Appendix 8.Optical design – criteria and merit function

	Requirement / characteristic	Weight (1-5)	Remarks
,	Diffraction-limited FOV	5	Min. 1 arc minute in the visible.
	Total field of view	5	Min. 8 arc minutes.
	Optical quality at edge of field of view	3	Must be seeing-limited.
	Field curvature	3	Convex in the direction of light propagation
			preferred.
	Focal ratio	3	Optimal range f/6-f/7.
	Maximum monolithic mirror diameter	5	Maximum allowable is 8.3-m.
	Emissivity (number of surfaces)	5	May be alleviated by high performance coatings.
	Sensitivity to M1-M2 decenters	5	Includes image motion and decentering aberrations.
	Sensitivity to M1-M2 axial despace	5	
	Sensitivity to decenters of M3, M4,	3	Lower weight than for M1-M2 decenters
	, , ,		because of (presumed) higher local stiffness.
	Sensitivity to axial despace of M3, M4,	3	Idem.
	Central obscuration	3	
	Vignetting in the science field	5	
	Vignetting outside the science field	2	Relevant for wavefront sensing; generous tolerances if several references & wavefront sensors available.
	M1-M2 separation	5	Ideally ≤ aperture diameter
	Structure aspect ratio	4	Ideal structure is (presumably) a cone with 60 degrees angle.
	Built-in IR adaptive optics (SCAO & GLAO)	5	oo degrees arigie.
	Built-in IR MCAO	5	
	Separation of active and adaptive functions in	5	Large amplitude, low temporal frequency
	different units (correctors)	3	(Active Optics) would over-constrain the adaptive mirror technology.
	SCAO / GLAO mirror dimensions	5	Assumed optimum ~2-3m.
	MCAO mirror(s) dimensions	5	Assumed optimum ~2-3m.
	Intermediate focus for AO calibration	2	On-sky calibration is an alternative, albeit an undesirable one.
	Number of segmented mirrors	4	aa.s.
	Feasibility of secondary mirror	5	Includes test set-up feasibility.
	Difficulty of fabricating most aspheric mirror(s)	4	у.
	Compatibility with serial production & maintenance of segments	5	
	Segments optical testing	4	Ideally against one unique reference.
	Compatibility with lightweight segments	3	racally against one unique reference.
	Baffling options	2	
	Allowable design volume for active/adaptive units	2	
	Allowable design volume for instruments	3	

Requirement / characteristic	Weight	Remarks
	(1-5)	
Access to gravity-stable platform(s)	3	For critical instrumentation.
Rapid switch between permanently mounted	2	For minimum overheads and maximum
instruments possible		operational flexibility.

Table A- 4. Function of merit, criteria and relative weights.

	Objective / guideline
1.	Diffraction-limited (Strehl Ratio ≥ 0.80, λ=0.5μm) over at least 1 arc minute FOV.
2.	Field aberrations over the science field (3 arc minutes diameter) shall be axisymmetrical or negligible.
3.	The field of view (diameter) available for adaptive optics wavefront sensing shall be 6 arc minutes.
4.	The design shall provide suitable surfaces for active optics, including deformable mirror(s), active
	centring, focusing, and field stabilization
5.	Monolithic mirrors shall be less than 8.3m in diameter (useful area).
6.	Field stabilization shall be done in a pupil image
7.	The design shall provide a suitably located surface for single-conjugate IR SCAO and GLAO.

Table A- 5. Mandatory requirements.

1 Diffraction-limited FOV 1: fails to meet requirements 1: 60 arc seconds diameter 2: 90 arc seconds diameter 3: 120 arc seconds diameter 4: 150 arc seconds diameter 5: 180 arc seconds diameter 6: 180 arc seconds diameter 7: 190 arc seconds diameter 8: 100 arc seconds diameter 9: 190 arc seconds diameter or more. 1: 190 arc minutes 1: 190 arc second RMS diameter		Requirement / characteristic	Ratings
2: 90 arc seconds diameter 3: 120 arc seconds diameter 4: 150 arc seconds diameter 5: 180 arc seconds diameter 5: 180 arc seconds diameter 6: 180 arc seconds diameter 7: 180 arc seconds diameter 7: 180 arc seconds diameter or more. 8: 180 arc seconds diameter or more. 9: 190 to 7 arc minutes 9: 190 to 7 arc minutes 9: 190 to 9 arc minutes 9: 190 to 10 arc minutes 9: 190 to 11 arc minutes or more. 190 to 11 arc minutes or more. 190 to 11 arc minutes or more. 190 to 10 arc second RMS diameter 190 to 0.04 arc second RMS diameter 190 to 0.05 arc second RMS diameter 19	1	Diffraction-limited FOV	0: fails to meet requirements
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5 Focal ratio 0: Less than f/3 or more than f/10 1: Less than f/4 or more than f/9 2: Less than f/5 or more than f/8 3: Less than f/5.5 or more than f/7.5 4: Less than f/6 or more than f/7 5: Between f/6 and f/7 6 Maximum monolithic mirror diameter 1: Up to 8.3-m 2: Up to 7.0-m 3: Up to 6.0-m 4: Up to 5.0-m 5: Up to 4.0-m 7 Emissivity (number of surfaces) 0: Less than f/3 or more than f/10 1: Less than f/4 or more than f/9 2: Less than f/8 or more than f/9 2: Less than f/8 or more than f/9 2: Less than f/5 or more than f/7 4: Less than f/6 or more than f/7.5 4: Less than f/6 or more than f/7.5 4: Less than f/5 or more than f/8 3: Less than f/5.5 or more than f/7.5 4: Less than f/6 or more than f/8 3: Less than f/8 or more than f/9 2: Less than f/9 3: Less than f/6 or more than f/7.5 4: Less than f/6 or more than f/8 3: Less than f/8 3: Less than f/6 or more than f/8 3: Less than f/8 4: Less than f/5 or more than f/7.5 4: Less than f/6 or more than f/7.5 5: Between f/6 and f/7 5: Between f/6 and f/7 6: Maximum monolithic mirror or than f/7 6: Less than f/6 or more than f/7 6: Less			
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5: Up to 4.0-m 7 Emissivity (number of surfaces) 0: 9 surfaces or more			
7 Emissivity (number of surfaces) 0: 9 surfaces or more			
·	7	Emissivity (number of surfaces)	
		, (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1: 8 surfaces

	Requirement / characteristic	Ratings
		2: 7 surfaces
		3: 6 surfaces
		4: 5 surfaces
0	Consitivity to M1 M2 decentors	5: 4 surfaces
8	Sensitivity to M1-M2 decenters	Qualitative; representative of image motion and decentering
9	Sensitivity to M1-M2 axial	aberration induced by gravity load z=0 to z=60 degrees Qualitative; representative of defocus induced by gravity load z=0
9	despace	to z=60 degrees.
10	Sensitivity to decenters of M3,	Qualitative; representative of the effect of gravity load from z=0 to
10	M4,	z=60 degrees, taking into account combined motion of mirrors.
11	Sensitivity to axial despace of	Qualitative; representative of defocus induced by gravity load z=0
1	M3, M4,	to z=60 degrees.
12	Central obscuration	0: More than 50% (linear)
		1: 40% or more
		2: 30% or more
		3: 20% or more
		4: 10% or more
		5: Less than 10%
13	Vignetting in the science field	0: More than 10% (linear)
		1: More than 8%
		2: More than 6%
		3: More than 4%
		4: More than 2%
14	Vignotting outside the egipnes	5: Less than 2% 0: 50% of more
14	Vignetting outside the science field	1: More than 40%
	ileiu	2: More than 30%
		3: More than 20%
		4: More than 10%
		5: Up to 10%
		Add one score point if 3 wavefront sensors, 2 points if 5 or more.
15	M1-M2 separation	0: More than 1.4 x D
	•	1: Up to 1.3 x D
		2: Up to 1.2 x D
		3: Up to 1.1 x D
		4: Up to 1.0 x D
40	Otherstein and action	5: Up to 0.9 x D
16	Structure aspect ratio	Qualitative; ideal structure is (presumably) a cone with 60 degrees
17	Built-in IR adaptive optics	angle. 0 : none or SCAO only (inappropriate conjugate for GLAO)
''	(SCAO & GLAO)	3: SCAO & some (non-optimal) GLAO capability
	(SCAO & GLAO)	5: SCAO & GLAO
18	Built-in IR MCAO	0: No MCAO
	Danit III III III III II II II II II II II I	3: Two-layers with optimal (~7-9 km) 2nd conjugate
		5: Three-layers with optimal conjugates
19	Separation of active and	0: No separation
	adaptive functions in different	3: Active and adaptive functions with different subsystems
	units (correctors)	5: Field stabilization, active and adaptive functions with different
		subsystems.
20	SCAO / GLAO mirror	0: Less than 1-m or more than 4-m
	dimensions	1: Less than 1.2-m or more than 3.8-m
		2: Less than 1.4-m or more than 3.6-m
		3: Less than 1.6-m or more than 3.4-m
		4: Less than 1.8-m or more than 3.2-m 5: Between 2 and 3-m
21	MCAO mirrors dimensions	0: Less than 1-m or more than 4-m
41	MOVO HIIITOIS MILIEUSIOUS	1: Less than 1.2-m or more than 3.8-m
		2: Less than 1.4-m or more than 3.6-m
		3: Less than 1.6-m or more than 3.4-m
		4: Less than 1.8-m or more than 3.2-m
		5: Between 2 and 3-m
22	Intermediate focus for AO	0: None
	calibration	3: Yes, requires aberrations compensation
		5: Yes, does not require aberration compensation
23	Number of segmented mirrors	0: More than two

	Requirement / characteristic	Ratings
		3: Two
		5: One
24	Feasibility of secondary mirror	Qualitative; includes test set-up feasibility.
25	Difficulty of fabricating most aspheric mirror(s)	Qualitative; includes test set-up feasibility.
26	Compatibility with serial production & maintenance of segments	Qualitative.
27	Segments optical testing	Qualitative.
28	Compatibility with lightweight segments	0: No; 5: Yes.
29	Baffling options	From 0 (none) to 5 (excellent baffling options)
30	Allowable design volume for active/adaptive units	Qualitative
31	Allowable design volume for instruments	Qualitative
32	Access to gravity-stable	5: Coude focus
	platform(s)	4: Nasmyth-type focus (foci)
		0: None of the above.
33	Rapid switch between	5: Yes, 6 instruments or more.
	permanently mounted	4: Yes, 5 instruments
	instruments possible (without	3: Yes, 4 instruments
	additional relay optics).	2: Yes, 3 instruments
		1: Yes, 2 instruments
		0: No, only one instrument permanently mounted.

Table A- 6. Merit function; guidelines for ratings.