KAON 548 - Science Requirements Summary in Support of System Architecture Evaluations

Requirement	Visible		Near-IR		Near-IR	Interferometer
	Imager	Spectrograph	Imager	Spectrograph	Deployable IFU	
λ (μm)	0.7-1.0	0.7-1.0	1.0-2.4 (+Y&z)	1.0-2.4 (+Y&z)	1.0-2.4 (+Y&z)	J,H,K,L (N-band goal?)
Field of view diameter (")	≥ 15	≥ 2 (goal ≥ 3)	≥ 15 for X4b	≥ 1 x 3 (goal 4)	≥ 1 x 3	≥ 1
Field of regard diameter (")	na	na	na	na	≥ 120	≥ 60
Pixel size (mas)	≤ 10 (Nyquist at I band)	na	≤ 13 (Nyquist at J)	na	≤ 35 (2 pixels/spaxel)	na
Minimum # of IFUs	na	na	na	na	6	na
IFU separation	na	na	na	na	> 1 IFU in 10x10" field	na
AO Background	na	na	≤ 20% of (sky + tel)	≤ 20% of (sky + tel)	≤ 20% of (sky + tel)	na
Sky coverage	≥ 30% for X3	≥ 30% for X3	≥ 30% for X1,X3,X4b	≥ 30% for X3,X4a	≥ 30% for X2	na
High order WFE (nm) for ≤ 5" fov	≤ 170	≤ 170	≤ 170	≤ 170	derived	≤ 250
Tip/tilt error (mas)	≤ 15	≤ 15	≤ 15 for sky cover; ≤ 3 for G2	≤ 15	derived	≤ 15
50% Ensquared energy (mas)	na	follows from 170nm & 15mas	na	≤ 25 at J band (X3)	≤ 70	na
Companion sensitivity	ΔI ≥ 7.5 at 0.75" for S1b	na	ΔJ ≥ 5.5 at 0.5" for S1b; ΔJ ≥ 8.5 at 0.1", ΔJ ≥ 11 at 0.2" for G1	na	na	na
Photometry (mag)	≤ 0.05 relative for S1b	na	≤ 0.05 relative for S1&G1	na	na	na
Astrometry (mas)	≤ 1.5 relative for S1b	na	≤ 1.5-2 for S1b&G1; ≤ 0.1 for G2a	na	na	na
Polarimetry (%)		na		na	na	na
PSF estimation	required	goal	required	goal	PSF spectrum reqd	not required
Differential tracking	required up to 50"/hr	required up to 50"/hr	required up to 50"/hr	required up to 50"/hr	goal: 1 tip/tilt sensor	not required
Acquisition accuracy (mas or % of instrument field)	≤ 10% of field	≤ 10% for IFU; ≤ 0.25λ/D for slit	≤ 10%	≤ 10% for IFU; ≤ 0.25λ/D for slit	≤ 10% (≤ 35 relative)	≤ 200 mas
Dither dist (" or % of inst field)	≤50%	≤ 50% of longest dimension	≤ 50%	≤ 50%	≤ 50% of longest dimension	na
Dither accuracy (mas)	≤ λ/D	≤λ/D	≤ λ/D	≤ λ/D	≤ 70	na
Dither time (sec)	≤ 3	≤ 3	≤ 3	≤ 3	≤ 10	na
Micro dither distance (mas)	≤ 0.5λ/D	≤ 0.5λ/D	≤ 0.5λ/D	≤ 0.5λ/D	≤ 35	
Micro dither accuracy (mas)	≤ 0.25λ/D	≤ 0.25λ/D	≤ 0.25λ/D	≤ 0.25λ/D	<10	
Micro dither time (sec)	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	
Nod reacquisition time (sec)	≤ 10	≤ 10	≤ 10	≤ 10	≤ 60	
Positioning knowledge (mas)	≤ 0.1λ/D	≤ 0.1λ/D	≤ 0.1λ/D	≤ 0.1 λ/D	≤ 5	na
Science image drift (mas/hr)	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
NGS mode	required	required	required	required	single IFU	required
AO instrument switching	to vis spectro	to vis imager	to NIR spectro (goal: vis)	to NIR imager (goal: vis)	not required	not required
AO backup switching	goal: to NIR instrument	goal: to NIR instrument	not required	not required	single IFU	goal: to NIR instrument
Science Cases	S1b,S2,S3,X3,X4b	X3	S1,S3,S4,G1,G2a,G3,G4,X1,X3, X4b,X4d,X5,X6	S3,S4,G1,G2b,G3,G4,X1, X3,X4a	G2b,X2,X4c	

Science Cases	
S1a	Asteroid companions survey
S1b	Asteroid companions orbit determination
S2	Asteroid size and shape
S3	Gas Giants and Moons of giant planets
S4	NGS observations of Neptune & Uranus
G1	Planets around low mass stars
G2a	General Relativity & the Galactic Center - astrometry
G2b	General Relativity & the Galactic Center - radial velocities
G3	Debris Disks
G4	Young Stellar Objects
X1	QSO host galaxies
X2	High-z galaxies
X3	Nearby AGNs
X4a	Distant galaxies lensed by galaxies - spectroscopy
X4b	Distant galaxies lensed by galaxies - imaging
X4c	Distant galaxies lensed by clusters - spectroscopy
X4d	Distant galaxies lensed by galaxies - imaging
X5	Astrometry in Sparse Fields
X6	Resolved Stellar Populations in Crowded Fields

Color code
Physical requirements
Performance requirements
Operational requirements
Science cases
Other
Goal: AO transmits Hα to visible instruments
NGS WFS field of regard ≥ 30" radius
Interferometer req'ments must be met by a NGAO mode (matched field, polarization, etc. for K1&2)
non-AO backup required for all cases
Goal: Provide full field (20" vis, 40" NIR) to 2k Nyquist sampled detector
Fixed field & fixed pupil modes required
Tip/tilt & LGS acquisition capabilities required
Alignment, calibration & diagnostic tools req'd

Seeing Assumptions
All values at λ = 0.5 μm
Challenging NGAO 37.5th percentile r_0 = 14 cm; θ_0 = 2.15"
Median NGAO 62.5th percentile r_0 = 18 cm; θ_0 = 2.9"
Good NGAO 87.5th percentile r_0 = 22 cm; θ_0 = 4.0"