Field of View and contrast limitations of stellar interferometers
A quick review

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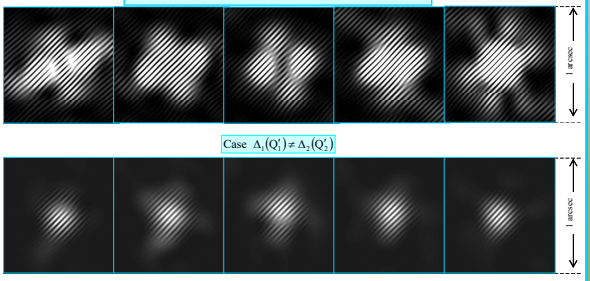
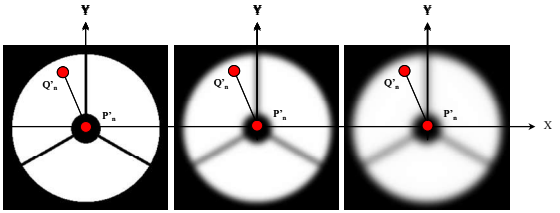
Summary

Field of View (FoV) and contrast limitations of stellar interferometers have been the scope of numerous publications for more than thirty years. Recently, this topic regained some interest since long-baseline terrestrial interferometers or space borne nulling interferometers are envisioned for detecting and characterizing extra-solar planets orbiting in the habitable zone of their parent star. This goal supposes to achieving a very high contrast ratio in the high angular frequency domain, thus on the whole interferometer FoV. The paper reviews some of the main contrast and FoV limiting factors, including spectral bandwidth, flux mismatches, fringe tracking, telescope image quality, atmosphere seeing, optical conjugation mismatch between the telescopes pupils, influence of anamorphous optics, pupil aberrations, signal-to-noise ratio, and deviations with respect to the "golden rule of imaging interferometers". Two "medium" and "high contrast" performance budgets are established.

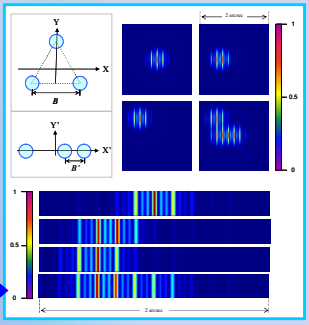
Image quality / AO residuals



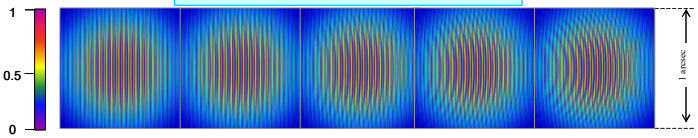


Pupil aberrations

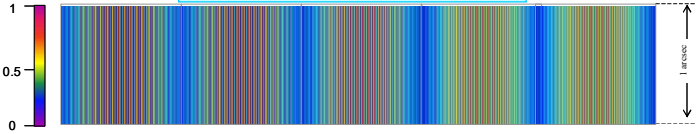
Deviation with respect to "Golden rule"



Pupil conjugation mismatches



Effects of anamorphose optics



Contrast budgets

	Parameters				Contrast	
Name		Medium contrast	High contrast	Unit	Medium contrast	High contrast
Flux mismatch	dI	10	0.01	% (*)	0.90	0.9999
Fringe tracking	$\delta_{12}(t)$	200	20	nm	0.99	0.9999
Telescope image quality	Δ_n	0.25	0.025	λ RMS	0.99	0.9999
AO residual WFE	Δ_n	0.25	0.025	λ RMS	0.99	0.9999
Entrance pupil locations	dz_{21}	40	1	m	0.97	1.0000
Exit pupil locations	dz'_{21}	0.025	0.002	m	0.99	0.9999
Pupil aberration	σ	10	1	% (**)	0.97	0.9997
Signal-to-Noise Ratio	SNR	10	100	-	0.98	0.9998
(*) with respect to flux impinging on a single telescope				Global	**0.80**	**0.9990**
(**) with respect to entrance pupil diameter				Goal	**0.80**	**0.9990**

Conclusion

The main contrast and FoV limiting factors include spectral bandwidth, flux mismatches, fringe tracking, telescope image quality, atmosphere seeing, optical conjugation mismatch of the telescope pupils, influence of anamorphous optics, pupil aberrations, signal-to-noise ratio, and deviations with respect to the golden rule of imaging interferometers. Two tentative contrast budgets are presented, one for a classical "visibility imaging" stellar interferometer and the other for a very high contrast instrument. The most critical contributors are the wavefronts resulting from telescope aberrations, AO residuals and Non common path aberrations (NCPA). Not surprisingly, the system requirements are much tougher for the extra-solar planet detection case, where flux mismatches and pupil aberrations are not negligible. It must be noted that the presence of anamorphous optics near the focal plane of the interferometer worsens two contrast loss factors related to the entrance and exit pupils location mismatch, and violation of the golden rule. This pleads in favor of replacing the anamorphous optics with an Integral field unit (IFU) subsystem.

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