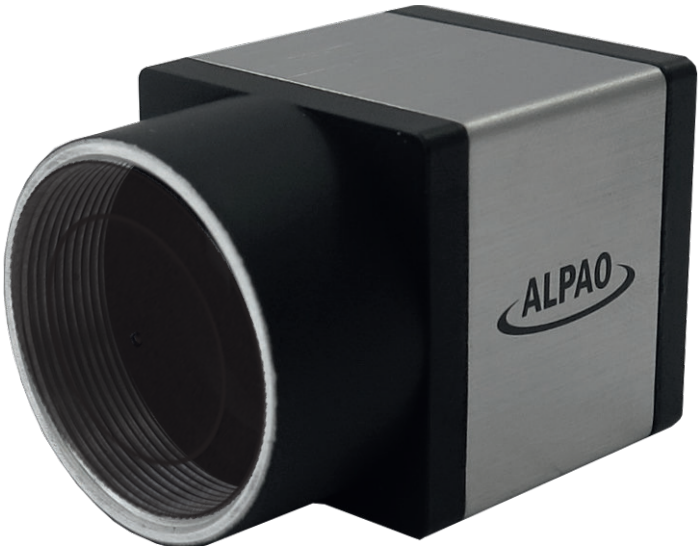
ALPAO Shack–Hartmann (SH) wavefront sensors (WFS) are the only range of WFS especially designed for Adaptive Optics (AO). They feature excellent performances to fit with every adaptive optics system. Sensitivity, speed and spectral range can be chosen depending on your needs. All **ALPAO SHs** perfectly fit with **ALPAO DMs** and **ALPAO software and real-time computers**.



Key features

OPTIMIZED FOR AO

Especially designed for adaptive optics

SPEED

Frequency up to 28.14kHz latency as low as 10.7µs (SH-CMOS fast)

HIGH SENSITIVITY

Photon flux for SNR=1 down to 3 photons/frame/sub-aperture (SH-EMCCD)

OPTIMIZED FOR AO

ALPAO SHs are specifically designed for adaptive optics.

ALPAO recommends the Fried configuration for low flux high speed applications. It allows for an optimal control of your DM.

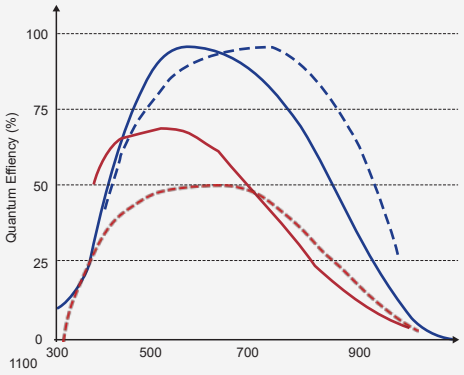
The latency has been minimized for best AO performances.

HIGH SENSITIVITY

For some applications, like in microscopy or astronomy, a high-sensitivity wavefront sensor is required.
EMCCD technology allows great performance in terms of sensitivity thanks to very low read-out noise. SH-EMCCD and SH-EMCCD *fast* are featuring such performances.

VIS WFS

ALPAO SH-CMOS and SH-EMCCD are perfect for large spectral applications and cover the range from 350 to 1000nm.



Typical Quantum Efficiency of SH-EMCCD (in blue), SH-EMCCD fast (in dash blue), SH-CMOS (in red) and SH-CMOS *fast* (in dash red)

SOFTWARE & DRIVERS

ALPAO WFS are designed to work with ALPAO Core Engine (ACE) or ALPAO RTC. They are not included and need to be purchased separately. ALPAO RTC includes the necessary hardware. The minimum configuration for ACE is 4Gb RAM, 100MB disk space, MATLAB® R2017a or higher.

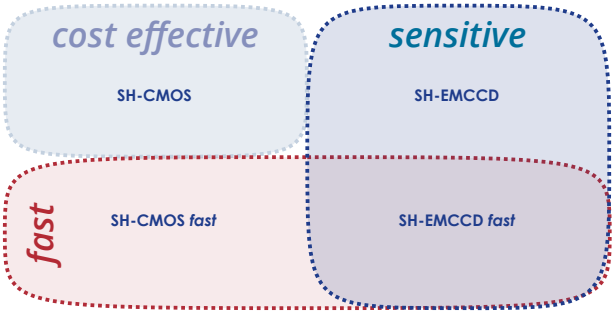
FAST WAVEFRONT SENSING

For atmospheric perturbation correction, kHz frequency wavefront sensors are needed. ALPAO WFS can be run up to 5kHz.

Beyond frequency, latency is a key parameter for real time compensation of the perturbations. ALPAO WFS interfaces are designed for extremely low latency.

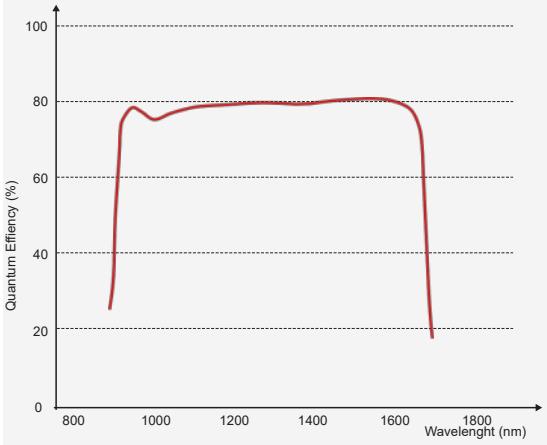
Thanks to their speed and low latency, those wavefront sensors associated with the ALPAO Real-Time Computer (RTC) and ALPAO DM can reach AO bandwidth greater than 100Hz.

CHOOSE YOUR VIS-WFS



NIR WFS

ALPAO SH-InGaAs fast is working in the near infra-red from 950 to 1700nm. It features high sensitivity at 1.5µm combined with very high frequency.



Typical Quantum Efficiency of SH-InGaAs *fast* (at 20°C, in red)

GENERAL SPECIFICATIONS

	SIZING					SPEED			SENSITIVITY			OPTICS
	Number of sub-apertures	Microlens pitch (µm)	Pupil diameter full ROI (mm)	Acquisition frequency (Hz)	Fastest acquisition frequency with ROI (Hz)	Peak quantum efficiency	Photons for SNR=1 (ph./fr/sub-aperture)	Read-out noise (e⁻ RMS)	Tip-tilt & defocus range full ROI (µm PV)	Repeatability (nm RMS)	Spectral range
SH-CMOS	50x50	96.6	4.83	119	477	67%	100	2.1	62/15	2	VIS
SH-CMOS *fast*	64x64	112	7.17	1730	28140	50%	1000	37	96/24	2	VIS
SH-EMCCD	16x16	192	3.07	1004	1838	95%	3	0.1	13/3	2	VIS
SH-EMCCD *fast*[1]	24x24	192	4.61	2067	2067	95%[2]	4	0.3	32/8	2	VIS
SH-InGaAs *fast*[1]	64x64	120	7.68	690	9596	80%[3]	400	40	123/30	2	NIR

[1] The SH-EMCCD fast and SH-InGaAs fast WFS are provided with a cooling pack.
[2] Measured at -45°C.
[3] Measured at 20°C.

SPEED

Camera acquisition frequency (Hz) indicates the frame rate of the camera upon which the WFS is based.
Readout latency (µs) defined as the lag between the end of exposure and the beginning of data transmission (provided by camera manufacturers).

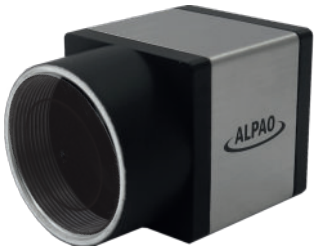
WFS sub-aperture ROI	8x8	10x10	15x15	16x16	19x19	23x23	31x31	50x50	63x63
Compatible DM (Fried geometry)	DM69	DM97	DM192	DM241	DM292	DM468	DM820	-	DM3228
SH-CMOS	477Hz 5000µs	417Hz 5000µs	317Hz 5000µs	302Hz 5000µs	266Hz 5000µs	229Hz 5000µs	179Hz 5000µs	118Hz 5000µs	n/a
SH-CMOS *fast*	28140Hz 10.7µs	22080Hz 11.2µs	14660Hz 12.48µs	13010Hz 12.79µs	10020Hz 13.78µs	8000Hz 15.30µs	5220Hz 18.9µs	2620Hz 31.1µs	1730Hz 42.2µs
SH-EMCCD	1838Hz 69µs	1004Hz 68µs	1004Hz 64.8µs	1004Hz 64.2µs	n/a	n/a	n/a	n/a	n/a
SH-EMCCD *fast*	2067Hz 43µs	2067Hz 43µs	2067Hz 43µs	2067Hz 43µs	2067Hz 43µs	2067Hz 43µs	n/a	n/a	n/a
SH-InGaAs *fast*	9590Hz 23.3µs	6510Hz 23.1µs	4760Hz 22.9µs	4760Hz 22.8µs	3650Hz 22.7µs	2900Hz 22.4µs	1970Hz 22µs	960Hz 21µs	715Hz 20.2µs

RANGE

Tip-tilt and defocus range (µm PV) are geometrical values without resorting to spot tracking algorithms.

WFS sub-aperture ROI	8x8	10x10	15x15	16x16	19x19	23x23	31x31	50x50	63x63
Compatible DM (Fried geometry)	DM69	DM97	DM192	DM241	DM292	DM468	DM820	-	DM3228
SH-CMOS	7/1	10/2	16/4	17/4	21/5	26/6	37/9	61/15	n/a
SH-CMOS *fast*	9/2	12/3	19/4	21/5	25/6	31/7	43/10	72/18	91/22
SH-EMCCD	5/1	6/1	10/2	11/2	n/a	n/a	n/a	n/a	n/a
SH-EMCCD *fast*	8/2	11/2	18/4	19/4	23/5	29/7	n/a	n/a	n/a
SH-InGaAs *fast*	11/2	15/3	25/6	27/6	32/8	40/10	56/14	92/23	118/29

WFS HOUSING



SH-CMOS
44x29x29mm

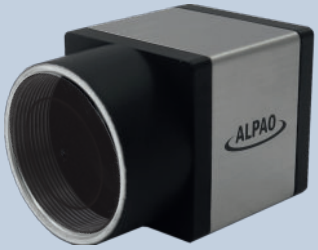
SH-CMOS *fast*
63x63x47mm

SH-EMCCD
156x156x204mm

SH-EMCCD ***fast*** 242x175x76mm
SH-InGaAs ***fast*** 55x55x80mm

All our WFS are provided with 5-meter Camera Link cables, except for SH-CMOS provided with a 5-meter USB cable.

ORDER TODAY



Need more information?

Contact us for one-to-one guidance and technical support.

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