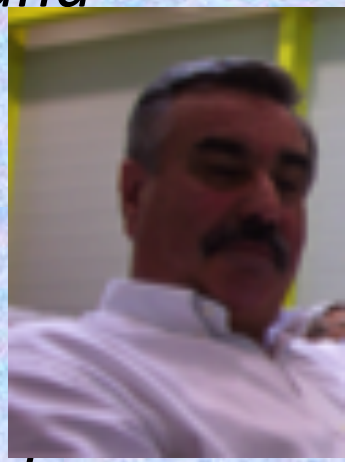
I must skip, for lack of time but not for lack of admiration, any direct comment on…the advances in optical interferometry..I doubt if the fringe benefits of ground-based coherent arrays ..outweigh the additional constraints and costs..

VLT as an array : interferometry ?

To a question by Prof. BLAAUW about the significance of the March conference in the context of the VLT, the DIRECTOR GENERAL replied that ESO was organizing a conference in the last week of March on the subject "The scientific importance of high angular resolution at optical and infrared wavelengths' which should have an immediate impact on the question as to whether the VLT - if it were built as an array - should be built as a coherent or as an incoherent array.

Council, May 1980

- *March 1981 :* ESO Conference *The scientific importance of high angular resolution at optical and infrared wavelengths*



- 1981 : **the VLT Study Group** (J.-P. Swings + 12)

  "ambition of a VLT…which would keep one large avenue for the future, i.e. the capability for spatial interferometry"

The VLT project moves ahead with interferometry

- 1983 : Cargèse Study week on VLT : 1 X 16-m, 4 x 8-m, 16 x 4-m ?
- *…it had been stated by some persons in Cargèse that it would be desirable to put all these telescopes on rails in order to move them about for interferometry… a slightly risky undertaking* (P. Ledoux, Council President, 1983)

Problem of aperture size : Roddier & Léna (1984) *Journ.Opt.*

- 1983, June. Council approval of a *VLT Project Group*
- August 1984. VLT Evaluation Panel (JP. Swings) & Interferometry Working Group (P. Léna) …*to define realistic scientific objectives for interferometry with large telescopes (in the optical and especially in the infrared) and to assess the implications of interferometry on the specifications (and thereby the cost !) of a VLT* (letter L. Woltjer to P. Léna, Chair of the WG).
- **Interferometry WG** : O. Citterio, D. Downes, A. Labeyrie, P. Léna, J. Noordam, F. Roddier, JP. Swings, G. Weigelt + ESO engineers (**D. Enard, F. Merkle, R. Wilson**)

NOAO - ESO Meeting at Oracle, Arizona, 1987

4. 1977-1987
The birth of the VLTI : scientific

Scientific grounds for the VLT interferometer

Even as late as 1987 (VLT approval)-1990 (Paranal selection),
there was a great contrast
between existing and potential *high angular resolution* science
at optical wavelengths

Speckle interferometry in the infrared : Understanding the atmosphere

$$r_o(\lambda) \propto \lambda^{6/5}$$

The dust envelope of Mira Ceti

Foy R, Chelli A, Sibille F, Léna P (1979) *Astron.Ap. 79, L5*

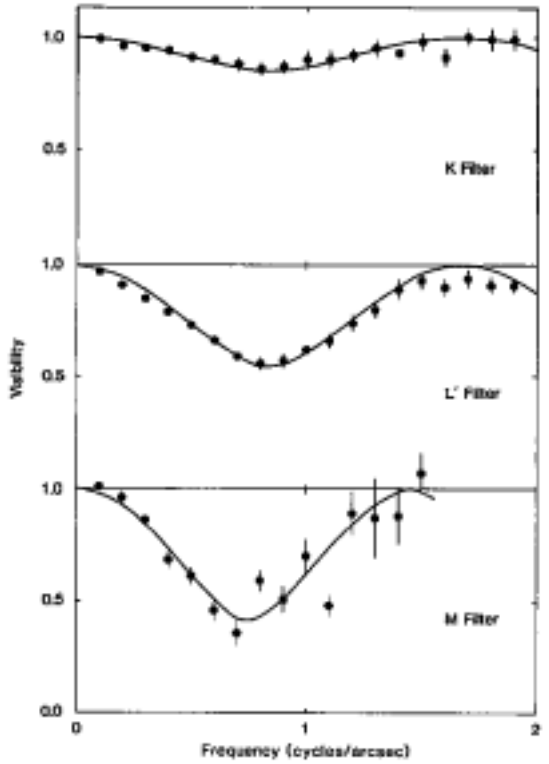


FIG. 1.—Visibility data (*filled circles*) and models (*solid lines*) in the north-south direction. The top panel is for 2.2 μm (*K* filter), the middle panel 3.8 μm (*L'* filter), and the bottom one 4.8 μm (*M* filter). The model source separations and brightness differences are given in Table 1.

Discovery of an IR companion to T Tau

Dyck H.M., Simon T., Zuckerman B.,(1982) *Ap.J.* 225, L103

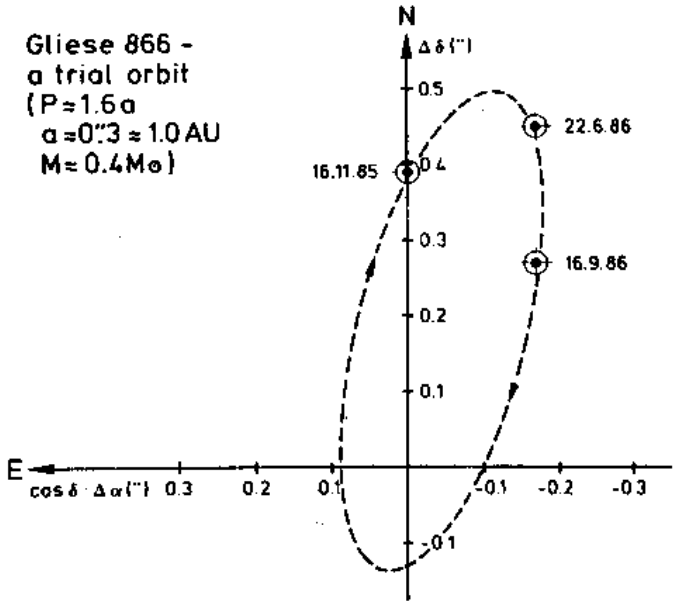


Figure 5

Orbit of the M dwarf GL 866

Leinert C., Haas, M., Jahreiss, (1986) *Astron.Ap.* 164, L29

At visible wavelengths, SUSI result at Narrabri (1986)

An accurate diameter for Sirius : 3.46 mas

Davis, J., Tango, W. (1986) *Nature*, 323, 234

…and I2T spectroscopic result at Cerga (1986)

The dimensions of the γ Cas star envelope in Hα : 3.9 mas

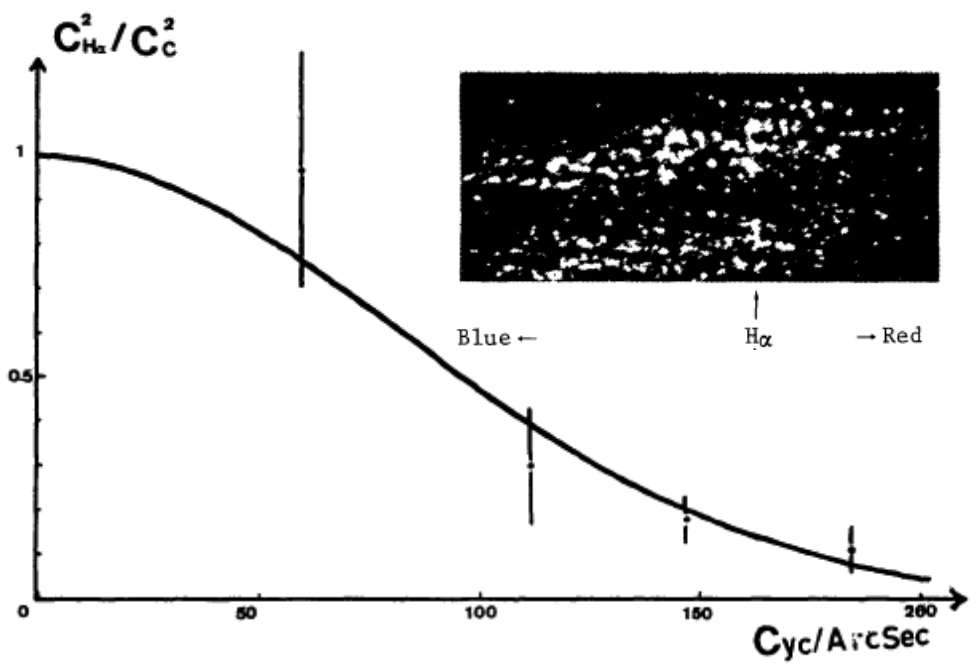


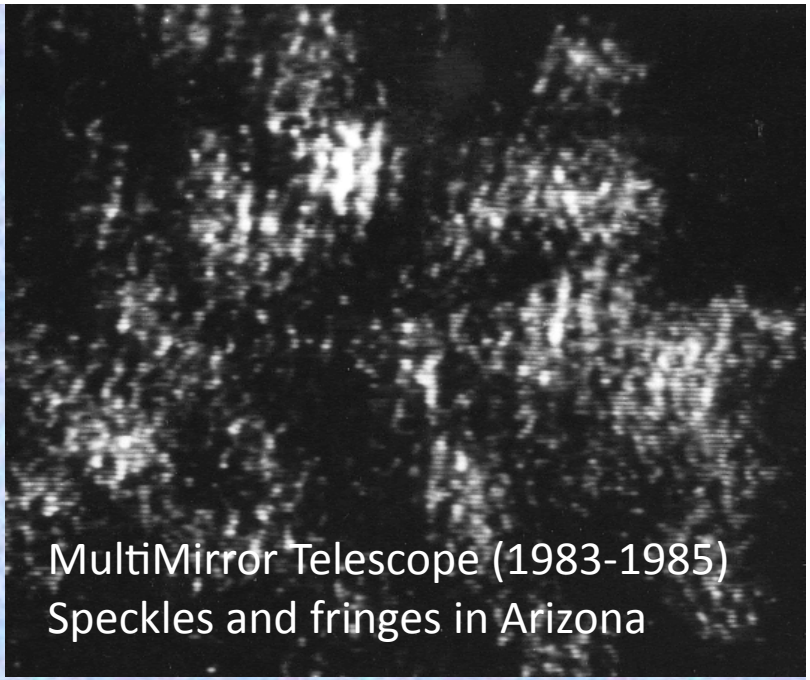
Figure 2. Visibility points measured on γCas. The contrast in Hα was normalized to the contrast in the continuum, and corrected for a 20% absorbed star in the line channel. The gaussian fit corresponds to an angular diameter of 3.9 marcs at 1/e.

Thom et al, A.A., 1986

Interferometry in the infrared ?

Roger Angel, Nick Woolf (1980-81)

$$r_o(\lambda) \propto \lambda^{6/5}$$



MultiMirror Telescope (1983-1985)
Speckles and fringes in Arizona

cf. J Beckers, Personal recollections, 2008

Moreover, a 4-m class pupil at 5 μm has the peculiar property to be close to diffraction limited. Not only this has the significant advantage of improving strongly the S/N ratio, but it also makes the analysis of aperture -synthetized field an easier task, since the fringes have no spurious speckle pattern within . The ease of aperture synthesis in the infrared with two pupils direct interferometry, already explored ([24]), should be soon confirmed and developped.

Léna P., *in ESO 1981 Conference*

Interferometer sensitivity with large telescope diameters :

Limited by speckles or overcome with adaptive optics ?

PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC
98:260-267, February 1986

GIANT INFRARED TELESCOPES FOR ASTRONOMY: A SCIENTIFIC RATIONALE

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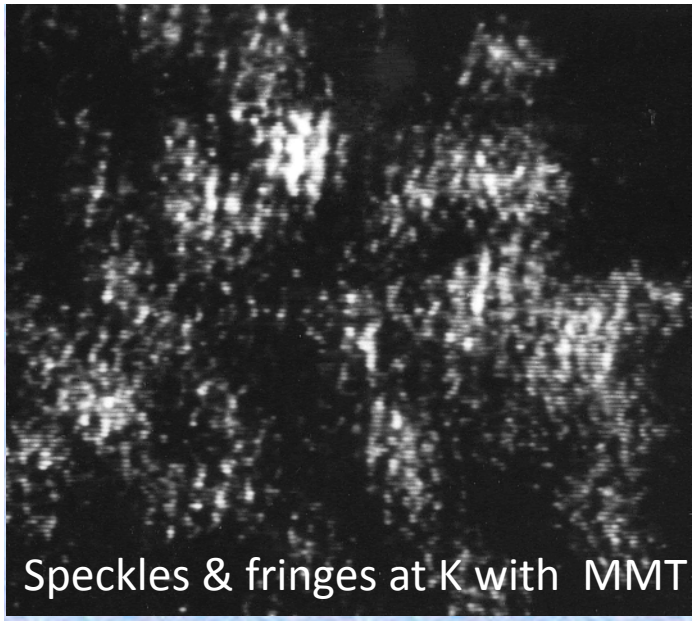
Received 1985 October 28

1985

ABSTRACT

In this paper we develop scientific criteria for choosing the dimensions of an interferometric array of telescopes to be used in the infrared. The ideal array consists of small collecting apertures which are either few in number, widely spaced and easily moved to new baselines or many in number, closely spaced and on fixed baselines. The proposed and planned "next-generation" of ground-based telescopes are found to be inadequate to solve the interesting problems of infrared astronomy which require high spatial resolution. Arrays consisting of telescopes with individual apertures larger than the atmospheric correlation length are probably not workable and certainly not cost effective.

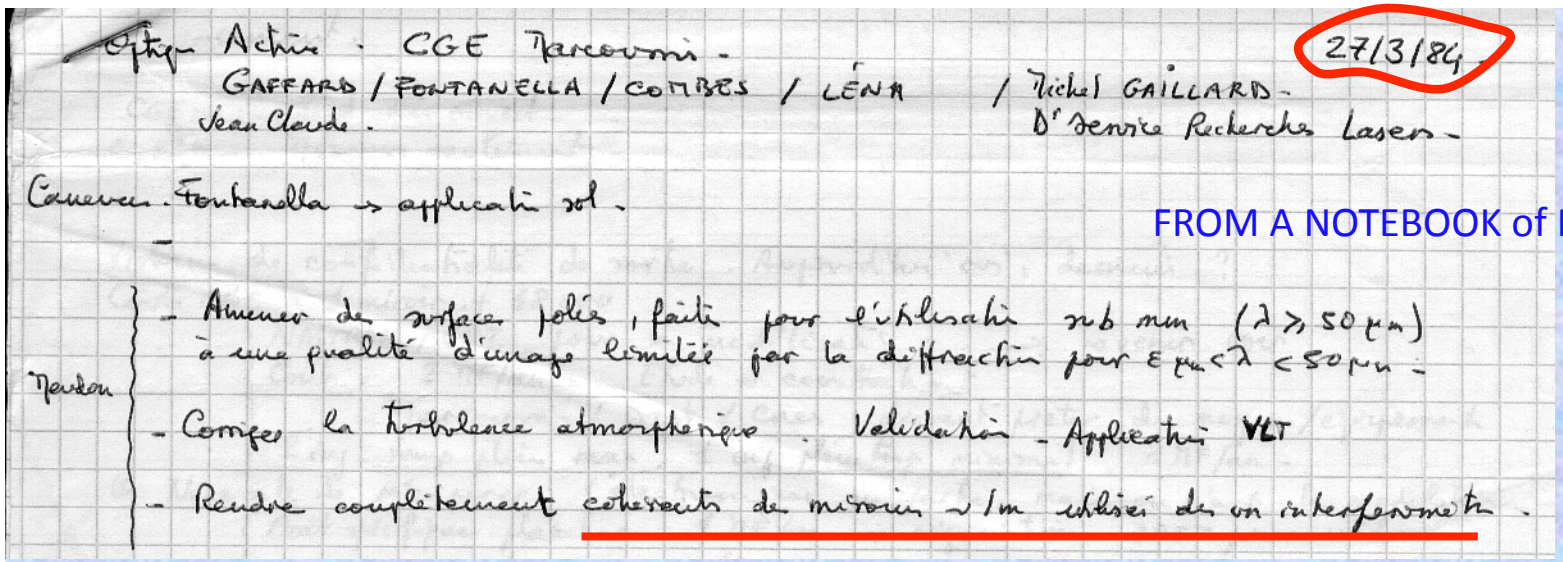


Speckles & fringes at K with MMT

VLT Proposal, 1987

Obtaining images or spectra at the diffraction limit from the ground, either with a single large pupil or with two or more smaller pupils, suffers basically from the same limitation: the fluctuations of the index of refraction of the atmosphere. In the interferometric mode, the full gain of the 8 metre single apertures of the VLT is, however, only obtained, if adaptive optics is applied for a real-time partial or full phase compensation of the degradations due to atmospheric turbulences. This technique has been discussed in detail in Chapter 11. Additionally, a great deal of knowledge has been accumulated during the last years in the treatment of images distorted by atmospheric turbulence in the visible and infrared, respectively, providing a firm basis for the planing of the performance and the operation of a ground-based optical interferometer.

The auxiliary movable telescopes are mainly selected for spatial frequency coverage reasons, but would also allow a full-time use of the interferometric instrumentation, while the large telescopes are used for other observation modes. The finally seclected arrangement depends strongly on the available site. The current configuration is the most compact arrangement. If a larger mountain top will be considered, it can be easily expanded.

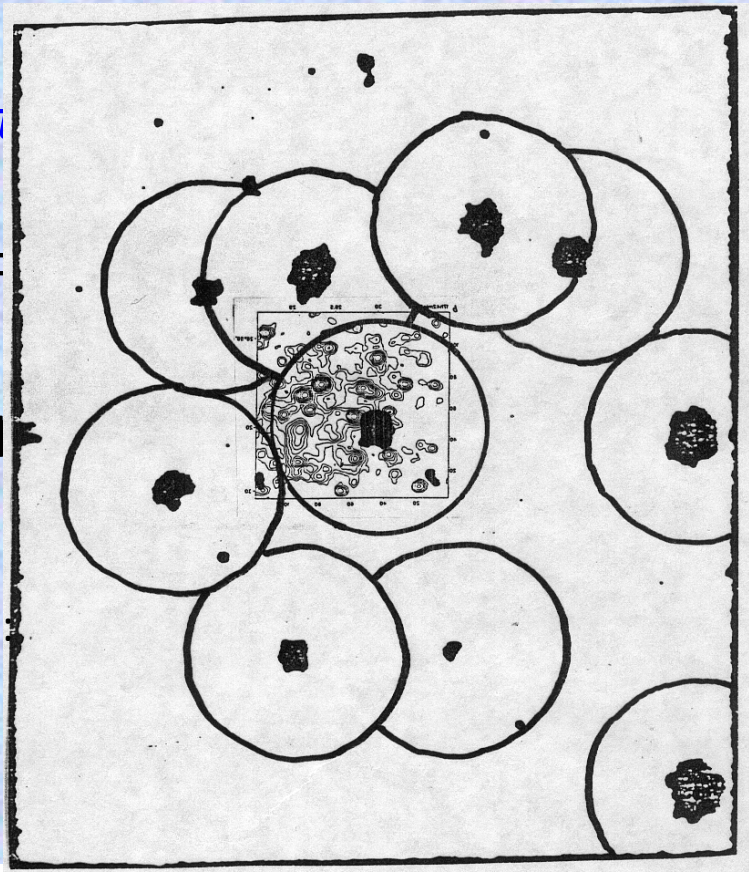


FROM A NOTEBOOK of P.Léna (1984)

ADAPTIVE OPTICS

- A fundamental paper : Roddier *1981 The effect in optical astronomy*, Progr. In Optics, XIX
- No trace of AO in several working papers (F
- CFHT AO Workshop, 1984 oct, Waimea
- AO+ Laser star (Foy & Labeyrie 1985) fully p in VLTI interim report (1985)

Already, the Galactic Center and AO (IR) isoplanetic fields :
Mourard, D. & Mercouroff N, Master thesis in Paris, 1986



- AO French project studies begin (27.3.1984), ESO soon joins ;
- Nov 1985 **ComeOn** begins ; 1986, PhD Pierre Kern (defended 1990 & quoted in VLT proposal 1987) ;
- First demonstration at Observatoire de Haute-Provence : 1989

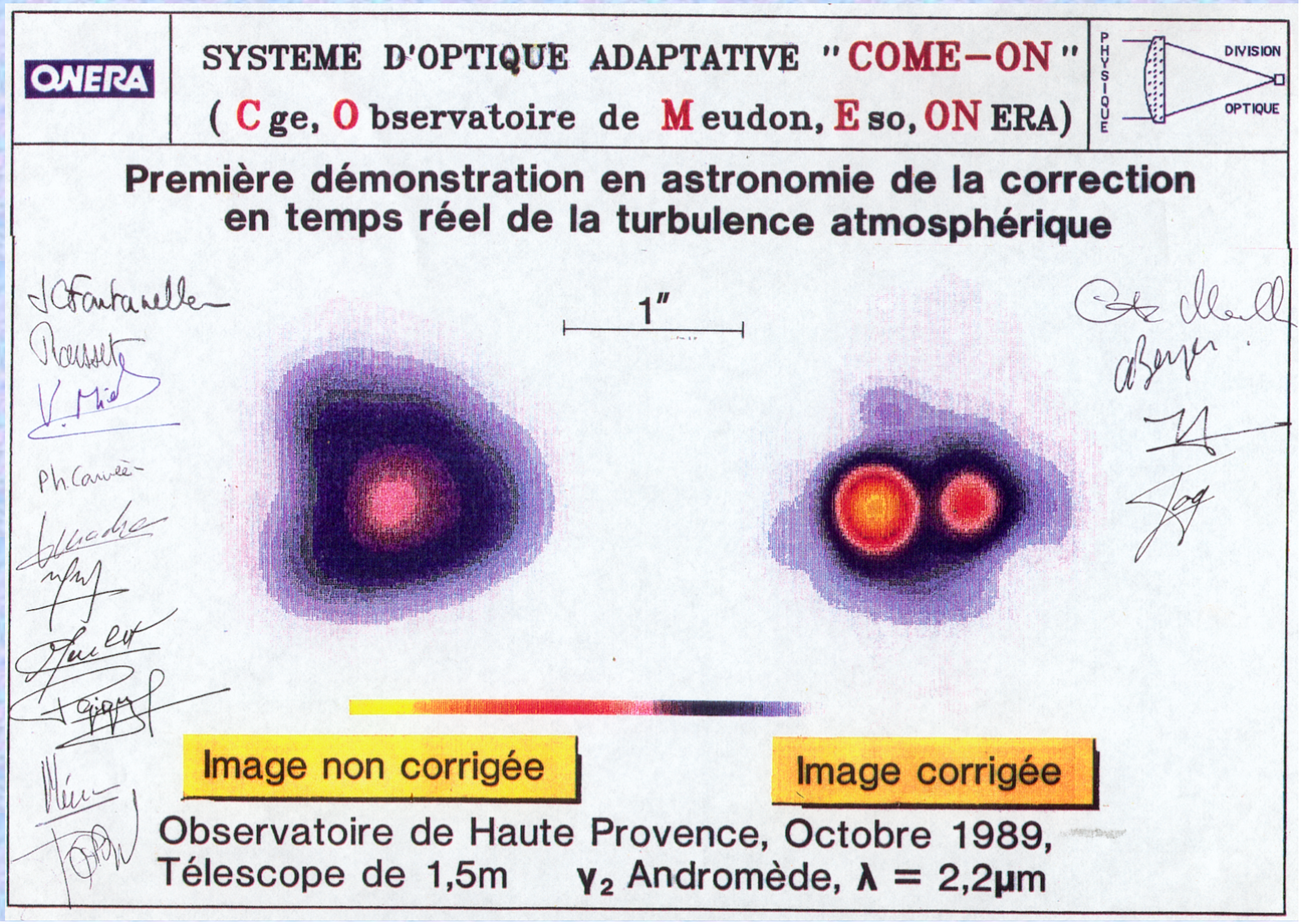
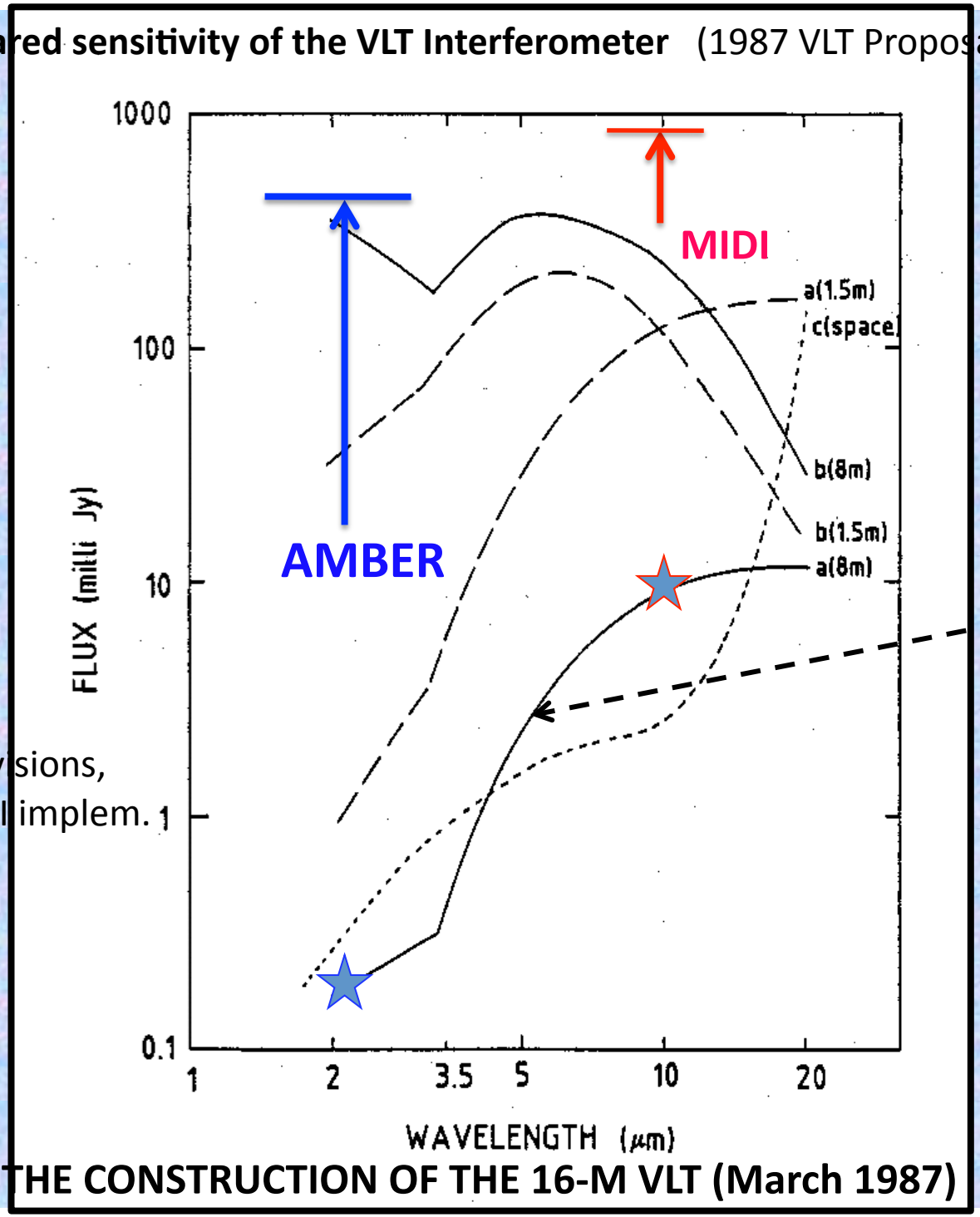


Fig.12.3 . Infrared sensitivity of the VLT Interferometer (1987 VLT Proposal,p. 297)



MIDI
N = 4
UT - Prism

AMBER
0.05 s
UT – Med Res
K= 7

See J. Beckers revisions, Oct 1989, for VLTI implem. Plan (Oct 89)

Expected Performance :
T_{exp} = 1s
Full AO

PROPOSAL FOR THE CONSTRUCTION OF THE 16-M VLT (March 1987)

Exploring the accuracy of measured visibilites…

1991
FLUOR

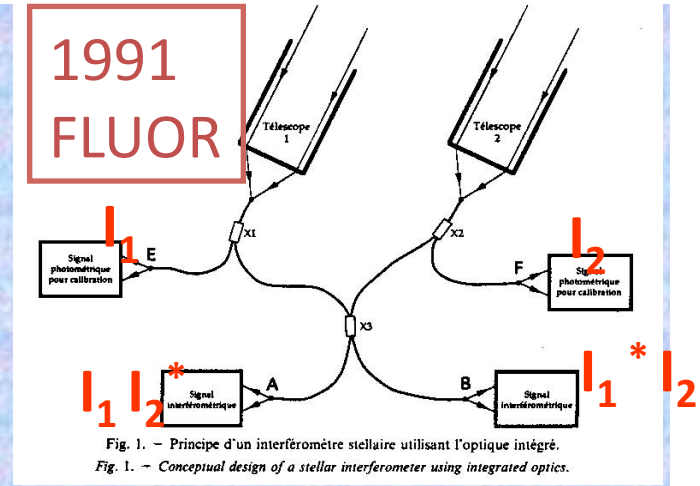
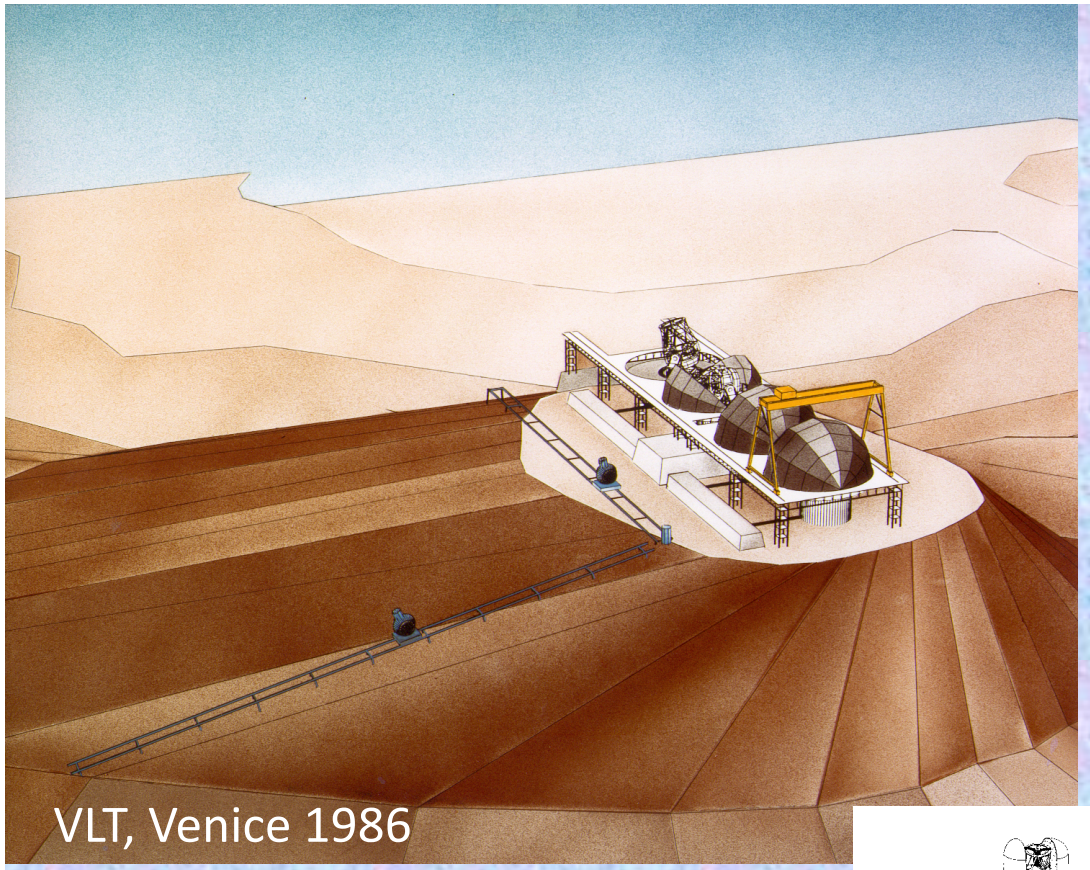


Fig. 1. – Principe d'un interféromètre stellaire utilisant l'optique intégré.
Fig. 1. – Conceptual design of a stellar interferometer using integrated optics.

- Understanding the atmosphere (speckle work) : r_o, τ_o, L_o ;
- An accuracy < 1% is mandatory for science with a few baselines, in order to strengthen constraints on models ;
- Spatial filtering with single mode fibers : Coudé du Foresto, Mariotti, Ridgway (1988 ->)

…But probably the most interesting feature of single-mode optical fibers is that they act like perfect spatial filters and considerably ease the calibration of fringe visibility….

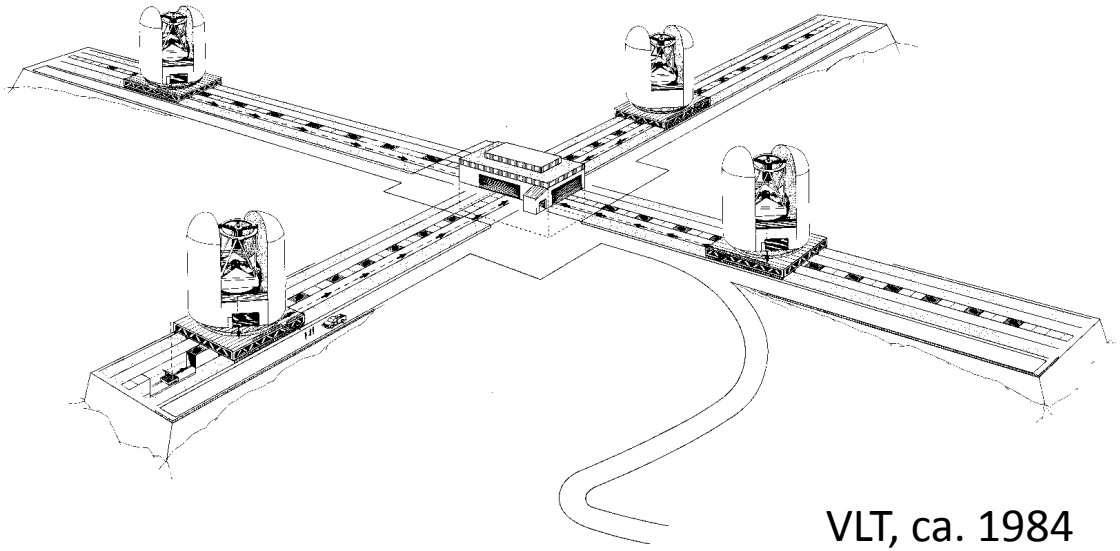
Coudé du Foresto V., Ridgway S., (Mariotti J.M.) 1991, *FLUOR : a stellar interferometer using single-mode infrared fibers*.



VLT, Venice 1986

GI2T, Calern, France ca. 1987

Exploring *u-v* coverage
Redundancy, Auxiliaries,
Site, Imaging…



VLT, ca. 1984

Obtaining real images ….

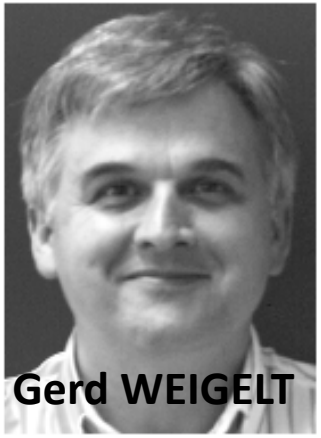

Gerd WEIGELT

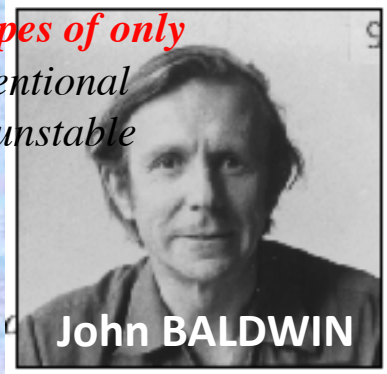
Image reconstruction : speckle triple correlation….

G.P. Weigelt: "Speckle holography measurements of the stars Zeta Cancri and ADS 3358", Applied Optics **17** (1978) 266

A.W. Lohmann, G. Weigelt, B. Wirnitzer: "Speckle masking in astronomy - triple correlation theory and applications", Appl. Opt. **22** (1983) 402

…and phase closure : Capella image at Cambridge (UK)

In February, Dr. John E. Baldwin and his colleagues at University's Mullard Radio Astronomy Observatory in England published the first detailed pictures ever obtained by any optical telescope of the double star Capella, which lies 40 light-years away. (A light-year is the distance light travels in one year, at the rate of 180,000 miles per second.) The two stars in the Capella pair are only a little more than one million miles apart, far too close to be seen from Earth as separate objects by any conventional optical telescope, including the huge Keck Telescope in Hawaii, the world's most powerful, and the Hubble Space Telescope. The remarkable resolution, or sharpness, of the Cambridge group's images of Capella was achieved ***using three optically linked telescopes of only modest size*** *at a site in England that would have been spurned by builders of large conventional telescopes. Cambridge is barely above sea level and is subject to England's notoriously unstable weather.* ***(New York Times, April 30,1996)***


John BALDWIN

5. After the 1987 VLT decision

From a European pre-VLT Interferometer to 4 Auxiliary Telescopes for the VLTI

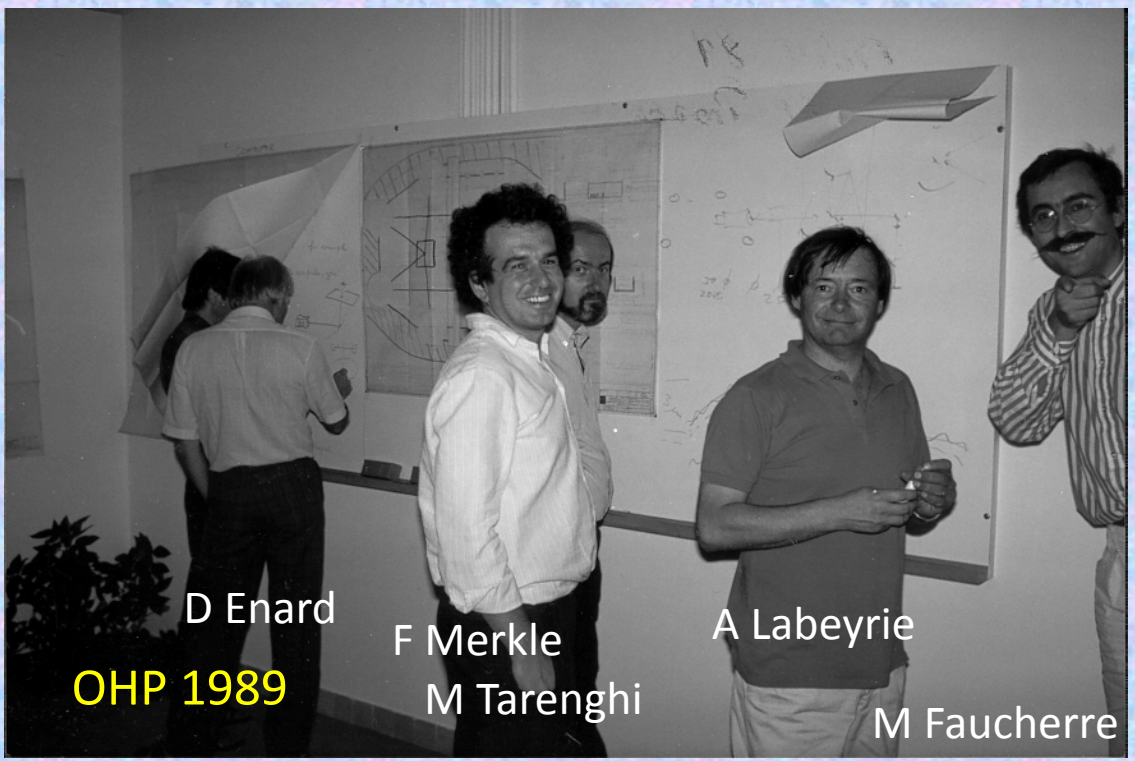
- 1986 : OVLA (Labeyrie), VISIR (Guilloteau, Léna, Foy)
- 1988 -> a *European Wide Band Multiaperture Interferometer* (1-2 m) to prepare VLTI : Letter of intent to MPG and CNRS by French & German astronomers; Arcetri interest ;
- 1988-89 : an IRAM study for a 1-2 m VISIR telescope + (1989) study of a transporter for ESO ;
- 1989 : convergence MPG-CNRS, a #3 AT with ESO + Joint RD program ;
- 1990 May : MOU MPG-CNRS-ESO : AT + instruments , signed Dec. 1992.
- VLTI enhancements policy : Netherlands, Italy, Switzerland, Belgium…

Some personal views as Council Member during 1986-1993

The VLTI design
& the Site selection of *Cerro Paranal*

The **VLT Interferometry Panel (1988) : J Beckers,** R Braun, G.P. di Benedetto, D Downes, R Foy, R Genzel, L Koechlin, A Labeyrie, P Léna, J M Mariotti, G Weigelt

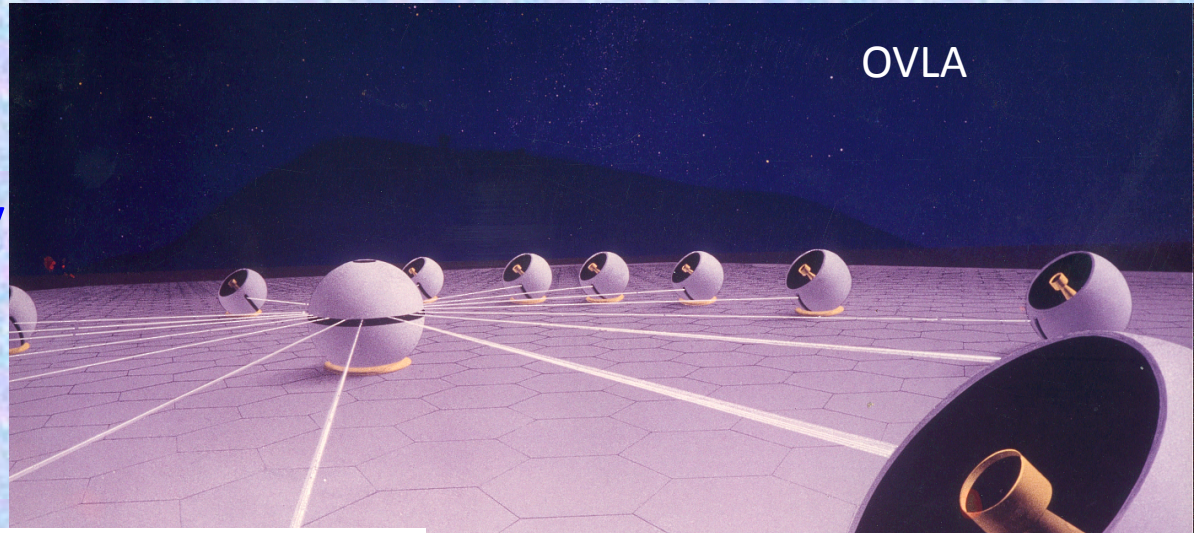
→ **The VLT Interferometer Implementation Plan (1989)** J Beckers



- 2-D, non redundant array
- Fixed UTs, movable ATs
- Choice of Paranal
- No vacuum windows

- **J. Beckers (1988-1993)** and **JM Mariotti** (**1992-1998**) at ESO, F. Roddier in Hawaii ;
- Questions by Italian delegation in Council about the MOU (1990) ;

Tensions in the community



Dear Gerd,

I have been kept informed of the recent developments of the VLT intertefometric aspects, and would like to share with you some aspects of my analysis.

1. After trying as much as possible to preserve some commonality between the VLT sub-array and Antoine Labeyrie's ideas, I am forced to recognize to-day that both projects have to go their own, separate routes. No compromise, e.g. in telescope concept, appears possible. I regret it, but it is a fact of life.

For the future, Antoine will have his own, highly creative way, toward **OVLA**, not easily merged into the inevitable rigidity of the VLT planning, design and execution. I hope he gets maximum support for his approach. The **VISA (VLT Sub Array)** must also go its way without delay or hesitation, otherwise it may never happen given all the pressures and priorities of the 8 meters. It seems perfectly feasible that Antoine remains a respected consultant for VISA, and brings on the **"R & D list of studies"** all his creativity and expertise, as in fact he has expressed the wish to do.

Letter from P Léna to G Weigelt, 1989 : 27 *Boules proposal* of AL to ESO

The November 1993 crisis

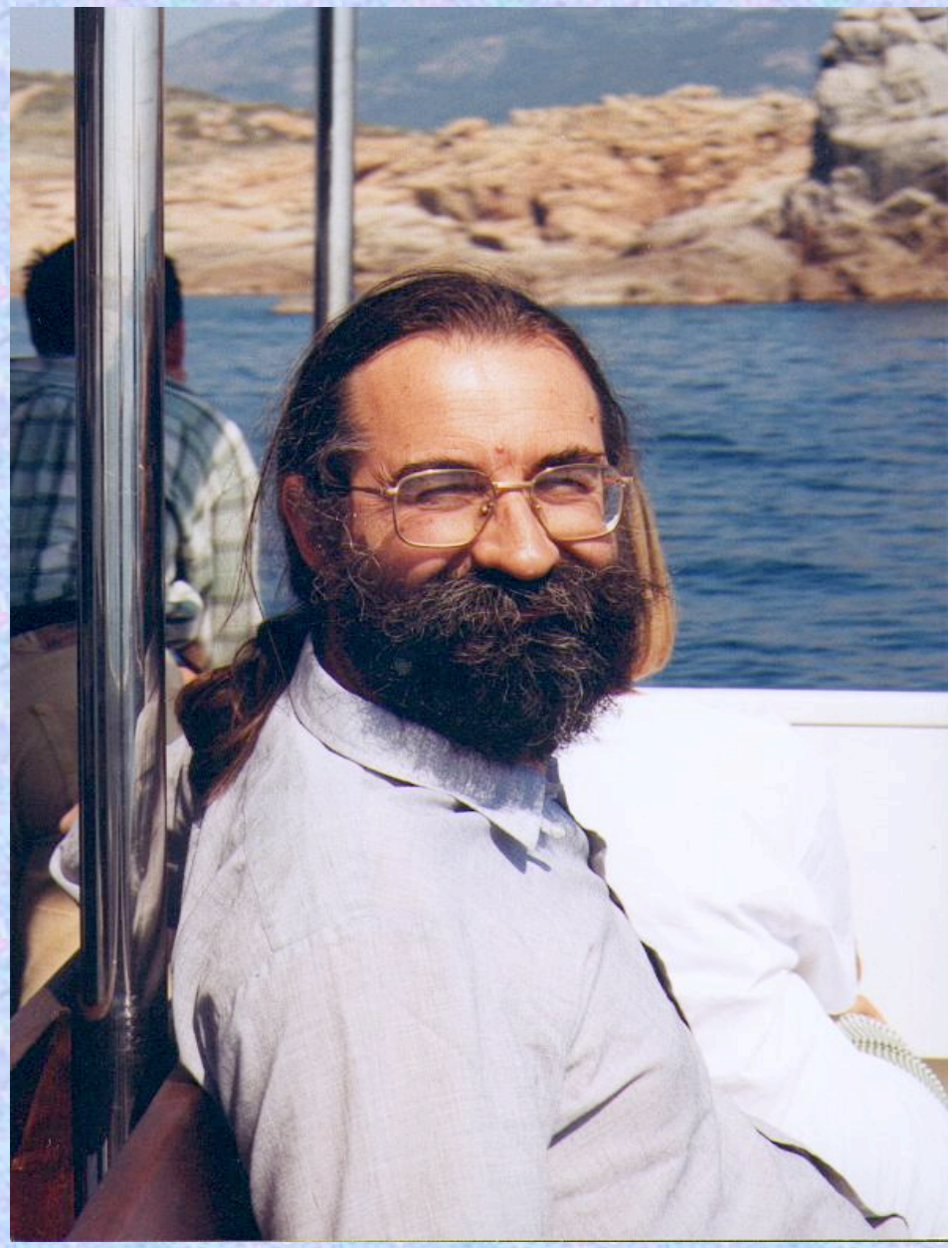
Following the presentation and discussion of different alternatives for cost reduction, Council adopts further modifications to the VLT programme plan. This includes the postponement of the implementation of VLTI, VISA, Coudé Train and associated adaptive optics for all telescopes. In consultation with the Scientific Technical Committee a solution will be sought to introduce adaptive optics at the Nasmyth foci at the earliest possible time.

Furthermore, the Executive will endeavour to reintroduce full Coudé and interferometric capabilities at the earliest possible date. This will include provisions for continuing technological research and development programmes devoted to this end.

1995-2001 : a slow but efficient recovery of AO and VLTI

- O von der Lühe +J-M Mariotti, STC May 1996,
- Visiting Committee, Cou. Dec 1996, with MPG+INSU,
- Australia hope, then abandon (1995)
- Adaptive optics with NAOS recovers -> success in 2001

Jean-Marie Mariotti
1955 (Paris)-1998 (Munich)



1998 at the Cargèse Summer School

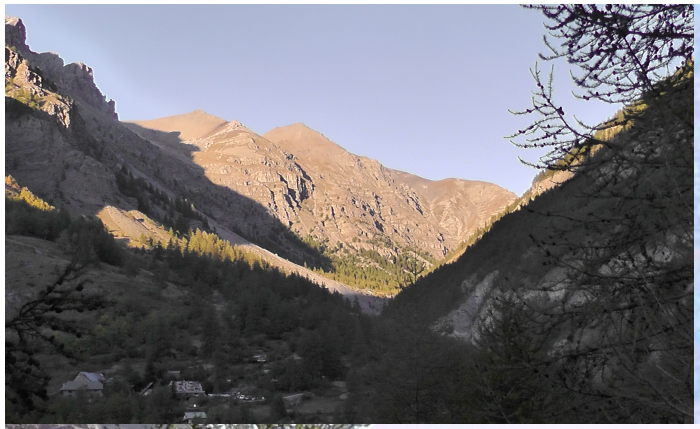
6. Looking at the future

What have we learned for the future ?

- Space : promising but slow (*Granada, ESA, June 1987* !)…SIM, DARWIN
- Ground : atmosphere is overcome by AO + dual-fringe tracking;
- The integrated project, coupling VLT + VLTI, has made sense ;
- Interferometry science is there, but *sensitivity* needs progress

At the E-ELT era, which future for optical interferometry ?

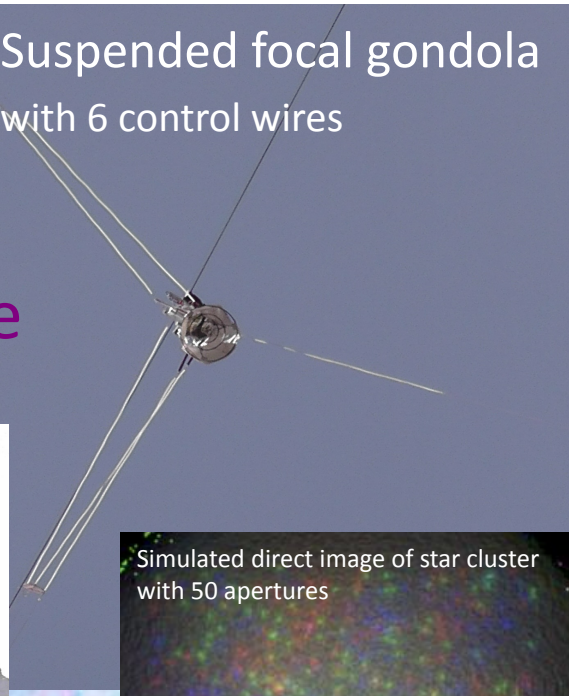
- Ten years ahead for VLTI progress : PRIMA, GRAVITY, AO on ATs…
- A future interferometer shall be kilometric & imaging : decoupling from ELTs
- Hypertelescope ? Fiber links ? OVLA ?



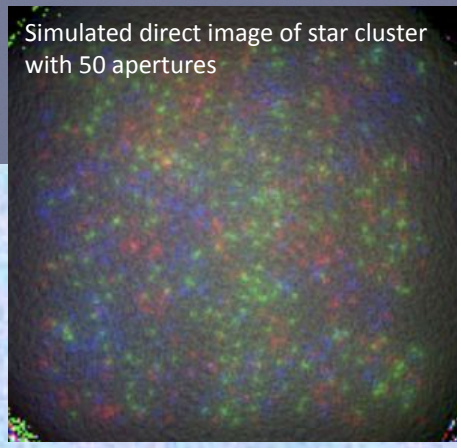
High valley site
(southern Alps)

Ubaye Hypertelescope

Suspended focal gondola
with 6 control wires

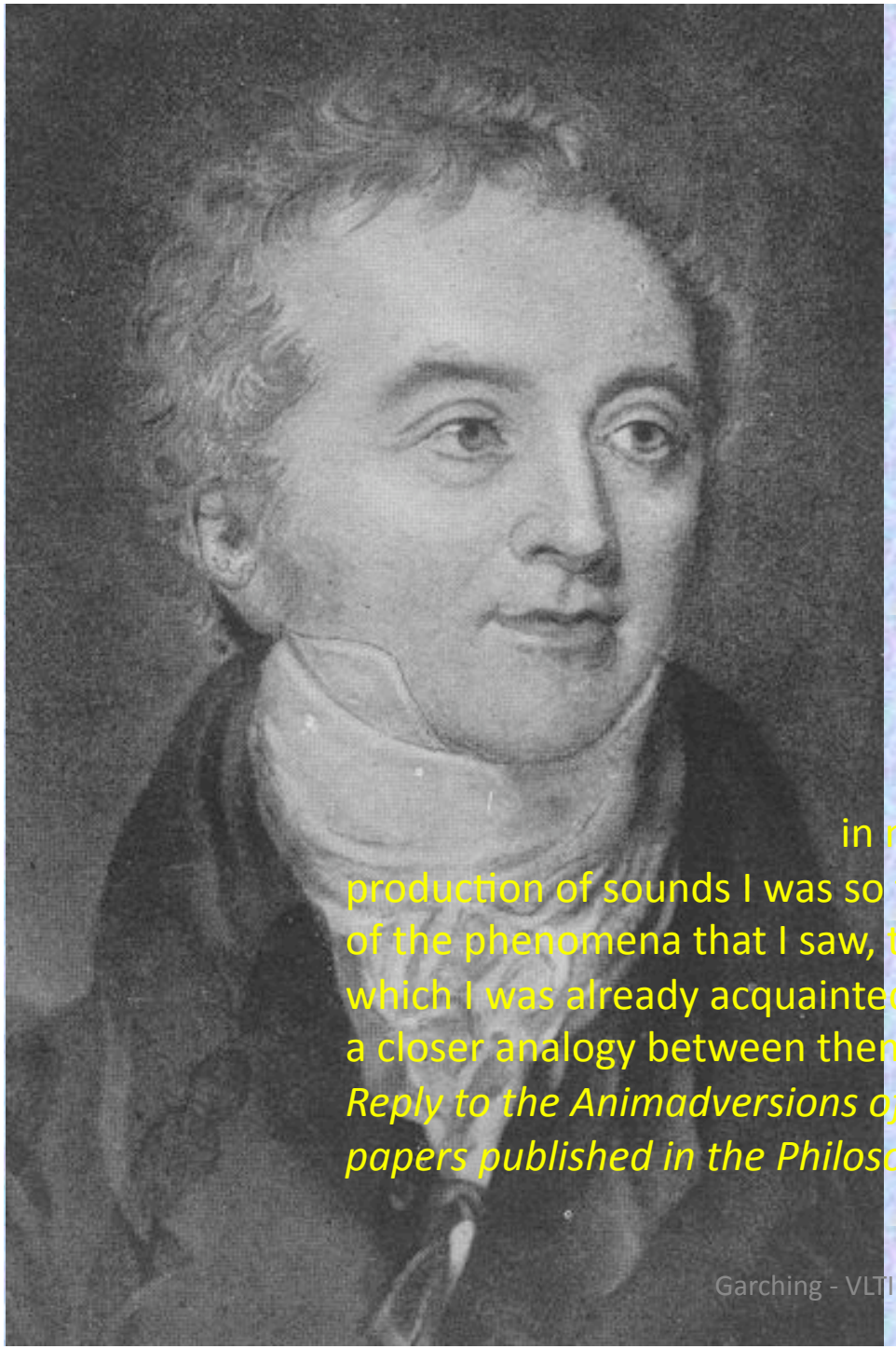


Aligning a mirror segment
on its fixed support

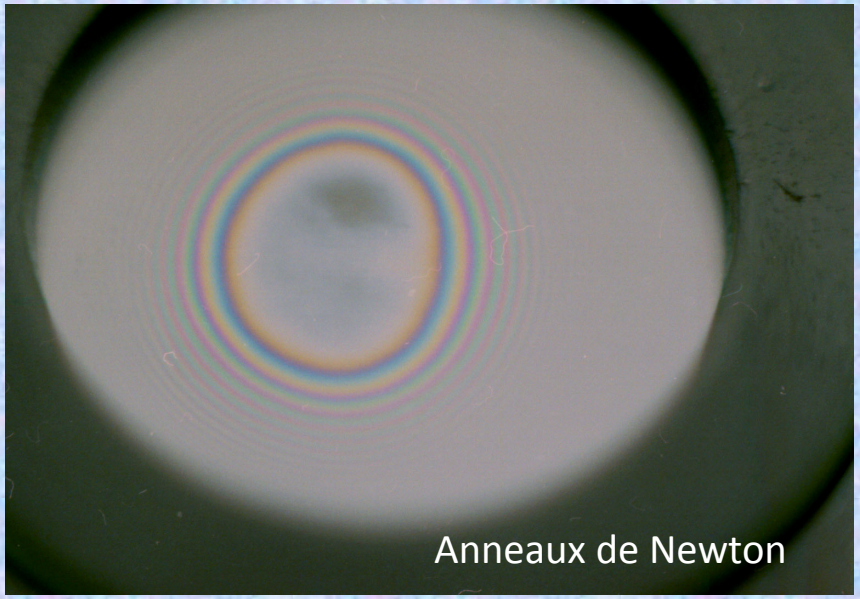


Simulated direct image of star cluster
with 50 apertures

- initial 57m aperture
- expandable to 200m
- with > 100 mirrors
- … for direct high-resolution images
- 1500m feasible at larger sites



Thomas Young 1773-1829

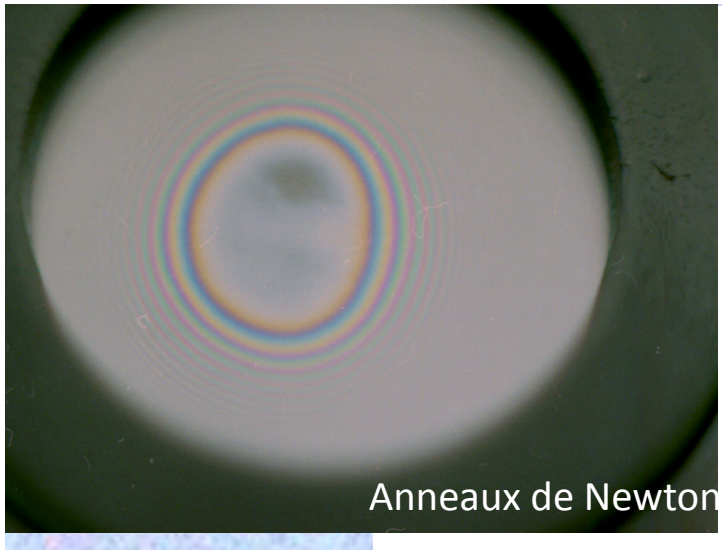


Anneaux de Newton

in making some experiments on the production of sounds I was so forcibly impressed with the resemblance of the phenomena that I saw, to those of the colours of thin plates, with which I was already acquainted, that I began to suspect the existence of a closer analogy between them than I could before have easily believed.

Reply to the Animadversions of the Edinburgh Reviewers, on some papers published in the Philosophical Transactions, London, 1804.

after a portrait by Sir Thomas Lawrence



Anneaux de Newton

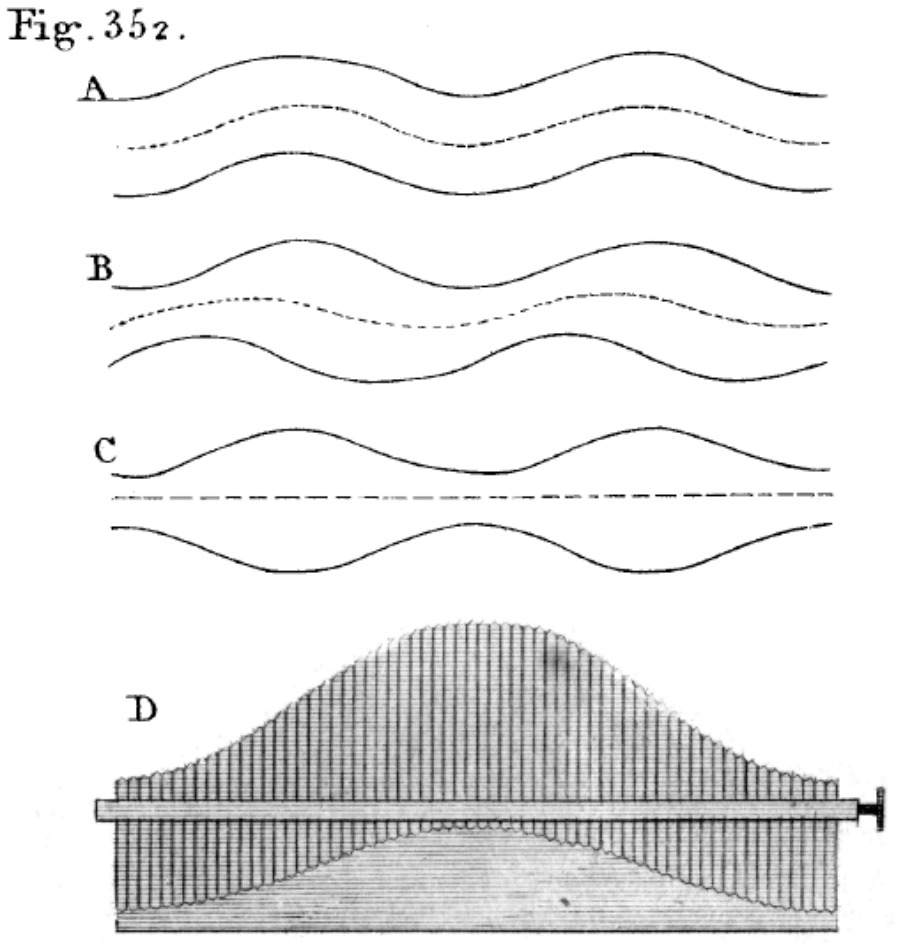


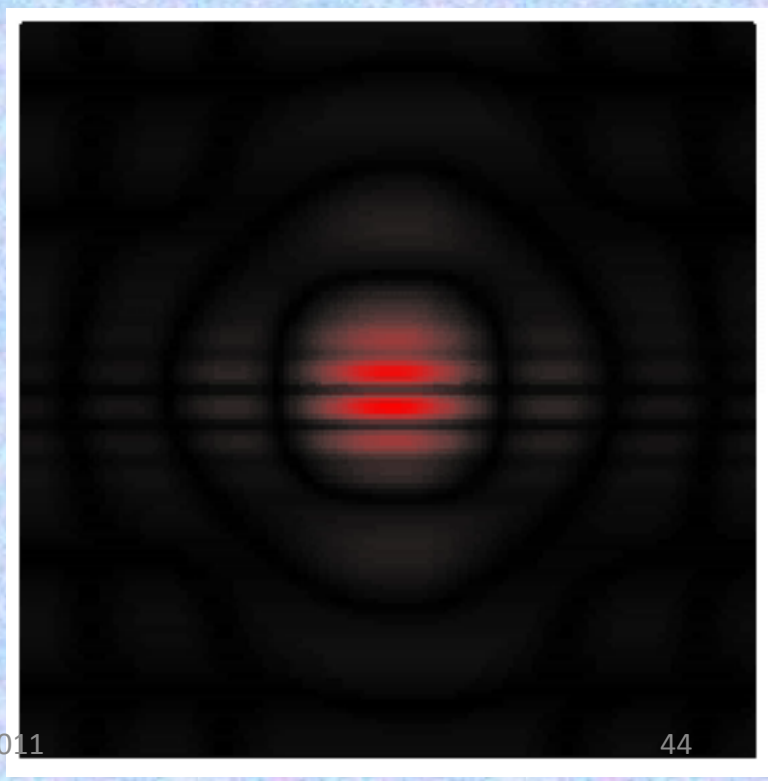
Figure 2. A figure from Young's *Lectures on Natural Philosophy* showing constructive and destructive interference of waves. The solid lines show the two component waves and the central, broken, line shows the compound vibration reduced to half its real extent. Lines A–C show the component waves in different phase relationships. Line D represents an instructional device for finding the combined effect of two waves: one component wave is formed by sliders of different length, the second by a shaped board on which the first can be placed (Young 1807).

Première détermination
de λ : 425-675 nm
Bakerian Lecture 1802

Young, T. 1807 *A course of lectures on natural philosophy and the mechanical arts*. London:J. Johnson.

In order that the effects of two portions of light may be thus combined, it is necessary that they be derived from the same origin, and that they arrive at the same point by different paths, in directions not much deviating from one another. . . ***the simplest case appears to be, when a beam of homogeneous light falls on a screen in which there are two very small holes or slits****, which may be considered as centres of divergence, from whence the light is diffracted in every direction. In this case, when the two newly formed beams are received on a surface placed so as to intercept them, their light is divided by dark stripes into portions nearly equal, but becoming wider as the surface is more remote from the apertures. . . .*

(Young 1807)



Double Fourier spatio-spectral interferometry at KPNO 4-m telescope

Mariotti, J.M. & Ridgway, S., 1988

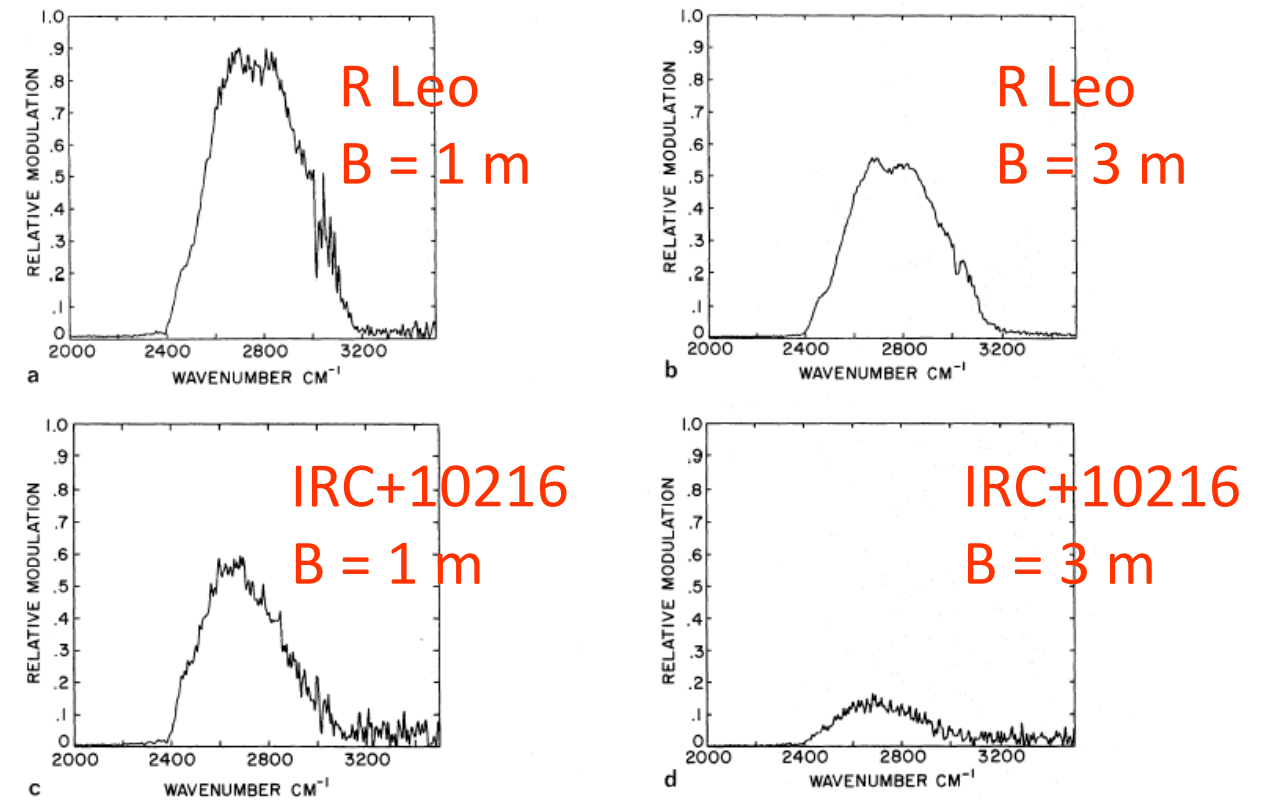


Fig. 7a–d. Spectra recorded in the *L* photometric window at the KPNO 4 m telescope. **a** The unresolved source R Leo, pupil separation of 1 m. **b** R Leo, pupil separation of 3 m. **c** The resolved source IRC 10216, pupil separation 1 m. **d** IRC 10216, pupil separation 3 m

Pioneers and epigons

- **CERGA (France)** : I2T (1974), GI2T (1986), Soir d'Eté (hétérodyne) : Labeyrie et al, Gay
- **Erlangen (Allemagne)** : G. Weigelt (end 1980s)
- **COAST, Cambridge, UK** : J. Baldwin (end 1980s)

- **Mark III, Mt. Wilson** (1986) : M. Shao & M. Colavita
- **SUSI, Australia (1985)** : J. Davis & W. Tango
- **MMT, Arizona** : a Fizeau interferometer (1983) : Keith Hege et al.

- 10.6 μm heterodyne @ McMath (Arizona), Mt. Wilson (1974..): C. Townes

- NNTT studies (1986), 4 telescopes, 8-m : J. Beckers
- CHARA (Mc Allister)
- Keck (Shao), ca. 1987

Technical challenges

- Superb engineers at ESO, in industry, in institutes

  D. Enard, F. Merkle, R. Wilson…B. Koehler…many others

- Long list of issues -> cf. J. Beckers's talk

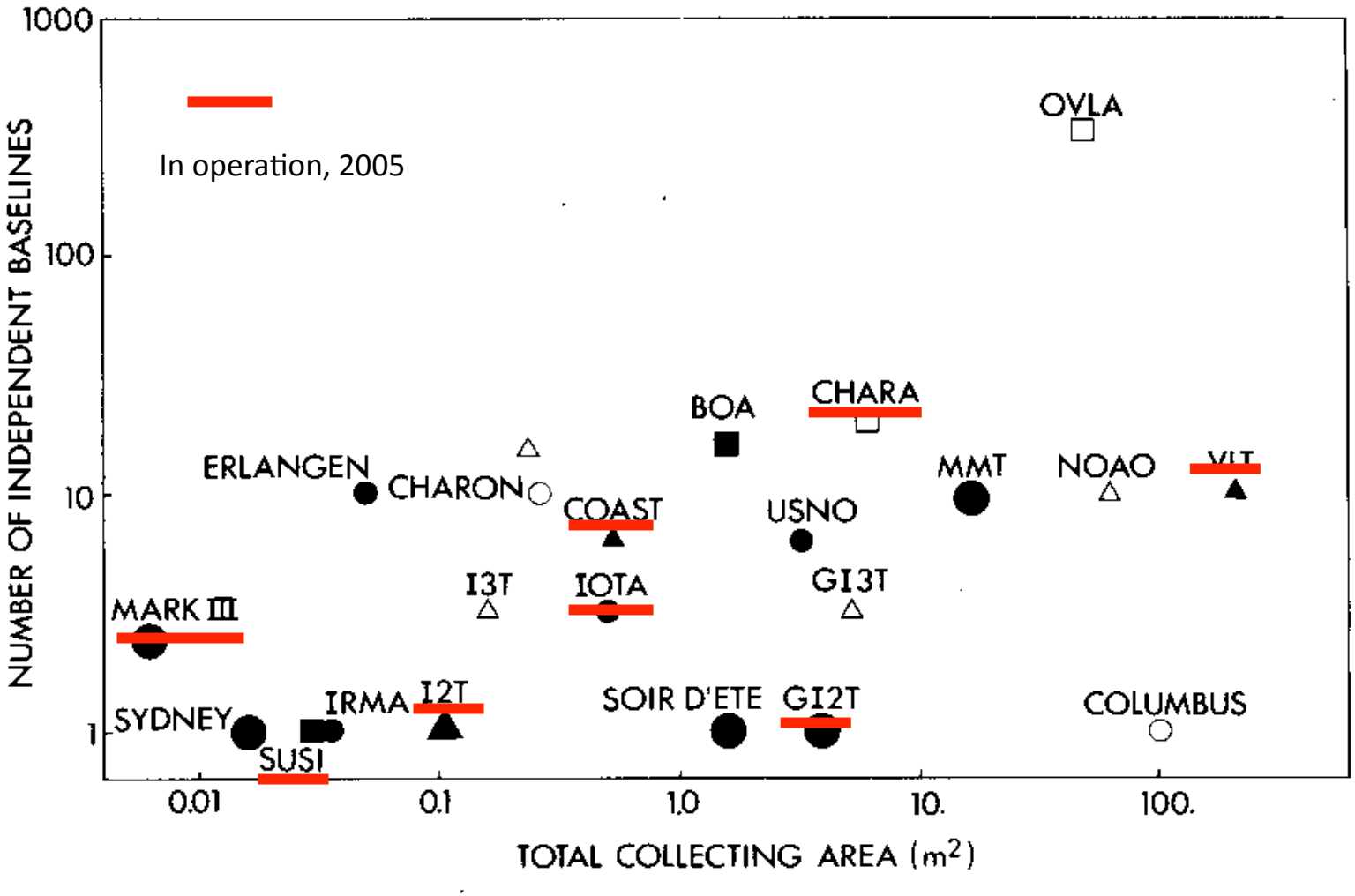
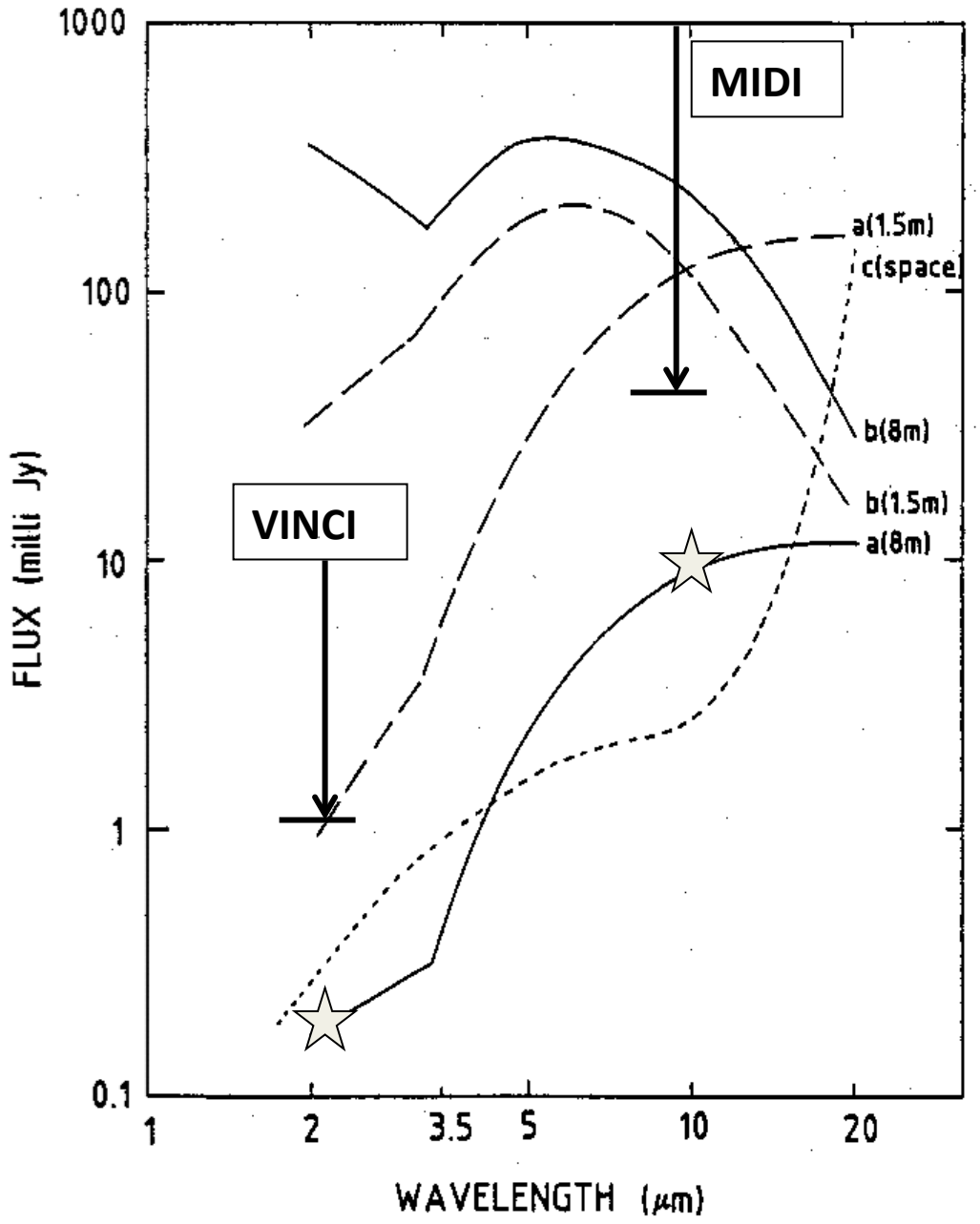
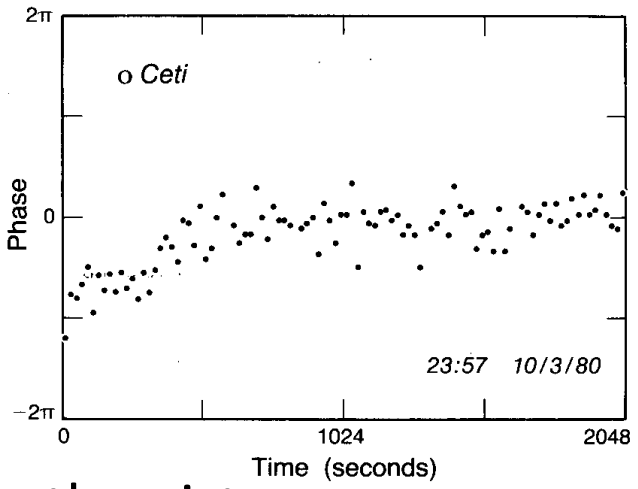


Figure 1.2: Distribution of Apertures and Numbers of Optical Astronomical Interferometers in existence or being developed. Baselines: circles: $< 100^m$; triangles 100 - 300^m, squares $> 300^m$. Large filled symbols: in operation; small filled symbols: under construction; open symbols: in planning

1989


MIDI
VINCI
a(1.5m)
c(space)
b(8m)
b(1.5m)
a(8m)
1000
100
10
1
0.1
FLUX (milli Jy)
1
2
3.5
5
10
20
WAVELENGTH (μm)

Sensitivity…



- Integration time for visibility measurements : the piston
  - 1974 : Danchi on MacMath 5.5m baseline heliostats with10.6 μm heterodyne

gure 2: Phase variations of interference fringe for o Ceti in an interferometer of baseline 5.5 meters. The phase variations are compared with theoretical values for a fixed baseline. Systematic deviation on the left-hand side of this figure is probably due to distortion of the baseline.

J. M. Mariotti and G. P. Di Benedetto

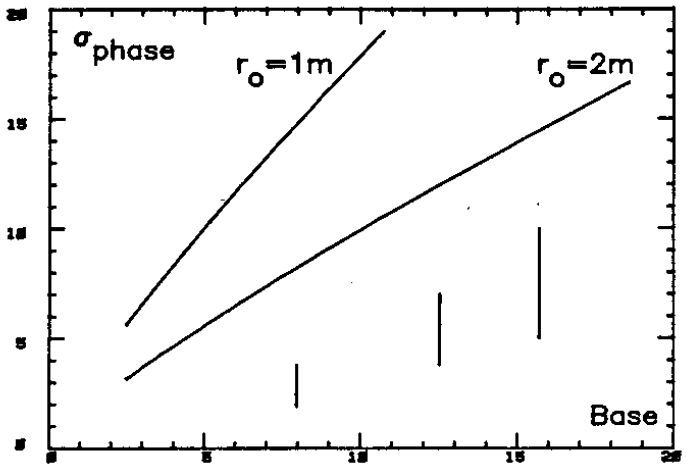
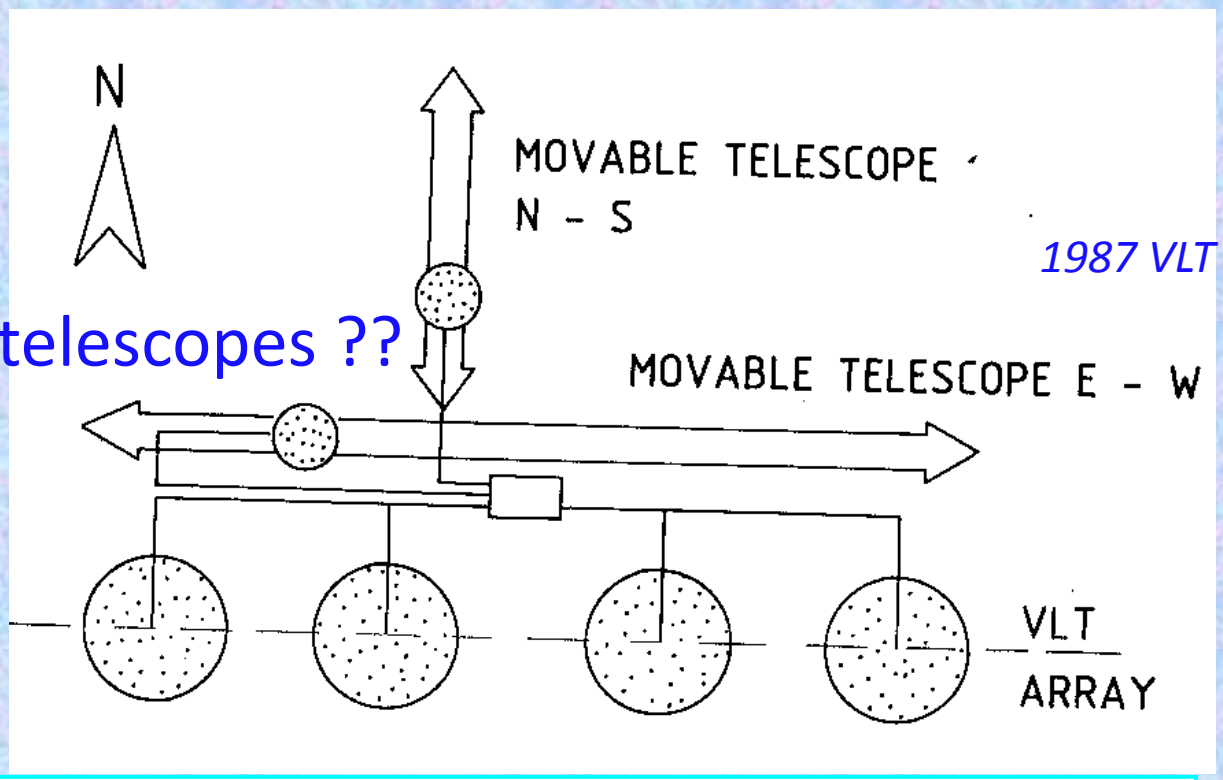


fig. 5 Vertical bars are the estimations of phase dispersion, in radian, measured at the three baselines. Continuous curves show the expected values for r_o=1 and 2 meters.

  - 1984 : Mariotti & Di Benedetto on I2T

8-m movable telescopes ??



1987 VLT Proposal

CONSIDERATIONS ON THE MOVABILITY OF THE TELESCOPES

FOR THE VLT INTERFEROMETRY CONFIGURATION

O. Citterio - June 1985

INTRODUCTION

THE SCOPE OF THIS NOTE IS TO PROVIDE SOME CONCEPTUAL SOLUTIONS FOR THE PROBLEM OF MOVING TELESCOPES OF 8 M. CLASS FOLLOWING THE NEEDS FOR BETTER PERFORMANCES OF THE VLT PROJECT IN THE INTERFEROMETRIC CONFIGURATION .