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Astrophysics with Optical Interferometers

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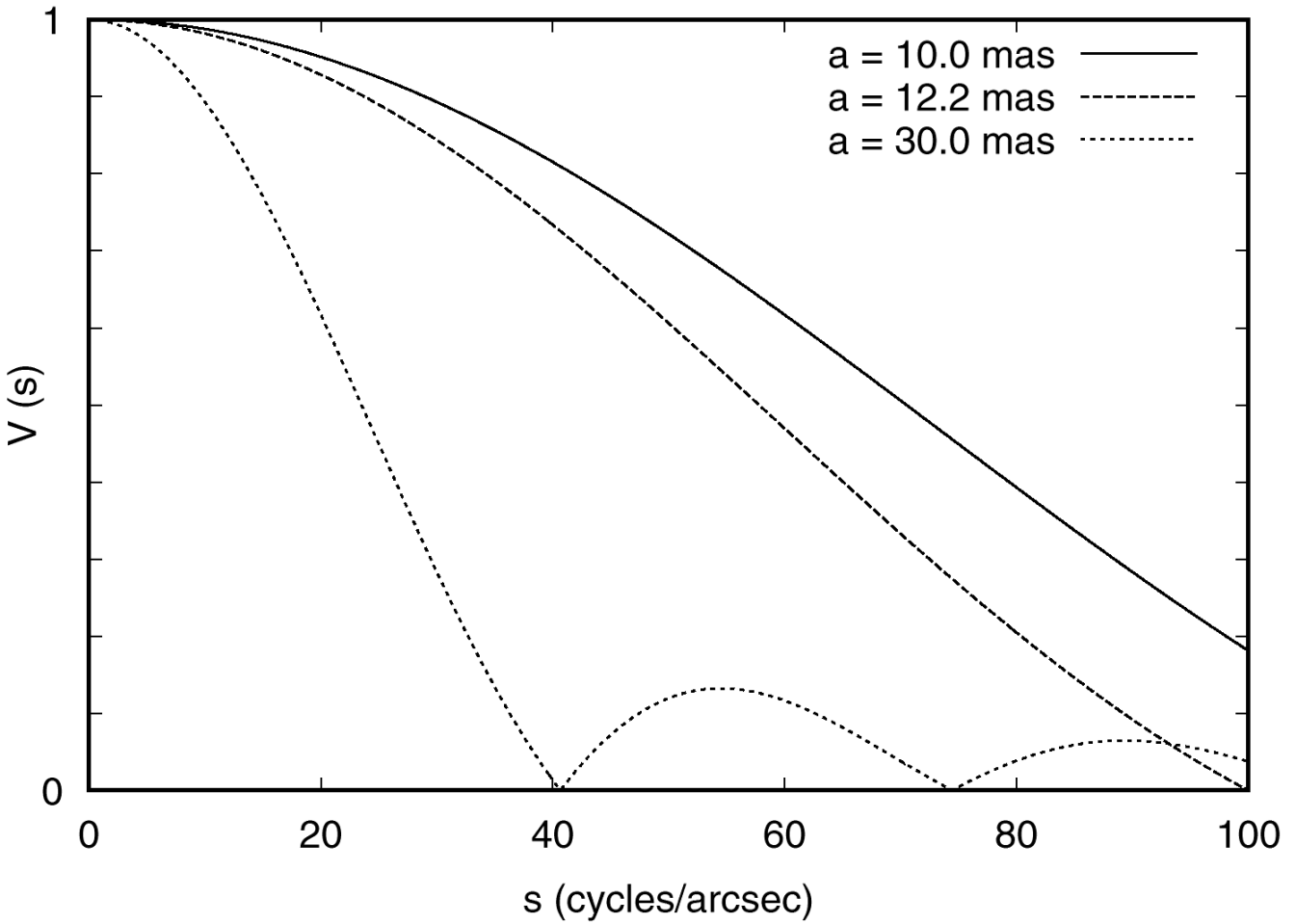
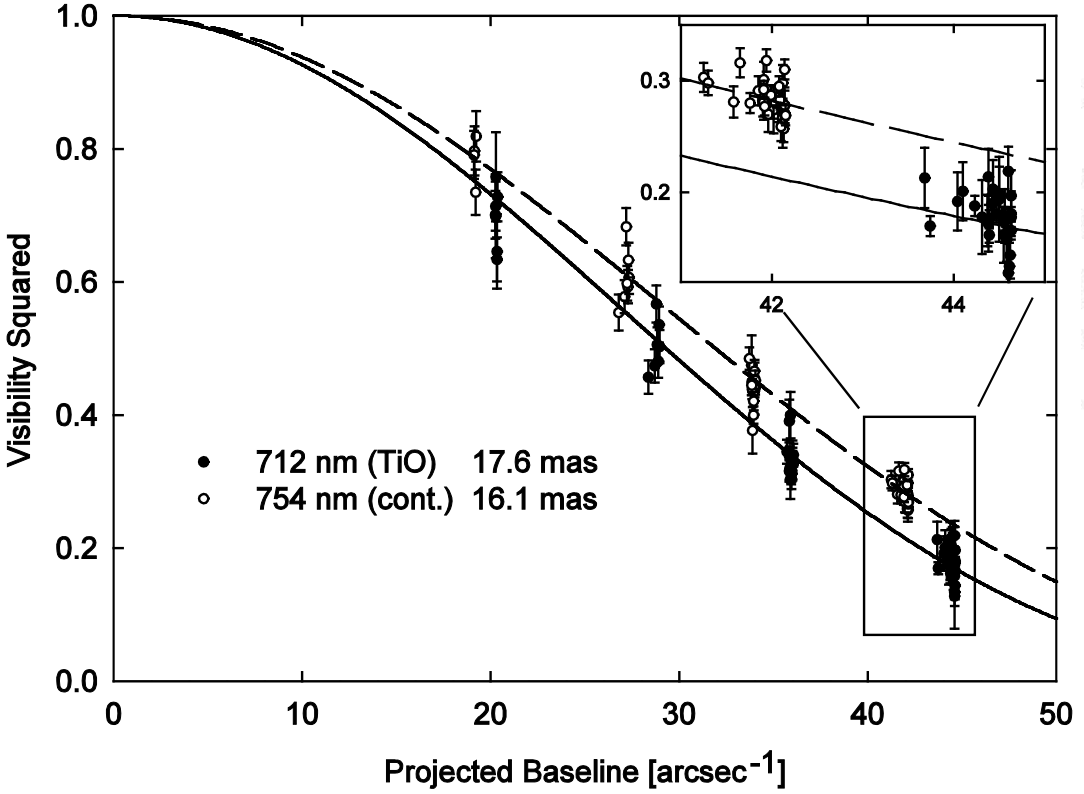
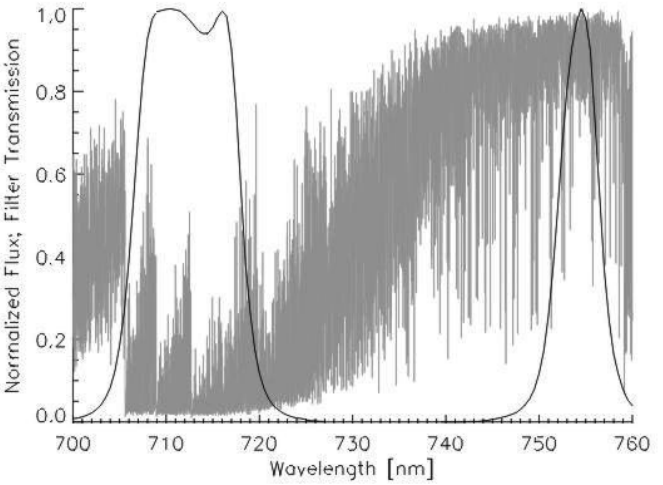
The Mark III Interferometer (1987-1992)

Stellar Diameters: Visibility as a Function of Baseline Length



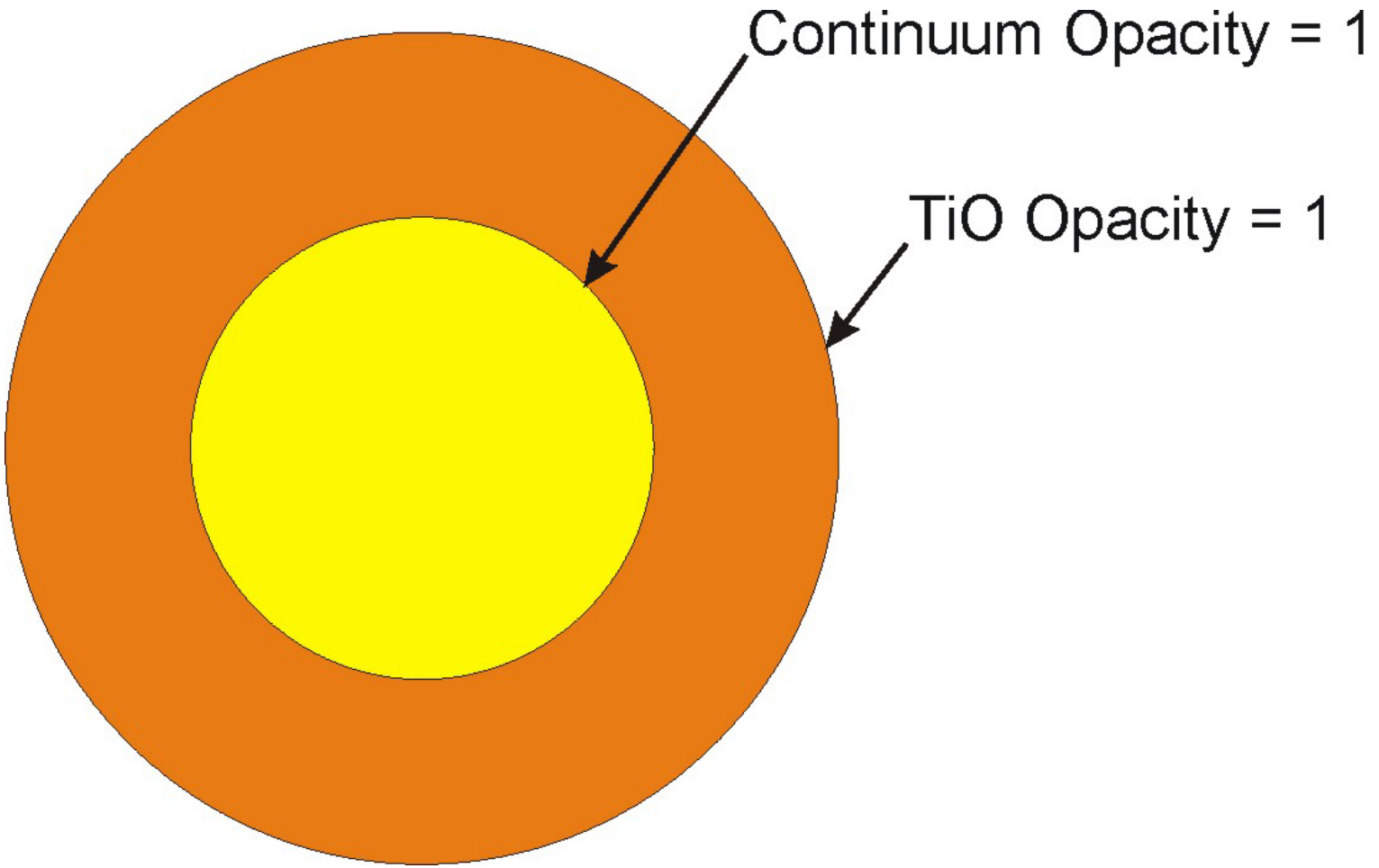
Mk III Diameter Measurements of the Giant Star β Pegasi



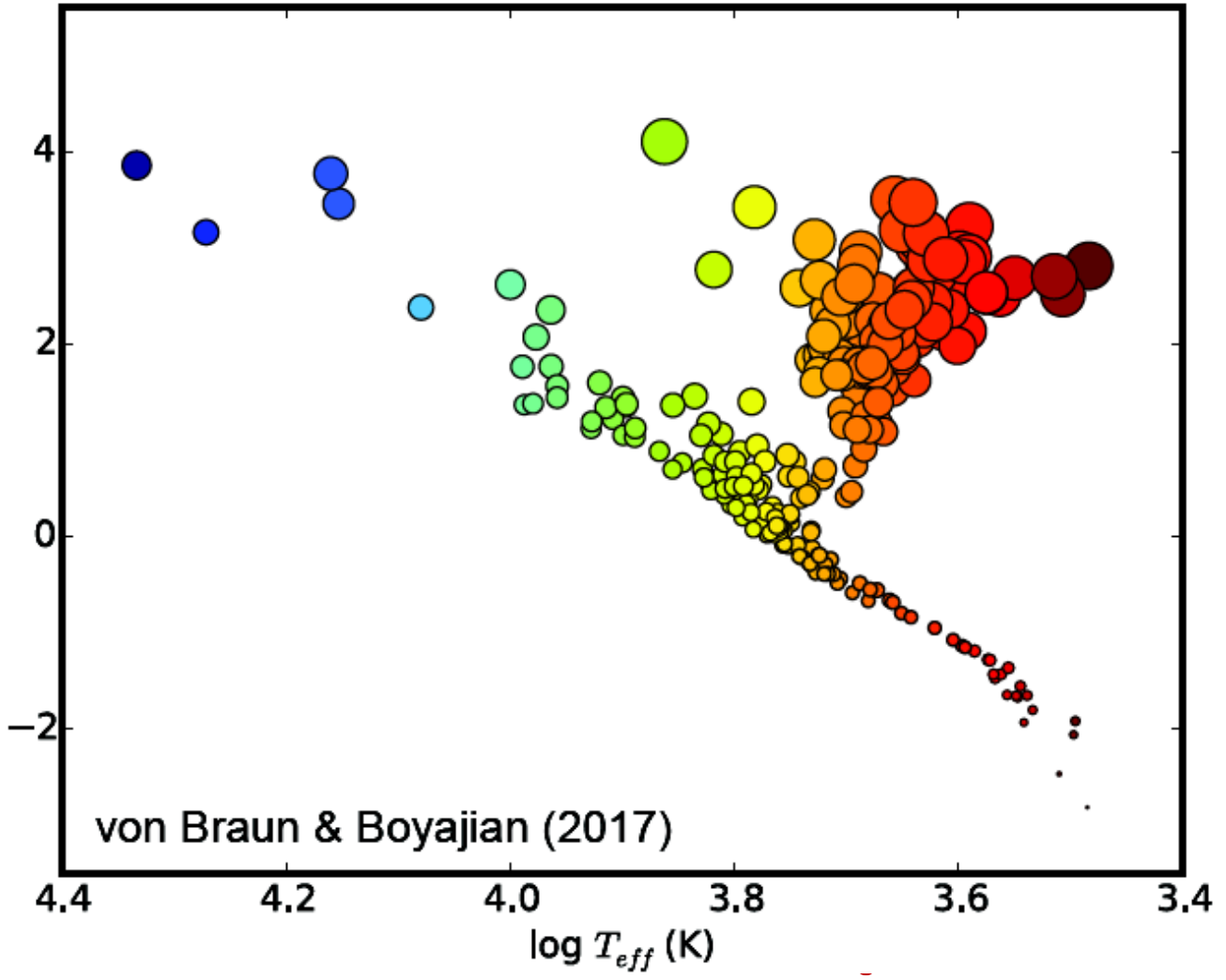


Quirrenbach et al. (1993)

Schematic Model of Extended Stellar Atmosphere

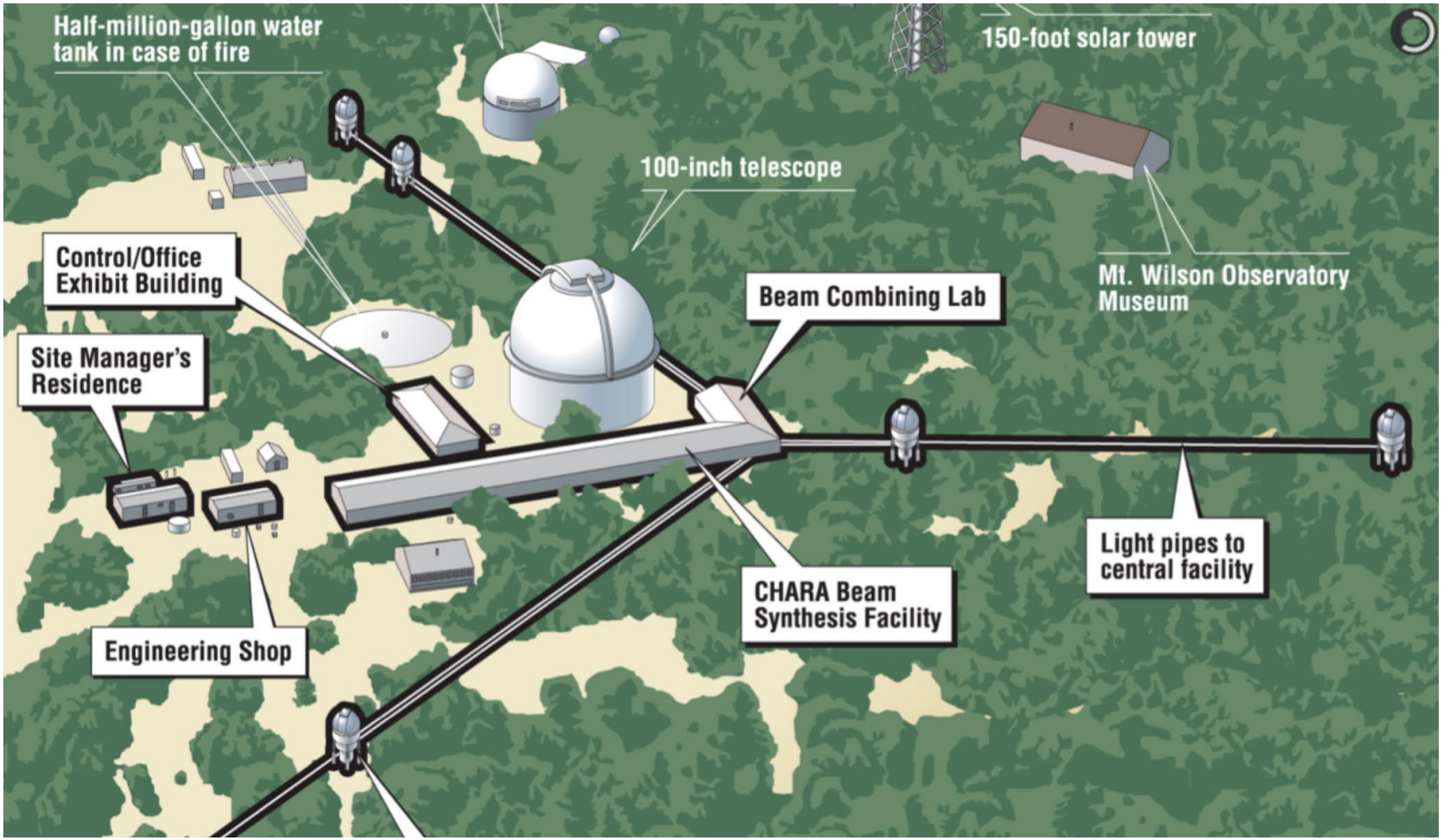


Compilation of Interferometric Stellar Diameters

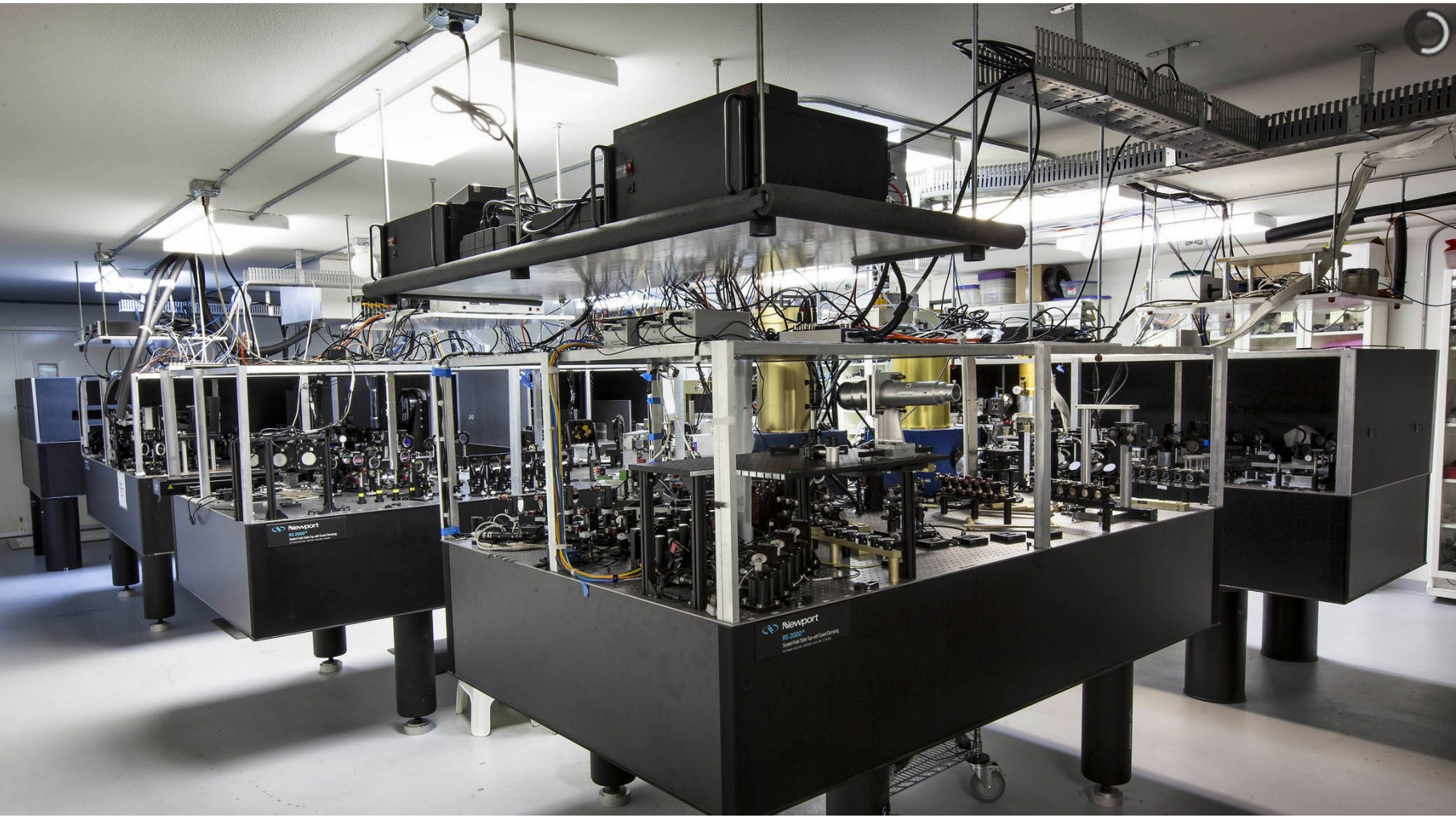


Aerial Photo of Mt. Wilson

CHARA Layout



CHARA
Beam Combination Lab



Rapidly Rotating Stars (CHARA)

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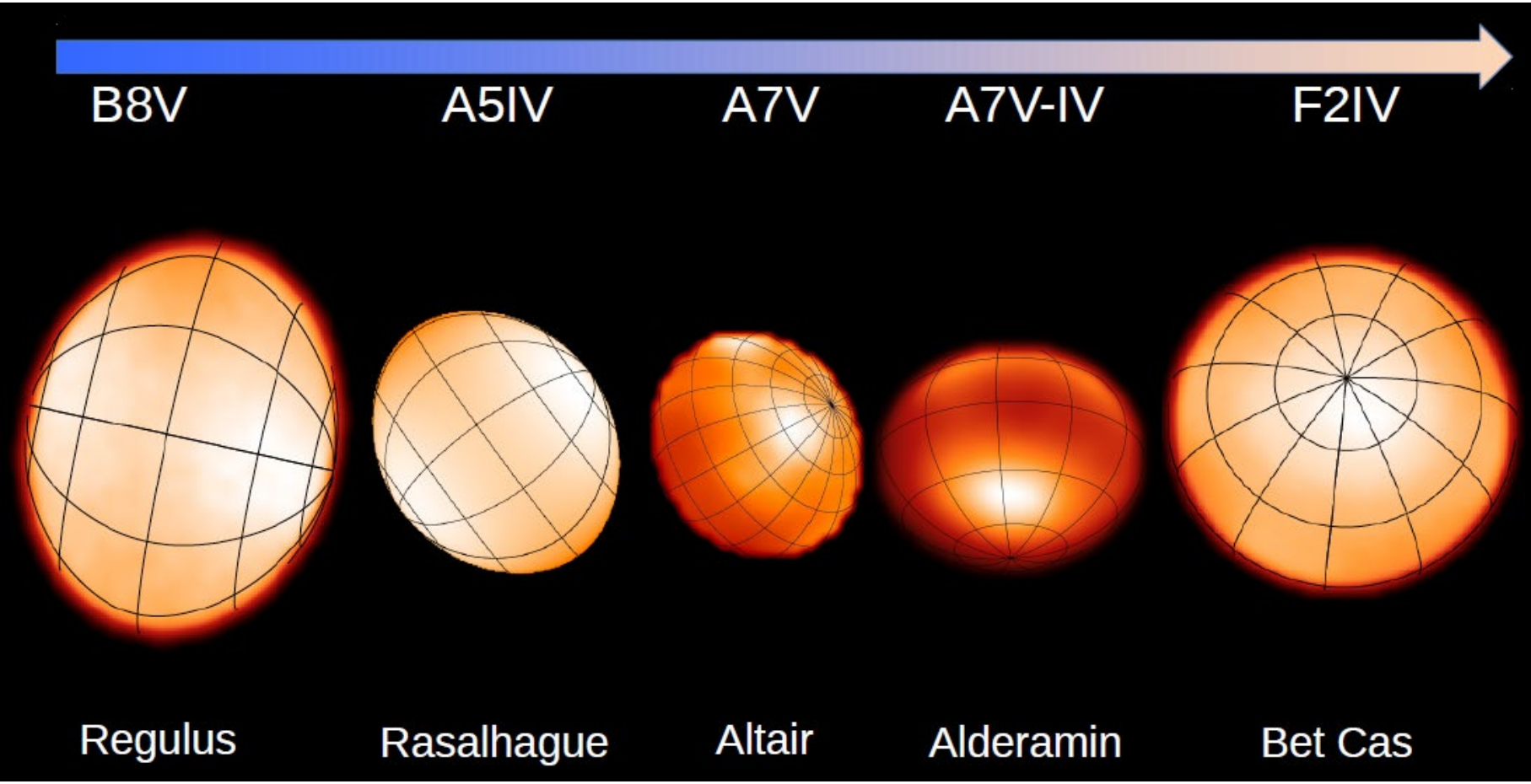
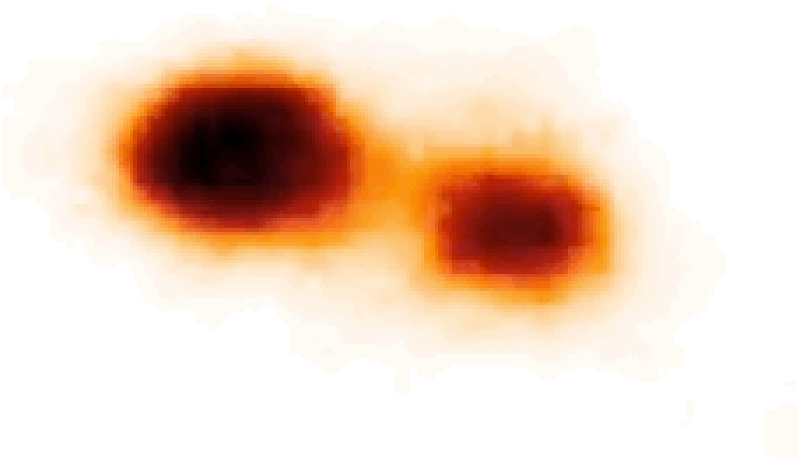


J. Monnier et al.

CHARA Movie of β Lyrae



ESO VLTI (Cerro Paranal)

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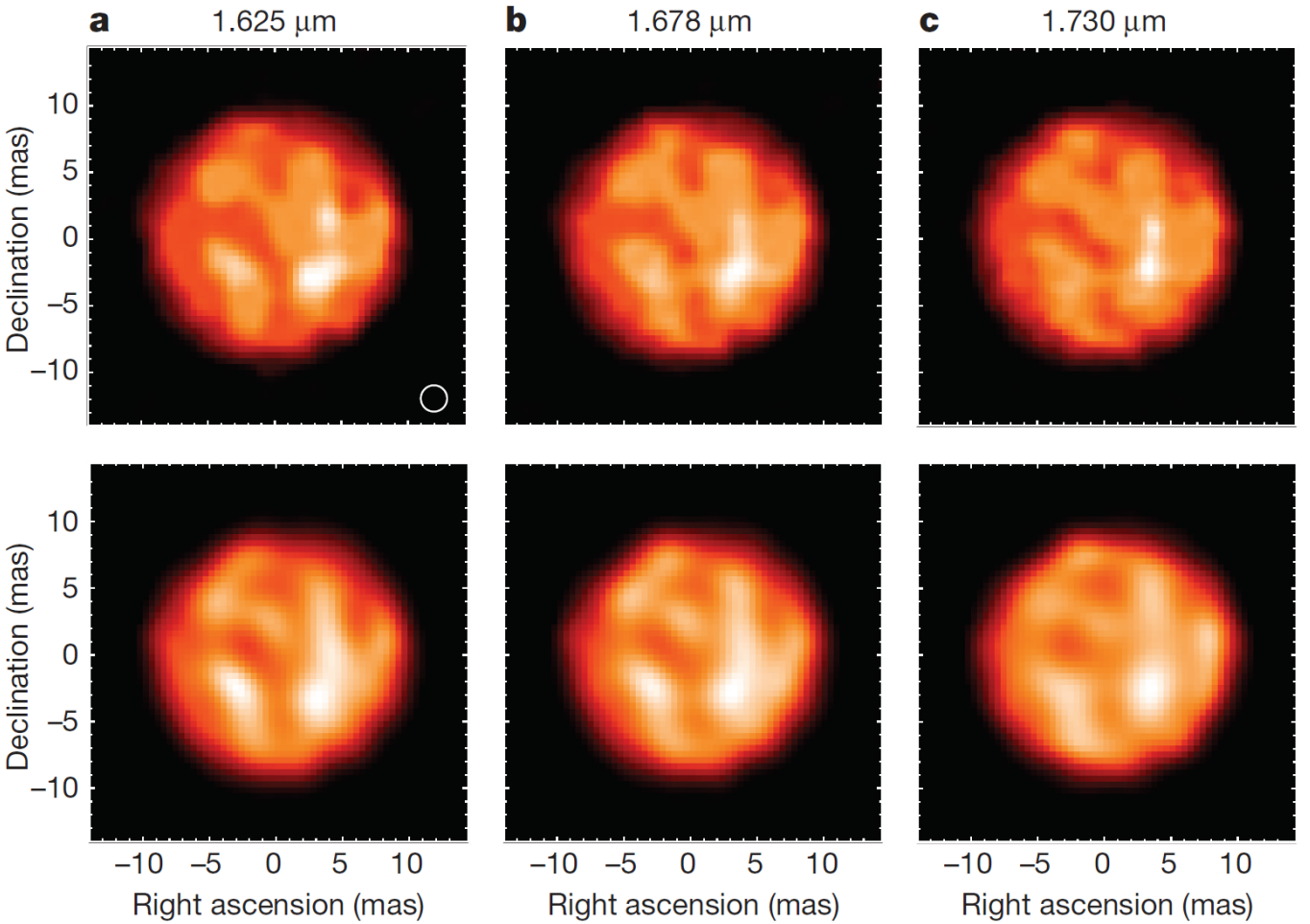
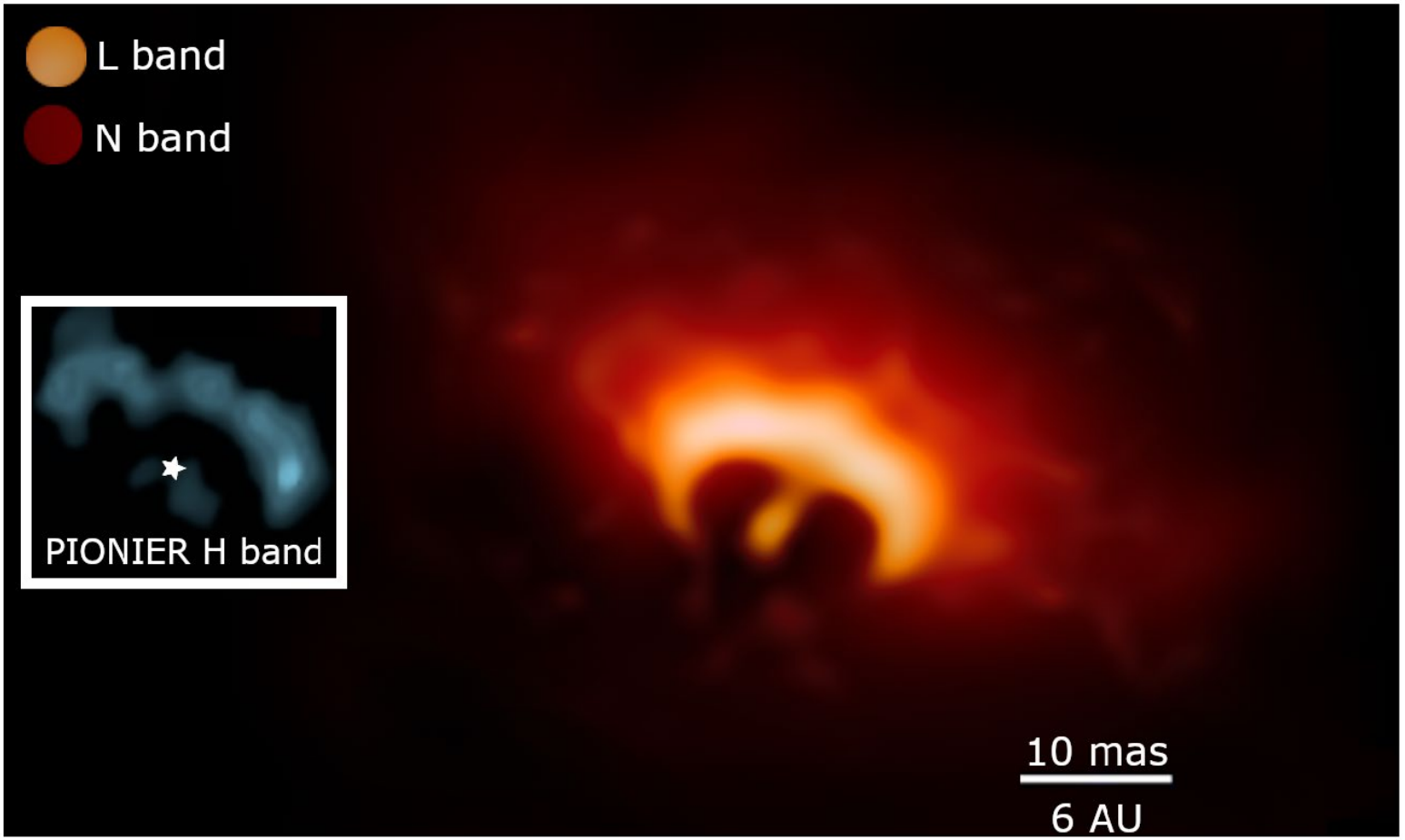
VLTI/PIONIER Images of the Giant Star π^1 Gruis



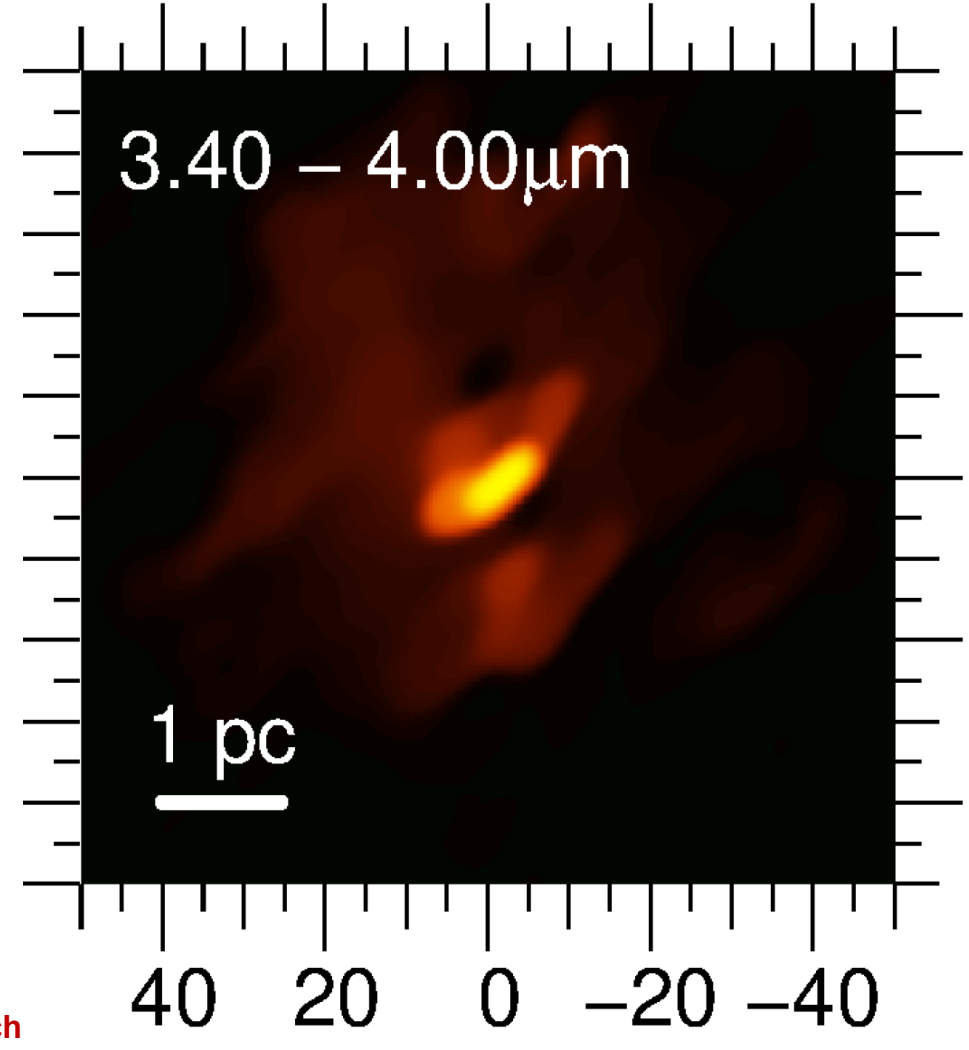
Paladini et al. (2018)

VLTI/MATISSE Image of the B[e] Star FS CMa



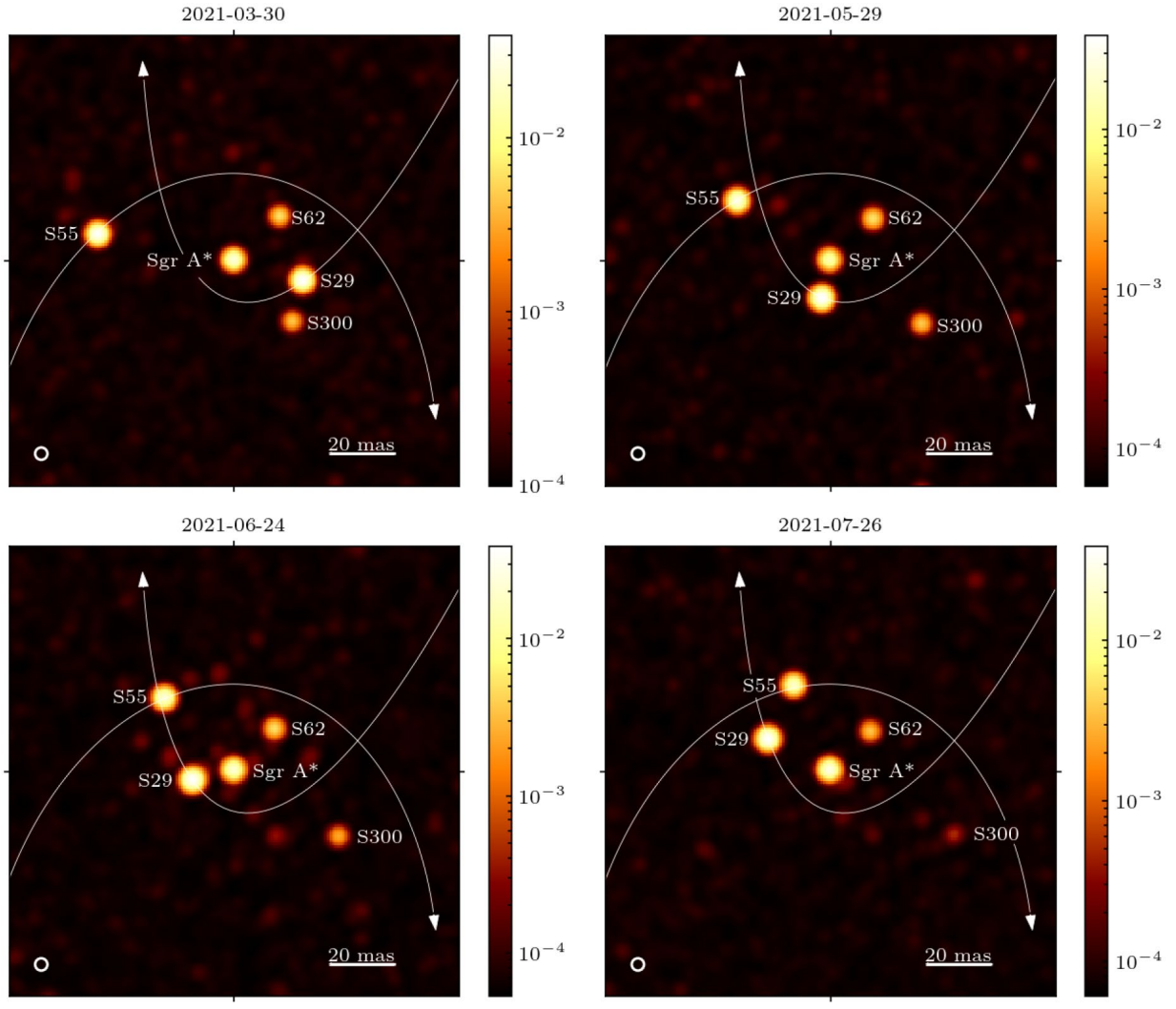
Lopez et al. (2022)

VLTI/Matisse View of the Nucleus of NGC1068



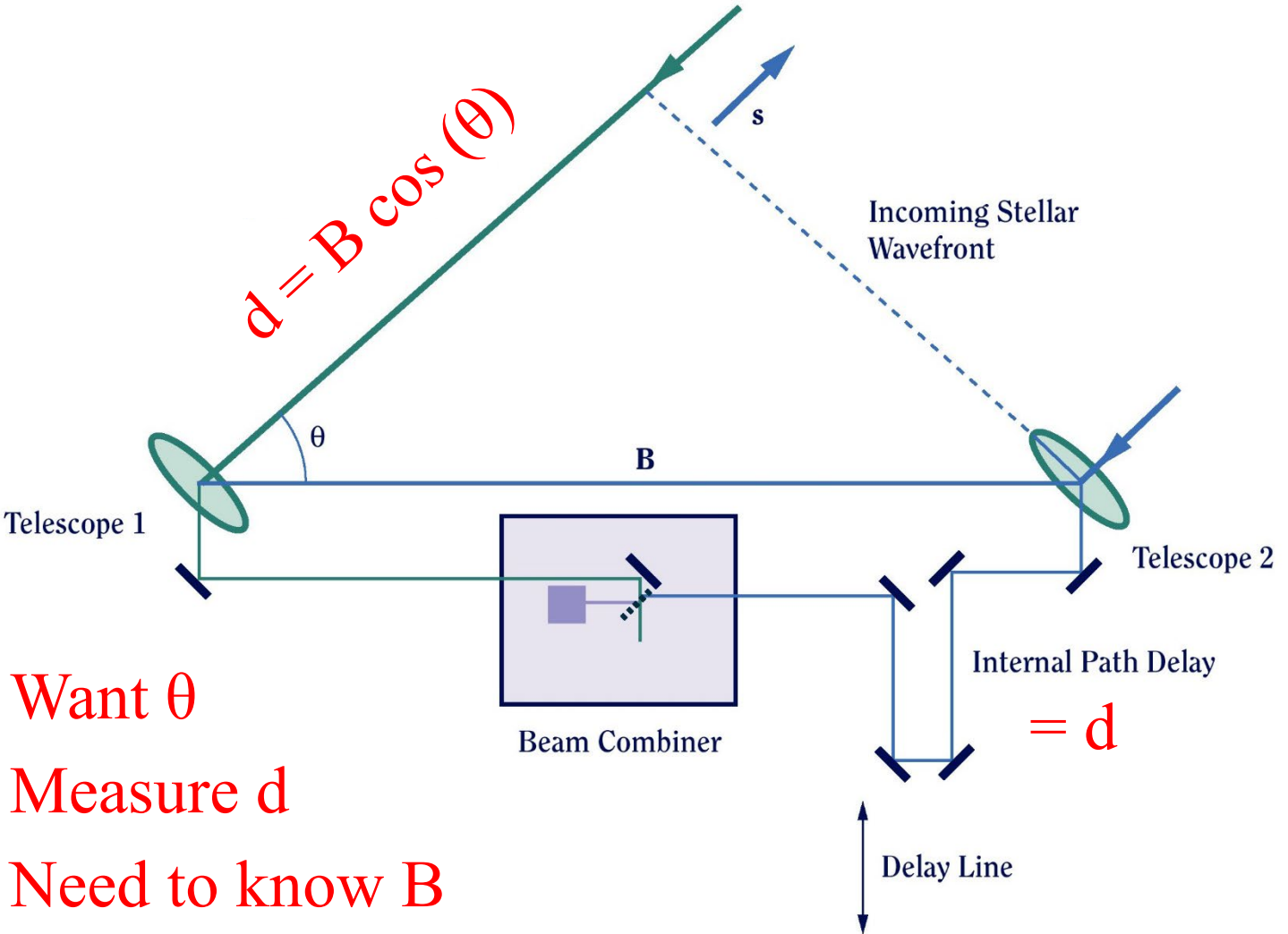
Lopez et al. (2022)

VLTI/GRAVITY Images of the Galactic Center



Gravity Collaboration (2022)

Astrometric Measurements with an Interferometer

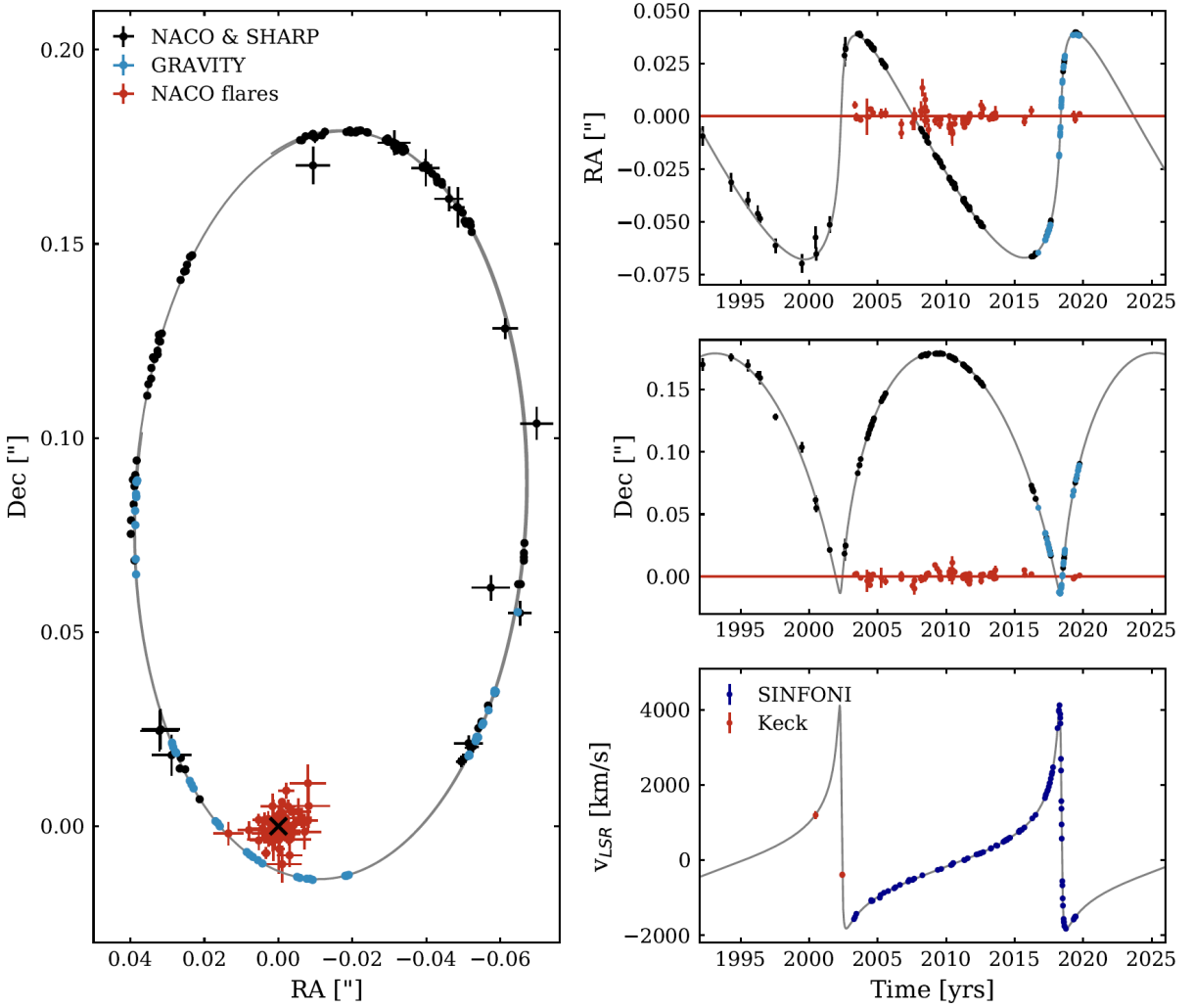


Want θ

Measure d

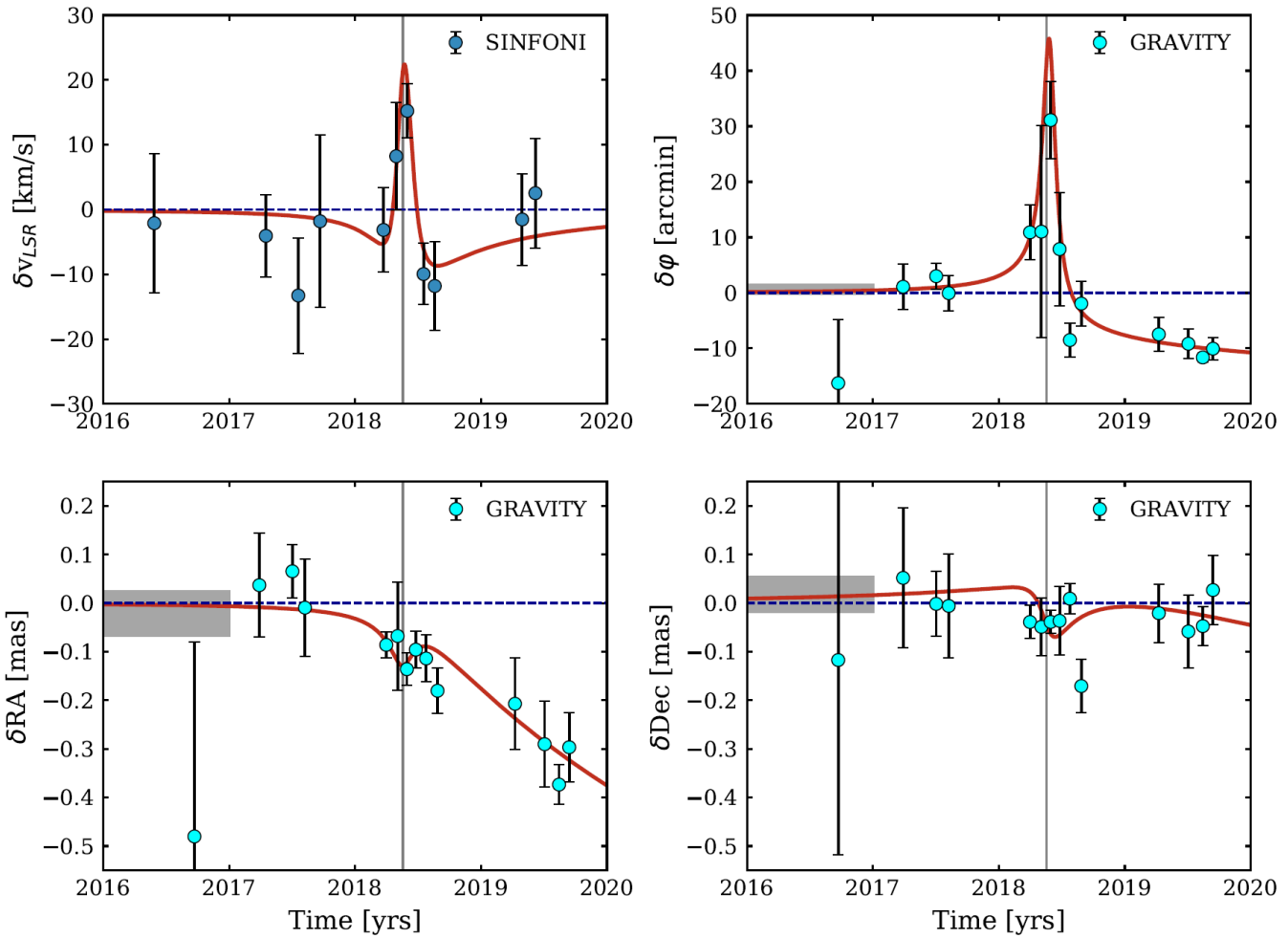
Need to know B

Orbit of the Galactic Center Star S2



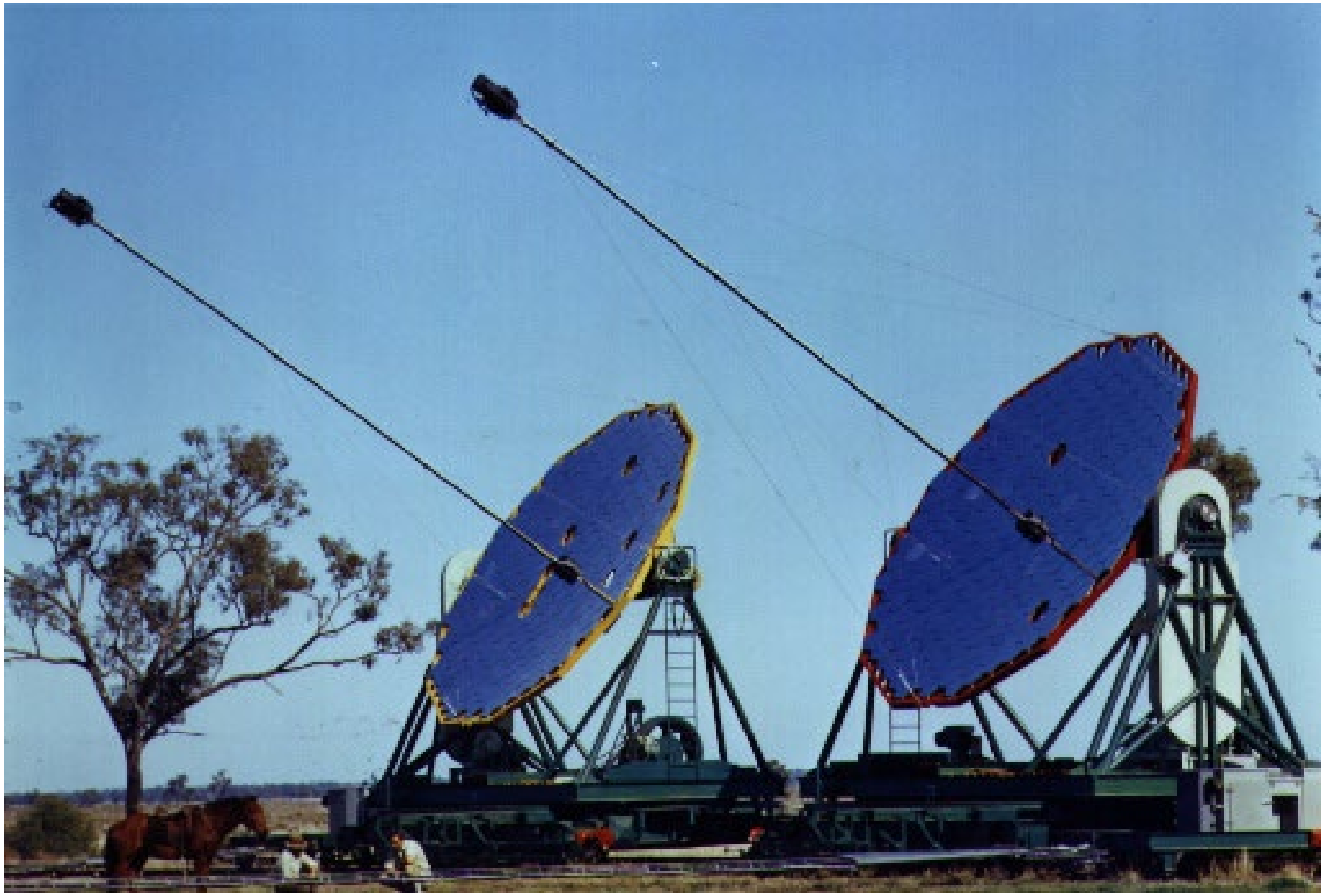
Gravity Collaboration (2020)

Schwarzschild Precession of the Orbit of the GC Star S2



Gravity Collaboration (2020)

Hanbury Brown's Intensity Interferometer (Narrabri)



Stellar Diameters from Narrabri Interferometer

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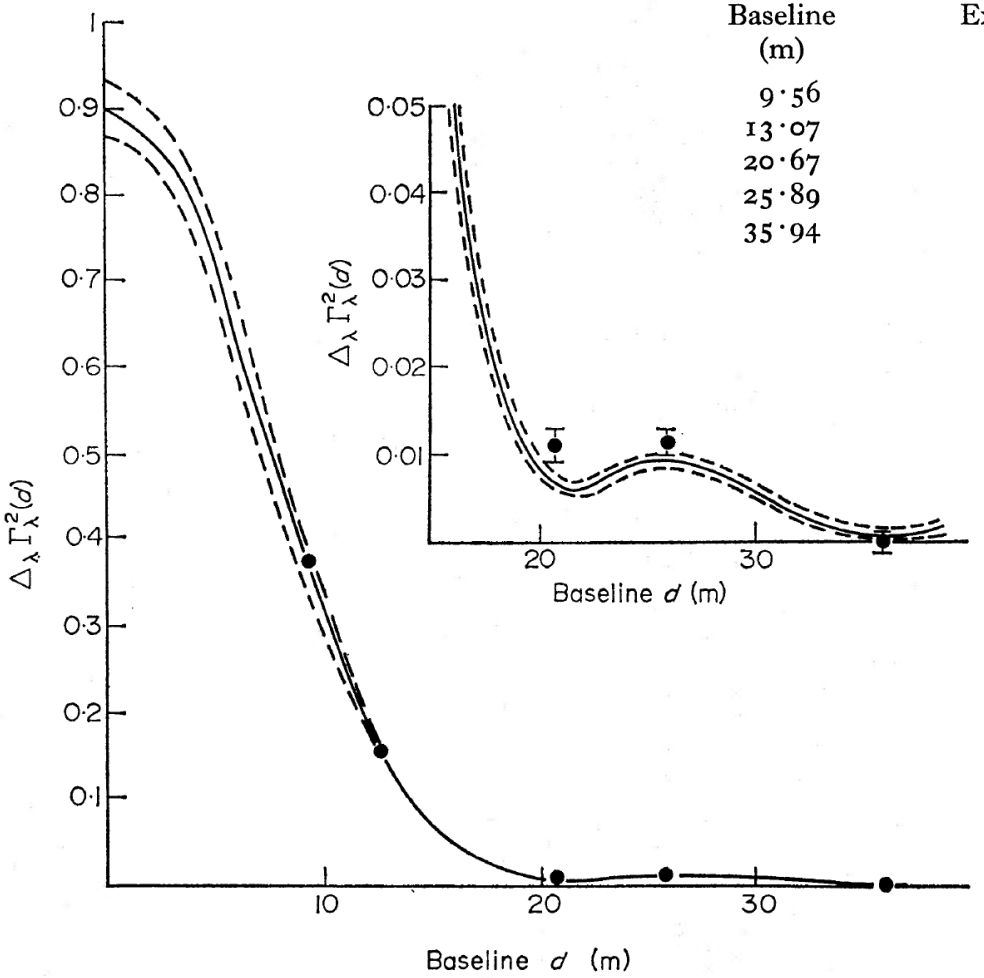
Star	Year	Wave-length (Å)	$C \pm \sigma$ (Arbitrary units)		$C_N \pm \sigma$ (Normalized)		Δ_λ	$\theta_{UD} \pm \sigma$ (10^{-3} seconds of arc)		$\tilde{\theta}_{UD} \pm \sigma$ (10^{-3} seconds of arc)	
β Cru	1965	4385	276	13	0·87	0·04	0·998	0·689	0·033		
	1966	4430	215	12	0·93	0·07	0·998	0·726	0·038	0·705	0·025
γ Ori	1966	4430	167	11	1·11	0·12	0·998	0·74	0·05	0·74	0·05
ϵ CMa	1967	4430	145	10	0·96	0·11	0·998	0·78	0·04	0·78	0·05
α Pav	1966	4430	241	16	1·06	0·09	0·998	0·77	0·06	0·77	0·06
ϵ Ori	1966	4430	140	11	0·93	0·11	0·998	0·70	0·05	0·70	0·05
α Eri	1964	4385	521	49	—	—	0·988	2·01	0·18		
	1965	4385	319	16	0·98	0·05	0·990	1·83	0·08	1·86	0·07
α Gru	1964	4608	119	19	1·03	0·17	0·997	0·97	0·20		
	1965	4385	374	32	1·13	0·10	0·997	0·98	0·07	0·98	0·07
α Leo	1966	4385	373	23	1·12	0·07	0·994	1·33	0·07	1·33	0·07
β Ori	1965	4385	318	24	0·99	0·08	0·980	2·57	0·14	2·57	0·14
α CMa	1966	4385	385	17	1·10	0·05	0·901	5·83	0·13		
	1967	4430	187	10	1·24	0·12	0·900	5·87	0·16	5·85	0·10
α Lyr	1963	4385	544	103	—	—	0·961	3·56	0·40		
	1965	4385	367	21	1·05	0·06	0·968	3·26	0·16	3·31	0·15
α PsA	1964	4608	103	16	0·89	0·14	0·990	1·65	0·28		
	1965	4385	373	31	1·08	0·09	0·987	2·07	0·15	1·98	0·13
α Car	1965	4385	345	55	1·08	0·17	0·880	6·48	0·39	6·48	0·39
α Aql	1964	4608	124	22	1·08	0·19	0·973	2·98	0·43		
	1965	4385	317	18	0·96	0·06	0·976	2·77	0·15	2·79	0·14
α CMi	1967	4430	182	28	1·21	0·21	0·917	5·31	0·36	5·31	0·36

Hanbury Brown et al. (1967)

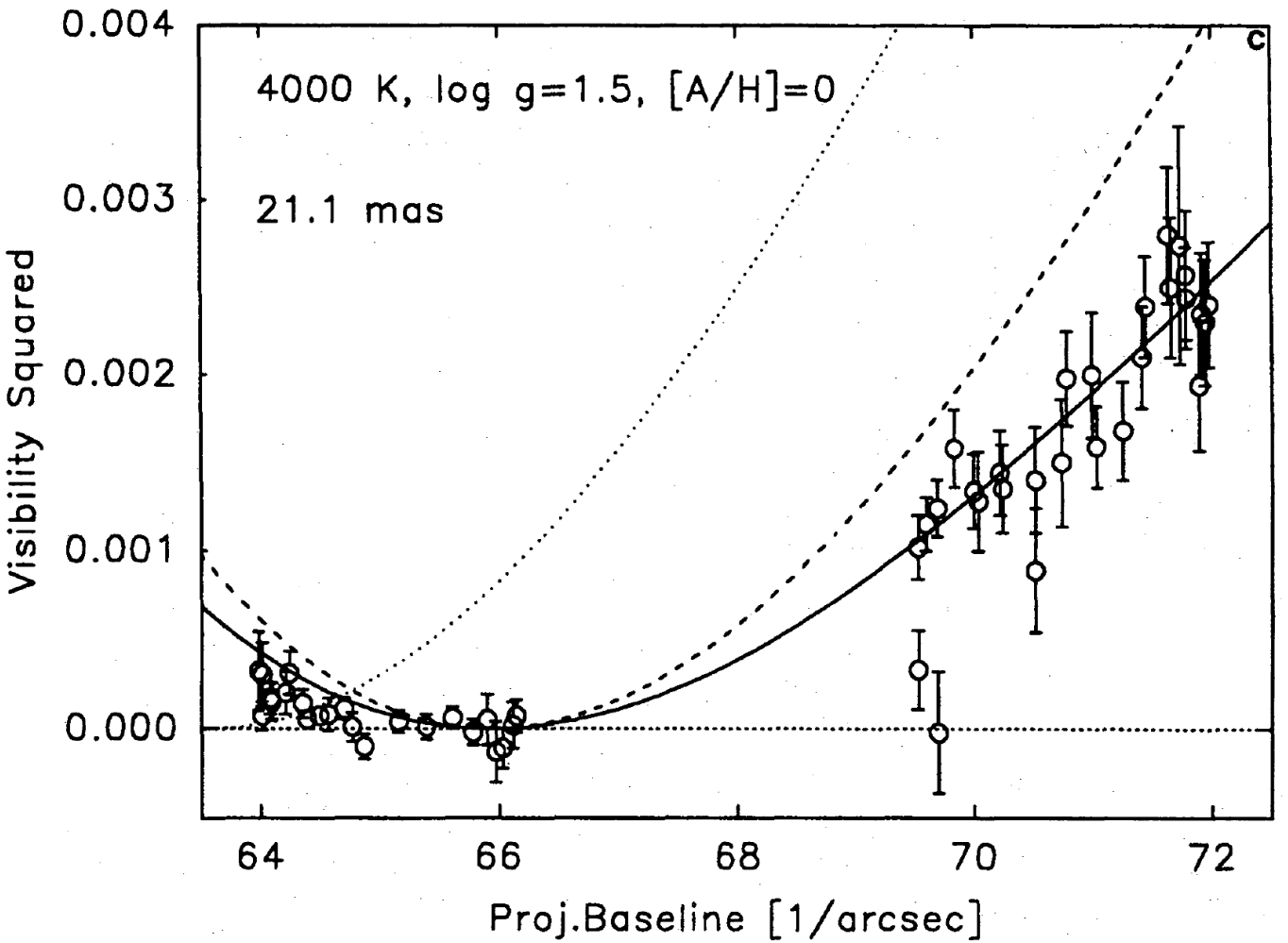
Limb Darkening of Sirius from Narrabri Interferometer



Baseline (m)	Exposure (h)	Correlation Observed	Correlation Theoretical*
9·56	41·3	0·371 ± 0·007	0·377
13·07	29·4	0·160 ± 0·002	0·159
20·67	37·2	0·0107 ± 0·0015	0·0061
25·89	57·5	0·0118 ± 0·0011	0·0100
35·94	37·9	0·0001 ± 0·0013	0·0009

Hanbury Brown et al. (1974)

Limb Darkening of Arcturus from Mark III Interferometer



Quirrenbach et al. (1996)

Conclusions

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- Optical interferometry enables astrophysical measurements at the sub-mas scale.
  - Parameter estimation, imaging, astrometry.
- OI has entered mainstream astronomy.
- Many topics in stellar astronomy.
  - Some very interesting extragalactic examples, too.
- Sensitivity is key to success.
  - Beware of scaling with coherence factor.