Velocity mass relation of cluster member galaxies with MUSE

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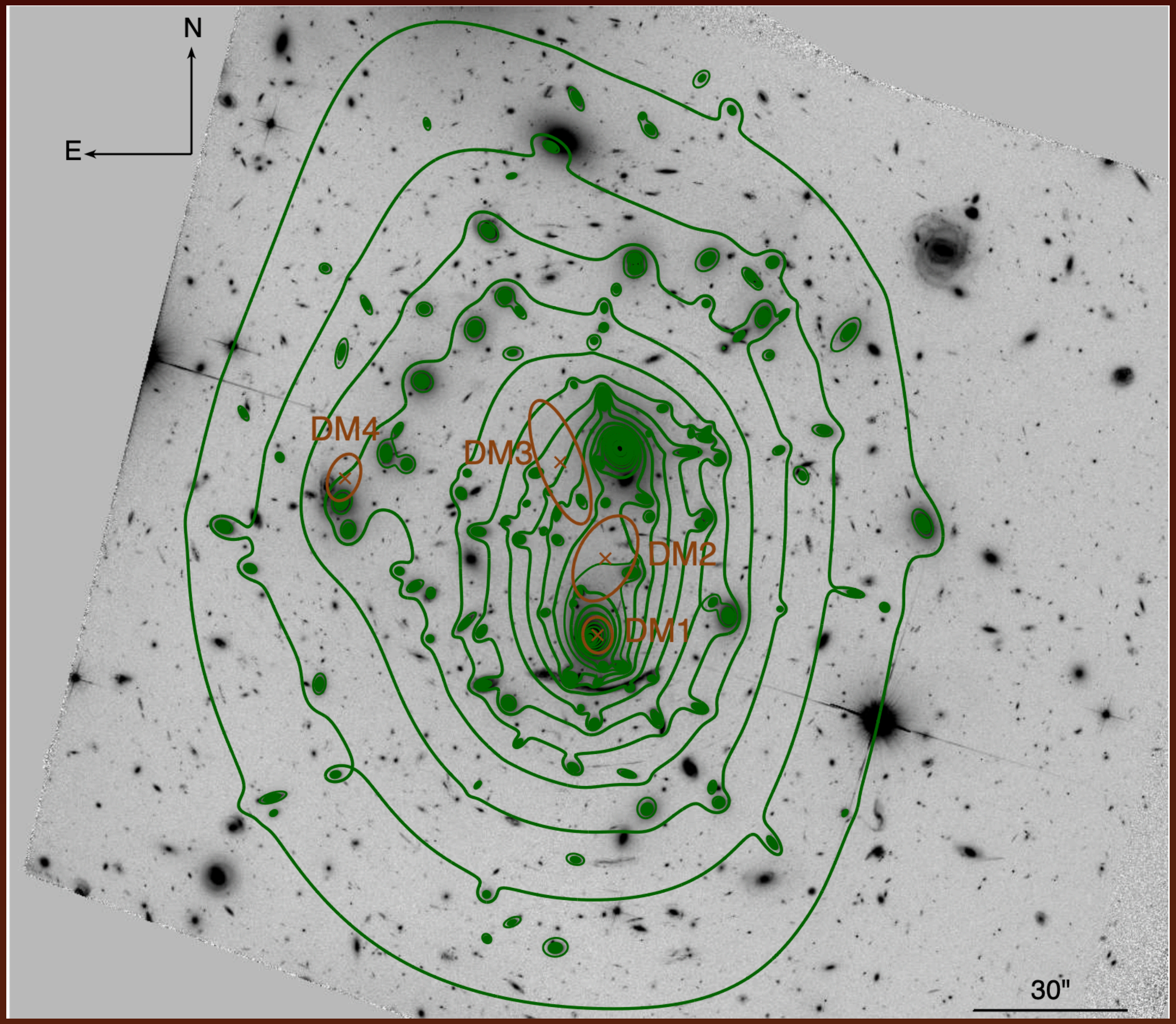
Durham University

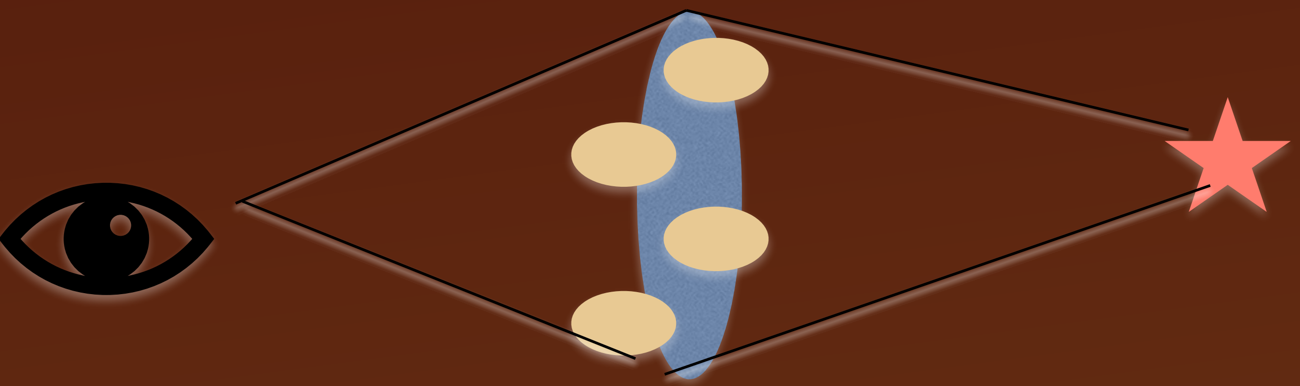
BUFFALO meeting - online

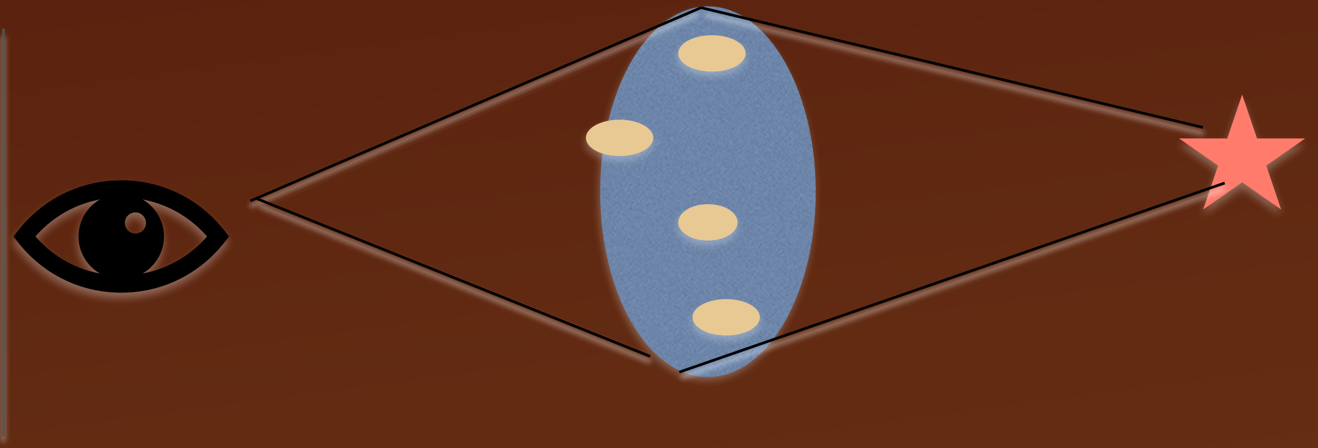
July 13 2021

Lensing is great… but it is total mass



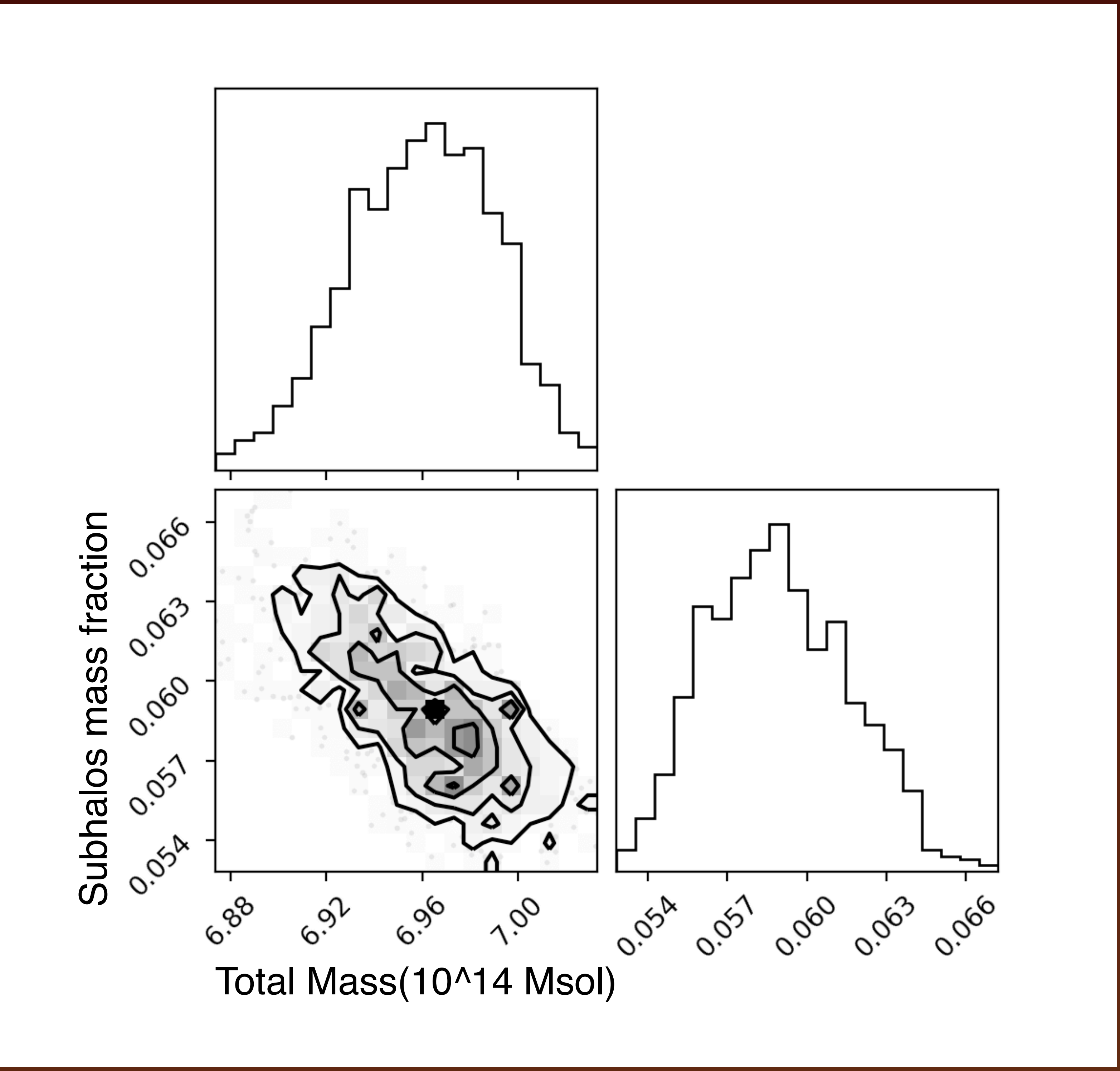
Abell 370 Lagattuta+19



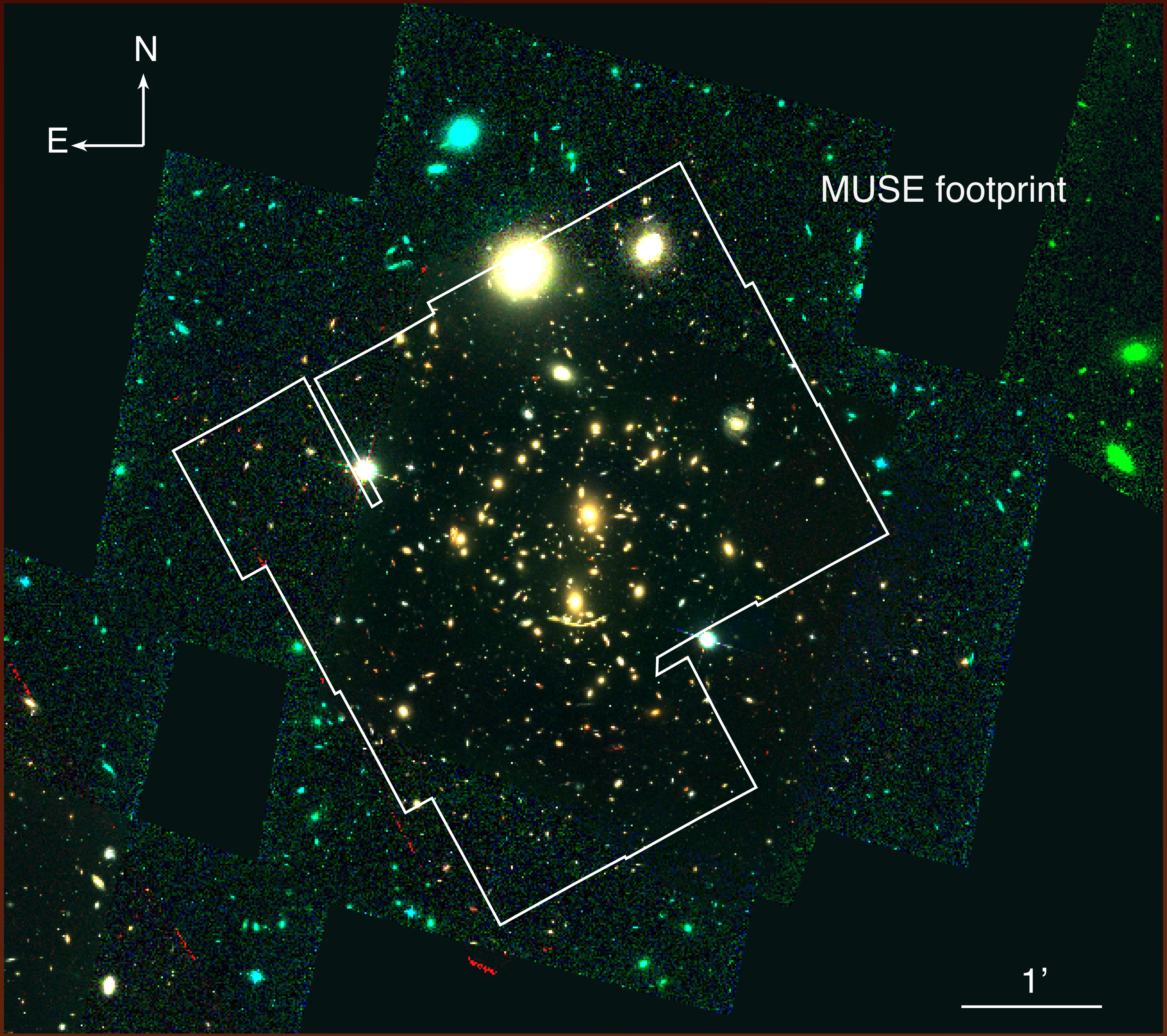


Strong lensing (only) sub_halos mass fraction

From SL only:
Total mass vs Subhalos mass Fraction
within 500 kpc



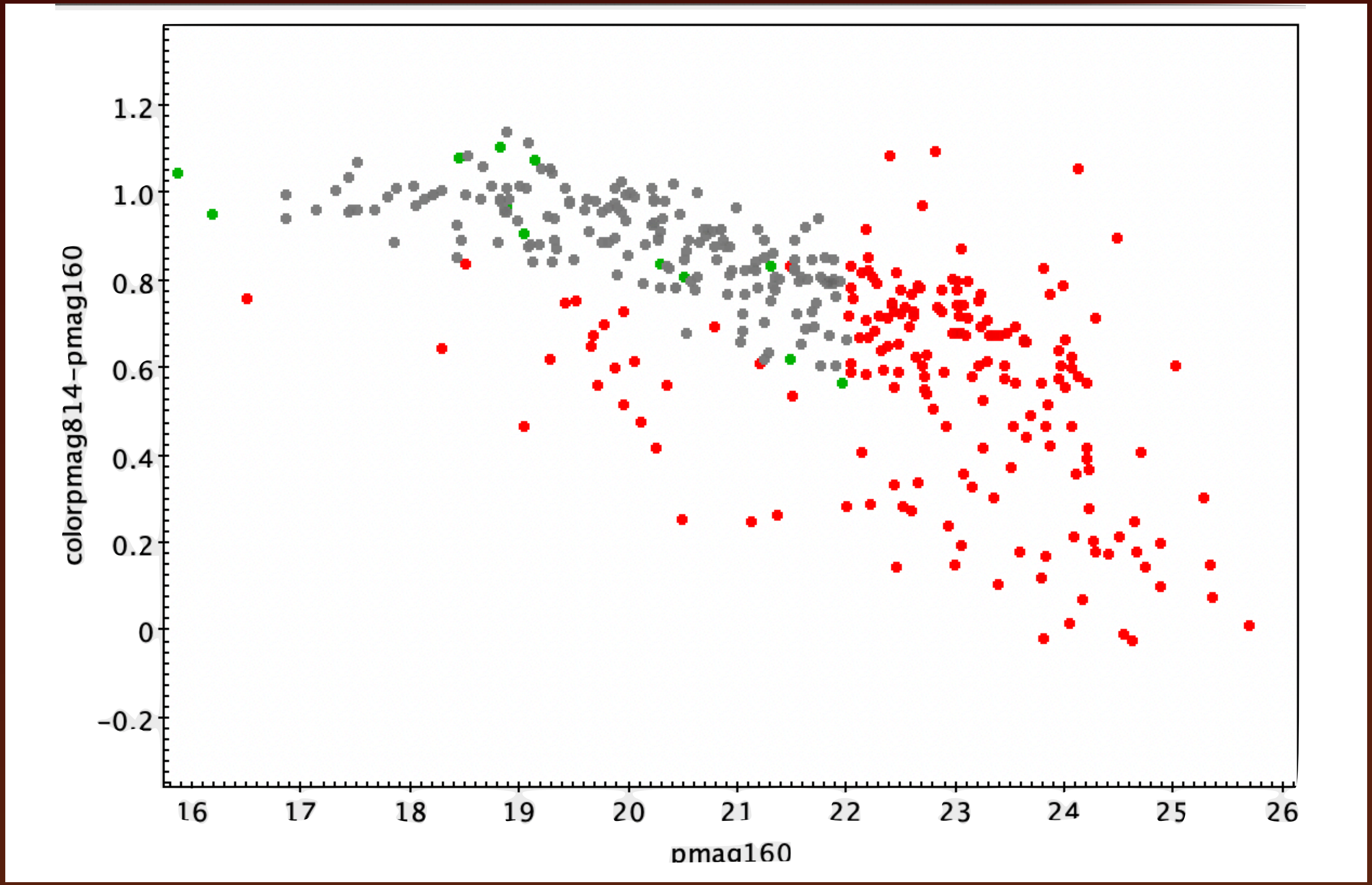
Spectroscopy to the rescue



See David L.'s talk
And catalog

Abell 370

Cluster members



Cut at F160Wmag< 22

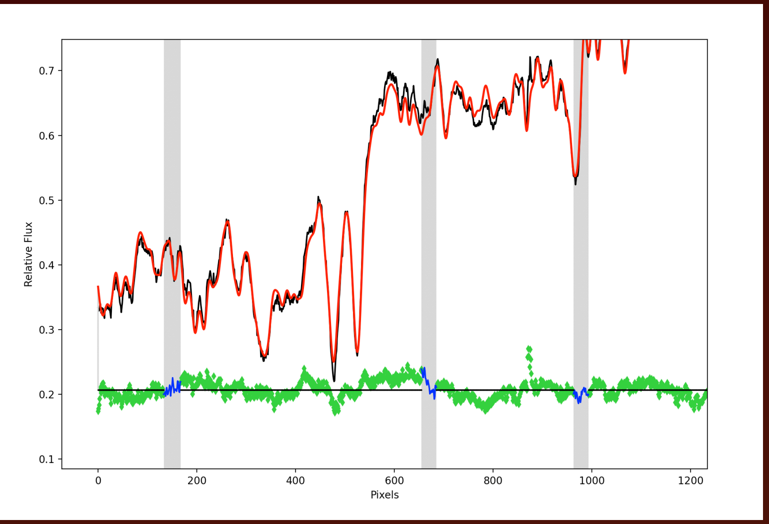
Close to the red sequence

No super bright galaxies

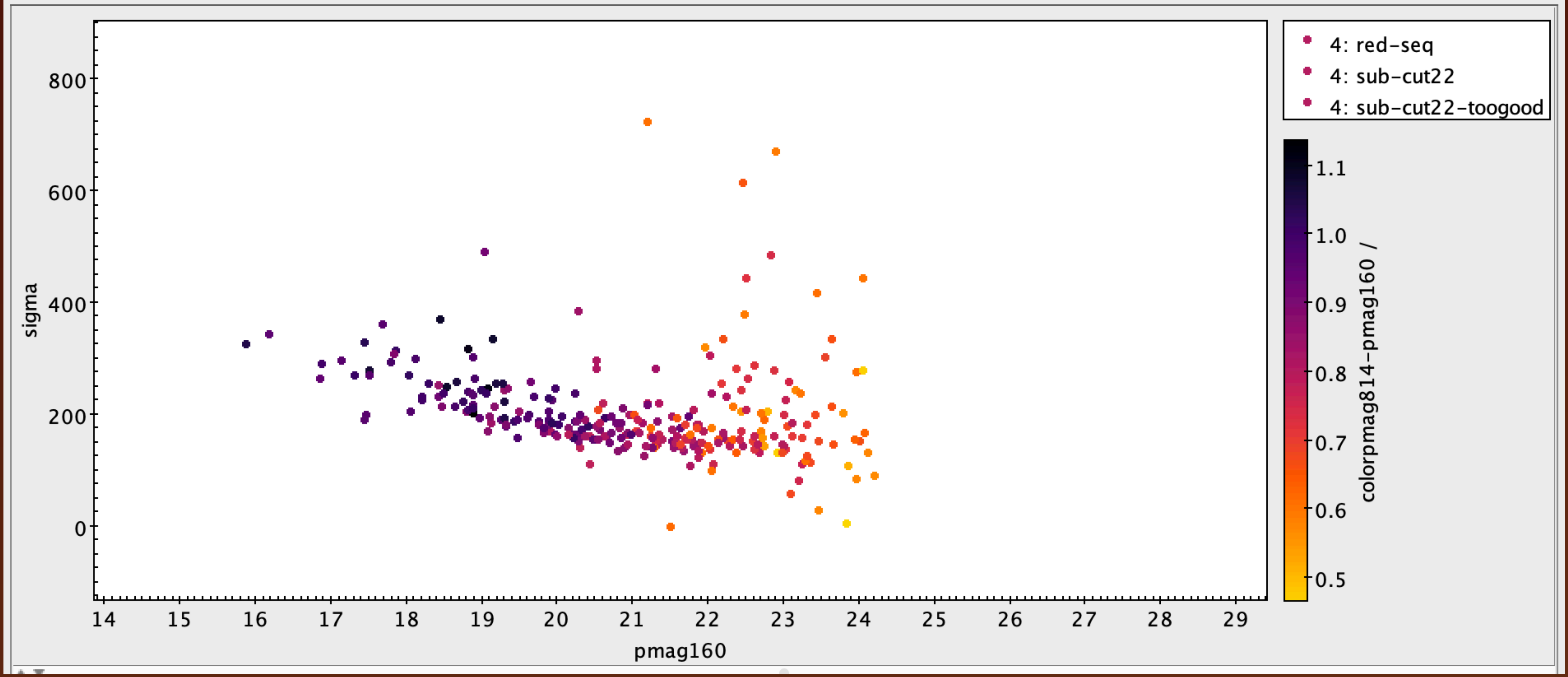
Cross-matched between a “new” cluster member catalog and the spectroscopic catalog of cluster member

“new” because it is a poor SExtractor run but I needed the effective radius

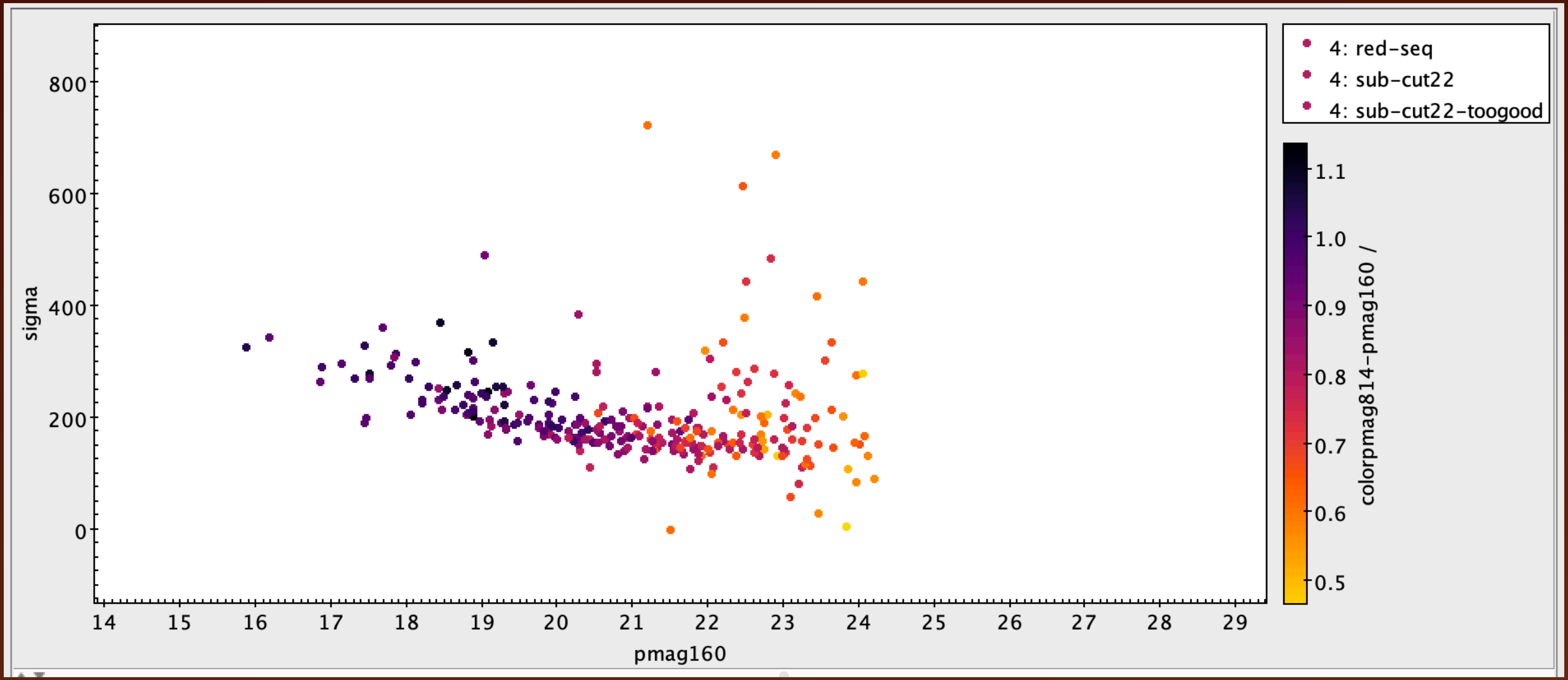
PPFX - velocity dispersion fit



<- Miles library
Indo-US seems more appropriate in the future because of the resolution and Wavelength coverage



Where to cut ?



sigma
pmag160
4: red-seq
4: sub-cut22
4: sub-cut22-toogood
colorpmag814-pmag160 /
800
600
400
200
0
14
15
16
17
18
19
20
21
22
23
24
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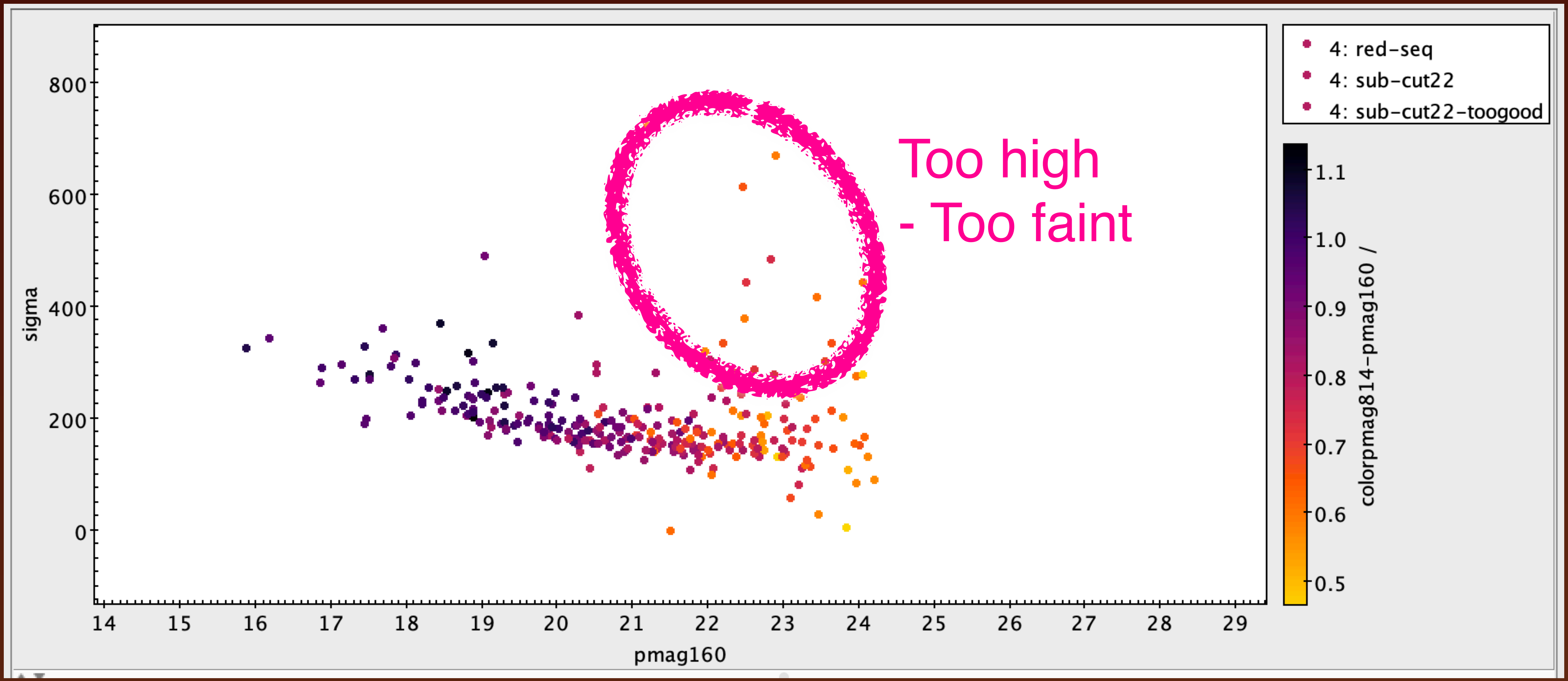
29
1.1
1.0
0.9
0.8
0.7
0.6
0.5

Where to cut ?


4: red-seq
4: sub-cut22
4: sub-cut22-toogood
Too high
- Too faint
sigma
pmag160
colorpmag814-pmag160 /
800
600
400
200
0
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29
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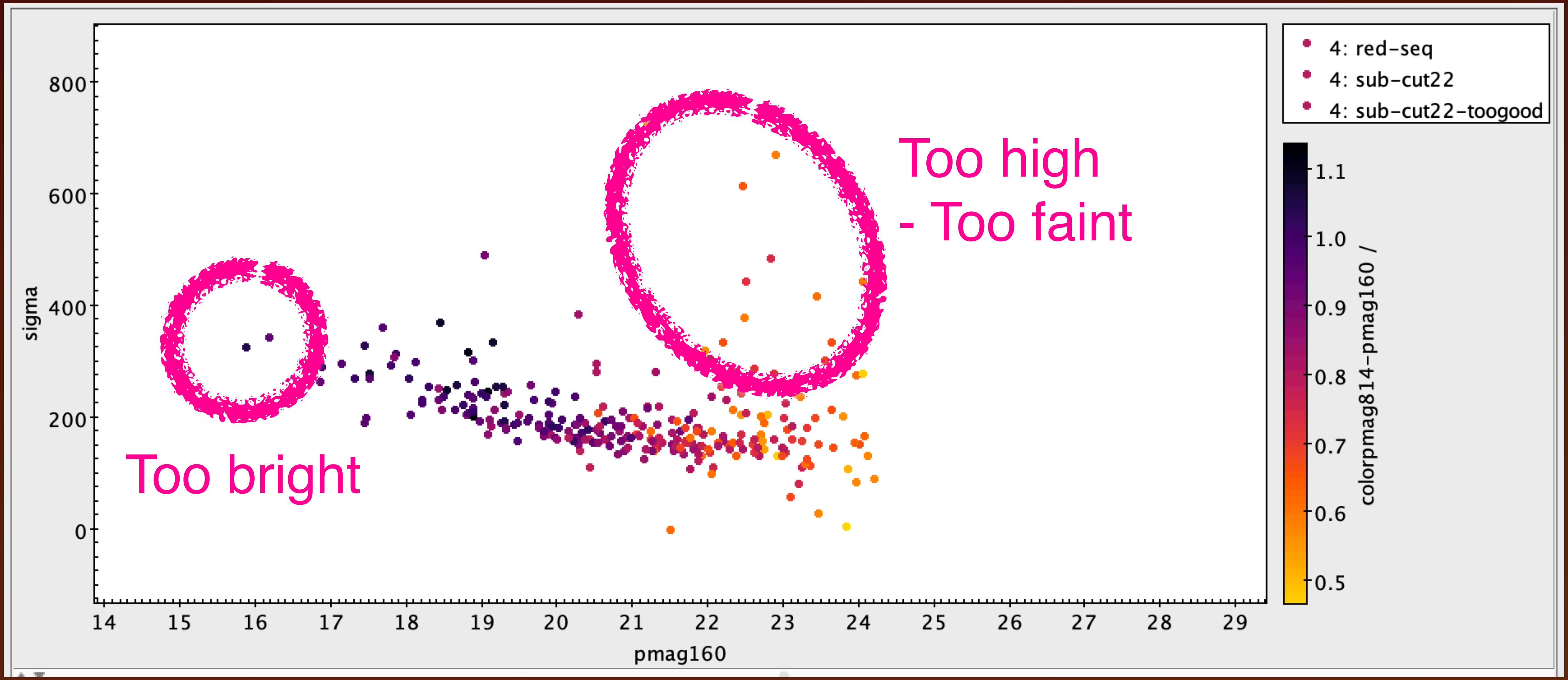
Where to cut ?



Too high
- Too faint
Too bright
4: red-seq
4: sub-cut22
4: sub-cut22-toogood
sigma
pmag160
colorpmag814-pmag160 /
800
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1.0
0.9
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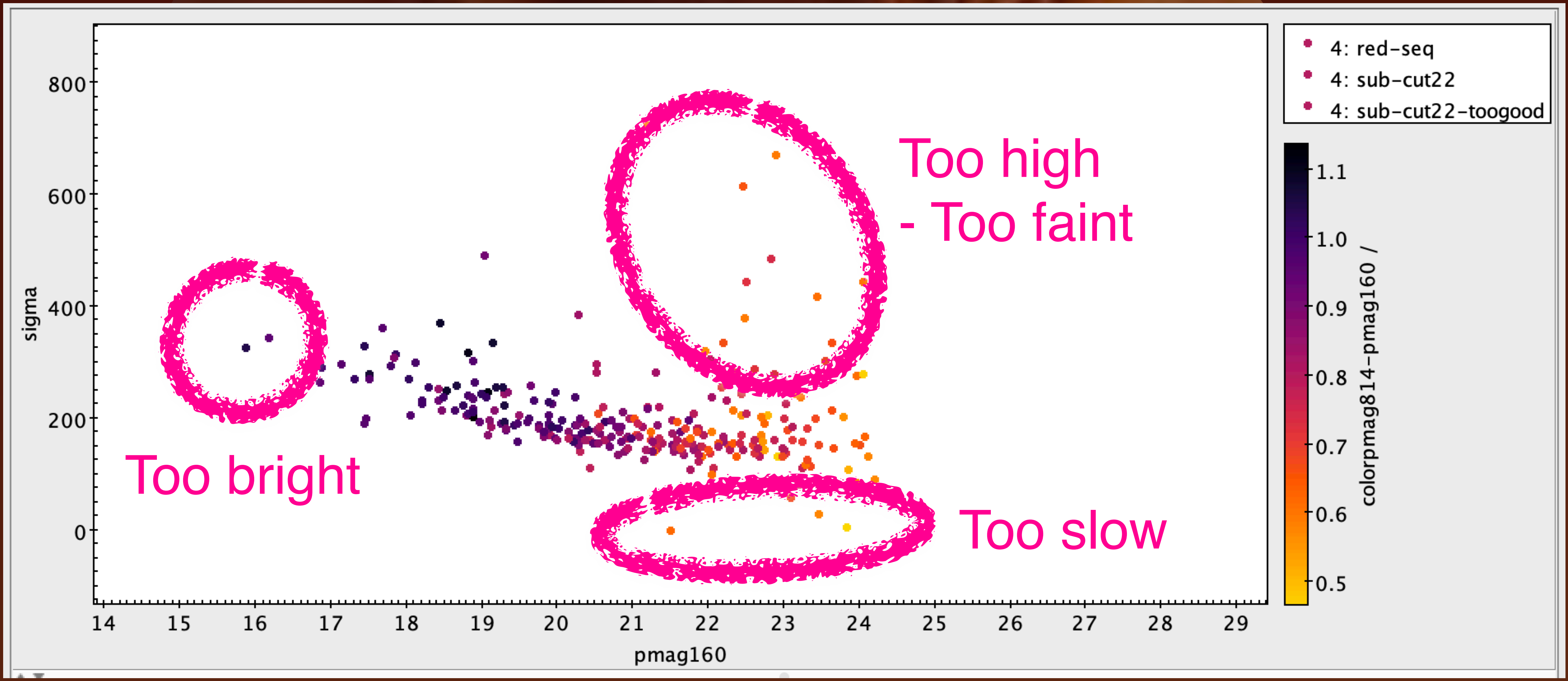
0.7
0.6
0.5

Where to cut ?



4: red-seq
4: sub-cut22
4: sub-cut22-toogood
Too high
- Too faint
Too bright
Too slow
sigma
pmag160
colorpmag814-pmag160 /
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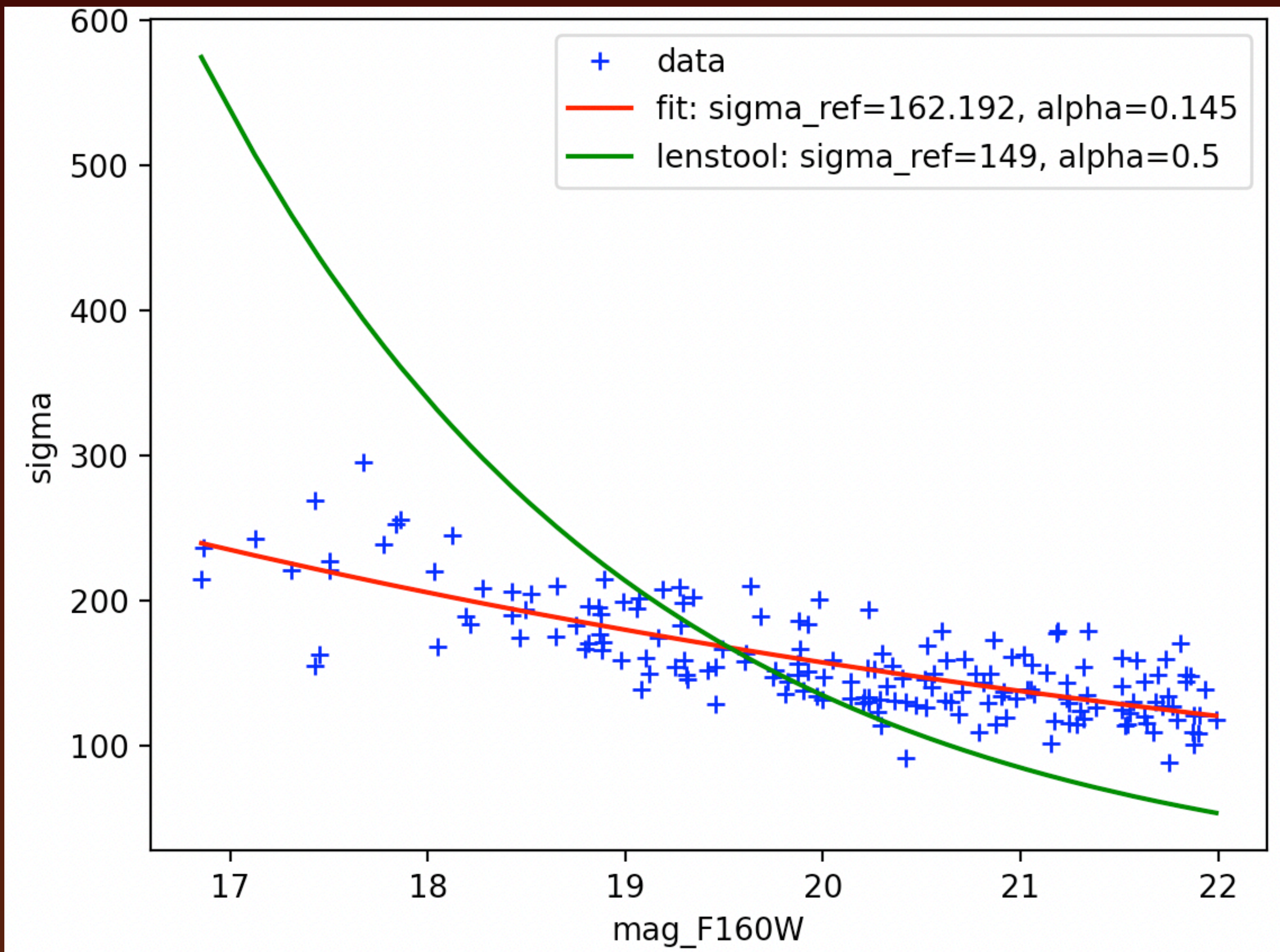
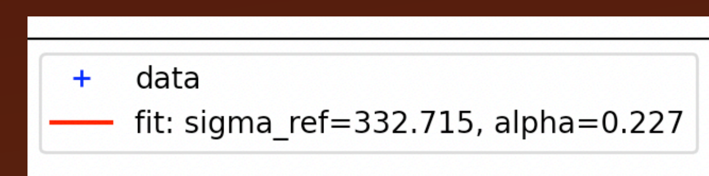
1.1
1.0
0.9
0.8
0.7
0.6
0.5

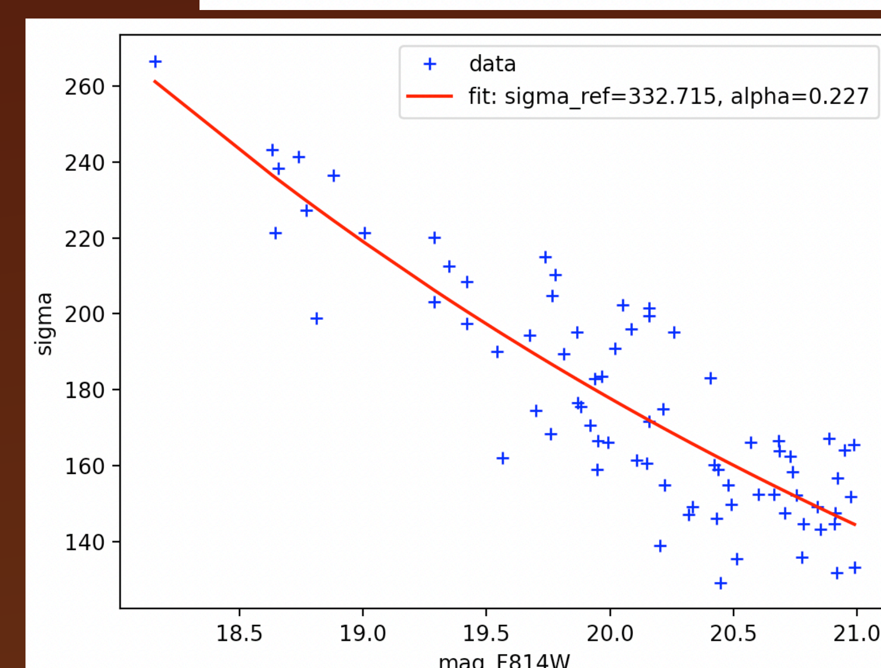
Sigma-L fitting relation

<=> Faber-Jackson



Only nicely behaving galaxies

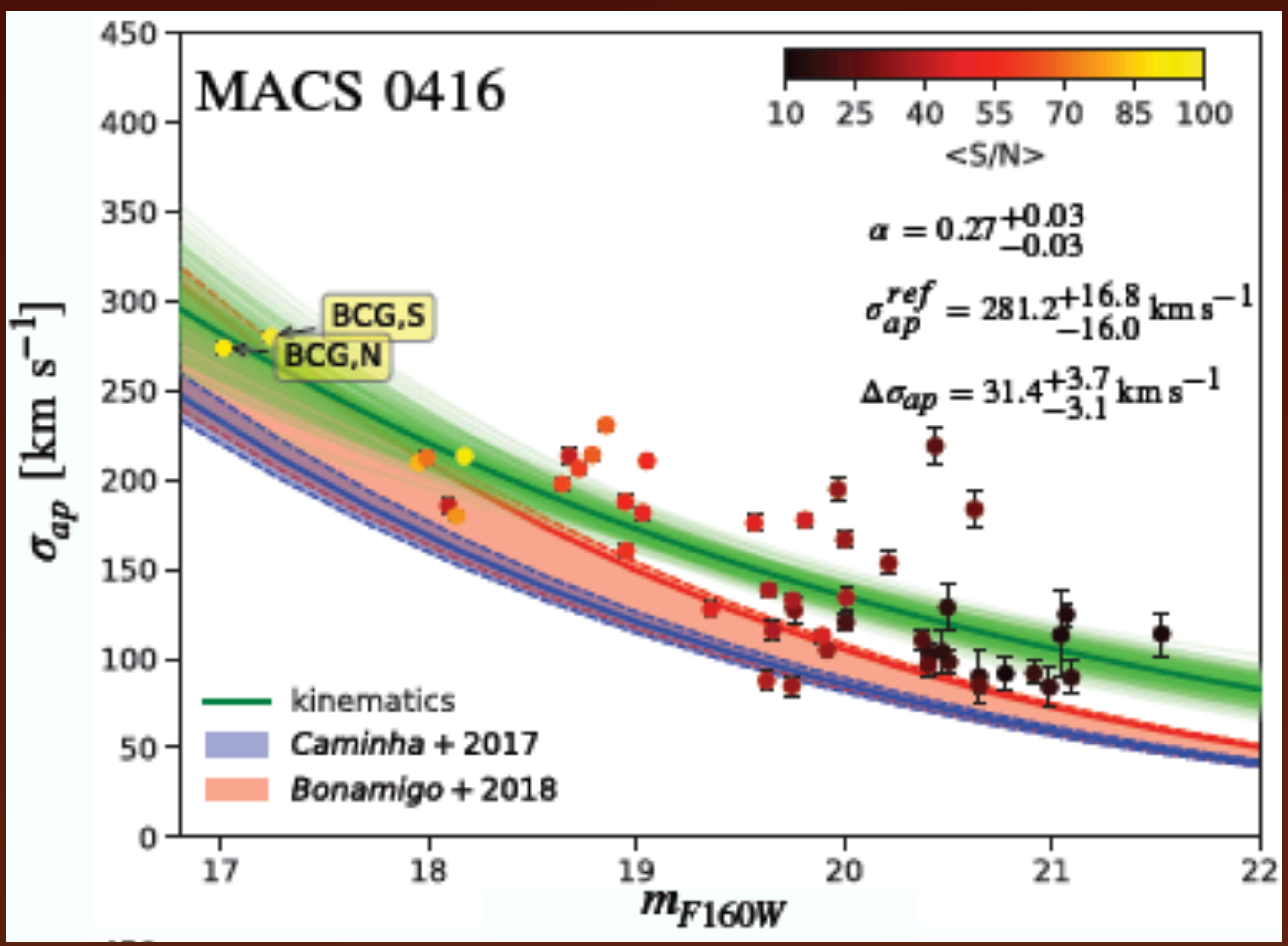


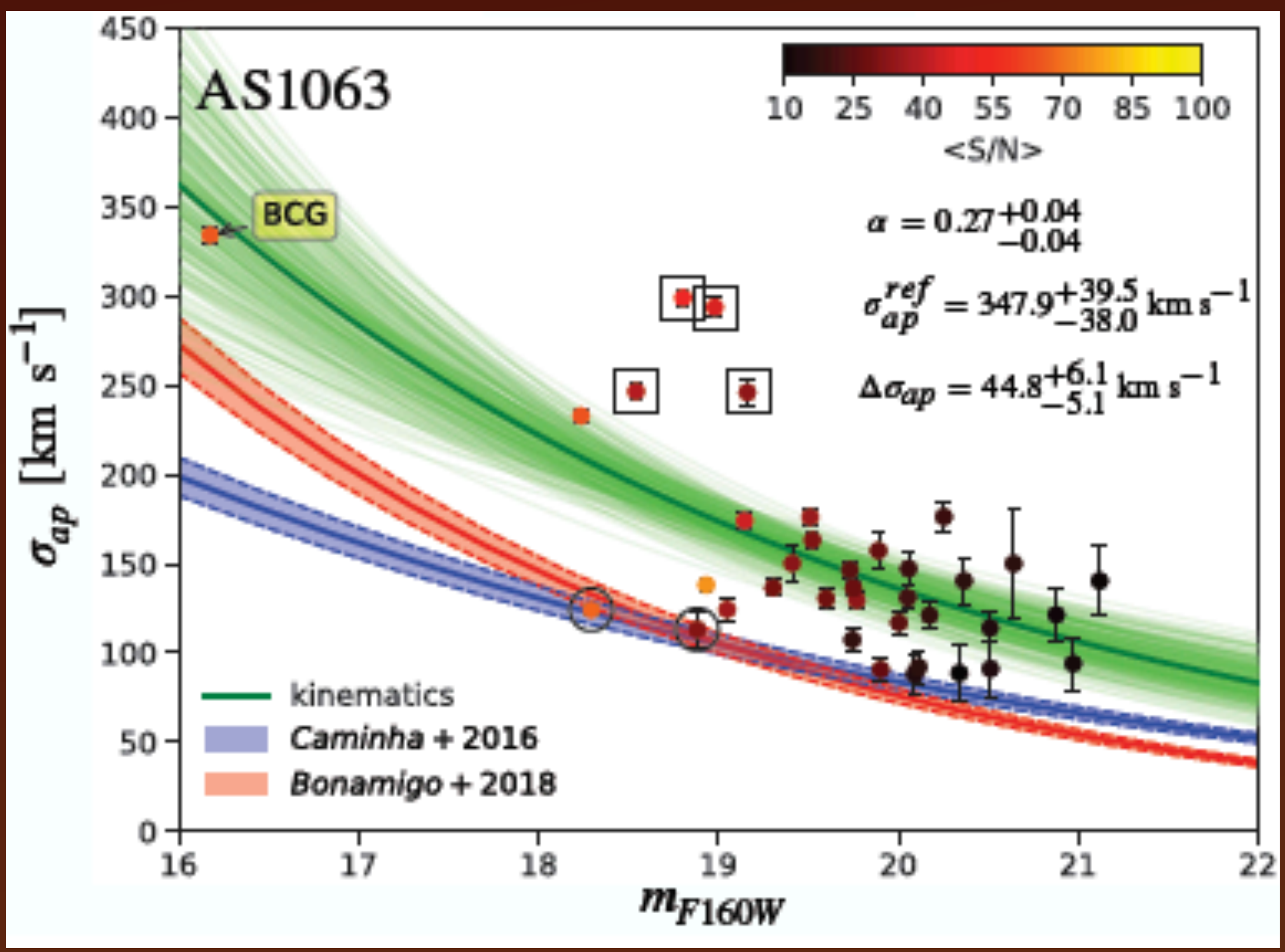


Values are suspiciously low

Input from the collaboration is welcomed here

Other teams found higher values



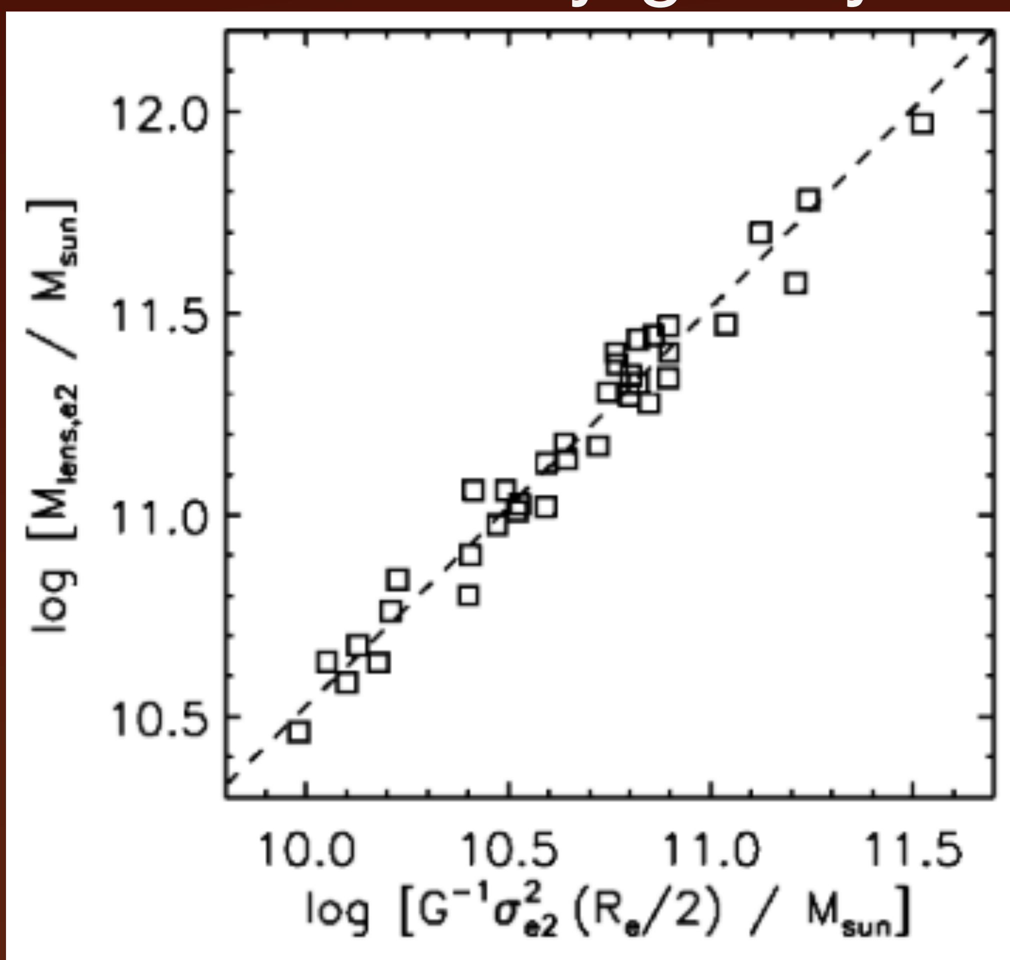


Bermamini+19

Reducing the scatter?

Does it matter?

Fundamental plane
Based on Galaxy-galaxy fitting



Botlon+07

interest. In the SLACS sample, a systematic variation of c with galaxy mass will be apparent in the relationship between the lensing-determined total mass M_{lens} within $R_e/2$ on the one hand and the dimensional mass variable $M_{\mathrm{dim}} = G^{-1}\sigma_{e2}^2(R_e/2)$ on the other, which we parameterize as

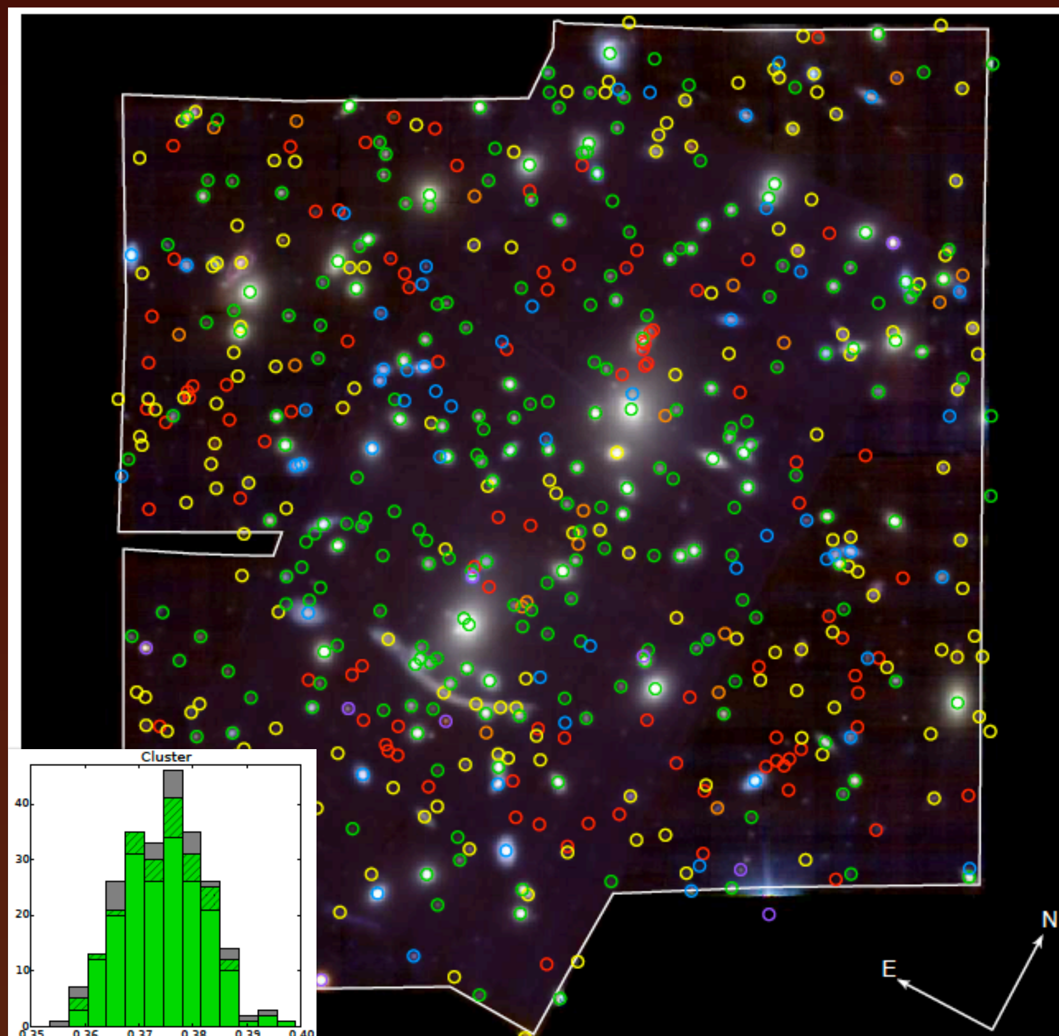
$$\log M_{\mathrm{lens}} = \delta \log M_{\mathrm{dim}} + \log c_0 . \qquad (3)$$

A systematic trend of c with mass thus corresponds to a value of δ different than 1. Minimizing the scatter orthogonal to the best-fit relation, we find $\delta = 0.986 \pm 0.034$ ($\delta = 0.956 \pm 0.042$) and $\log c_0 = 0.58 \pm 0.16$ ($\log c_0 = 0.74 \pm 0.19$) for isothermal (LTM) aperture mass corrections. This relationship

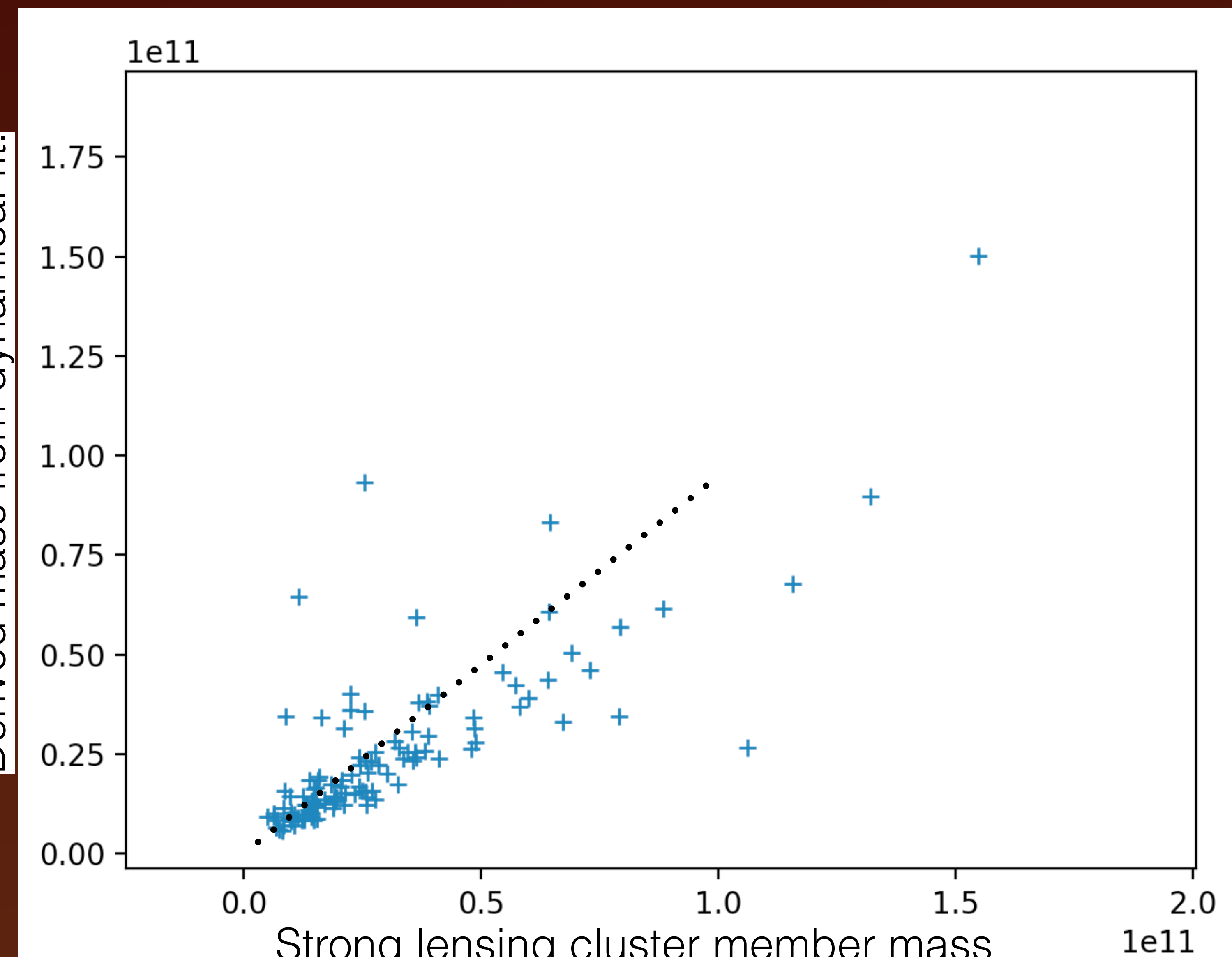
Botlon+07

Hint of physics? DM stripping?

Abell 2744



Dynamical mass vs lensing mass



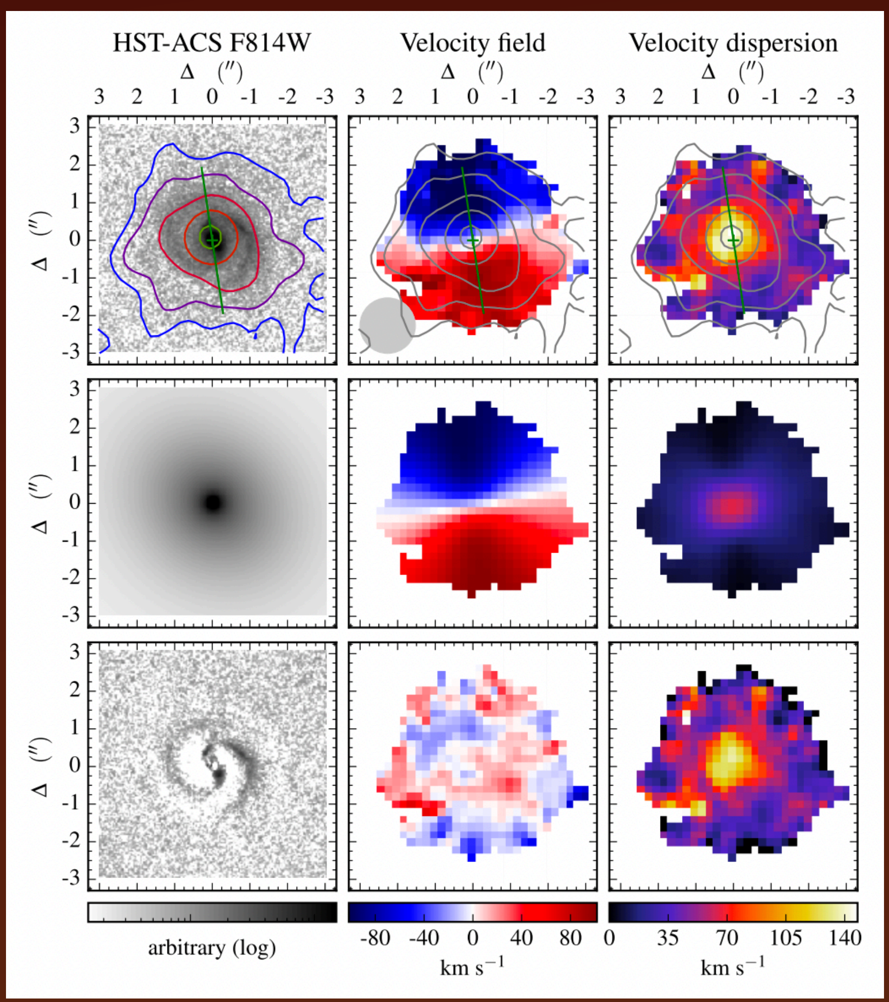
Conclusion

- The four stage of sub_halos mass comparison:
  - Direct lensing fit
  - Partial fit of the Faber-Jackson relation
  - Fondamental plane relation plugged
  - (Fondamental plane fit)

Expect the paper by the end of August

Model name (Fit statistics)	Component –	$\Delta\alpha$ [a] ($''$)	$\Delta\delta$ [a] ($''$)	ε [b]	θ (deg)	σ_0 (km s^{-1})	r_{cut} (kpc)	r_{core} (kpc)
FFcopper	O1	$1.5^{+0.2}_{-0.2}$	$0.7^{+0.2}_{-0.1}$	$0.2^{+0.03}_{-0.03}$	$-83.6^{+4.1}_{-3.0}$	$480.9^{+10.7}_{-9.0}$	[800.0]	$3.3^{+0.2}_{-0.3}$
rms = 0.78″	O10	[26.3]	[56.9]	[0.1]	[37.0]	$27.1^{+8.0}_{-6.7}$	$1.2^{+0.2}_{-0.2}$	[0.1]
$\chi^2/\nu = 2.4$	O11	–	–	–	$-18.3^{+1.1}_{-1.2}$	–	–	–
log($\mathcal{L}$) = -228	O2	$3.1^{+0.2}_{-0.2}$	$15.7^{+0.4}_{-0.3}$	$0.46^{+0.02}_{-0.02}$	$-117.7^{+0.9}_{-1.7}$	$1007.0^{+20.6}_{-29.3}$	[800.0]	$20.8^{+0.6}_{-0.5}$
log($\mathcal{E}$) = -332	O3	[-0.0]	[0.0]	[0.3]	[-81.9]	$186.9^{+5.5}_{-4.4}$	$5.7^{+0.8}_{-1.0}$	[0.1]
BIC = 714 AICc = 567	O4	[7.9]	[-9.8]	[0.26]	[25.7]	$149.5^{+7.5}_{-10.5}$	$0.3^{+0.0}_{-0.0}$	[0.1]
–	O5	[5.9]	[37.2]	[0.2]	[-63.9]	$410.7^{+5.5}_{-4.0}$	$17.8^{+1.0}_{-0.9}$	[0.1]
–	O6	$-48.2^{+1.0}_{-1.0}$	$31.6^{+0.7}_{-0.7}$	$0.41^{+0.03}_{-0.03}$	$69.4^{+2.2}_{-1.3}$	$552.0^{+4.2}_{-13.0}$	[800.0]	$17.0^{+0.5}_{-0.7}$
–	O7	$-5.8^{+0.7}_{-0.9}$	$34.5^{+1.4}_{-1.6}$	$0.8^{+0.02}_{-0.02}$	$110.7^{+0.5}_{-0.9}$	$872.0^{+30.5}_{-39.4}$	[800.0]	$38.4^{+1.6}_{-1.3}$
–	O8	[2.7]	[46.8]	[0.6]	[-84.3]	$282.9^{+12.9}_{-11.5}$	$1.9^{+0.3}_{-0.1}$	[0.2]
–	O9	[29.3]	[59.3]	[0.57]	[42.5]	$184.9^{+14.2}_{-15.1}$	$0.8^{+0.1}_{-0.1}$	[0.2]
–	Pot0	–	–	–	–	$149.9^{+1.1}_{-1.5}$	$15.0^{+1.4}_{-0.8}$	[0.15]
Alpha0.1	O1	$-0.5^{+1.8}_{-2.8}$	$0.6^{+1.4}_{-1.6}$	$0.47^{+0.25}_{-0.3}$	$-67.7^{+23.7}_{-20.1}$	$487.3^{+202.4}_{-265.1}$	[800.0]	$2.3^{+2.4}_{-2.1}$
rms = 1.11″	O10	[26.3]	[56.9]	[0.1]	[37.0]	$74.4^{+79.6}_{-32.0}$	$0.8^{+0.6}_{-0.5}$	[0.1]
$\chi^2/\nu = 4.9$	O11	–	–	–	$56.3^{+43.8}_{-77.1}$	–	–	–
log($\mathcal{L}$) = -396	O2	$2.2^{+3.1}_{-3.7}$	$5.3^{+10.4}_{-6.5}$	$0.9^{+0.3}_{-0.43}$	$-114.8^{+10.4}_{-10.2}$	$416.8^{+541.8}_{-530.9}$	[800.0]	$21.7^{+5.7}_{-3.5}$
log($\mathcal{E}$) = -390	O3	[-0.0]	[0.0]	[0.3]	[-81.9]	$131.7^{+59.1}_{-60.7}$	$7.3^{+5.9}_{-4.0}$	[0.1]
BIC = 1044 AICc = 900	O4	[7.9]	[-9.8]	[0.26]	[25.7]	$169.7^{+41.4}_{-54.2}$	$0.1^{+0.2}_{-0.1}$	[0.1]
–	O5	[5.9]	[37.2]	[0.2]	[-63.9]	$416.9^{+37.2}_{-34.1}$	$22.3^{+4.9}_{-5.4}$	[0.1]
–	O6	$-42.4^{+7.4}_{-3.5}$	$31.0^{+4.6}_{-5.3}$	$1.2^{+0.24}_{-0.36}$	$57.8^{+11.2}_{-10.8}$	$1135.2^{+339.7}_{-243.4}$	[800.0]	$10.0^{+3.3}_{-5.1}$
–	O7	$0.1^{+5.5}_{-3.7}$	$24.6^{+18.5}_{-12.1}$	$0.3^{+0.33}_{-0.32}$	$114.3^{+10.1}_{-10.4}$	$718.8^{+498.5}_{-306.5}$	[800.0]	$34.8^{+5.0}_{-4.9}$
–	O8	[2.7]	[46.8]	[0.6]	[-84.3]	$249.8^{+38.0}_{-45.5}$	$0.6^{+0.9}_{-0.5}$	[0.2]
–	O9	[29.3]	[59.3]	[0.57]	[42.5]	$93.8^{+118.3}_{-72.8}$	$0.9^{+1.0}_{-0.8}$	[0.2]
–	Pot0	–	–	–	–	[162.192]	$24.3^{+0.1}_{-0.1}$	[0.0]

Velocity disp what it is?



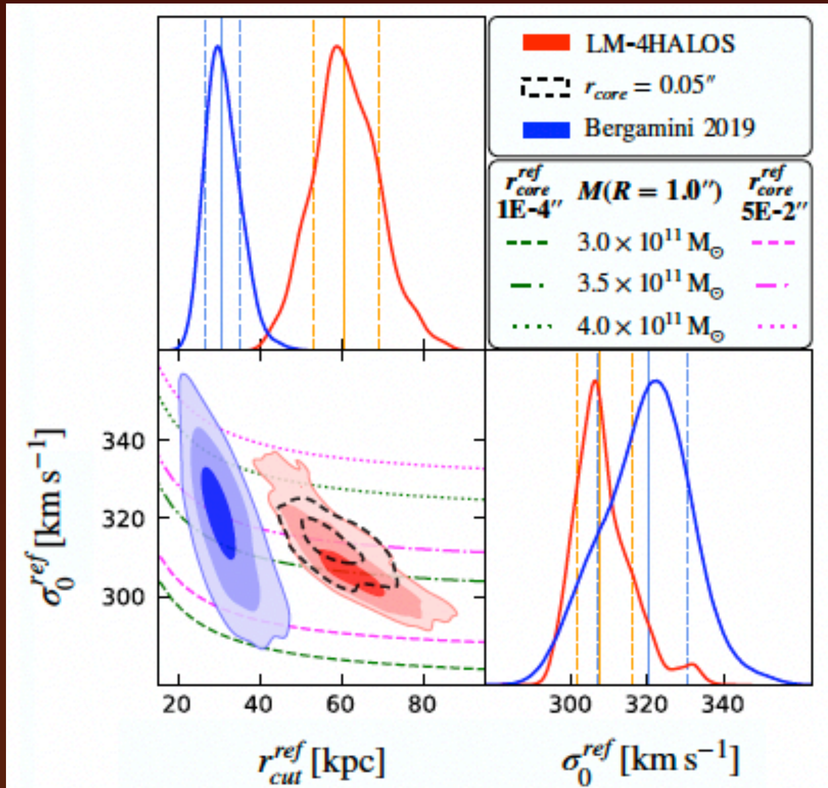


Fig. 15. Marginalized posterior distributions of the normalizations σ_0^{ref} and r_{cut}^{ref} of the cluster member scaling relations (see Eq. 8 and 9). Normalizations are computed at the magnitude of the BCG-N (mag^{ref}_{F160W} = 17.02). Red distributions refer to the LM-4HALOS reference lens model; results from the previous model by B19 model are in blue. Colored contours encompass the 1, 2, 3 σ confidence levels; the vertical solid and dashed lines correspond to the 50-th, 16-th and 84-th percentiles of the marginalized distributions. The 1 and 2 σ black dashed contours refer to the LM-4HALOS model with $r^{ref}_{core} = 0.05''$, instead of $r^{ref}_{core} = 1'' \times 10^{-4}$ of the reference model. The green and magenta lines are σ_0-r_{cut} curves with constant projected mass, within an aperture of $R = 1''$ (= 5.34 kpc at $z = 0.396$), for a circular dPIE profile. The mass values from bottom to top are quoted in the legend. Green curves refer to $r^{ref}_{core} = 1'' \times 10^{-4}$, magenta curves refer $r^{ref}_{core} = 0.05''$ (as in B19).

Velocity disp what it is?