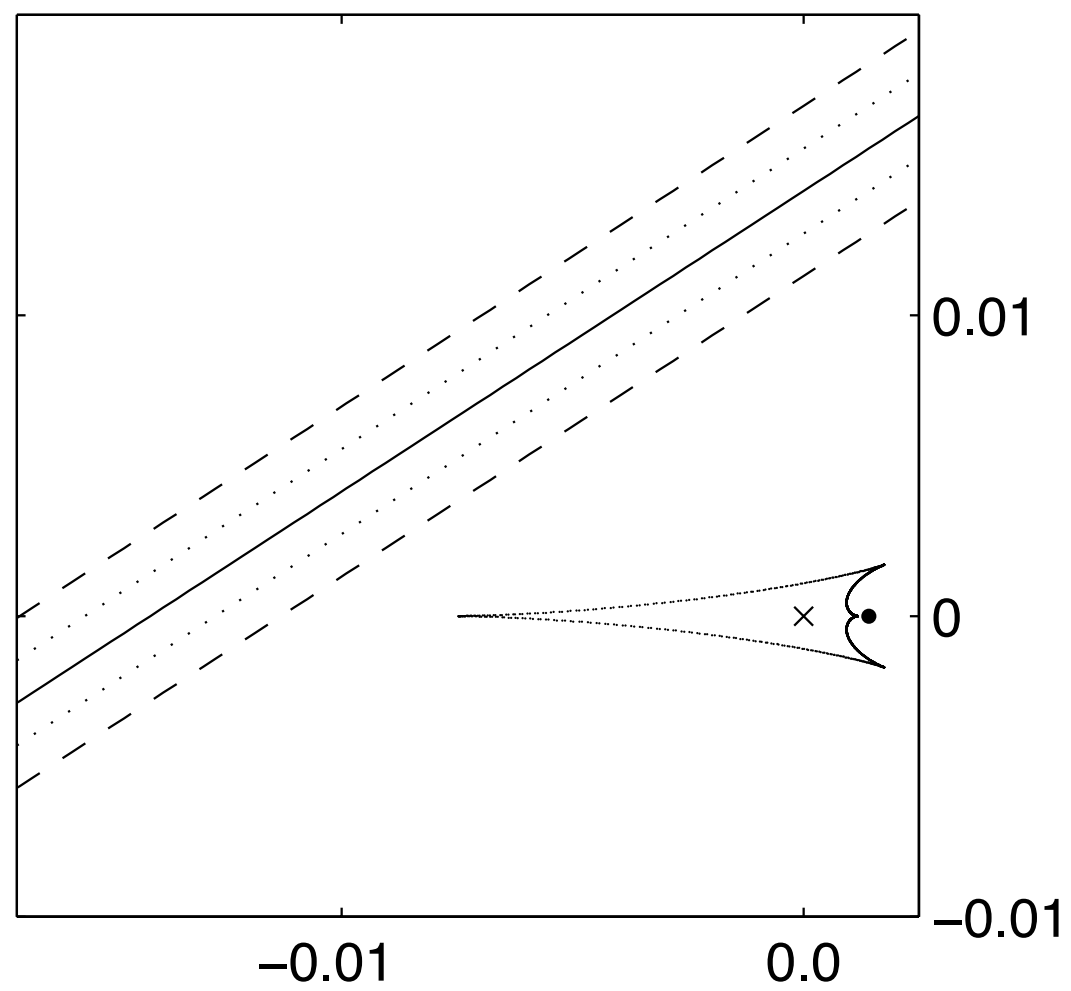
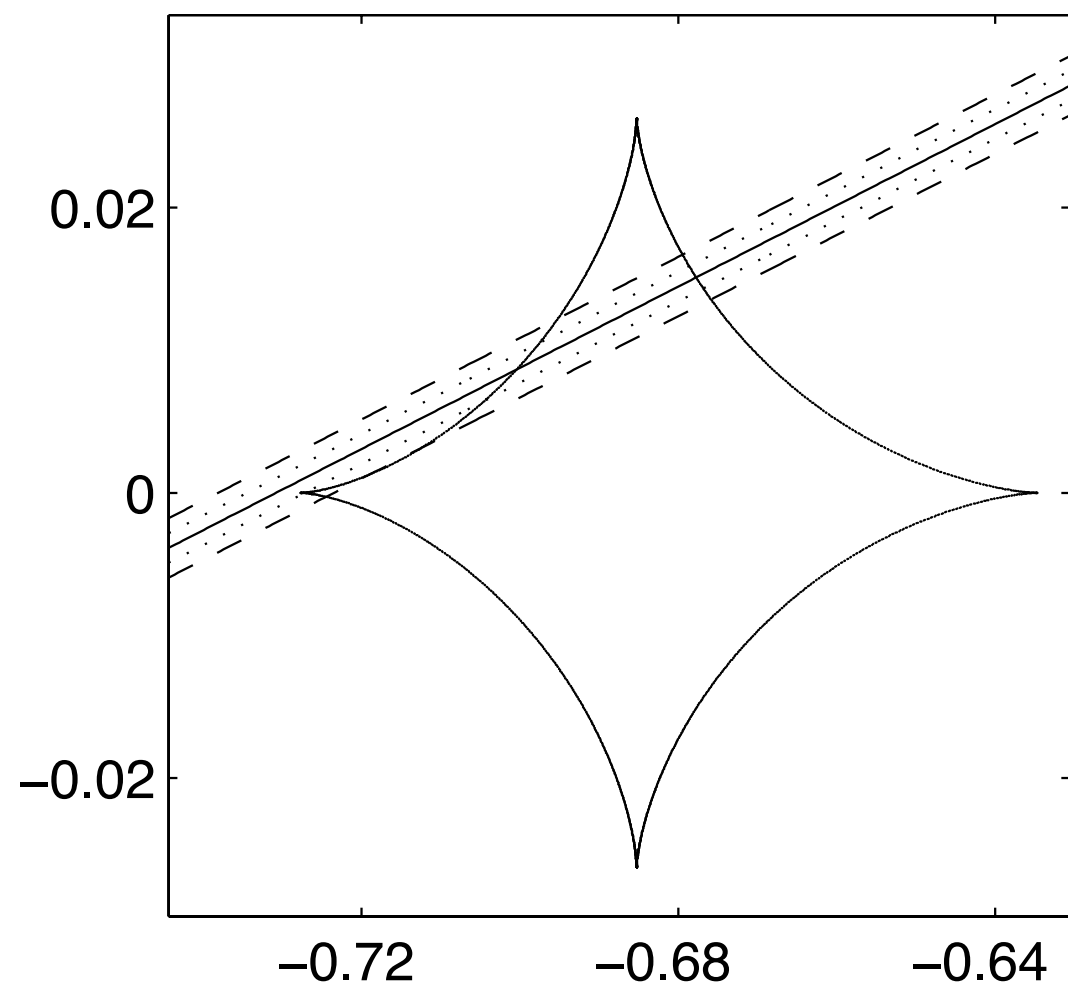
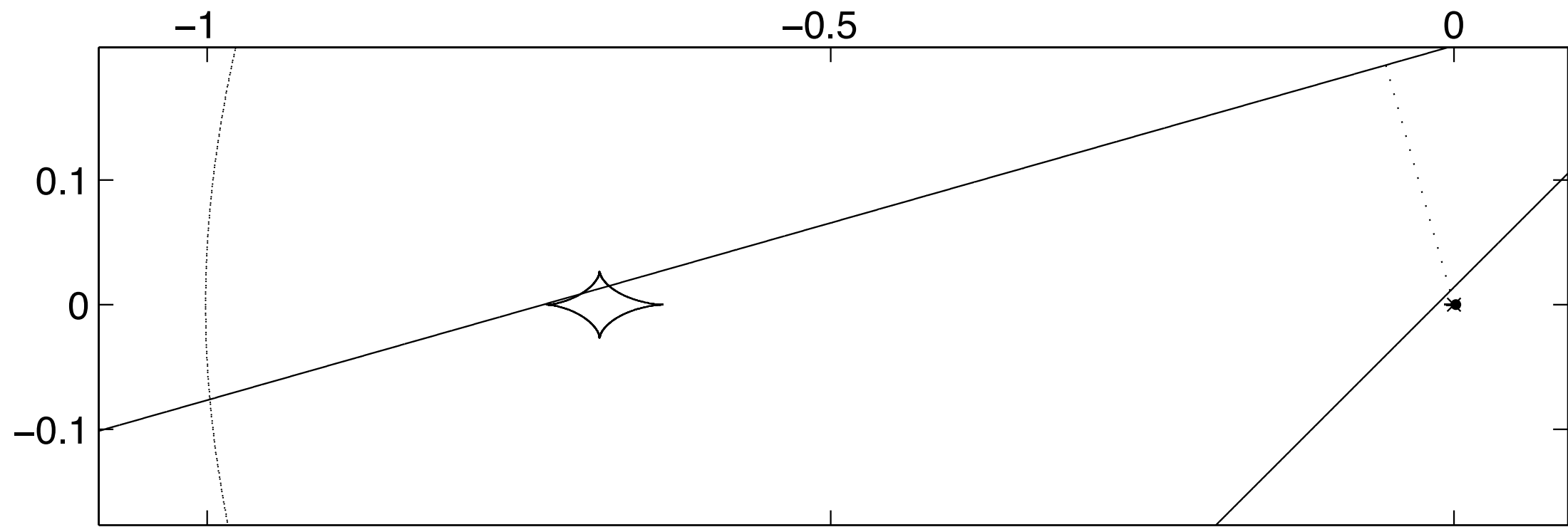
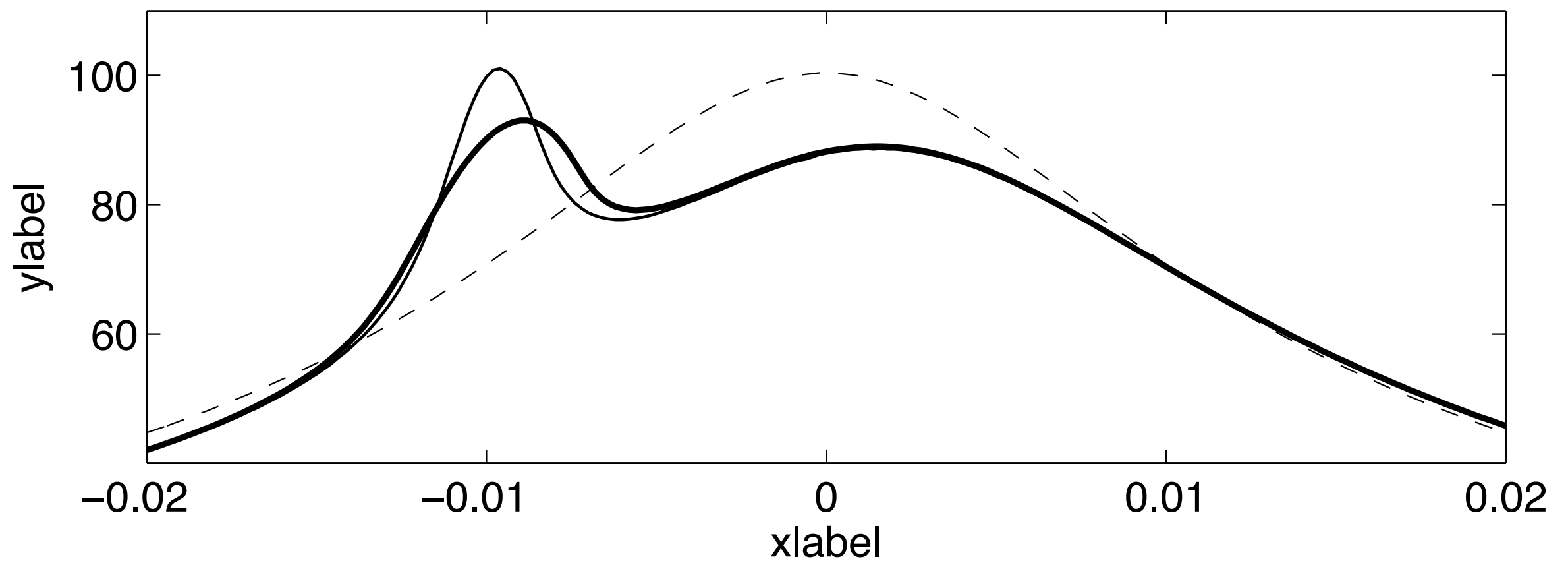
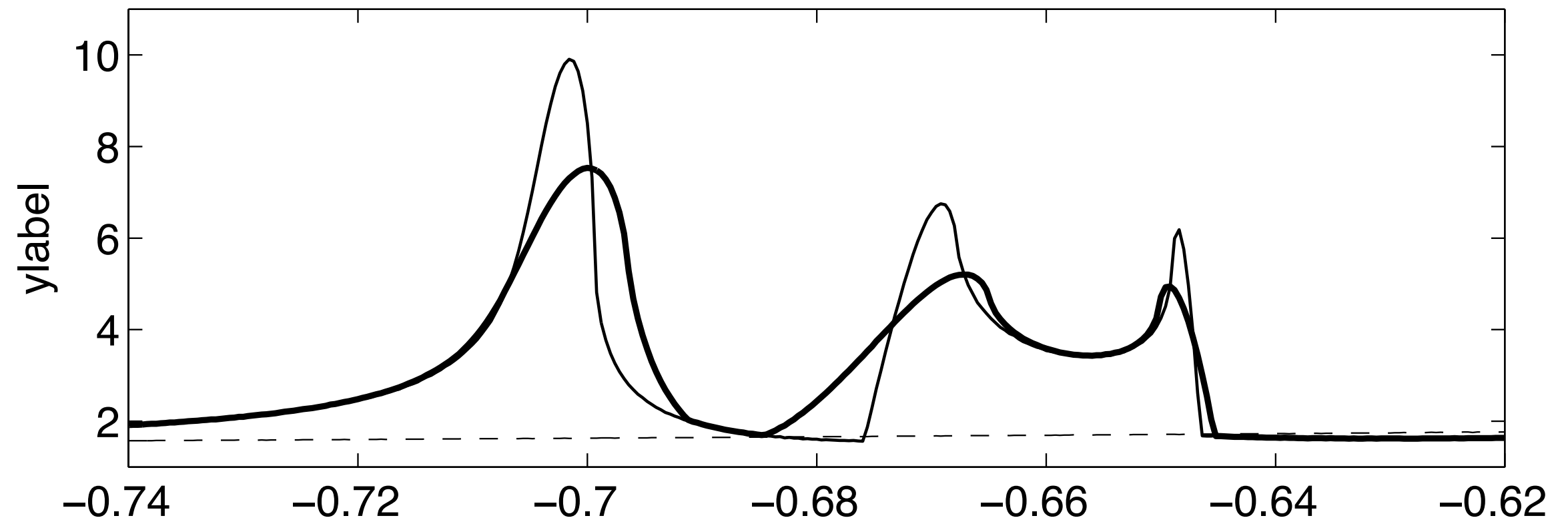
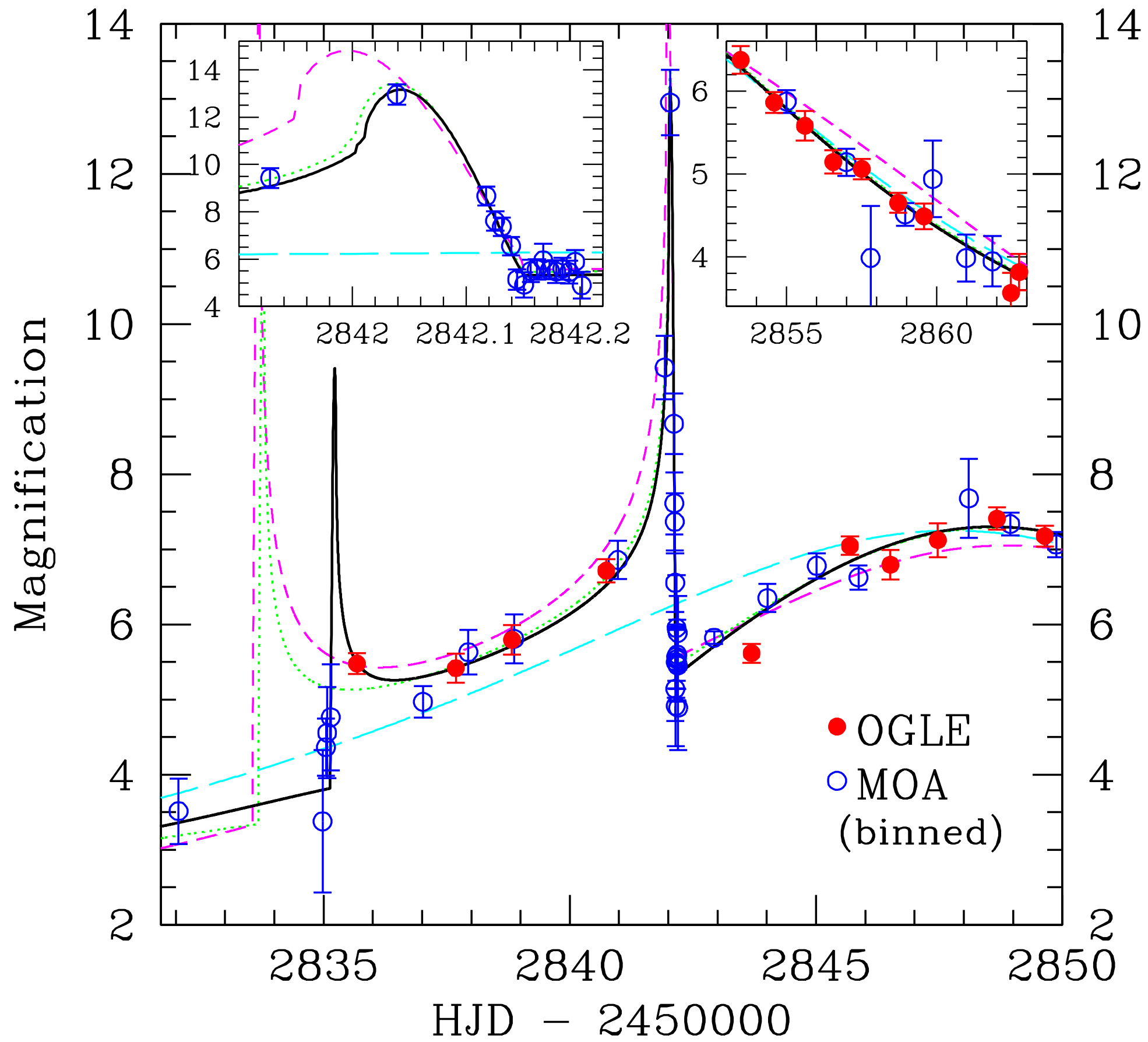

APPLICATIONS OF LENSING

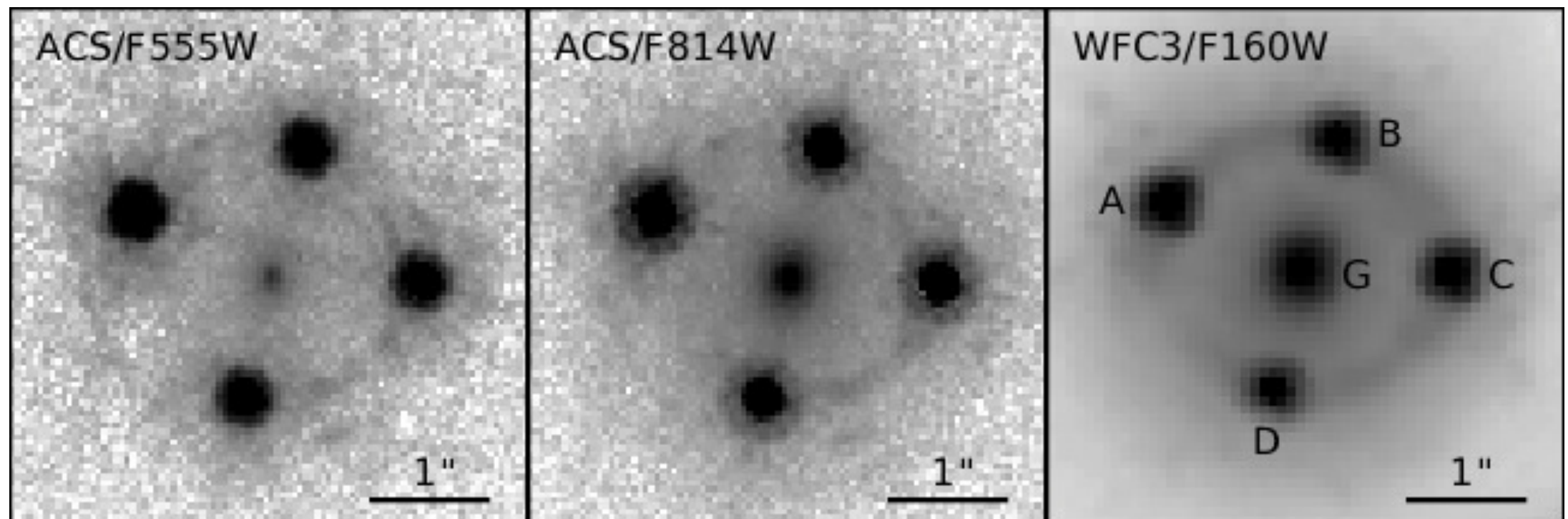
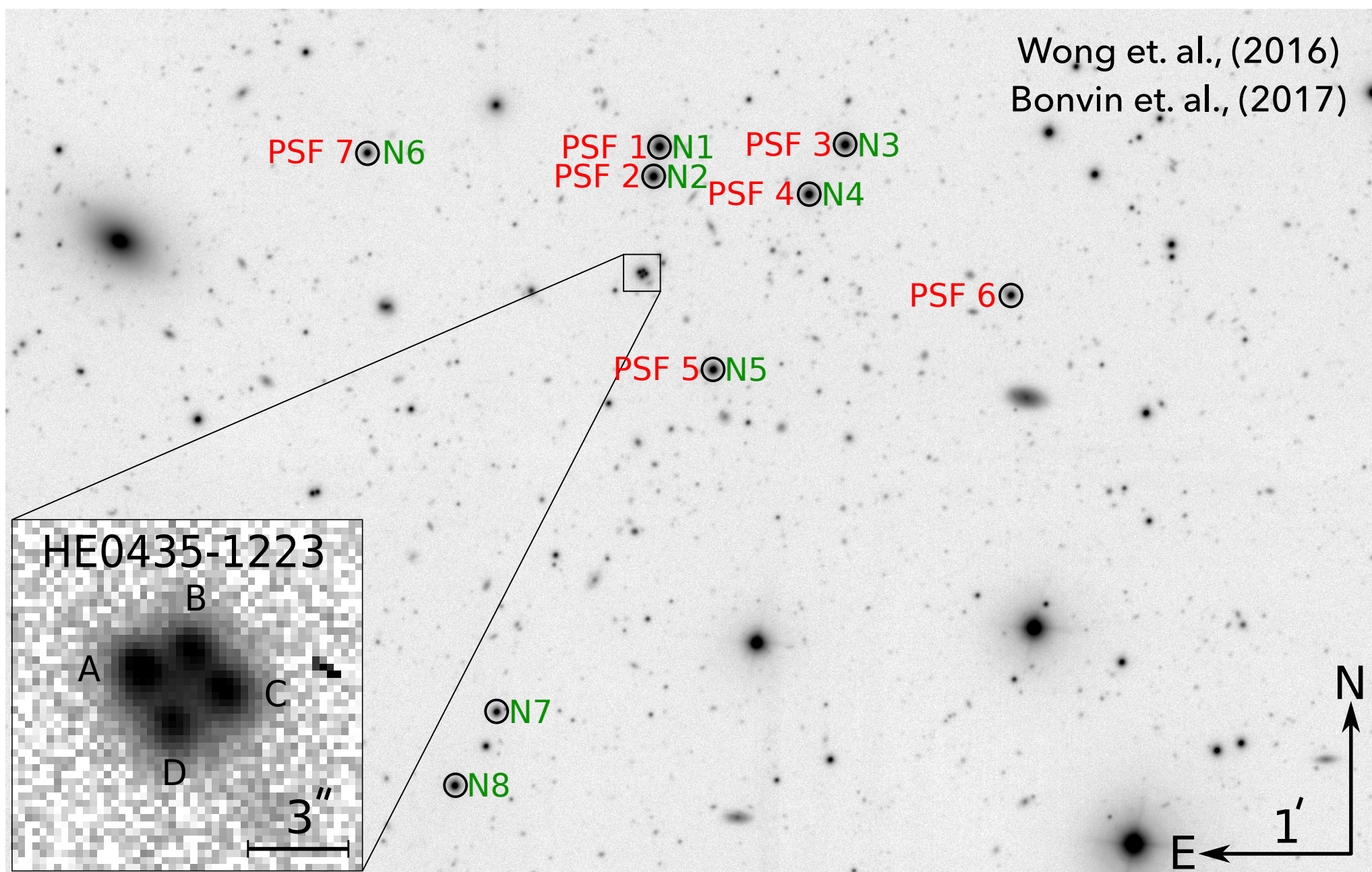
EXOPLANETS

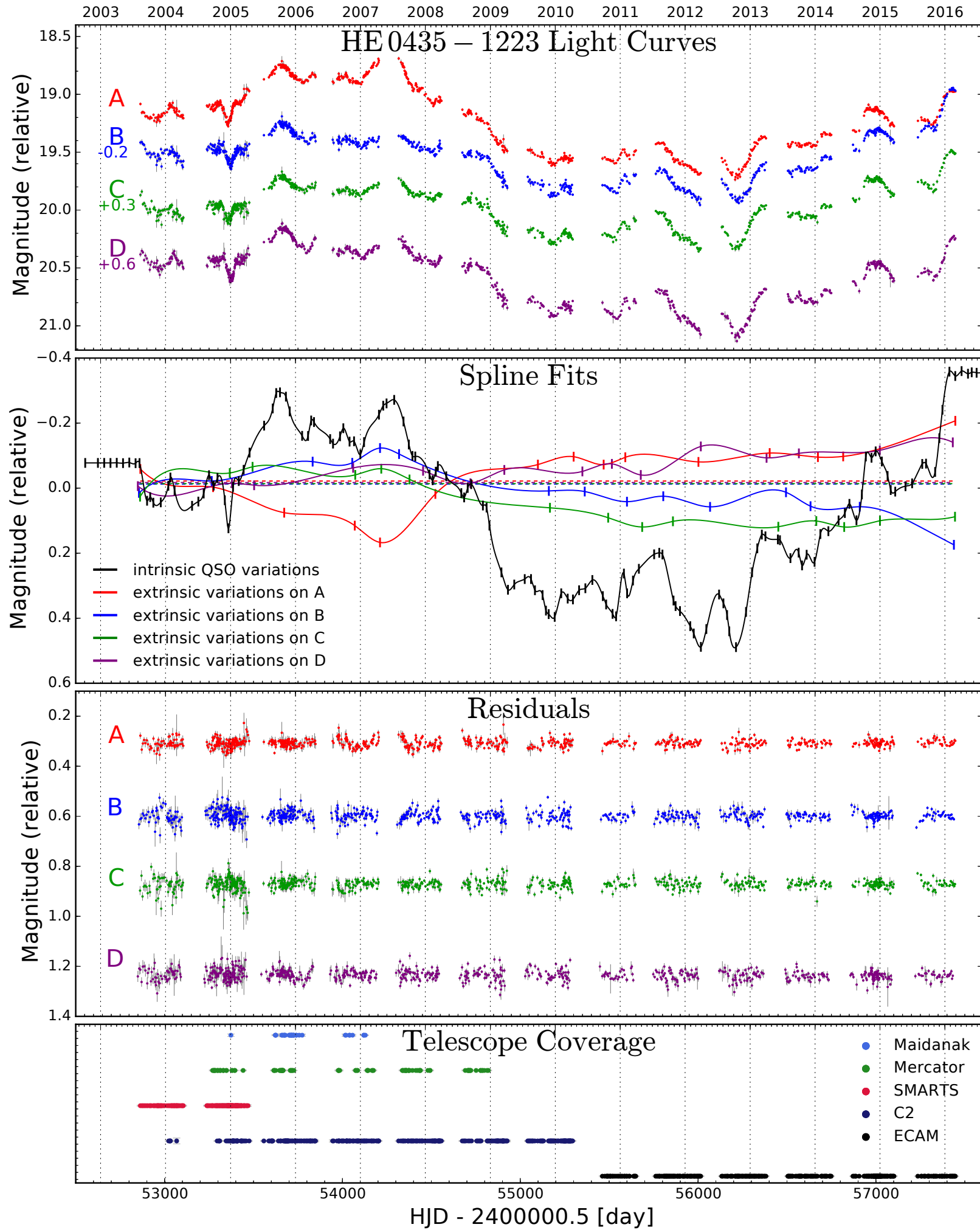


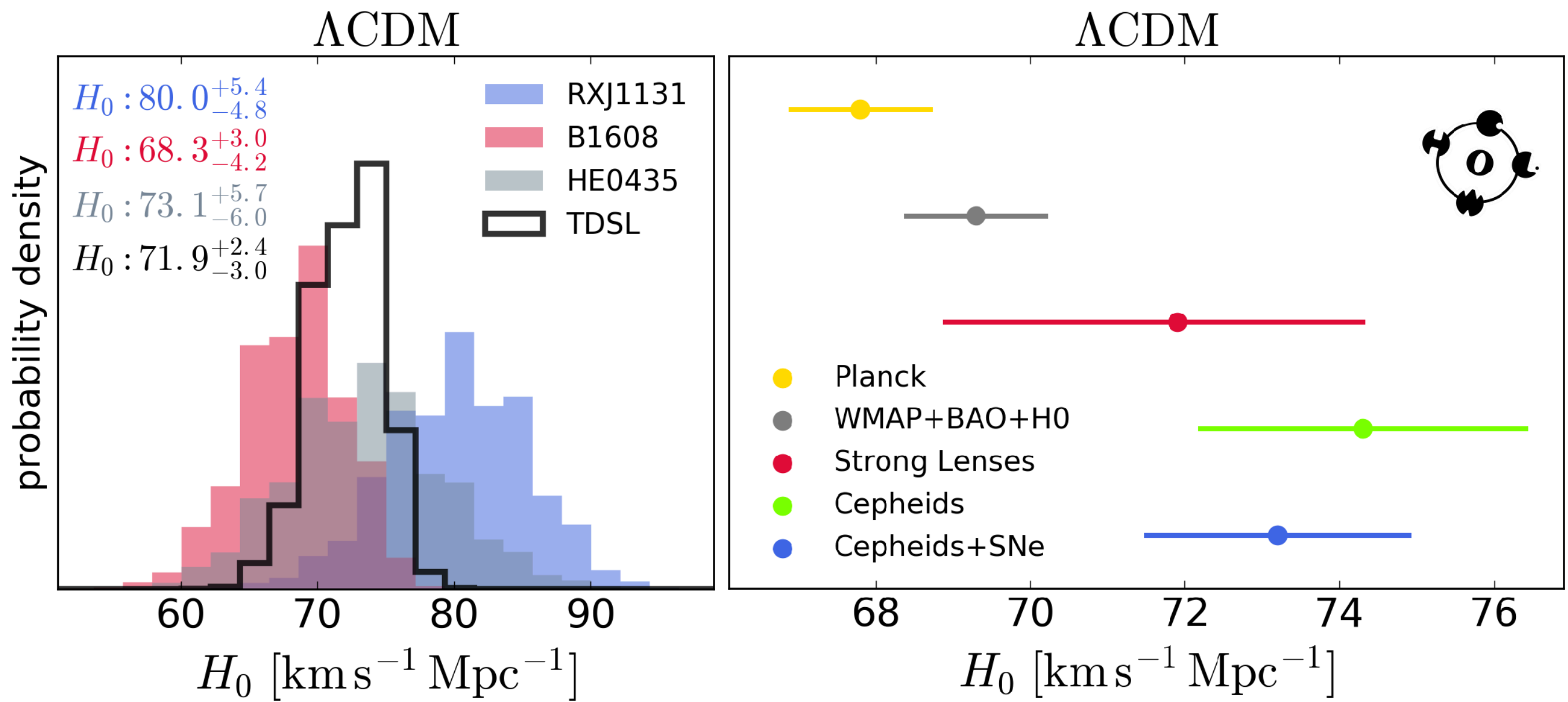


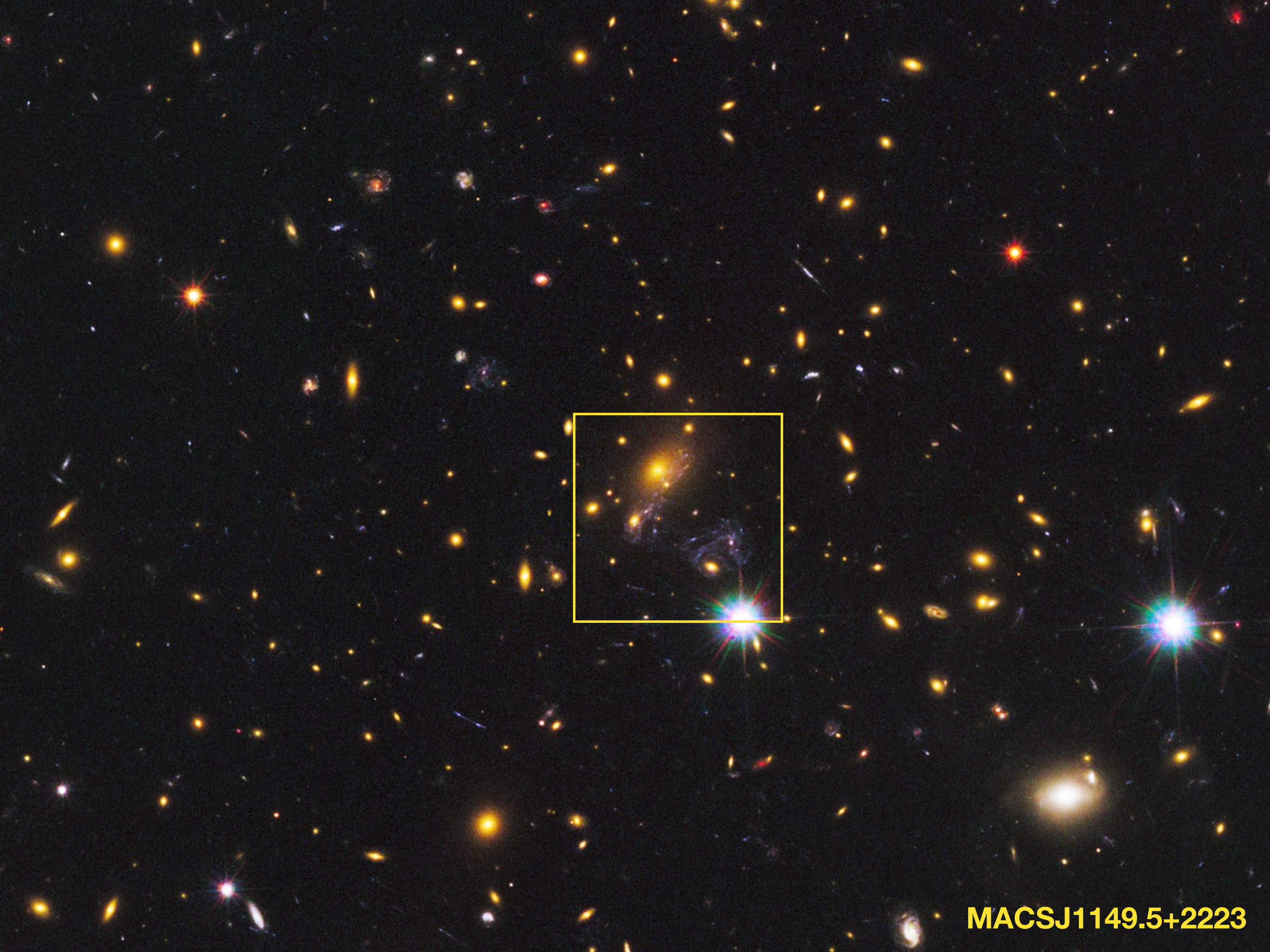


TIME DELAYS



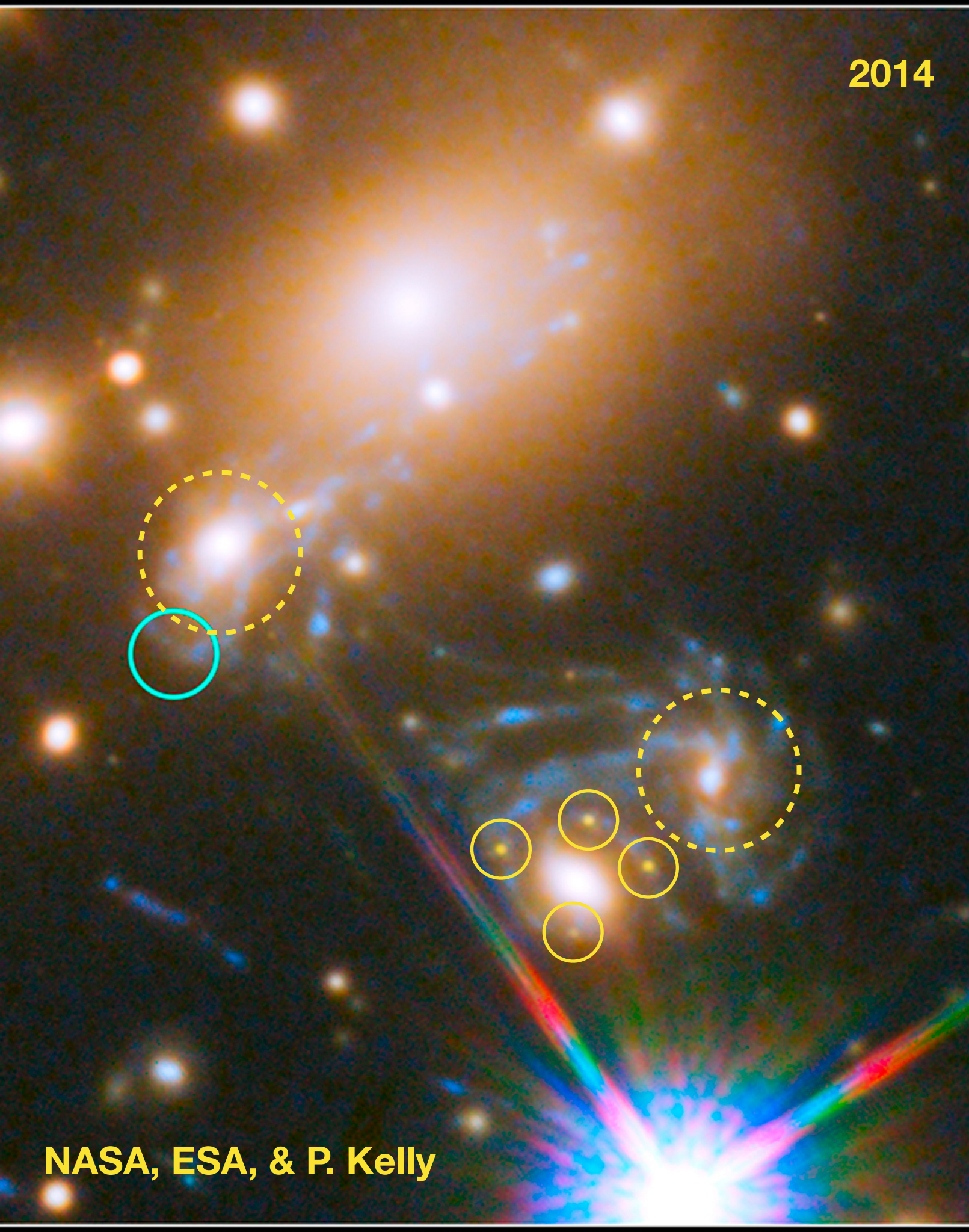






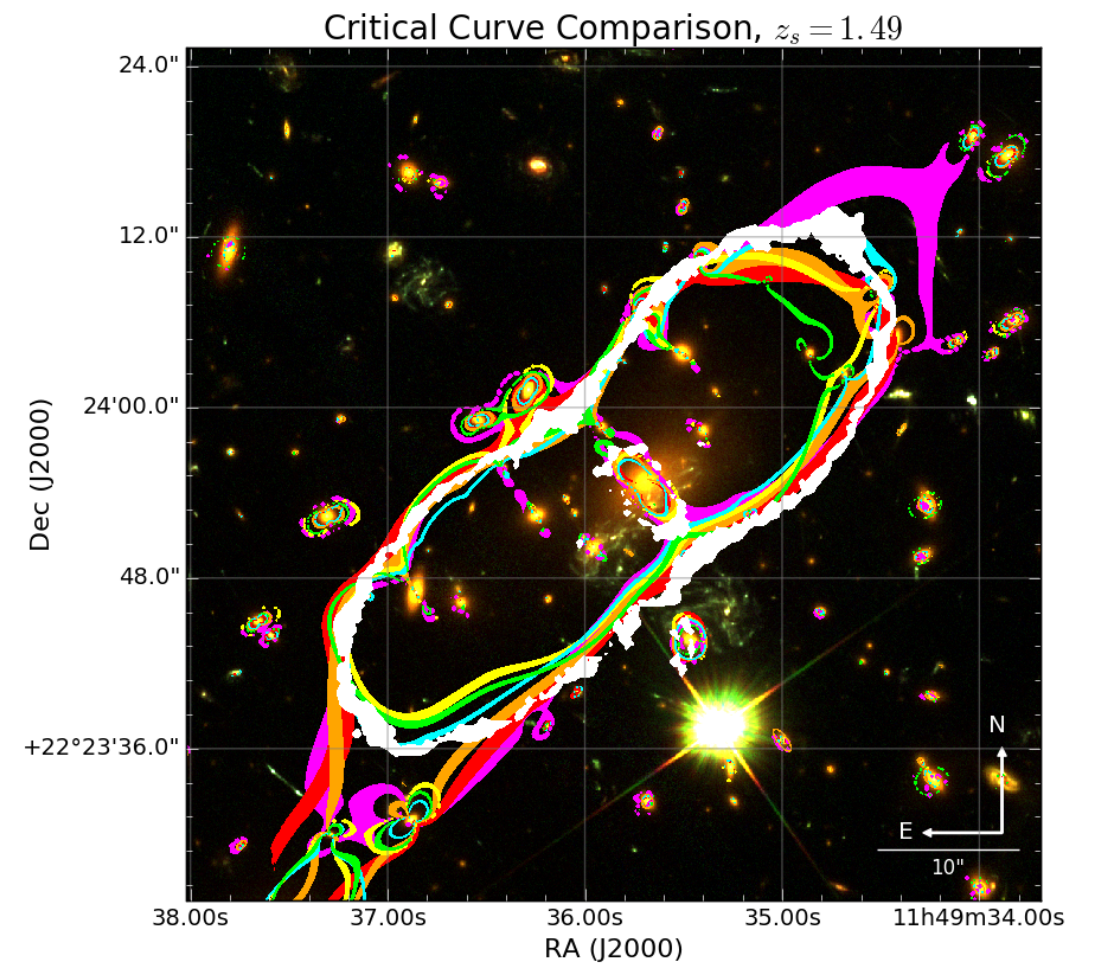
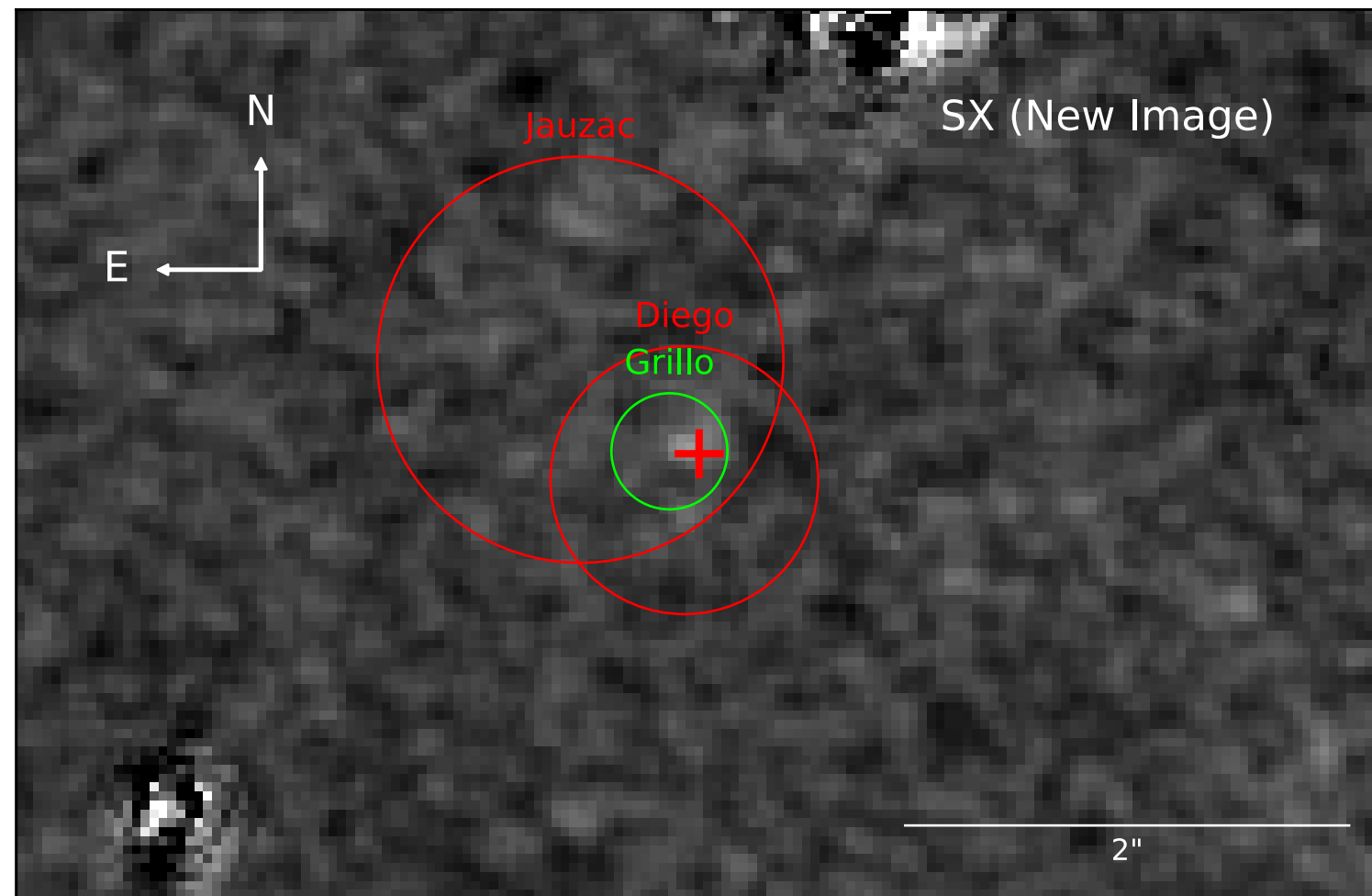
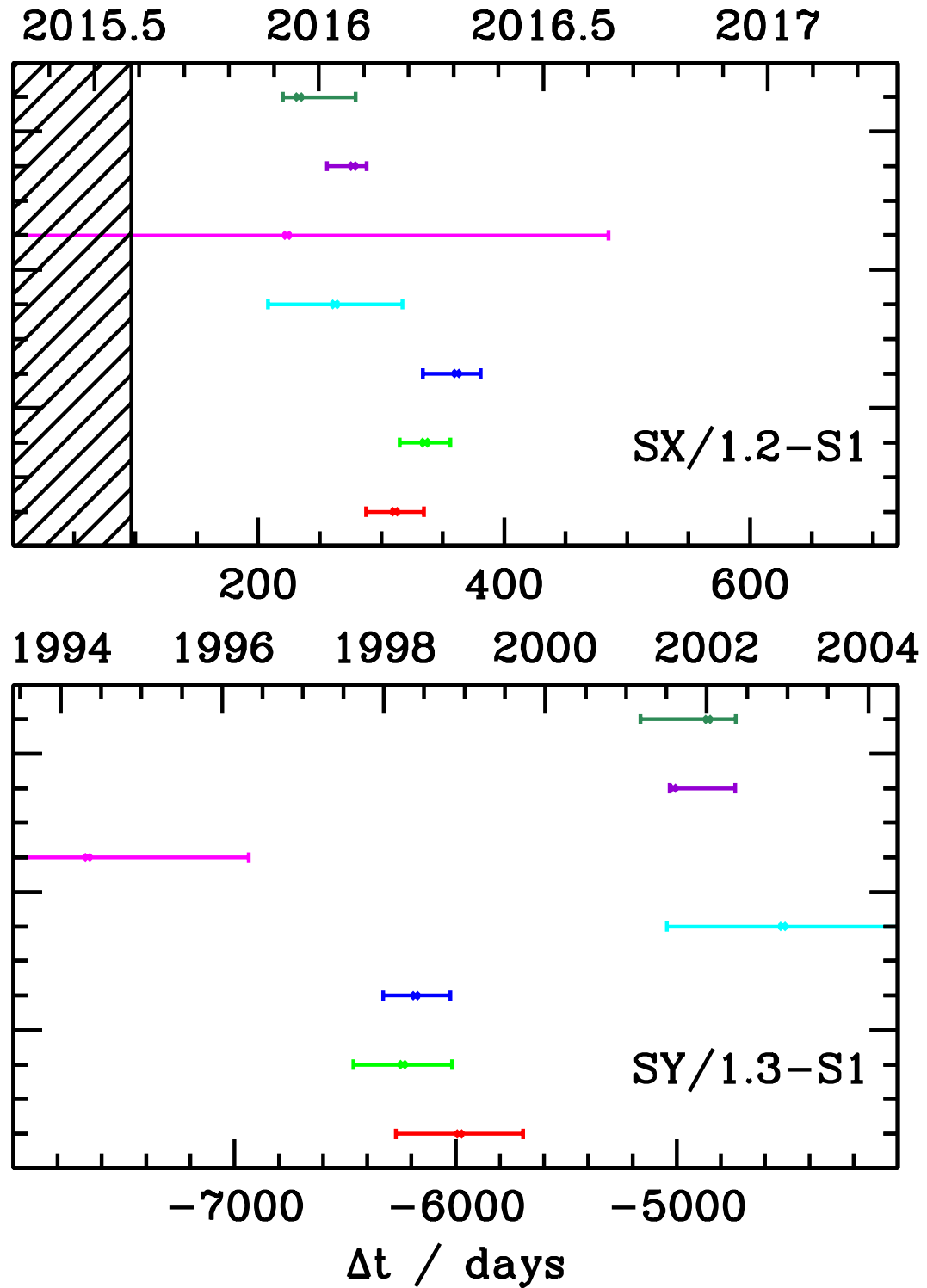
MACSJ1149.5+2223

2014



NASA, ESA, & P. Kelly

Treu et. al., (2015)
 Kelly et. al., (2015)
 Finney et. al., (2018)



MASS MODELING



X-ray: NASA/CXC/CfA/M.Markevitch et al.

Optical: NASA/STScI; Magellan/U.Arizona/D.Clowe et al.

Paraficz et. al. (2012)

10"

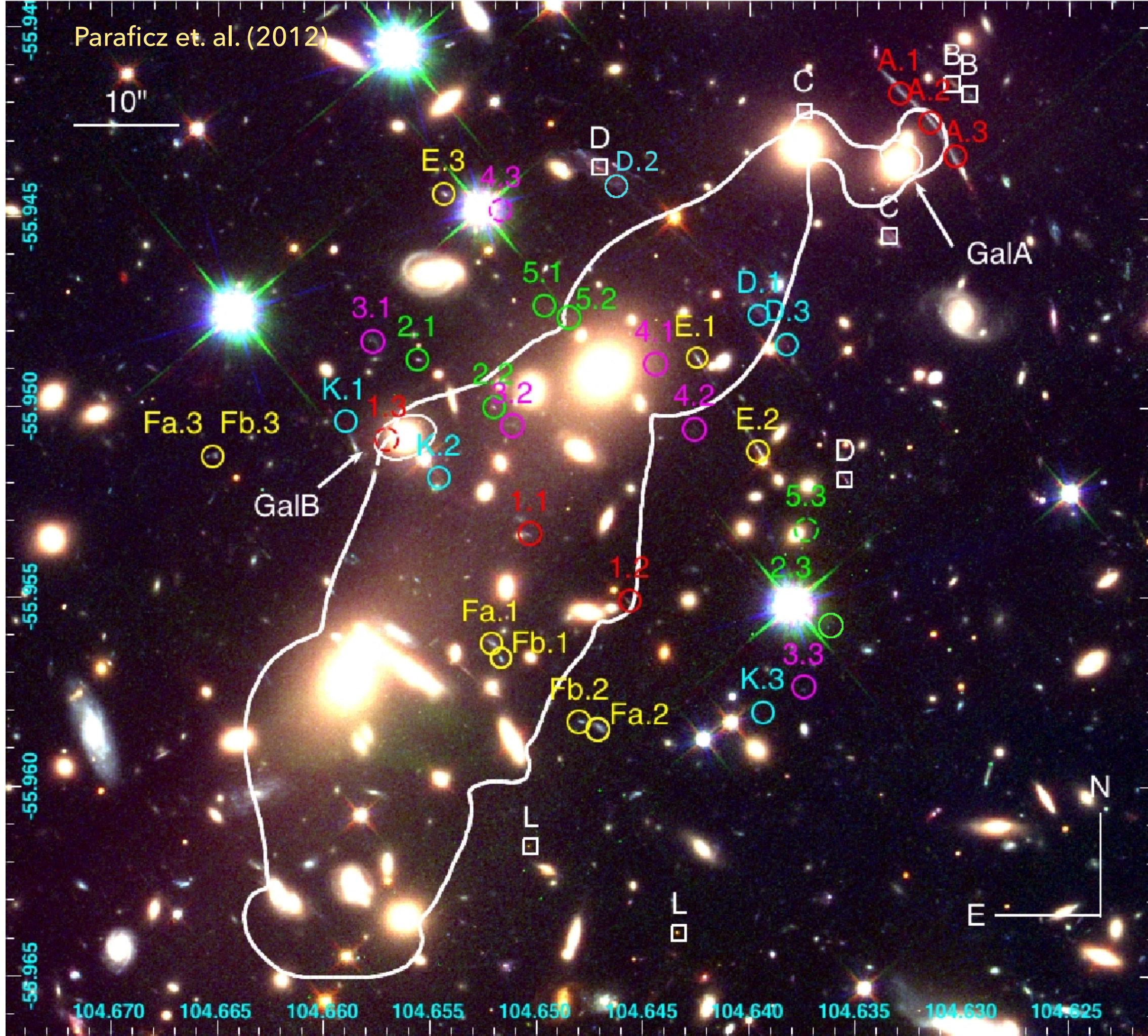
GalA

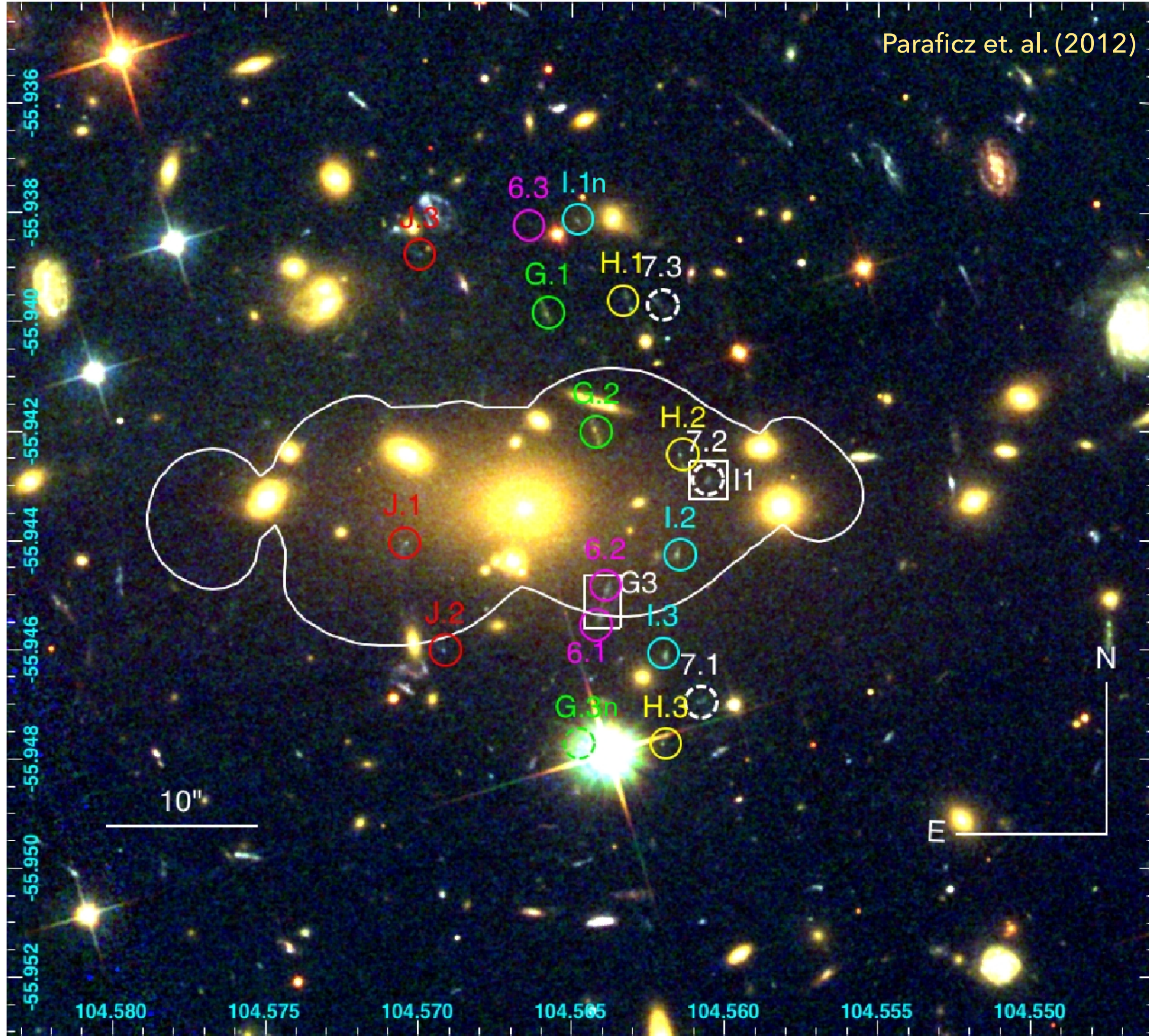
GalB

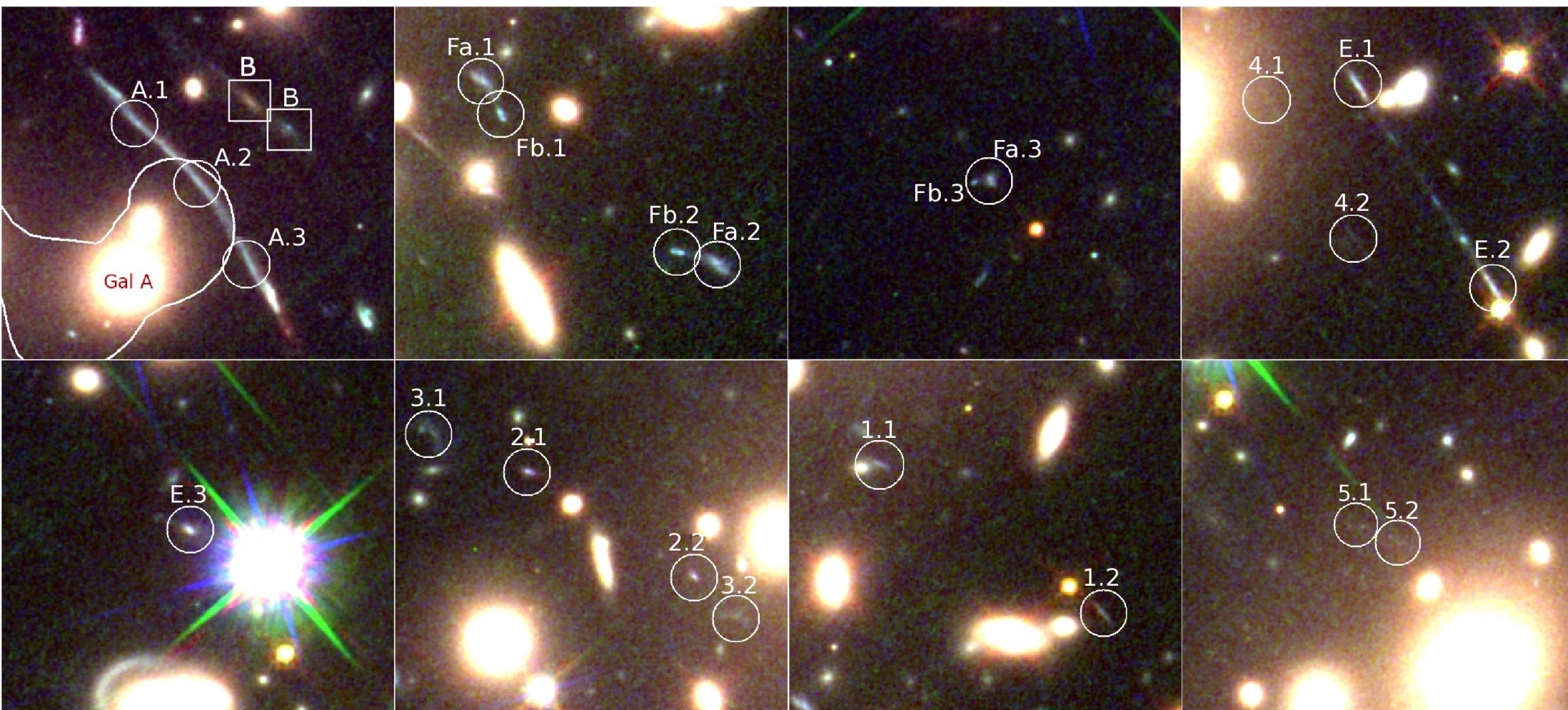
N

E

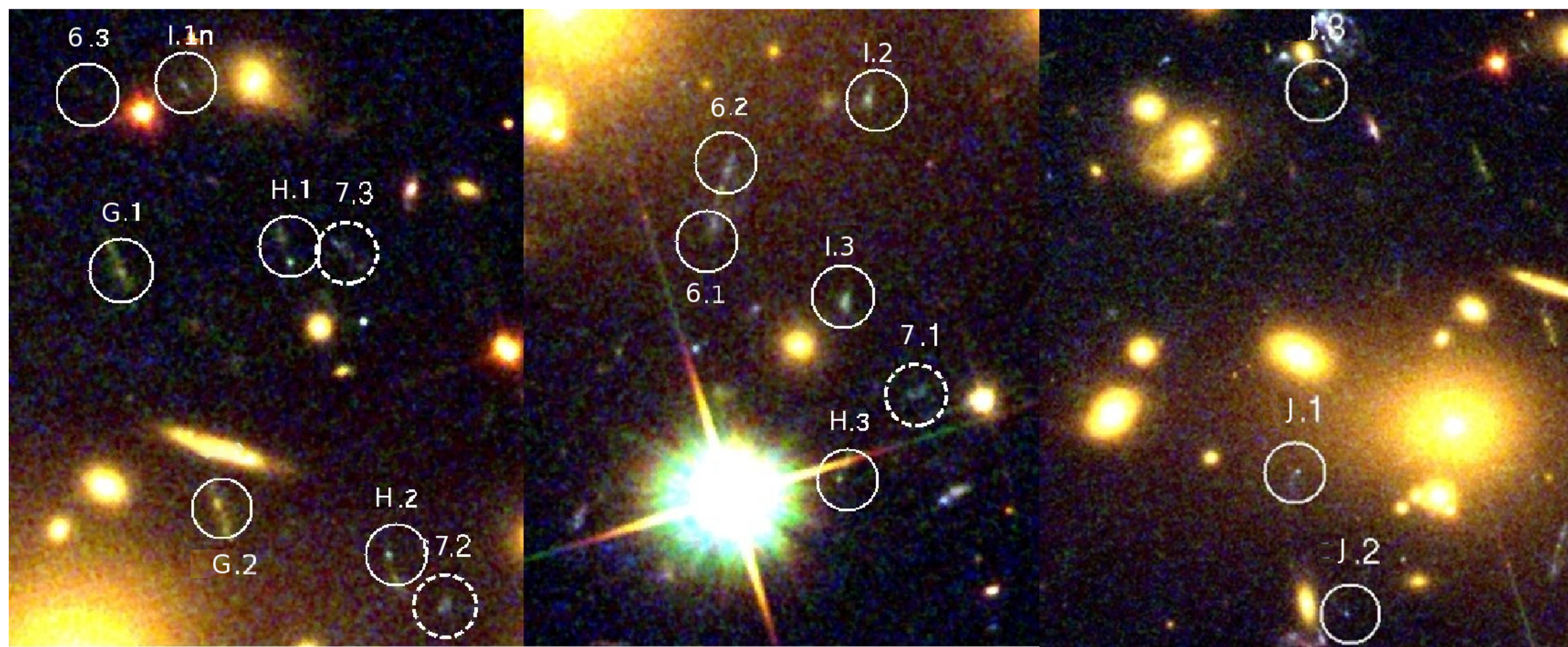
104.670 104.665 104.660 104.655 104.650 104.645 104.640 104.635 104.630 104.625

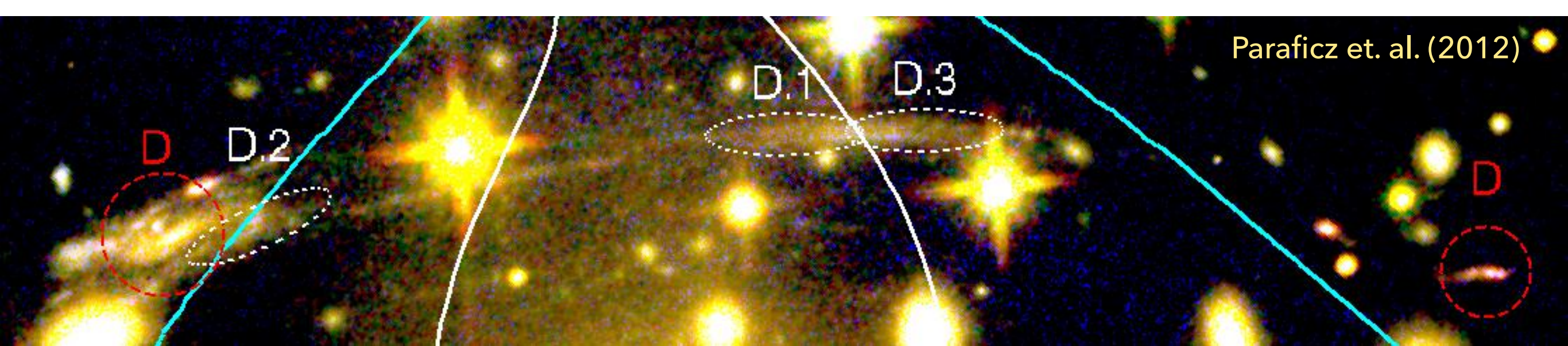






Paraficz et. al. (2012)





System	$\Delta\alpha$ ($''$)	$\Delta\delta$ ($''$)	ϵ	θ^a	r_{core} (kpc)	r_{cut} ($''$)	σ_0 (km/s)
FJ log(Evidence)=-35.1			RMS _{FJ} = 0.197 $''$				
DM 1	8.3 ± 0.3	-2.5 ± 0.8	0.64 ± 0.05	72.0 ± 2.1	117.4 ± 5.9	[1000.0]	884.2 ± 31.9
DM 2	24.2 ± 1.0	28.3 ± 1.2	0.13 ± 0.11	56.6 ± 1.0	127.3 ± 17.1	[1000.0]	840.2 ± 37.5
DM 3	185.9 ± 0.3	50.1 ± 0.1	0.46 ± 0.05	5.2 ± 0.5	47.3 ± 0.9	[1000.0]	795.7 ± 18.9
BCG 1	[0.00]	[0.00]	[0.26]	[43.5]	[0.3]	150.0 ± 2.1	255.9 ± 39.3
BCG 2	[24.05]	[29.13]	[0.20]	[37.4]	[0.2]	112.2 ± 1.8	201.6 ± 2.4
Gal A	[51.94]	[48.93]	[0.13]	[9.9]	[0.1]	60.0 ± 0.9	199.3 ± 3.9
Gal B	[5.23]	[23.01]	[0.10]	[-49.0]	[0.1]	53.3 ± 1.3	105.1 ± 1.6
σ_{FJ}^*	...	...	...	...	[0.1]	48.6 ± 8.5	119.2 ± 5.1
FP log(Evidence)=-34.0			RMS _{FP} = 0.160 $''$				
DM 1	8.2 ± 0.3	-2.3 ± 0.7	0.56 ± 0.07	72.4 ± 2.6	125.8 ± 7.0	[1000.0]	938.1 ± 39.0
DM 2	24.8 ± 0.8	27.9 ± 1.0	0.23 ± 0.09	55.4 ± 1.1	133.4 ± 7.6	[1000.0]	847.0 ± 42.0
DM 3	186.0 ± 0.4	50.1 ± 0.1	0.44 ± 0.04	4.8 ± 0.5	50.0 ± 3.0	[1000.0]	815.2 ± 16.8
BCG 1	[0.00]	[0.00]	[0.26]	[43.5]	[0.3]	50.5 ± 12.3	201.8 ± 32.0
BCG 2	[24.05]	[29.13]	[0.20]	[37.4]	[0.2]	48.8 ± 5.8	212.7 ± 7.2
Gal A	[51.94]	[48.93]	[0.13]	[9.9]	[0.1]	48.1 ± 10.1	230.5 ± 4.9
Gal B	[5.23]	[23.01]	[0.10]	[-49.0]	[0.1]	48.5 ± 2.2	117.2 ± 13.1
S_{FP}	...	...	...	...	[0.1]	71.1 ± 5.1	1.16 ± 0.14^b
FP log(Evidence)=-31.7			RMS _{FP+X} = 0.147 $''$				
DM 1	9.6 ± 0.4	-1.6 ± 1.6	0.41 ± 0.06	81.7 ± 3.8	131.2 ± 12.3	[1000.0]	918.6 ± 49.6
DM 2	21.6 ± 1.2	25.6 ± 2.1	0.43 ± 0.07	64.5 ± 1.8	108.5 ± 12.5	[1000.0]	733.0 ± 54.9
DM 3	185.6 ± 0.3	50.1 ± 0.1	0.30 ± 0.02	3.5 ± 0.7	58.9 ± 1.2	[1000.0]	862.2 ± 7.0
BCG 1	[0.00]	[0.00]	[0.26]	[43.5]	[0.3]	49.2 ± 5.8	302.3 ± 10.5
BCG 2	[24.05]	[29.13]	[0.20]	[37.4]	[0.2]	50.3 ± 7.2	215.5 ± 7.6
Gal A	[51.94]	[48.93]	[0.13]	[9.9]	[0.1]	49.5 ± 6.8	224.4 ± 5.8
Gal B	[5.23]	[23.01]	[0.10]	[-49.0]	[0.1]	51.4 ± 7.0	117.5 ± 13.5
S_{FP}	...	...	...	...	[0.1]	93.1 ± 59.3	1.19 ± 0.76^b

