Layers and Pyramids: lessons learned & future perspectives

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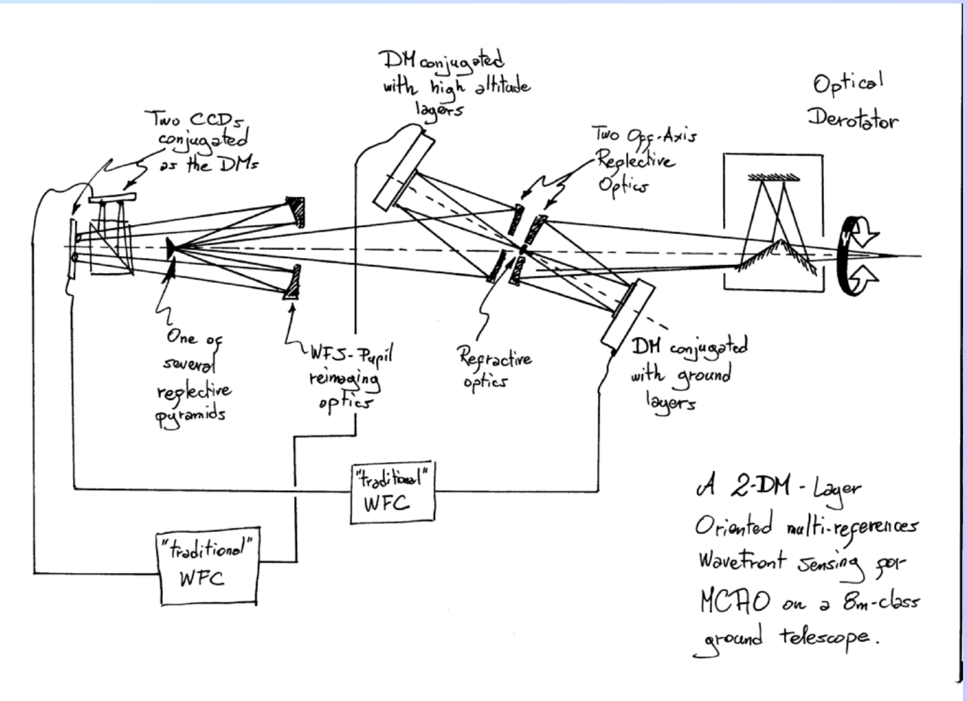
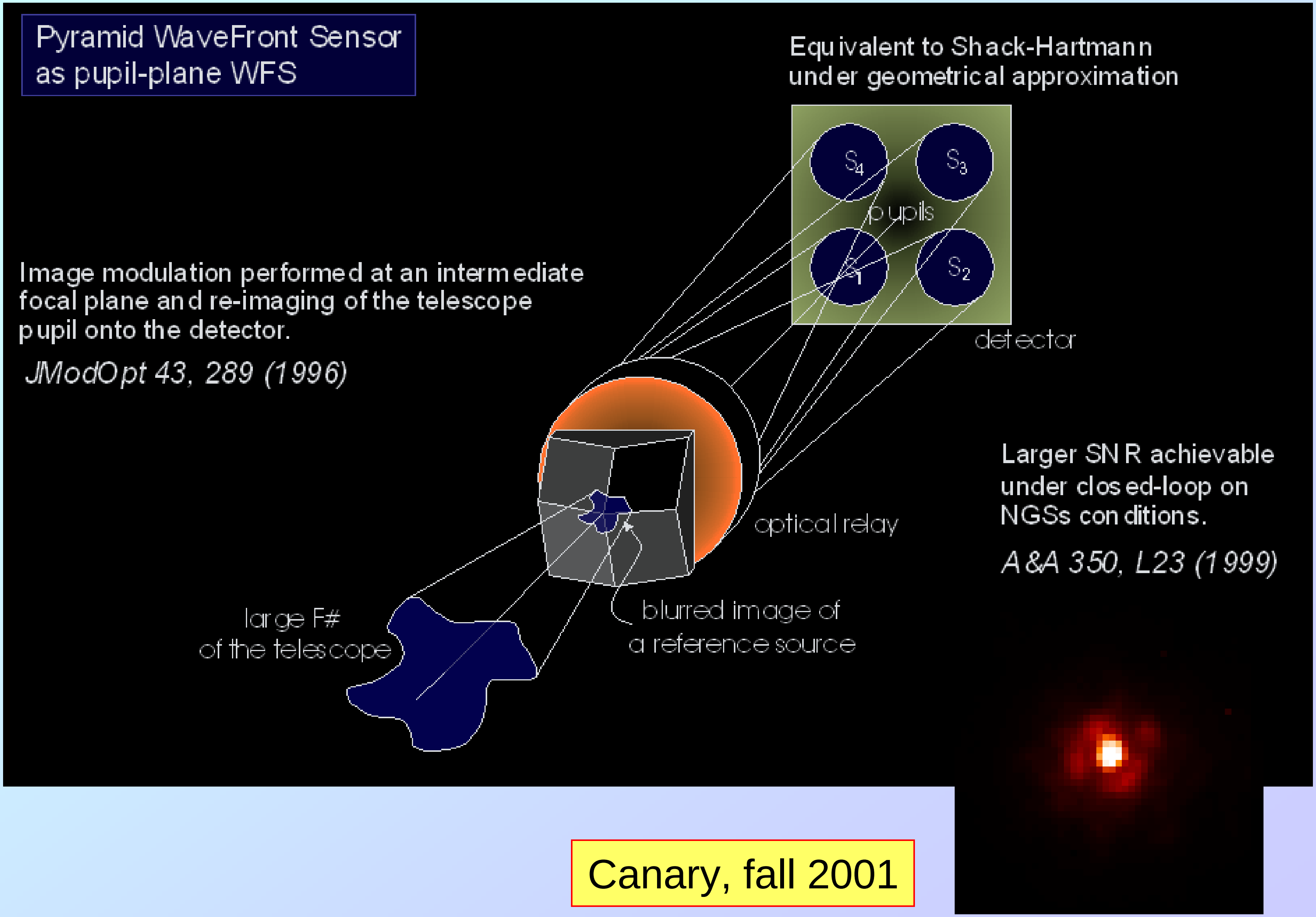
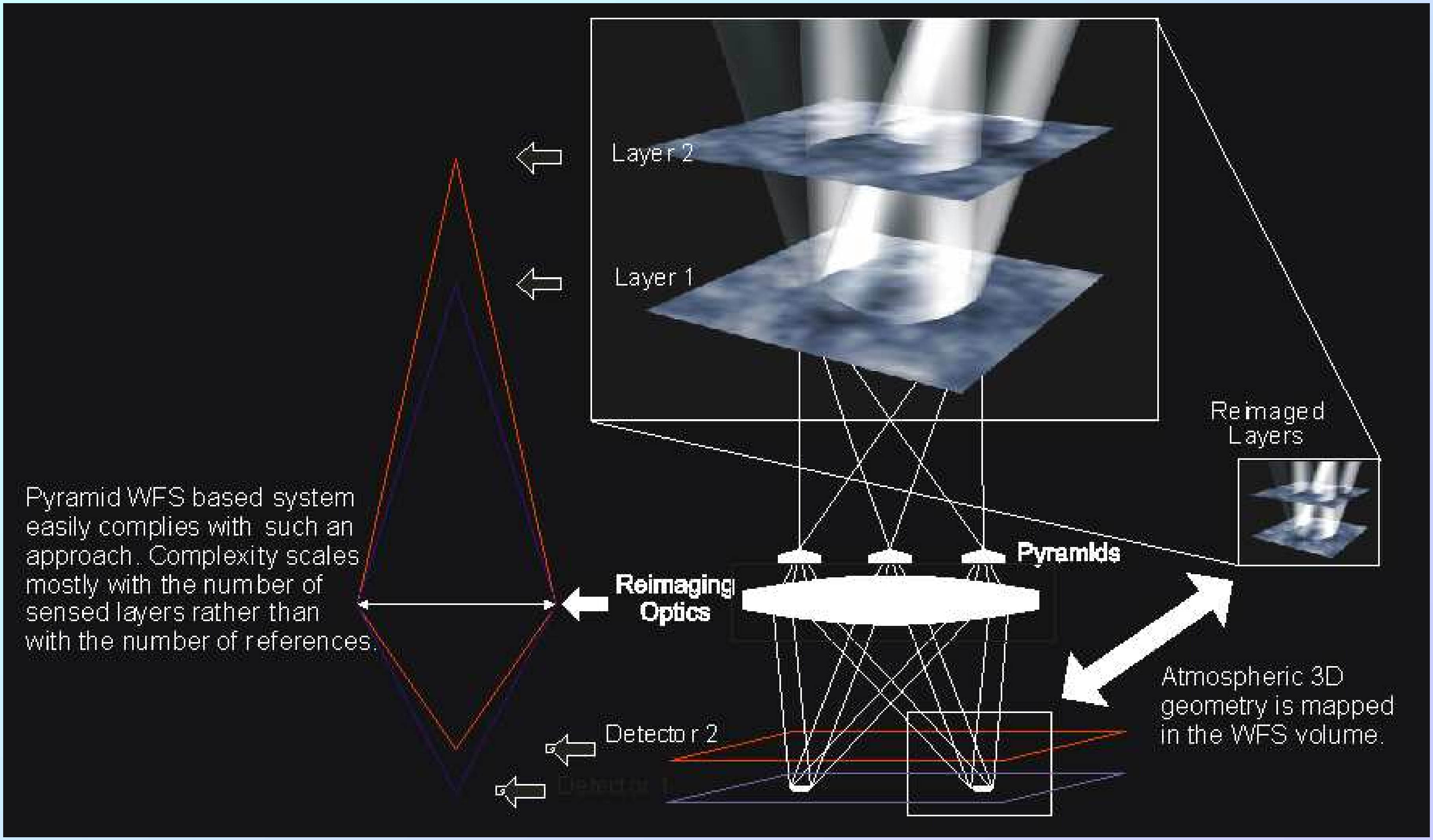
An *historical* perspective…

- Layer Oriented approach is shown in Backaskog 1999 and Munich 2000
- Optical co-addition of light
- Multi-pyramids.
- One CCD per layer.
- Let's build at VLT!

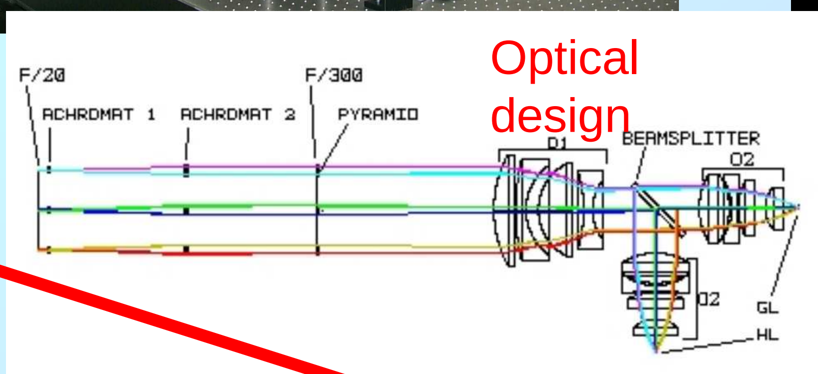


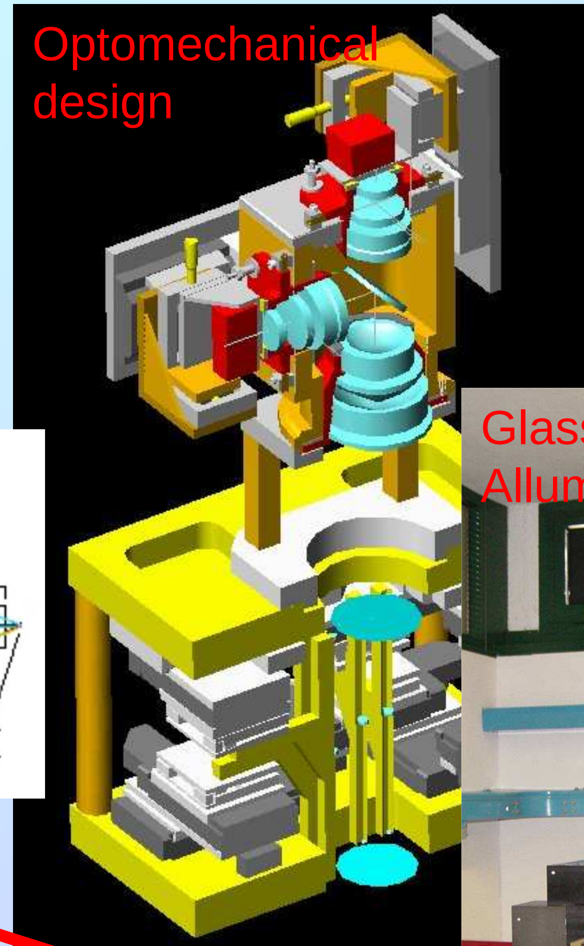


Canary, fall 2001

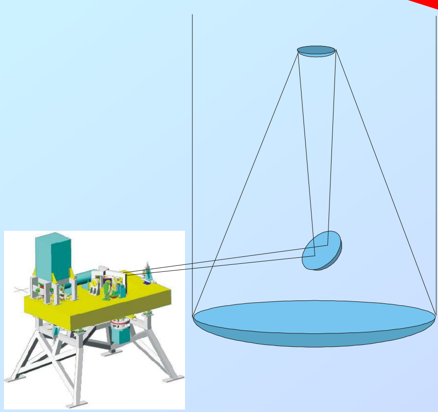

Layer 2
Layer 1
Reimaged Layers
Pyramids
Reimaging Optics
Pyramid WFS based system easily complies with such an approach. Complexity scales mostly with the number of sensed layers rather than with the number of references.
Atmospheric 3D geometry is mapped in the WFS volume.
Detector 2


Prototyping
(4 stars)


Optical
design
F/20
F/300
ACHROMAT 1
ACHROMAT 2
PYRAMID
D1
BEAMSPLITTER
O2
D2
GL
HL


Optomechanical
design


Glass and
Alluminum




nature

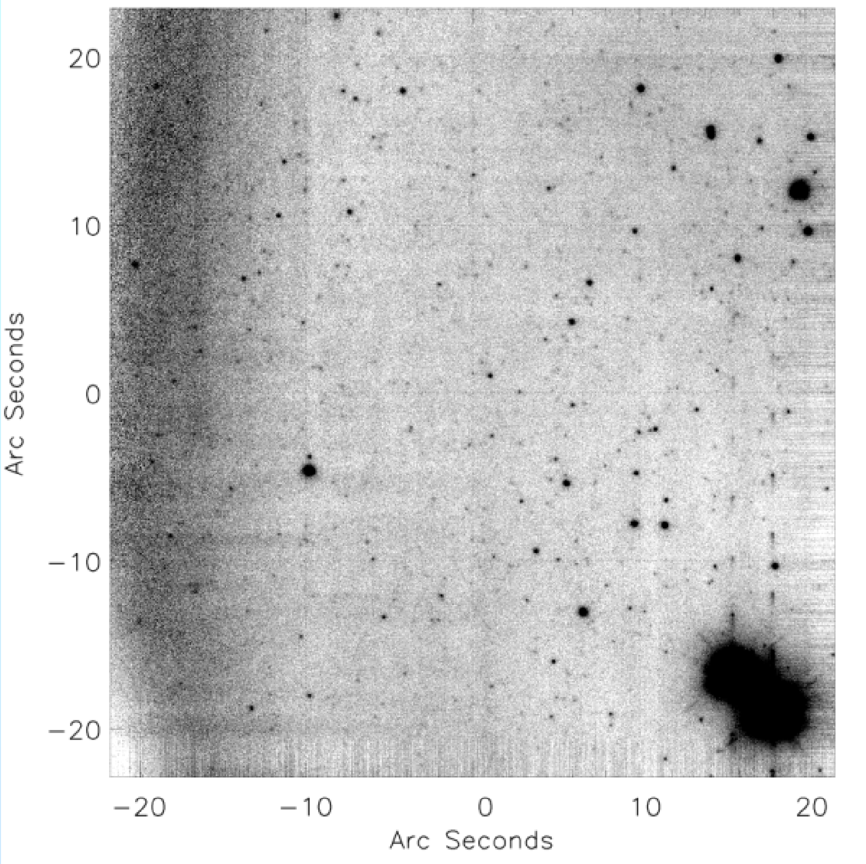
The MAD-LO run

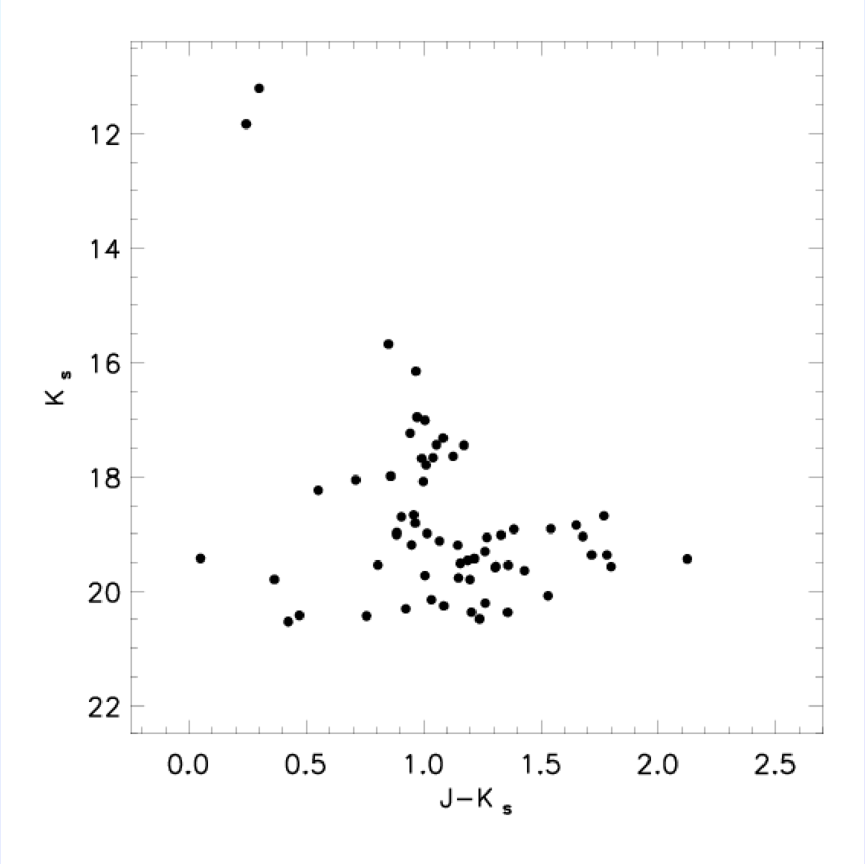
- Basically the whole group of LO-MAD plus ESO support (3 initially, then 1)
- Total of 9 contiguous nights
- First 3 night of technical run under ESO responsibility
- Then 6 nights of "GTO" basically devoted to science

LETTER TO THE EDITOR

Resolving Stellar Populations outside the Local Group: MAD observations of UKS 2323-326*

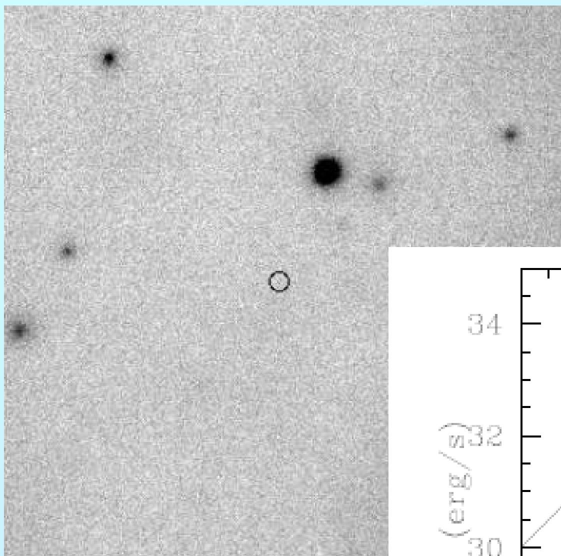
M. Gullieuszik[1], L. Greggio[1], E. V. Held[1], A. Moretti[1], C. Arcidiacono[1], P. Bagnara[1], A. Baruffolo[1], E. Diolaiti[2], R. Falomo[1], J. Farinato[1], M. Lombini[2], R. Ragazzoni[1], R. Brast[3], R. Donaldson[3], J. Kolb[3], E. Marchetti[3], and S. Tordo[3]

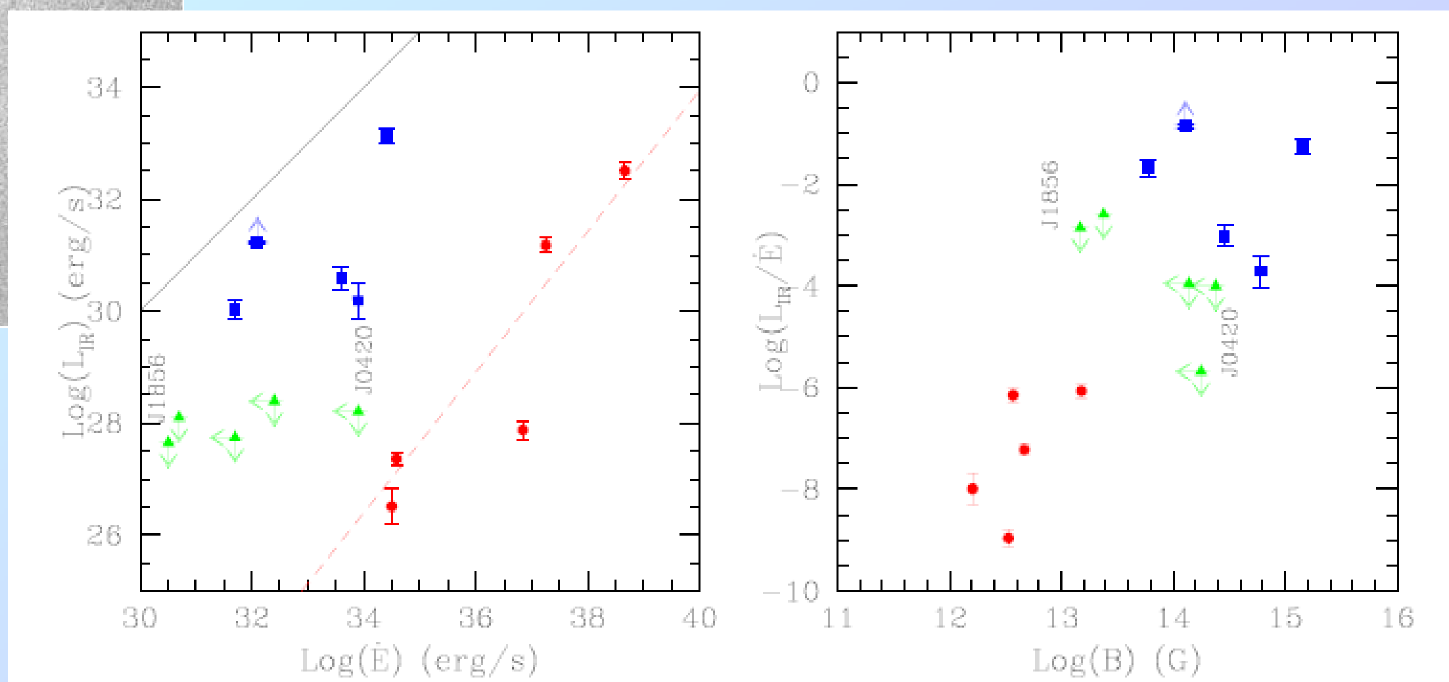




Near infrared VLT/MAD observations of the isolated neutron stars RX J0420.0−5022 and RX J1856.5−3754 ⋆ (Research Note)

R. P. Mignani[1], R. Falomo[2], A. Moretti[2], A. Treves[3], R. Turolla[4,1], N. Sartore[3], S. Zane[1], R. Ragazzoni[2], C. Arcidiacono[2], J. Farinato[2], M. Lombini[5], and E. Marchetti[6]





Astronomy & Astrophysics manuscript no. mad0521final
May 19, 2009

The jet of the BL Lac object PKS 0521 -365 in the near-IR : MAD adaptive optics observations. ⋆

R. Falomo[1], E. Pian[2], A. Treves[3], G. Giovannini[4,5], T. Venturi[4], A. Moretti[1], C. Arcidiacono[1], J. Farinato[1], R. Ragazzoni[1], E. Diolaiti[6], M. Lombini[6], F. Tavecchio[7], R. Brast[5], R. Donaldson[8], J. Kolb[8], E. Marchetti[8], and S. Tordo[8]

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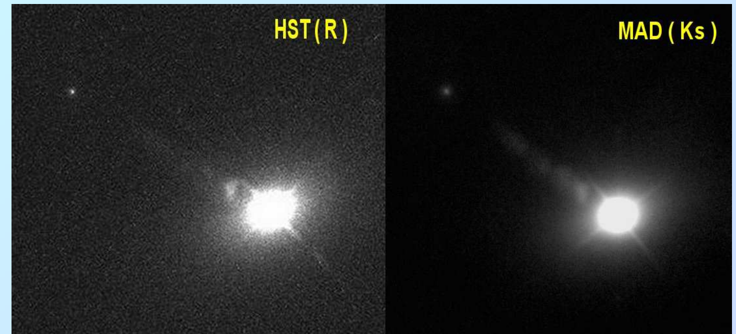
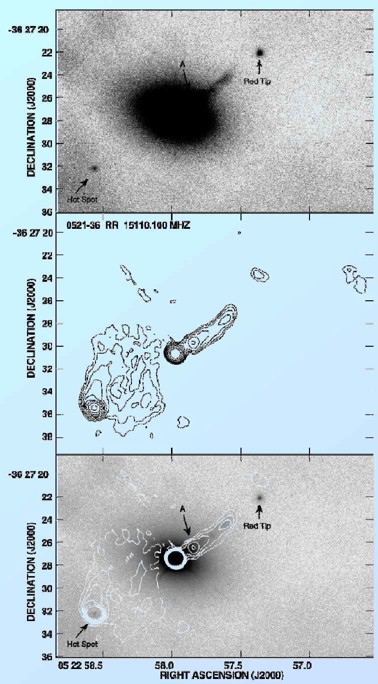
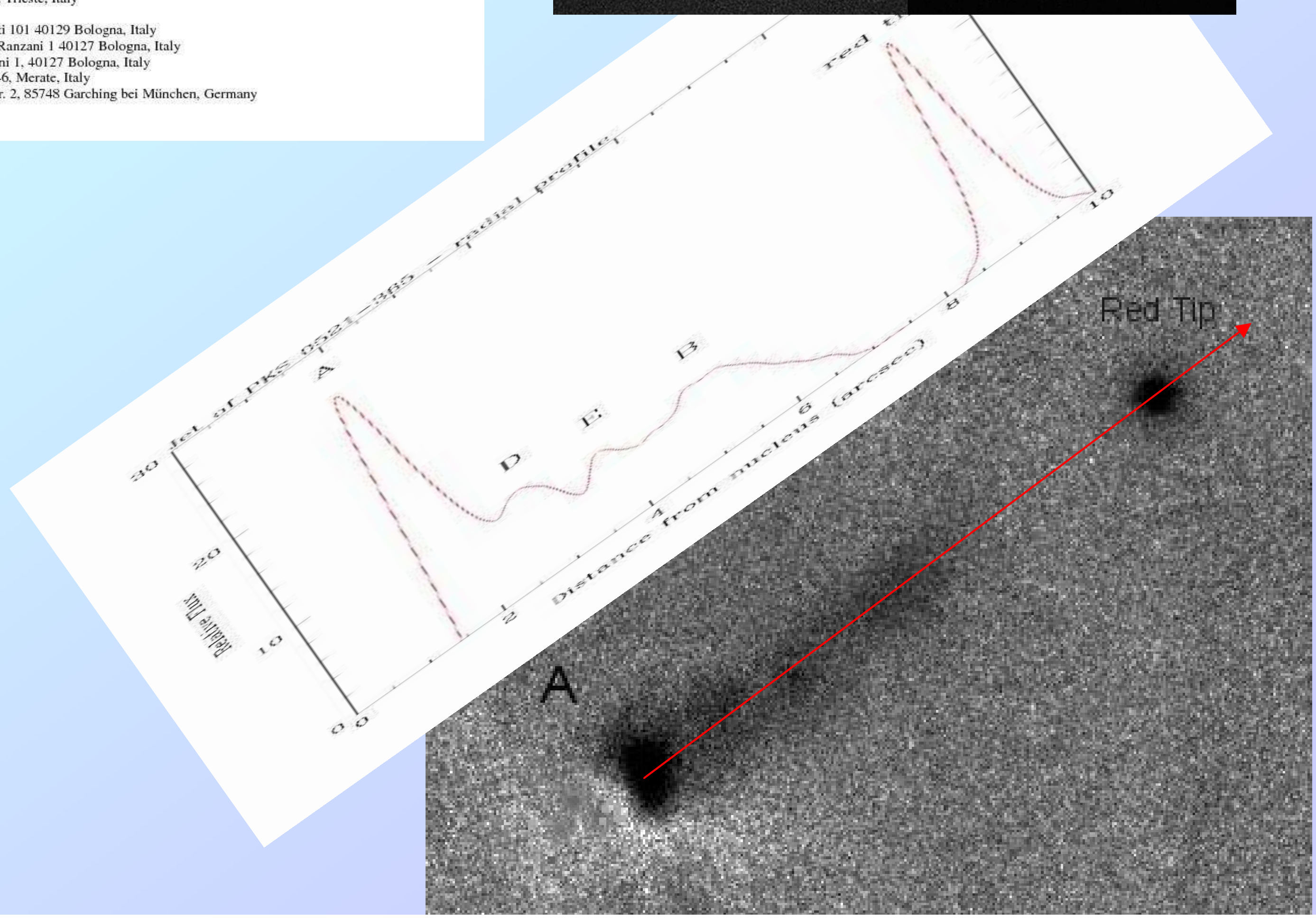
5 Dipartimento di Astronomia - Bologna University - via Ranzani 1 40127 Bologna, Italy
6 Osservatorio Astronomico di Bologna, INAF, via Ranzani 1, 40127 Bologna, Italy
7 Osservatorio Astronomico di Brera, INAF, via Bianchi 46, Merate, Italy
8 European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching bei München, Germany

Received ... ; accepted ...



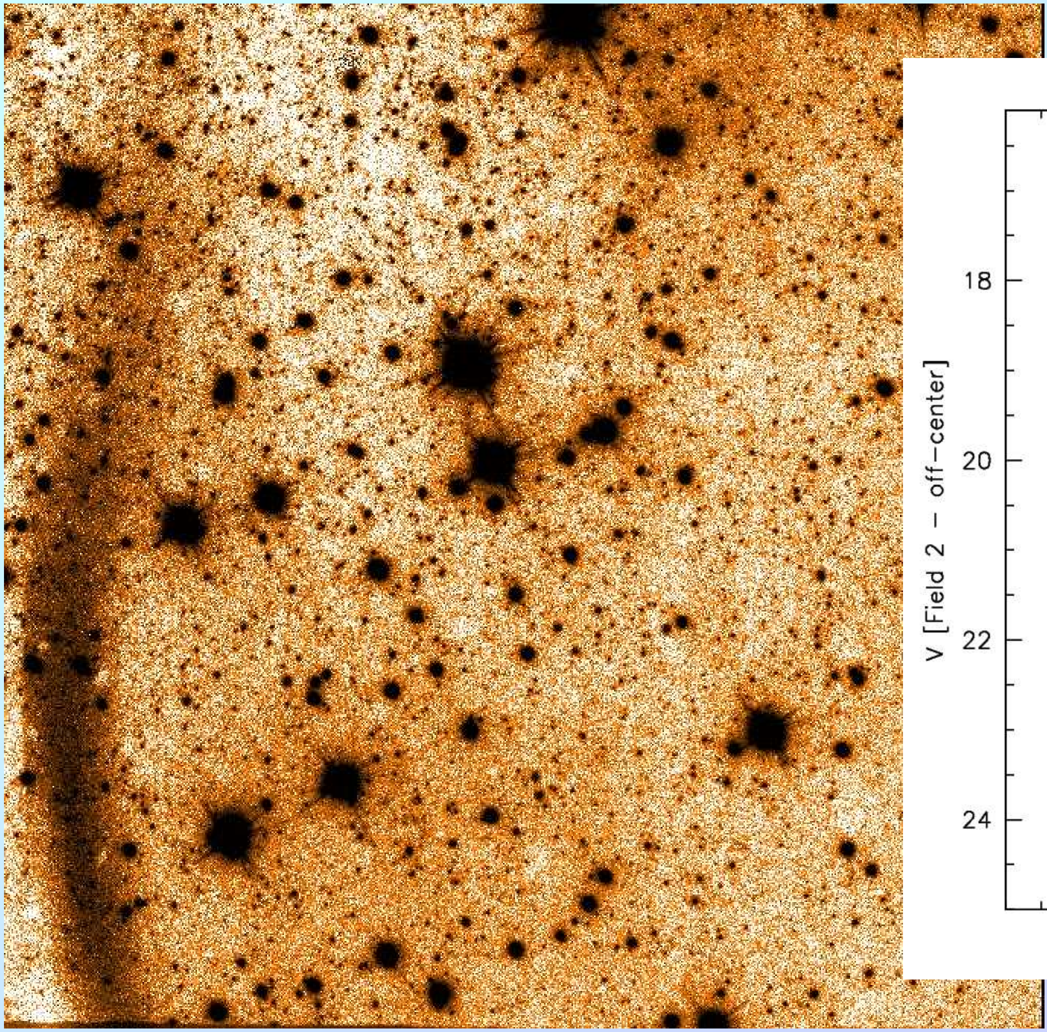


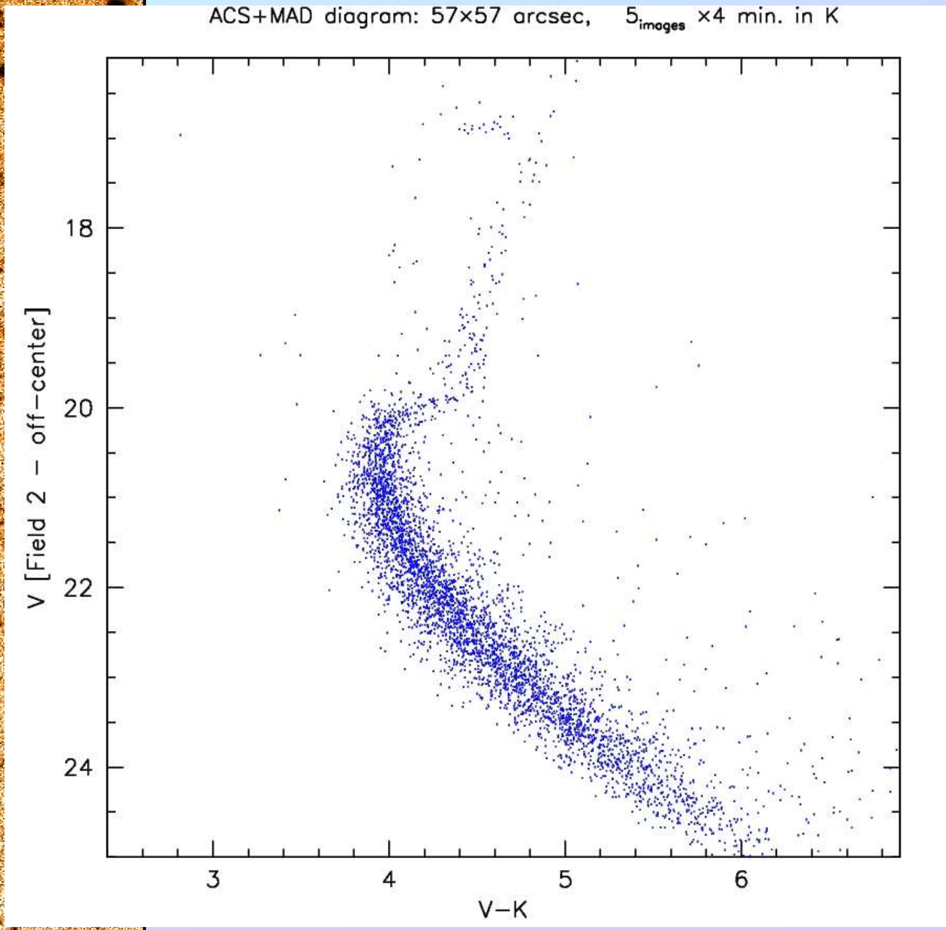


Astronomy & Astrophysics manuscript no. ms
June 20, 2008

MAD observations of the Globular Cluster NGC 6388

A. Moretti et al.





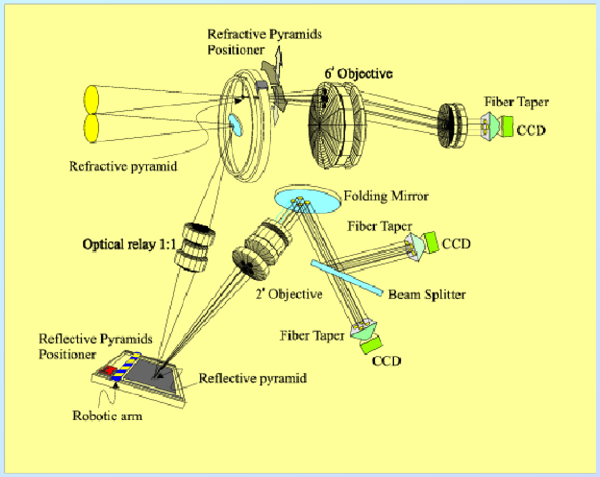
A&A 396, 731–744 (2002)
DOI: 10.1051/0004-6361:20021406

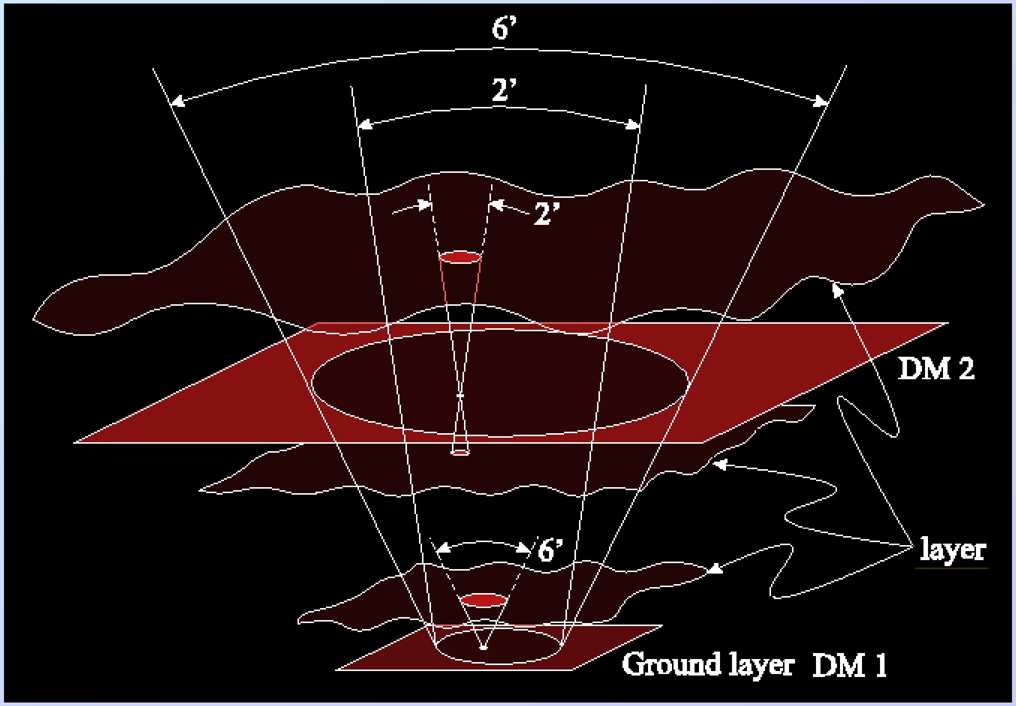
Astronomy & Astrophysics

Multiple field of view layer-oriented adaptive optics

Nearly whole sky coverage on 8 m class telescopes and beyond

R. Ragazzoni[1,2], E. Diolaiti[3], J. Farinato[1], E. Fedrigo[4], E. Marchetti[4], M. Tordi[5], and D. Kirkman[6]





Sky coverage issue…

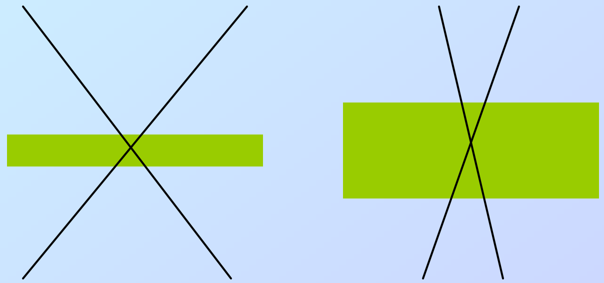
Two key things:

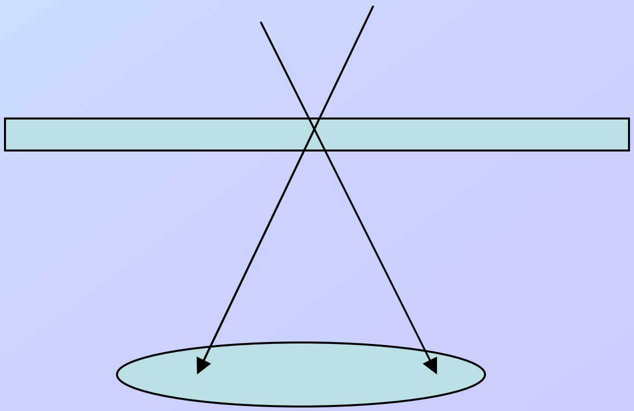
1*. How much large can be the FoV where to find for suitable stars?*

2*. Where is the "zero-point" of the calculation?*

How large can be the FoV?

- It cannot be too large as otherwise the thickness of the turbulence corrected become too small
- And it must prevent geometrical limits (so for an 8m 2’ is almost on the limit, but on a 42m the limit is at 12’)





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  If we fix it here we have a chance for E-ELT!

- And it must prevent geometrical limits (so for an 8m 2' is almost on the limit, but on a 42m the limit is at 12')

  Ok, so for VLT we have hit the limit!

How large can be the FoV?

- There are several possible solutions that has been just briefed in the past…

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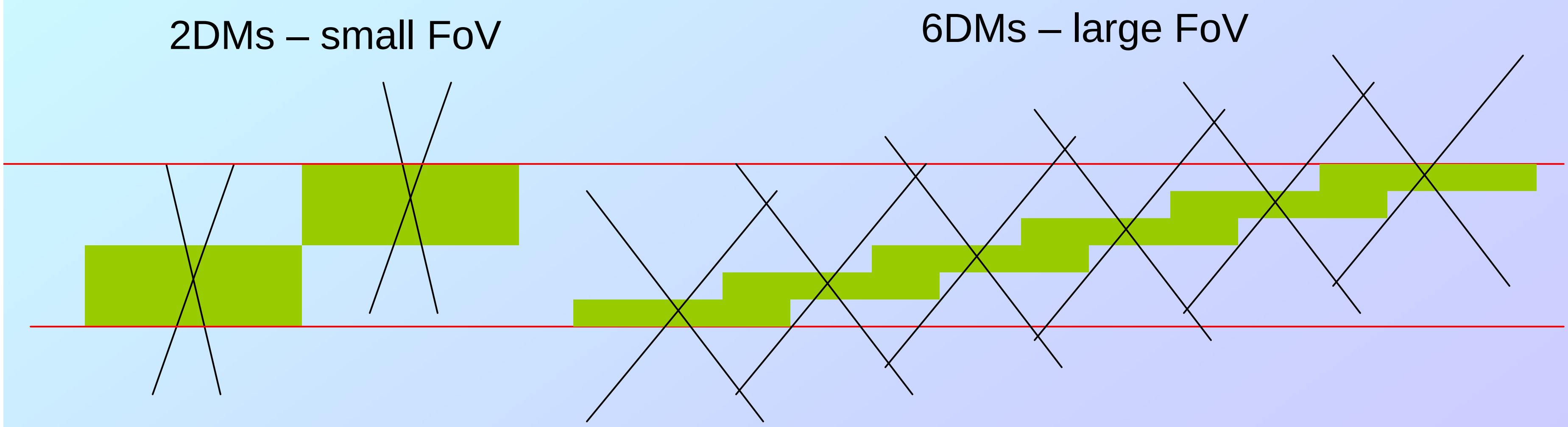

How large can be the FoV?

- There are several possible solutions that has been just briefed in the past…
- The obvious solution would be to have much more DMs!
- If you have five DMs you can have a five times larger FoV (Beckers 1988, + others much later)
- The only thing that does matter is that the WaveFront "sees" the five DMs
- Two real DMs + 3 "virtual DMs" *continuously updated (*not just used to make the interaction matrix)
- Linearity to be attacked in an active way (like measuring it in real time during the measurement!)

Zero point…

- Of course it depends upon Cn2, seeing, how much Strehl you wish, the wavelength…
- We made LOST in the past, and then used MAD true data to deduct it…

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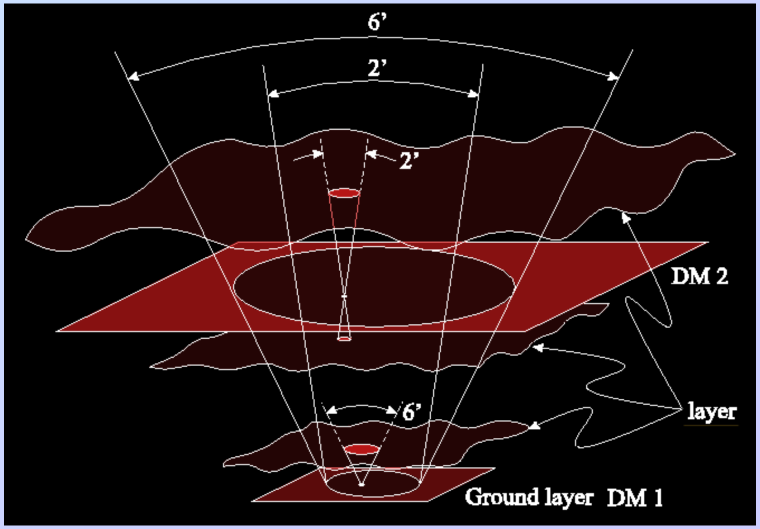
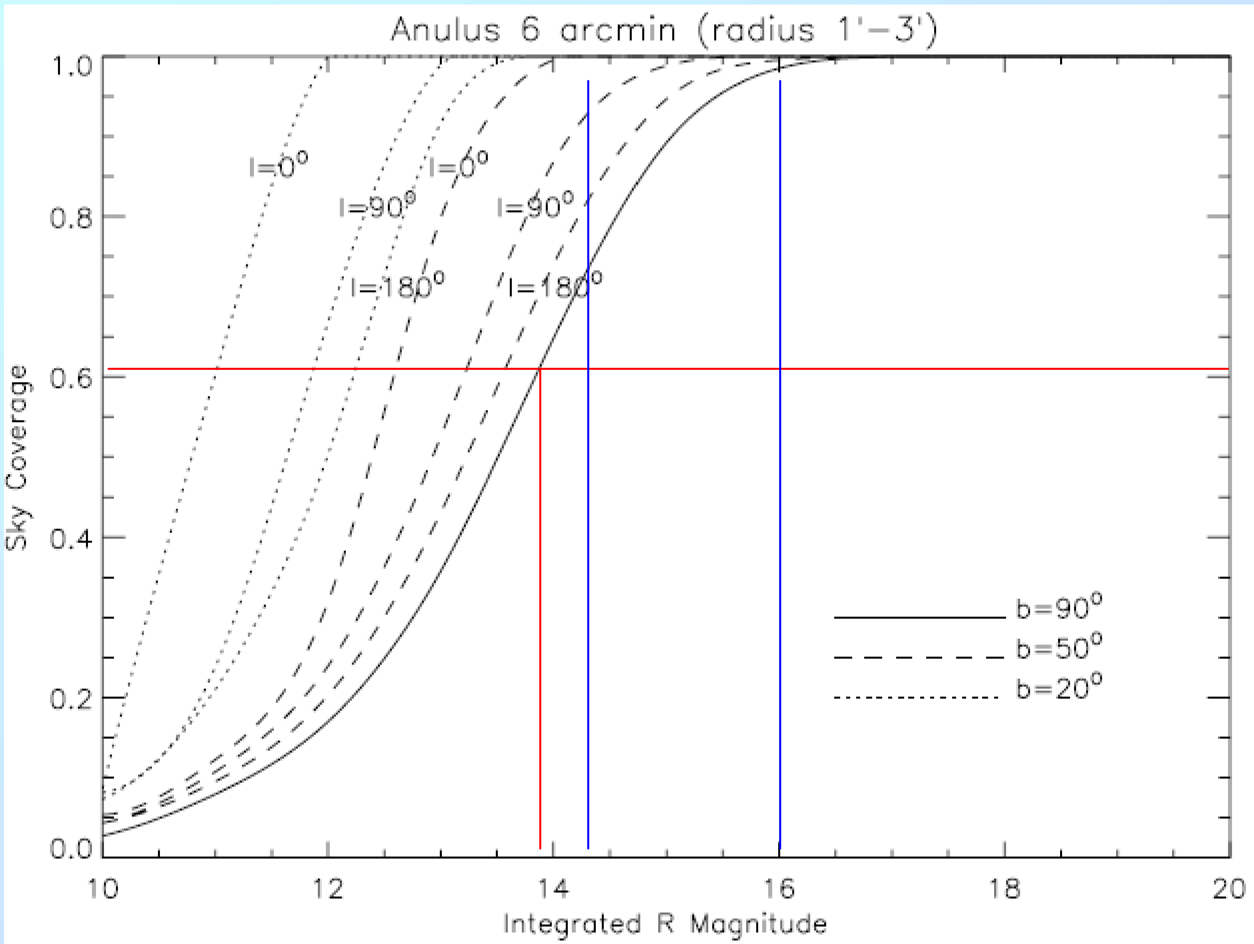


Red: estimates given in the 2002 paper
Blue: left – actual measurements in the sky; right – laboratory measures



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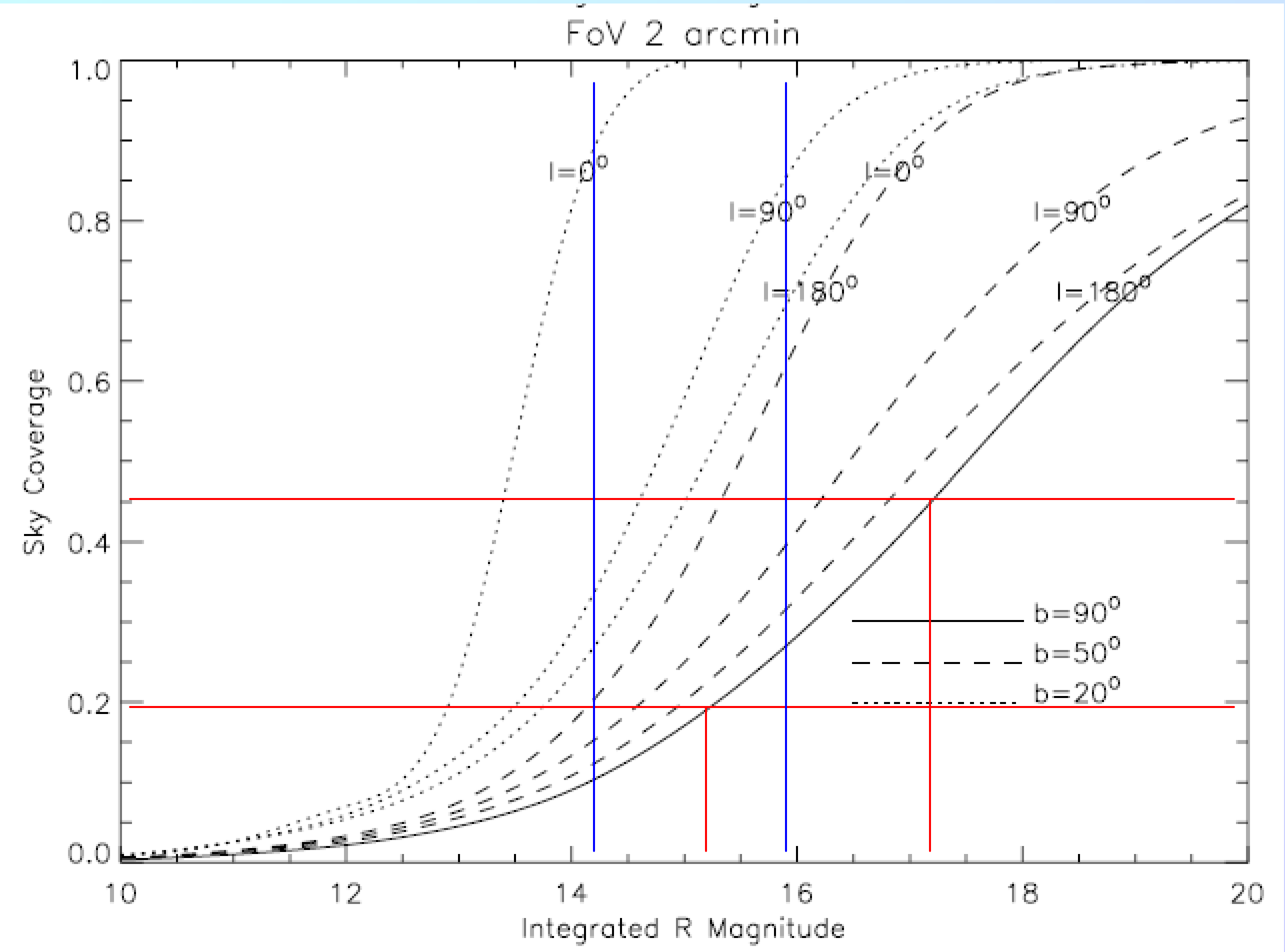

Gal. Lat.	LO with PS magnitude gain and $RON = 2.5$ e$^-$		
	GL6	HL	**Total**
$b = 20°$	1.00 ... 1.00	0.67 ... 0.99	**0.67 ... 0.99**
$b = 50°$	0.83 ... 0.83	0.28 ... 0.63	**0.23 ... 0.52**
$b = 90°$	0.61 ... 0.61	0.20 ... 0.45	**0.12 ... 0.27**

→ 0.70 … 0.99 0.10 … 0.25 **0.07 … 0.25**

!

Remember that the CCD is blue-sensitive…!!!

Zero point…

- Two arguments in order to (try to) convince you…:
- MAD-MAX with noise-free CCDs can be equivalent to LO as RON noise do not superimpose
- Íf you find 3 stars on 2’ of a certain range you will find 75 on a 10’….
- If you think that 3 NGSs on a FoV of several arcminutes gives a 50% GLAO sky coverage on an ELT why should not some like 10…20 stars on 10’ gives full MCAO if you can use them at such large off-axis?

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There are also other arguments… once GL is gone AO is gentler, Taylor hypothesis usage, and so on…

Where is the future of MCAO ?

- I think there are strong arguments to make a technical case for an ELT MCAO with solely NGSs
- These could requires just more probes for the NGSs with WFSs able to measure non-linearity
- To make *more* in closed loop you would need *more* FoV going through a MAORY-like facility

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Stay tuned for Paris in a couple of weeks…