EELT: Phase B status

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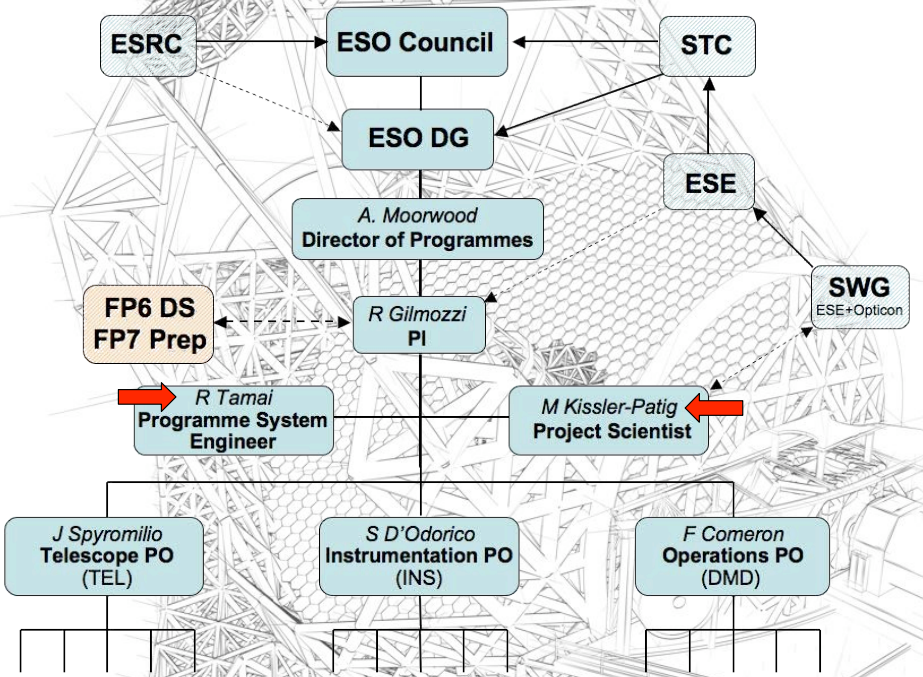
EELT Principal Investigator
DRM workshop, Garching, May 20-21 2008

The EELT: Phase B Status

- Goal
  - Proposal for construction by mid 2010 (goal end 2009)
- Resources
  - 2007-2009: 57.2 M€ (including 110 FTEs)
  - 2008-2011: 5 M€ for EELT related R&D
  - Supporting activities from FP6 (28.8 M€) & FP7 (6.1 M€)
- Telescope (~60% budget committed)
  - Several industrial contracts running
  - BRDv2 following Baselining meeting (Feb 29 - Mar 4)
- Instrumentation
  - Started Phase A studies
- Design Reference Mission
  - Progress in simulations
  - First iteration completed

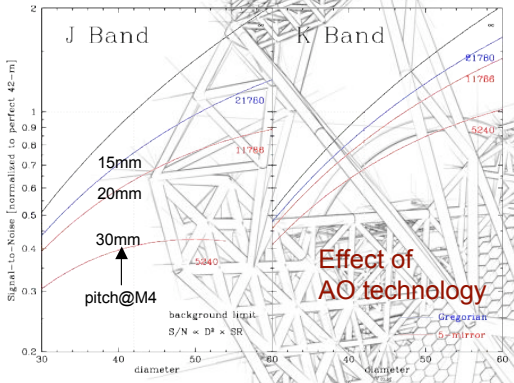
Programme organization



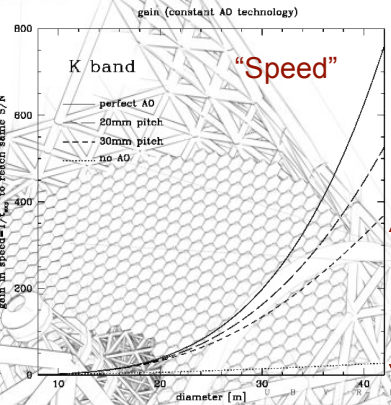
News

- Program System Engineer on board (R Tamai)
- Project scientist appointed (M Kissler)
- MAD Science Verification ("Star Oriented") executed
  - Two runs (Nov and Jan)
  - 12 programs, 21 targets
    - 15 targets completed, 2 almost complete, 4 not executed (time, gde)
    - 1 program not executed (unsuitable guide stars)
  - Additional runs recommended by STC (planned for the Summer)
- FP7 contract signed, work started

Summary: powerful performance

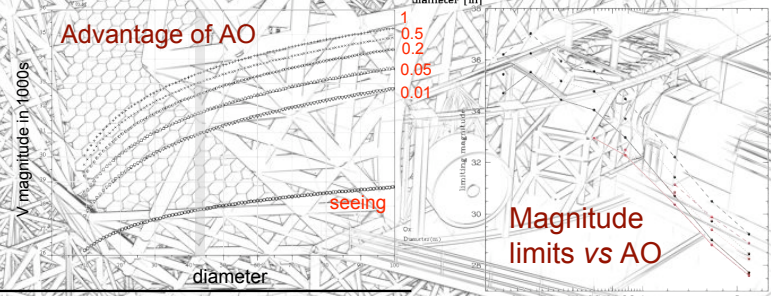


Effect of AO technology



≈ 1 year of VLT obs in 1 night

Advantage of AO



$S/N = F / \sqrt{(F+B+\ldots)}$

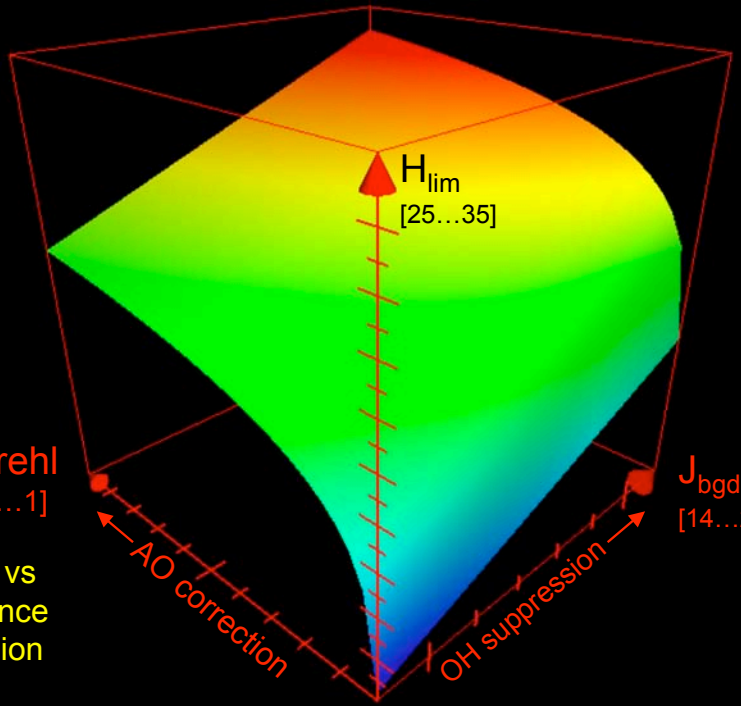
Flux: $F \approx F_0 \times SR \propto D^2 \times SR$

Bgd: $B = sky/'' \times pix^2 \propto D^2 \times D^{-2} \equiv B_0$

For faint sources:

$S/N \approx F/\sqrt{B} \propto \mathbf{D^2 \times SR}$

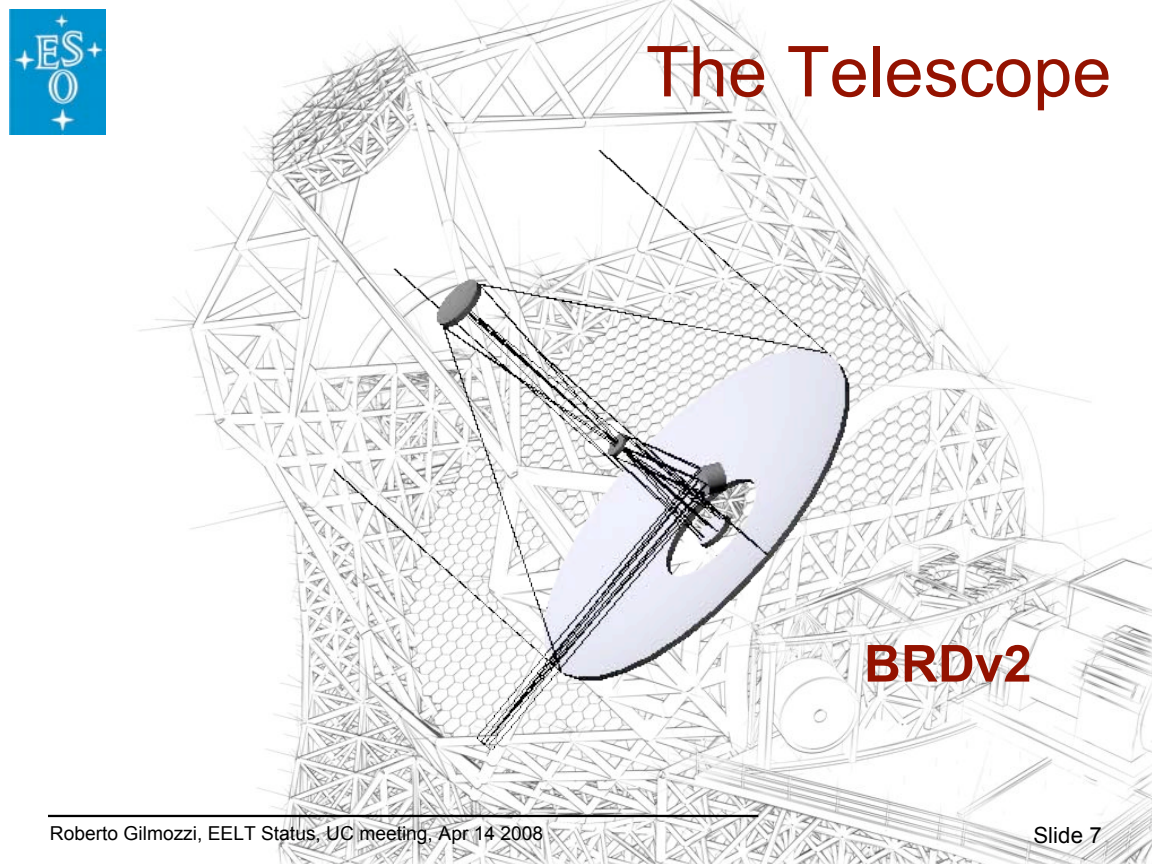
Performance upgrade paths



Limiting mag vs
AO performance
OH suppression

Gilmozzi & Cuby, 2008

The Telescope



The Baselining meeting

An internal meeting (***not*** a review) to define the *baseline for design consolidation*

- Consolidation over the next 8 months

Consolidation will yield the definitive EELT design and the specs/requirements for the final subsystem contracts

- This will provide the input to the Proposal for Construction, including the cost and schedule

Fri. 29th February

09:00	Overview	Gilmozzi
09:30	Science case	Kissler-Patig
10:30	Telescope project management	Spyromilio
10:45	Project control	Basbilir
11:00	*Coffee*	
11:30	Site operations	Tamai
11:50	Science operations and systems	Comeron
12:30	***Lunch***	
13:30	Optical design	Delabre
14:00	System engineering	Dierickx
14:30	Error budget	Bonnet
15:00	Interfaces	Koehler
15:30	*Coffee*	
16:00	Discussion	

Mon. 3rd March

09:00	Telescope mount design	Brunetto
09:45	Enclosure design	Schneermann
10:30	*Coffee*	
11:00	Primary mirror cell	Brunetto/Cayrel
11:30	Primary mirror	Swat
11:45	Primary mirror control	Erm
12:00	Primary mirror phasing	Noethe
12:30	***Lunch***	
13:30	Secondary mirror cell	Brunetto
14:15	Secondary mirror	Swat
14:30	M4	Hubin
15:00	*Coffee*	
15:15	M5 electromechanics	Hubin
15:45	M5 mirror	Swat/Cayrel
16:00	Lasers	Holzloehner
16:30	Discussion	

Tu. 4th March:

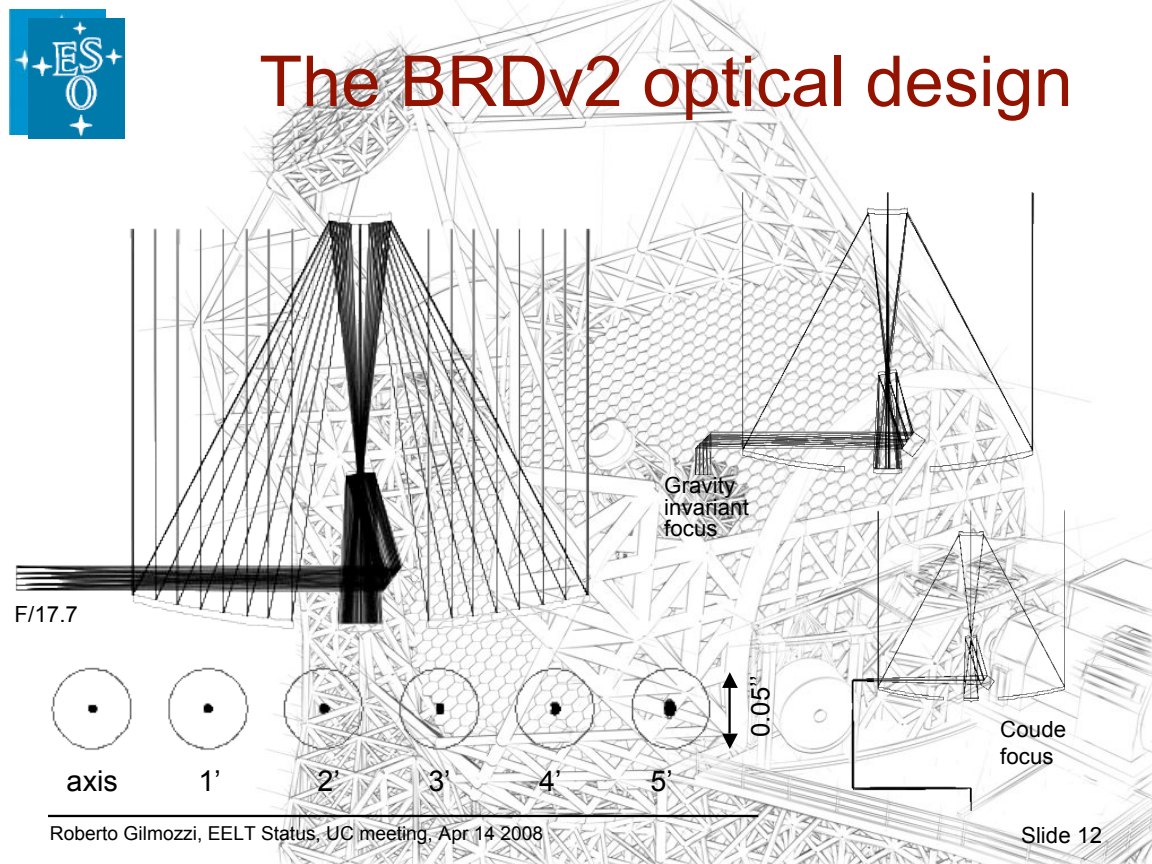
09:00	Wavefront control adapters	Noethe
10:00	Central control	Wallander
10:30	*Coffee*	
11:00	Telescope costs	Spyromilio
12:30	***Lunch***	
14:00	Instrument and Post Focal AO modules studies	D'Odorico & Hubin
15:00	Instrumentation-related infrastructure and Telescope Interface	Casali et al
16:00	Discussion	

Cast

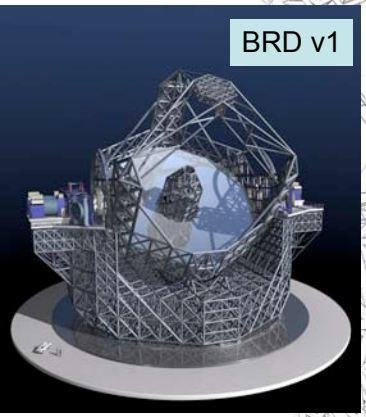
Outcome of the meeting

- Current status: progress of Phase B
- Current baseline for each subsystem
  - Selected by subsystem responsible(s)
- Identification of issues to be resolved during the consolidation
- Crucial input to the decision making process
- After the consolidation the telescope design will be under configuration control.
- Milestones (T0 is 5 Mar)
  - T0+3 months interface baseline
  - T0+5 months performance baseline
  - T0+8 months BRDv3

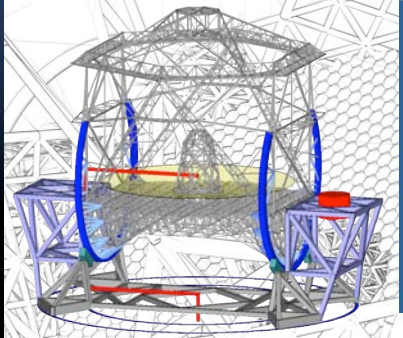
The BRDv2 optical design

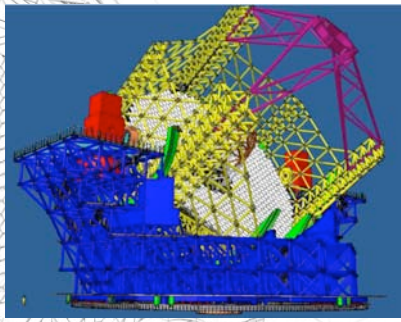


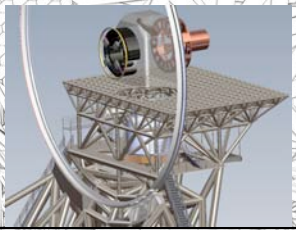
The telescope mount



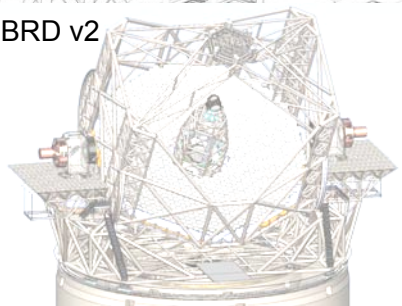
Industrial studies



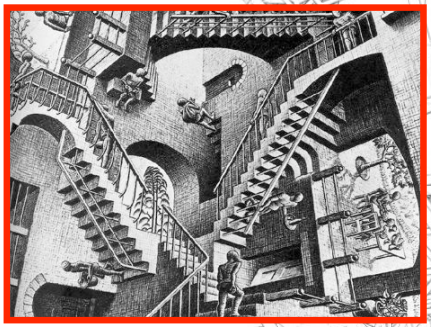


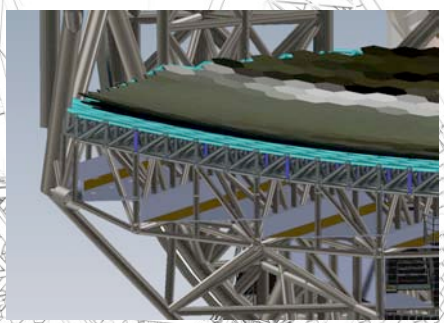


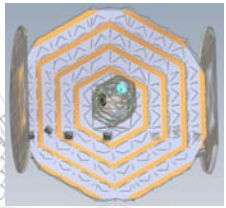
BRD v2



Accessing the subsystems

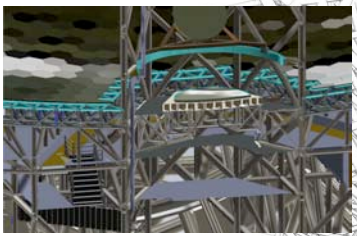


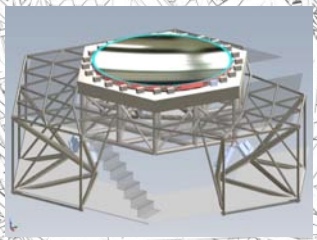


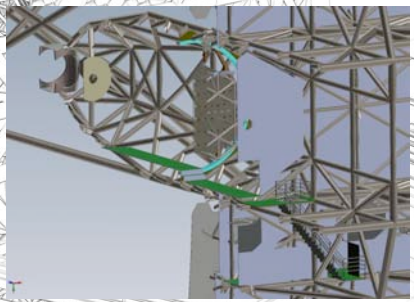


Safety

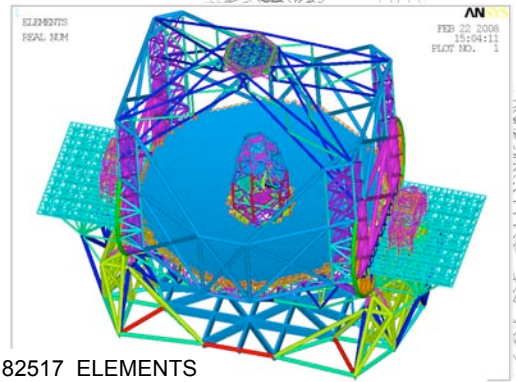
shortest way out



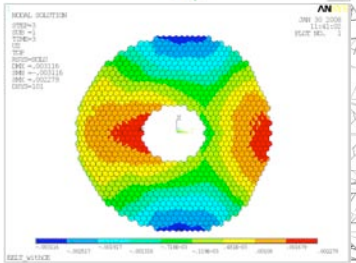




Analysis



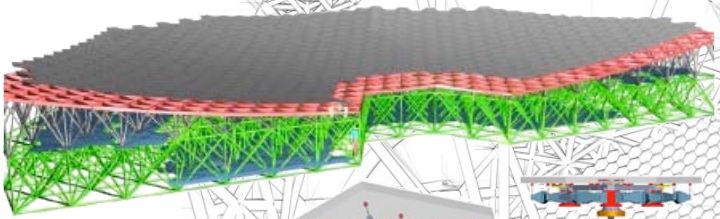
82517 ELEMENTS
28817 NODES

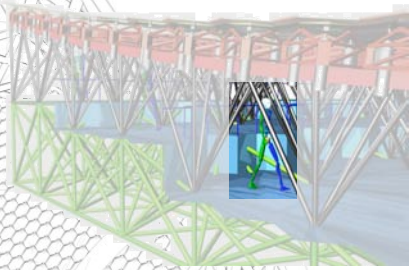


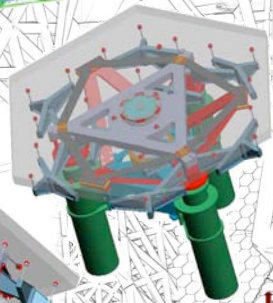
Mass summary [tons]		
Total Mass	4580	(density increased by 10%)
Altitude	2210	
M1	342	163 glass 80 moving frame 99 fixed frame
M2	25	6.2 glass (ULE)
ARU	130	65 structure + 5 ADC 20 M3 + 15 M4 + 25 M5

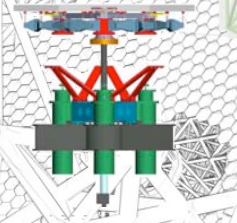
Mode	Frequency [Hz]	Effective mass in % of total						Mode shape
		MX	MY	MZ	IXX	IYY	IZZ	
1	2.8		48.8		3.2			Altitude LR
2	3.1	51.0						Cross altitude
4	3.7			2.6			40.3	Piston M2 unit
7	4.0		7		1			Azimuth LR
17	6.0			26.9				Pumping mode

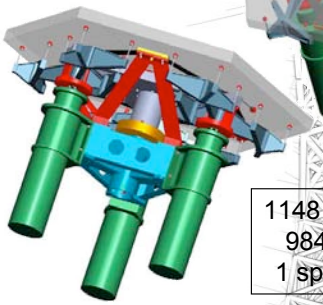
The primary

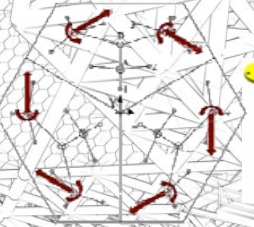




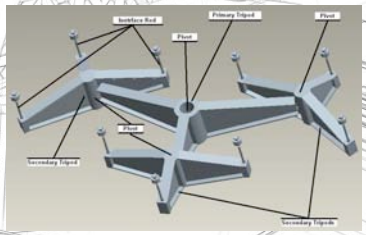








1148 segments:
984 mirror +
1 spare/family



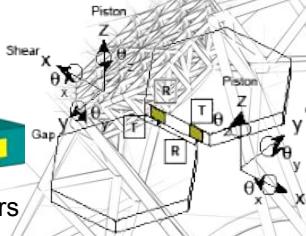
27-point whiffle tree

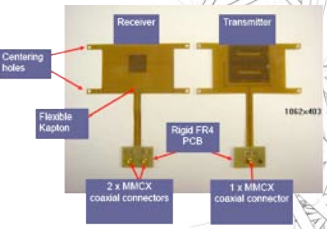
The primary (2)

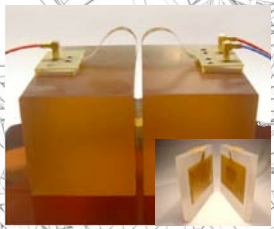
Segment dimensions:
1428.64 mm – 1414.00 mm
(1387.29 - 1427.13 @pupil)
central thickness: 50 mm
gap: 4 mm
bevel 2: mm (goal 1.5)

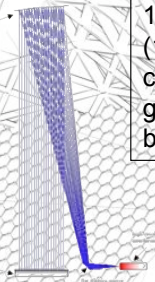
2 x 7 segments to be produced by contractors

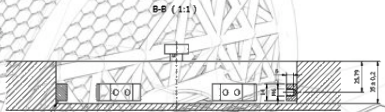
Edge sensors



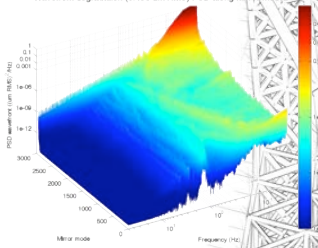


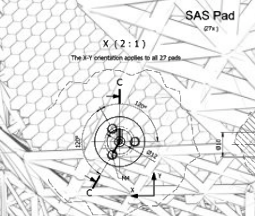


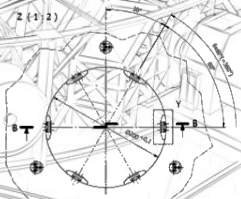




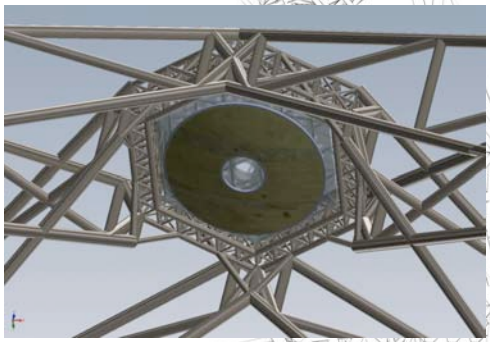
Wavefront degradation (0.496 um RMS) PSD along mirror modes

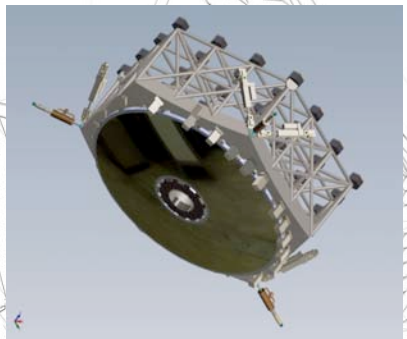


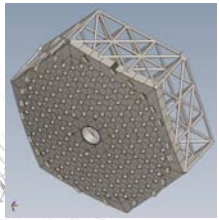


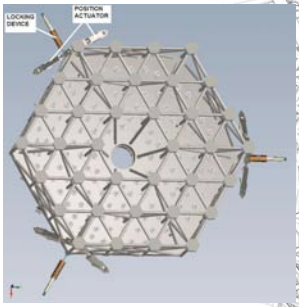


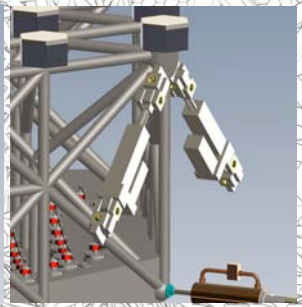
The secondary

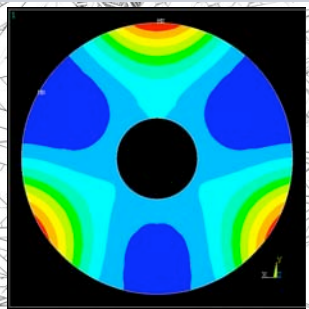


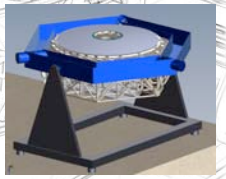




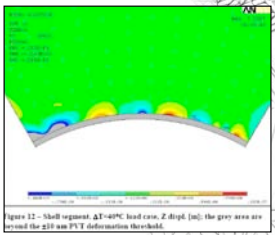


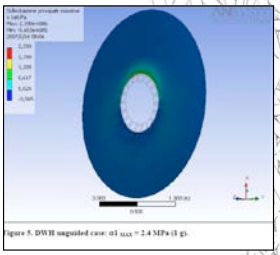


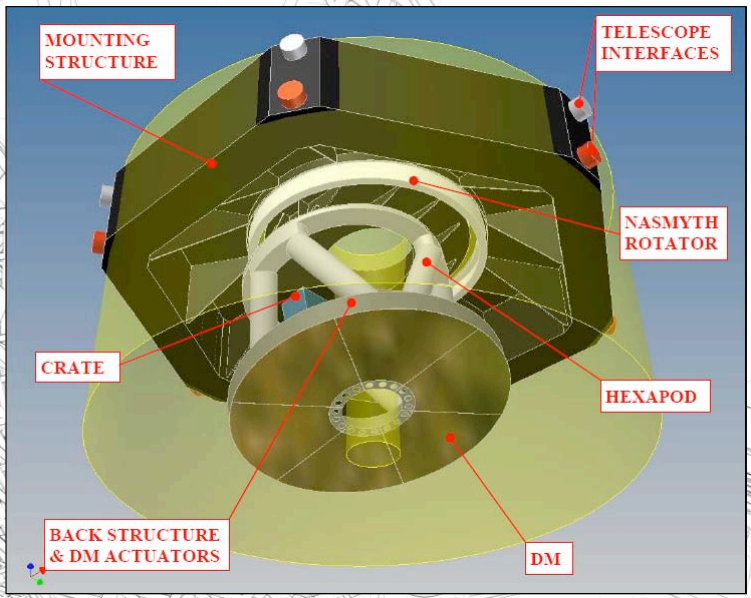




The M4 adaptive mirror



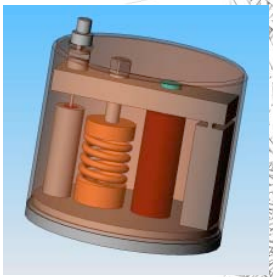




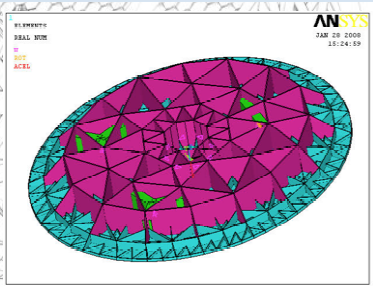
Both industrial studies will deliver working prototypes

Either voice coil **30-mm** pitch or piezo **20-mm** pitch

The M5 field-stabilization mirror



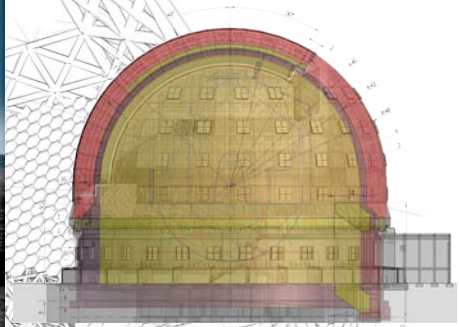
Deliverable of industrial electromechanical study: scale 1 prototype

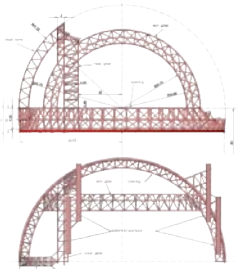


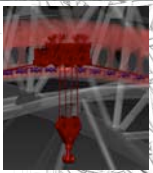
Goal: 40 kg/m^2

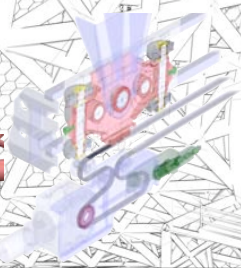
361 Kg (**67 kg/m^2**) mirror design
254 Hz eigenfrequency

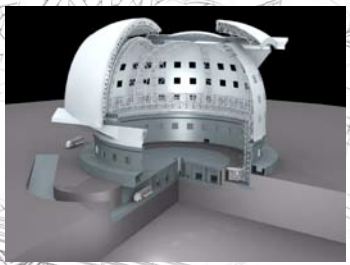
The enclosure (dome)



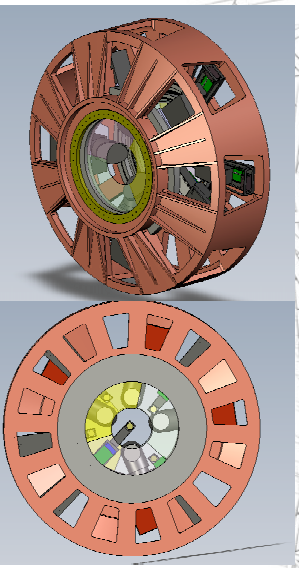


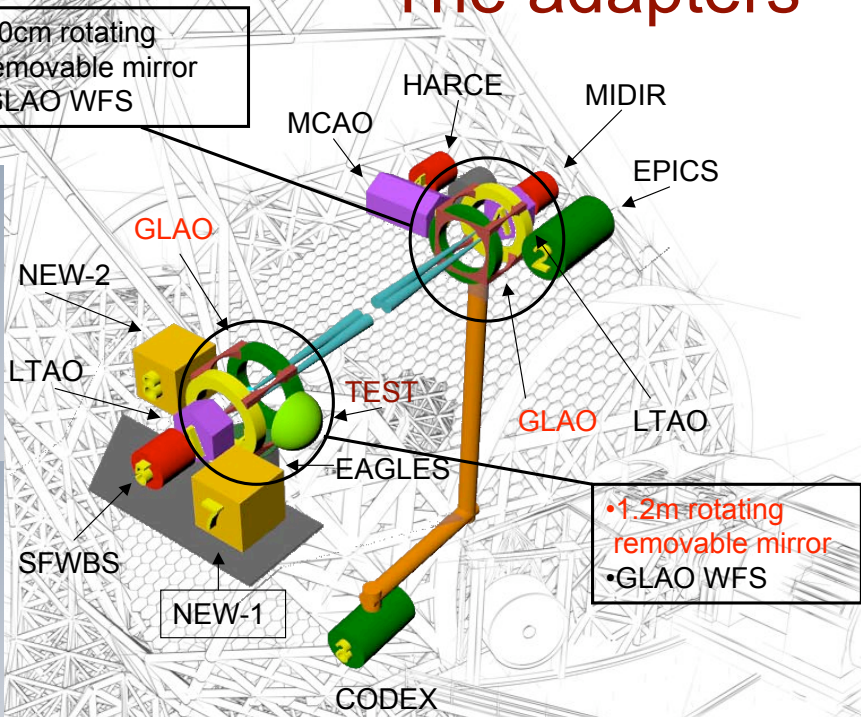


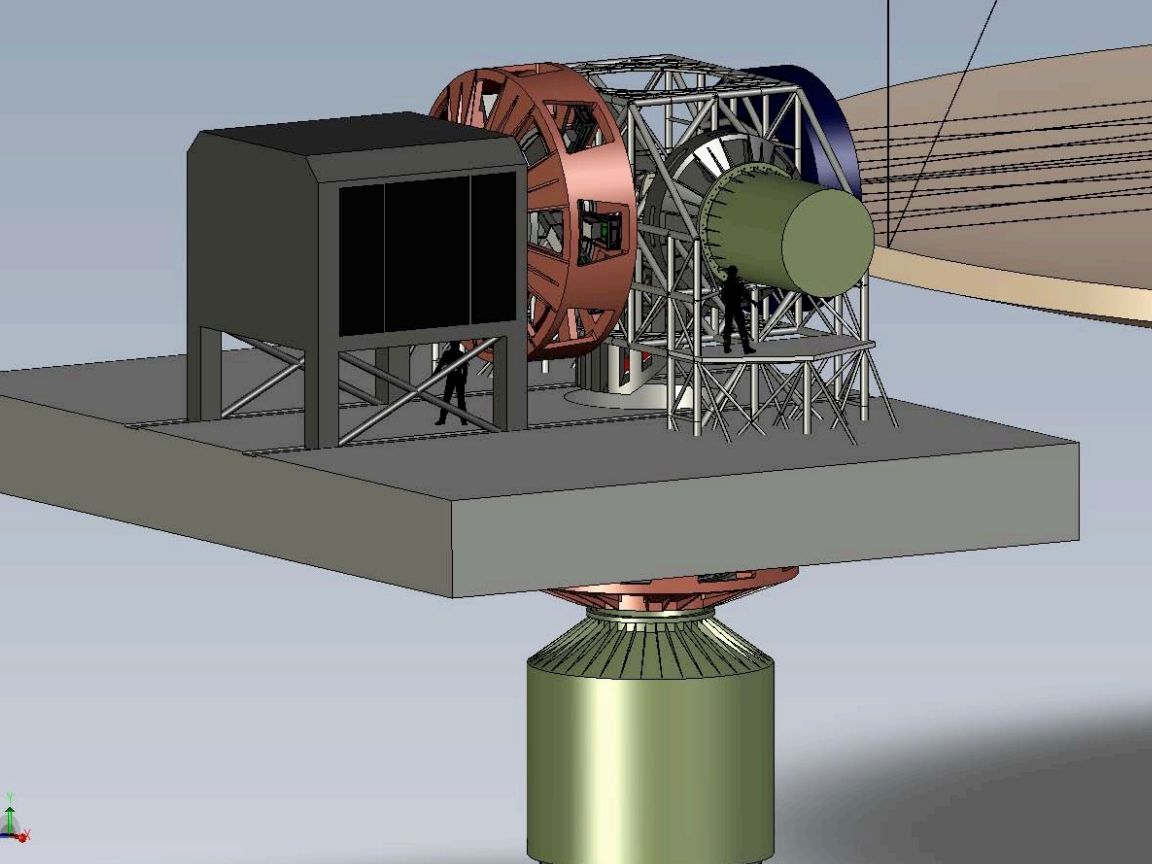




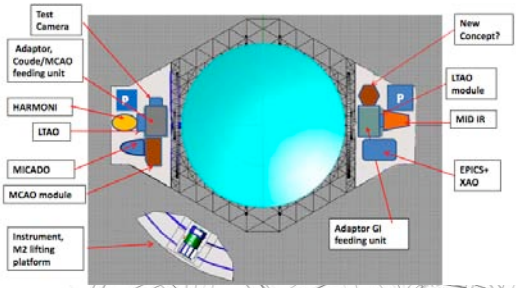
The adapters



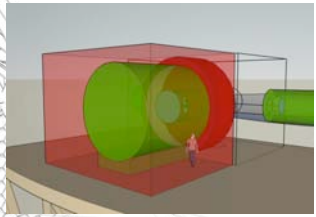


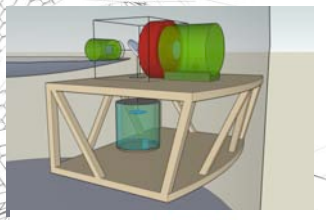


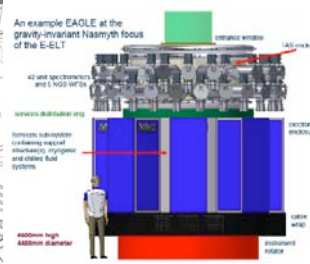
Instrumentation



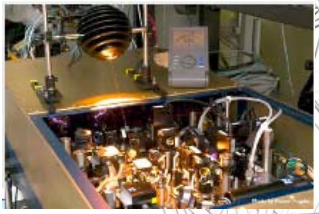
INSTRUMENT STUDY	MAIN OBSERVING MODES	PROCUREMENT MODUS / STATUS
EAGLE	*WF, Multi IFU NIR Spectrograph. +AO*	*SSP / Agreement with Consortium of Institutes from France and UK*
CODEX	*High Resolution, High Stability Visual Spectrograph*	*ESO coordinates study with Institutes from Italy, Spain, Switzerland and UK*
EPICS + XAO	*Planet Imager and Spectrograph*	*ESO coordinates study with Institutes from France, Italy, Switzerland, UK*
MICADO	*NIR Camera sampling to the DF*	*Open Call/ Agreement with Consortium of Institutes from Germany, Italy, The Netherlands*
HARMONI	*Single IFU , Wide Spectral Band Spectrograph*	*Open Call/ Agreement with Consortium of Institutes from UK, France, Spain*
MACAO Module	*Provides DL images over a field up to 2 ', with 2 additional DM*	*SSP/ Agreement with Consortium of Institutes from Italy and France*
MIR Instrum.	*Mid IR camera /spectrograph*	*Open Call for fixed cost study, deadline March 08*
New Concepts	*Left to the bidders to propose*	*Open Call for up to 2 fixed cost studies; deadline May 14*
LTAO Module	*Provides DL images over a field <30"*	*Open Call for fixed cost study; deadline April 30(tbc)*

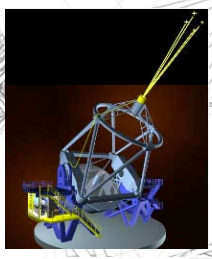


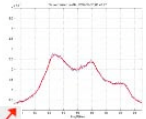


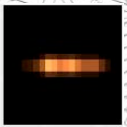


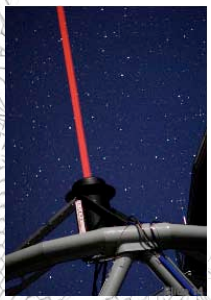
Lasers

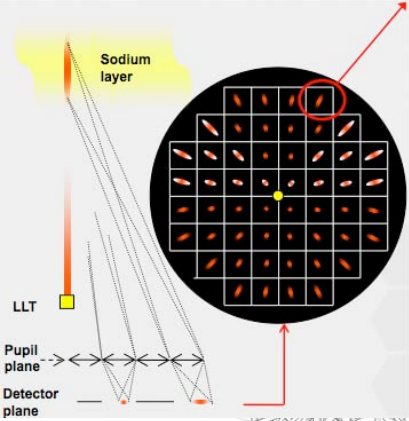


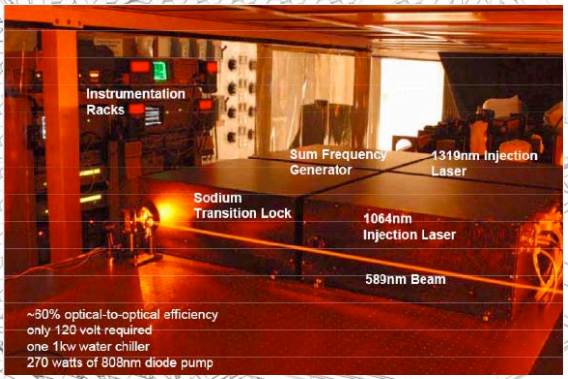




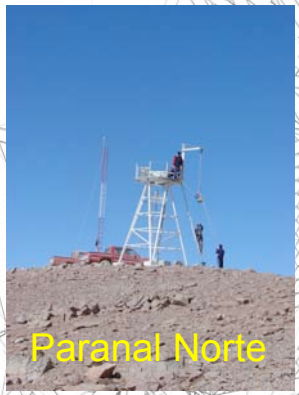





Sodium
layer
LLT
Pupil
plane
Detector
plane

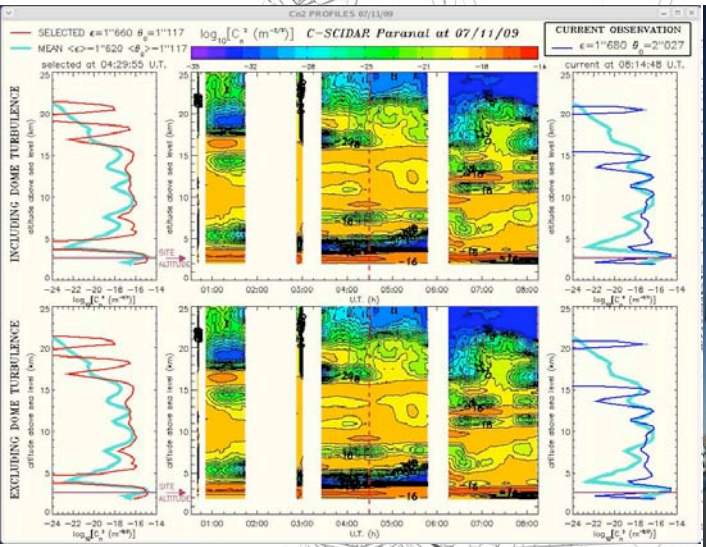

Instrumentation
Racks
Sum Frequency
Generator
1319nm Injection
Laser
Sodium
Transition Lock
1064nm
Injection Laser
589nm Beam
~30% optical-to-optical efficiency
only 120 volt required
one 1kw water chiller
270 watts of 808nm diode pump

Site characterization



Other sites:
Las Campanas
San Pedro Martir
Maidanak
Tibet
Pamir

Site characterization



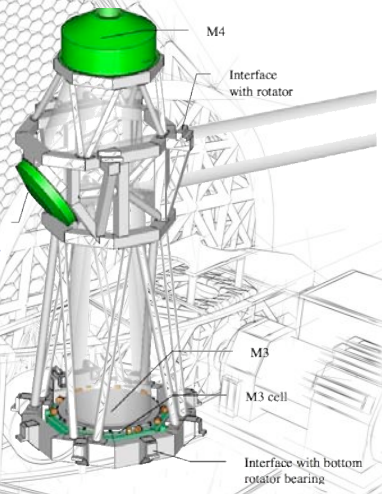
Cute-SCIDAR campaign

Site Selection Advisory Committee

- Task:
  - To work out the full technical decision matrix
  - No political issues (these are for Council)
- Composition
  - Five/six high profile members (e.g. directors of observatories)
  - May decide to consult experts
- Advise Director General
  - To present a proposal to Council by end 2009

And much more…

- Phasing of the primary
- Interface definitions
- Error budget
- Control system architecture
- Science operations concept
- Site operations
- Budget, schedule



Conclusions

- Phase B is well advanced
  - In budget
  - 3 month “structural” delay (to meet first FC)
- Strong and exciting science case
  - DRM progressing
- Basic Reference Design v2 is baseline
- Consolidation has started
  - BRDv3 in 8 months