

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)	$\geq 30''$ for S3	$\geq 1 \times 3$ (goal 4)	$\geq 1 \times 3$	≥ 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 $10 \times 10''$ field	na
AO Background	na	na	Background (mag/arcsec ²) J: 15.9, H: 13.7, K wide field 13.6, K narrow field 13.2		$\leq 30\%$ of unattenuated(sky+tel)	na
Sky coverage	$\geq 30\%$ for X3	$\geq 30\%$ for X3	$\geq 30\%$ for X1,X3,X4b	$\geq 30\%$ for X3,X4a	$\geq 30\%$ for X2	na
High order WFE (nm) for $\leq 5''$ 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	$\Delta I \geq 7.5$ at $0.75''$ for S1b	na	$\Delta J \geq 5.5$ at $0.5''$ for S1b; $\Delta J \geq 8.5$ at $0.1''$, $\Delta J \geq 11$ at $0.2''$ for G1		na	na
Photometry (mag)	≤ 0.05 relative for S1b	na	≤ 0.05 relative for S1&G1		na	na
Astrometry (mas)	≤ 1.5 relative for S1b	na	G2a		na	na
Polarimetry (%)	na	na	na		na	na
PSF estimation	required	goal	required	goal	PSF spectrum reqd	not required
Differential tracking	required up to $50''/\text{hr}$	required up to $50''/\text{hr}$	required up to $50''/\text{hr}$	required up to $50''/\text{hr}$	goal: 1 tip/tilt sensor	not required
Acquisition accuracy (mas or % of instrument field)	$\leq 10\%$ of field	$\leq 10\%$ for IFU; $\leq 0.25\lambda/D$ for slit	$\leq 10\%$	$\leq 10\%$ for IFU; $\leq 0.25\lambda/D$ for slit	$\leq 10\%$ (≤ 35 relative)	≤ 200 mas
Dither dist ("" or % of inst field)	$\leq 50\%$	$\leq 50\%$ of longest dimension	$\leq 50\%$	$\leq 50\%$	$\leq 50\%$ of longest dimension	na
Dither accuracy (mas)	$\leq \lambda/D$	$\leq \lambda/D$	$\leq \lambda/D$	$\leq \lambda/D$	≤ 70	na
Dither time (sec)	≤ 3	≤ 3	≤ 3	≤ 3	≤ 10	na
Micro dither distance (mas)	$\leq 0.5\lambda/D$	$\leq 0.5\lambda/D$	$\leq 0.5\lambda/D$	$\leq 0.5\lambda/D$	≤ 35	
Micro dither accuracy (mas)	$\leq 0.25\lambda/D$	$\leq 0.25\lambda/D$	$\leq 0.25\lambda/D$	$\leq 0.25\lambda/D$	< 10	
Micro dither time (sec)	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	
Nod reacquisition time (sec)	≤ 10	≤ 10	≤ 10	≤ 10	≤ 60	
Positioning knowledge (mas)	$\leq 0.1\lambda/D$	$\leq 0.1\lambda/D$	$\leq 0.1\lambda/D$	$\leq 0.1\lambda/D$	≤ 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		Color code	Seeing Assumptions
S1a	Asteroid companions survey	Physical requirements	All values at $\lambda = 0.5 \mu\text{m}$
S1b	Asteroid companions orbit determination	Performance requirements	Challenging NGAO
S2	Asteroid size and shape	Operational requirements	37.5th percentile
S3	Gas Giants and Moons of giant planets	Science cases	$r_0 = 14 \text{ cm}; \theta_0 = 2.15''$
S4	NGS observations of Neptune & Uranus	Other	Median NGAO
G1	Planets around low mass stars	Goal: AO transmits $H\alpha$ to visible instruments	50th percentile
G2a	General Relativity & the Galactic Center - astrometry	NGS WFS field of regard $\geq 30''$ radius	$r_0 = 16 \text{ cm}; \theta_0 = 2.7''$
G2b	General Relativity & the Galactic Center - radial velocities	Interferometer req'ments must be met by a NGAO mode (matched field, polarization, etc. for K1&2)	Good NGAO
G3	Debris Disks	non-AO backup required for all cases	62.5th percentile
G4	Young Stellar Objects	Goal: Provide full field ($20''$ vis, $40''$ NIR) to 2k Nyquist sampled detector	$r_0 = 18 \text{ cm}; \theta_0 = 2.9''$
X1	QSO host galaxies	Fixed field & fixed pupil modes required	Excellent NGAO
X2	High-z galaxies	Tip/tilt & LGS acquisition capabilities required	87.5th percentile
X3	Nearby AGNs	Alignment, calibration & diagnostic tools req'd	$r_0 = 22 \text{ cm}; \theta_0 = 4.0''$
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		