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Sarah Mulroy

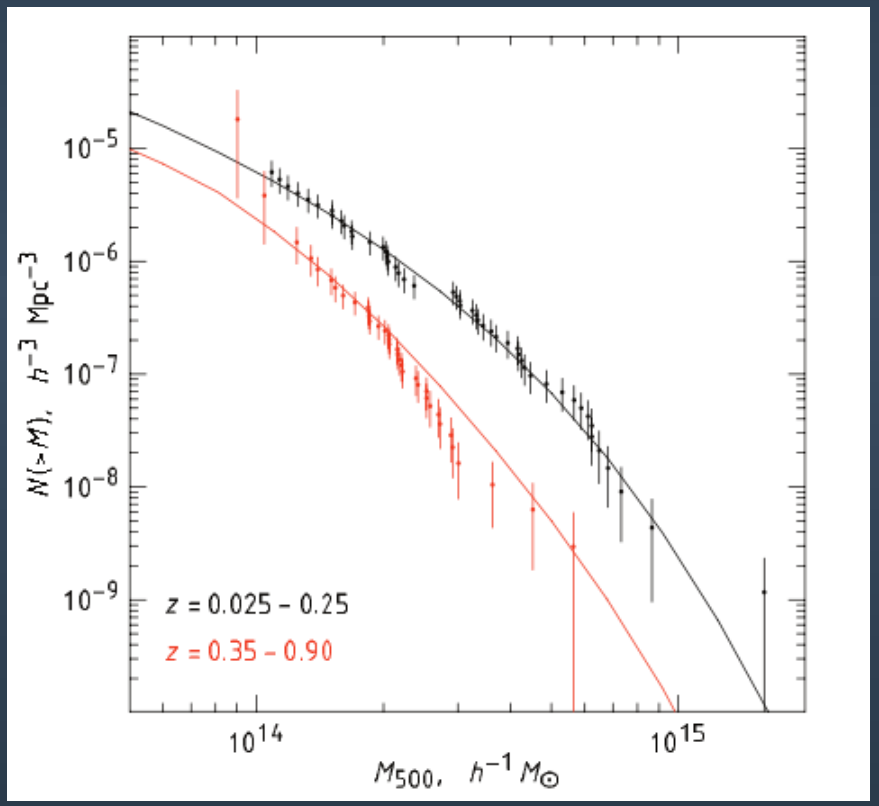
LoCuSS:

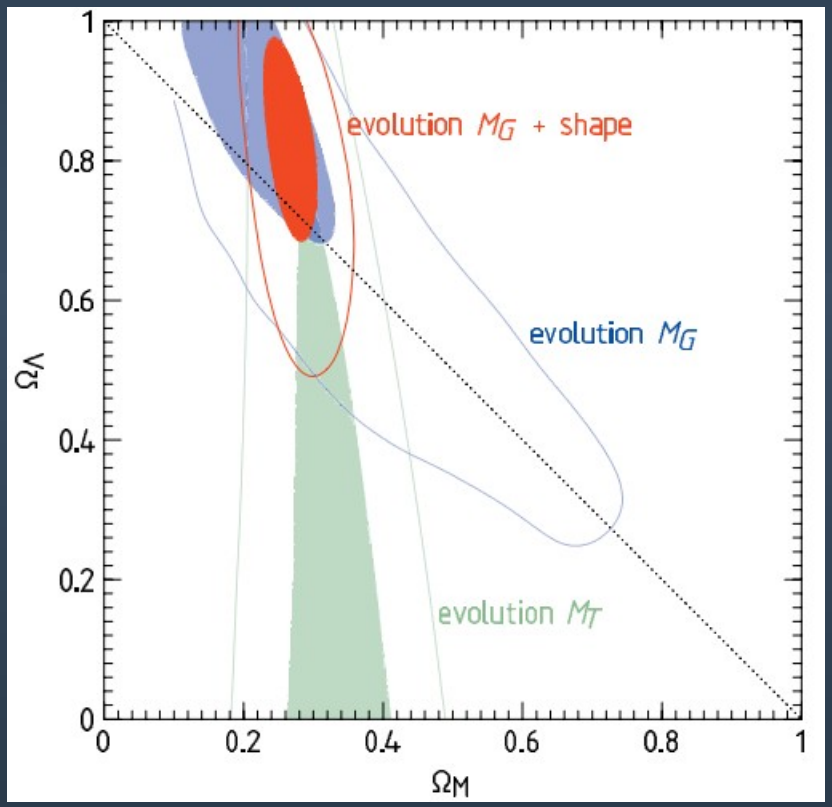
Near-infrared luminosity as a low scatter proxy for weak-lensing mass of galaxy clusters

Mulroy et al., 2014
MNRAS, 443, 3309

In collaboration with -
Graham Smith, Chris Haines, Dan Marrone, Nobuhiro Okabe,
Maria Pereira, Eiichi Egami, Arif Babul, Alexis Finoguenov, Rossella Martino

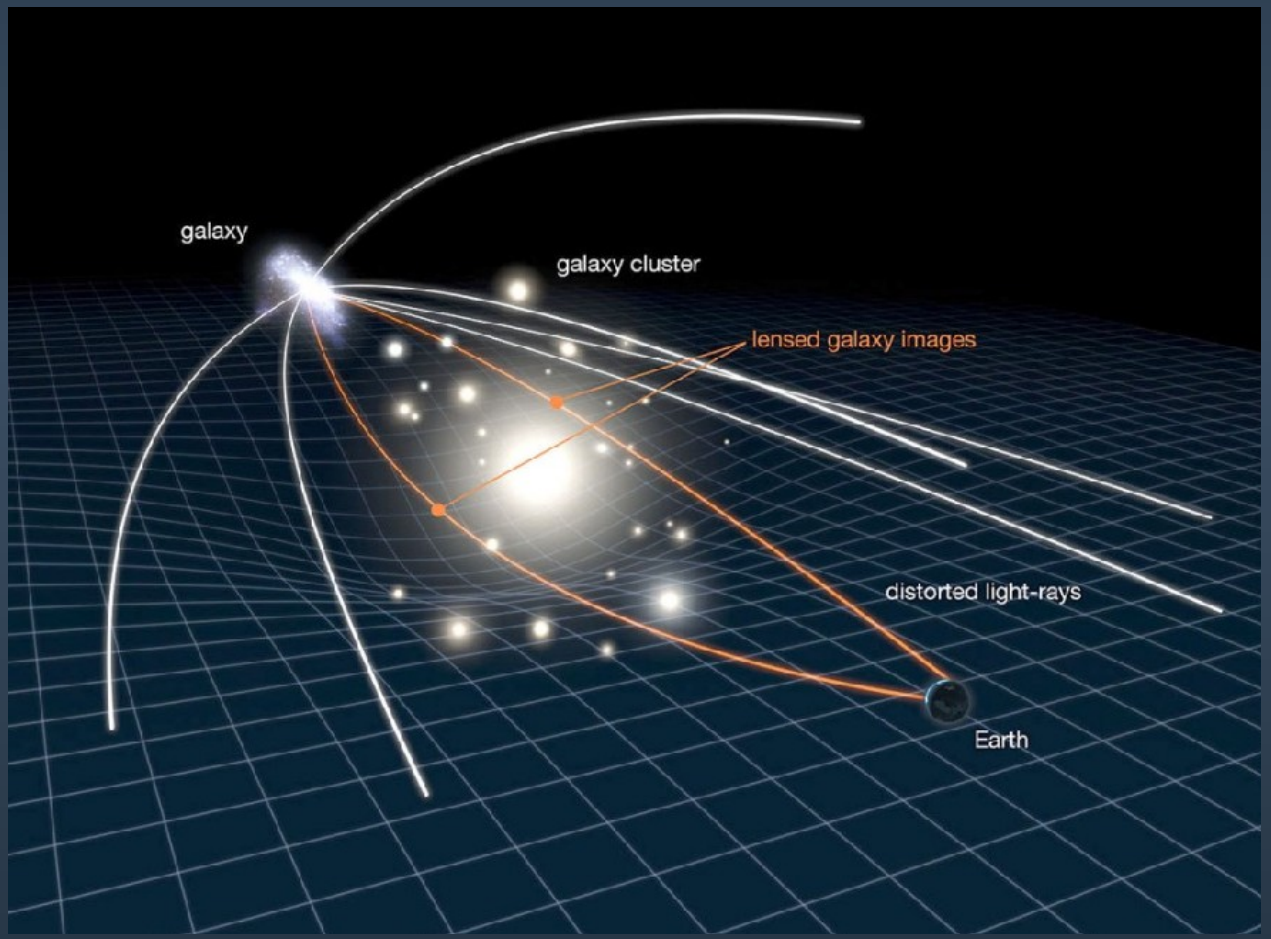
Galaxy Clusters are Sensitive Cosmological Probes





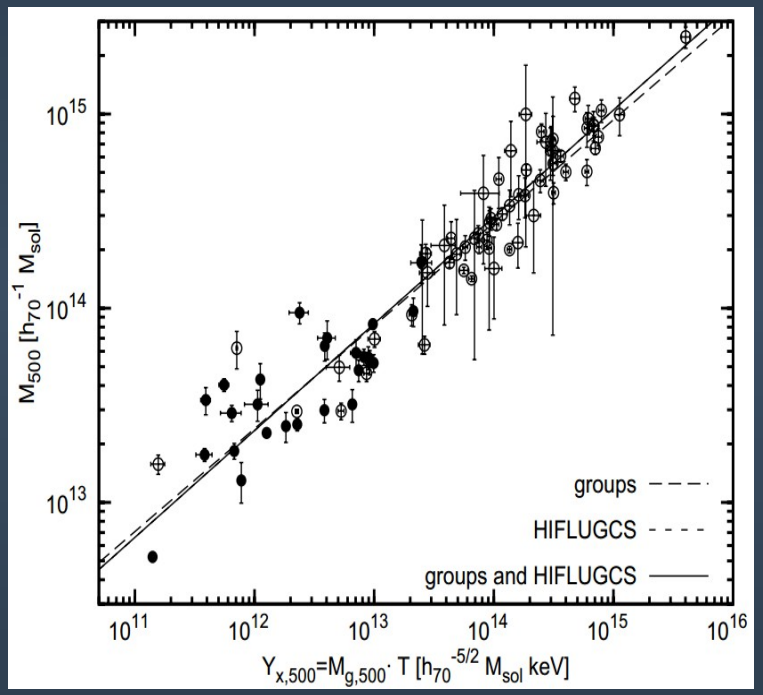
Vikhlinin et al. 2009

Cluster Mass from Gravitational Lensing

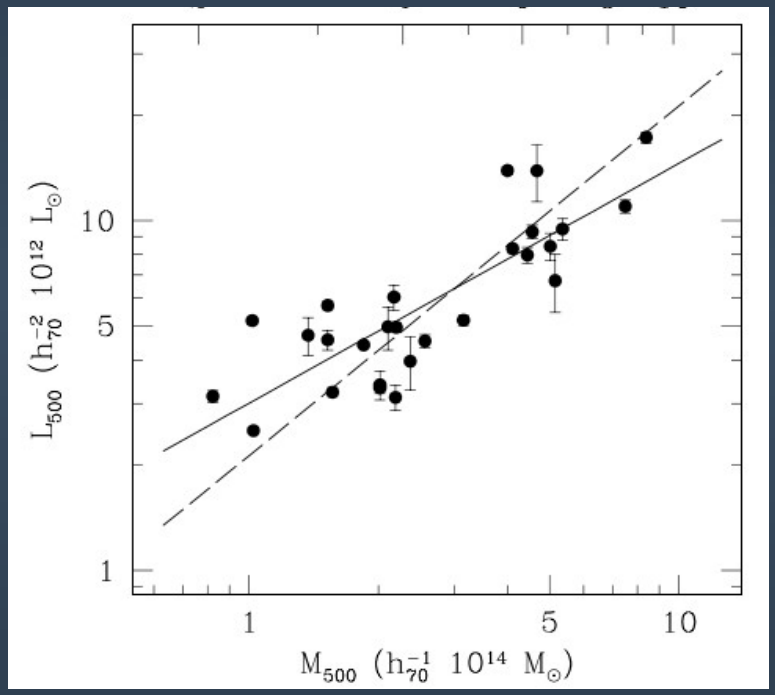


NASA / ESA

Large Surveys need Accurate Mass Proxies



Eckmiller et al. 2011
Scatter: 14%



Lin, Mohr & Stanford 2003
Scatter: 28%

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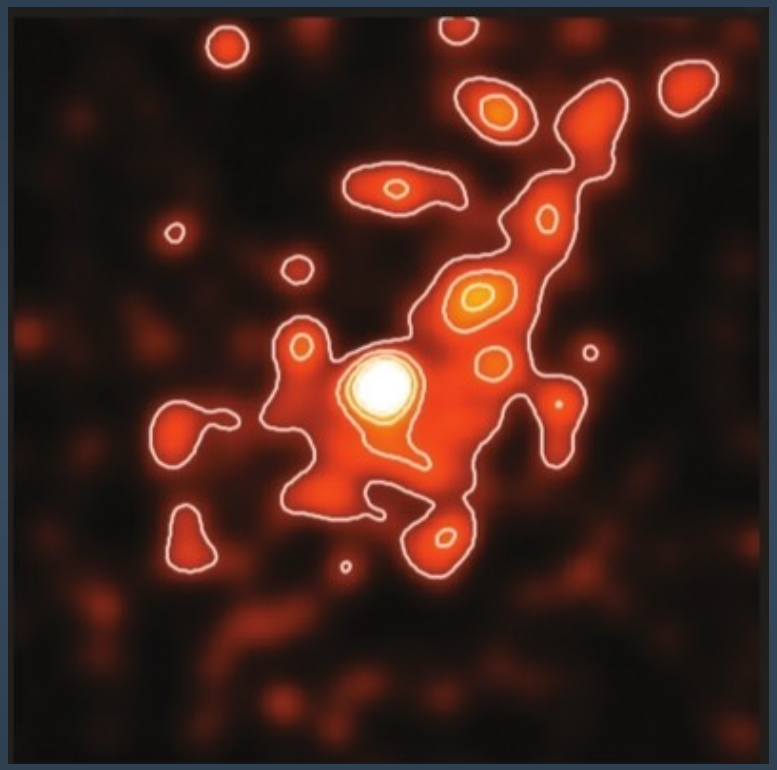
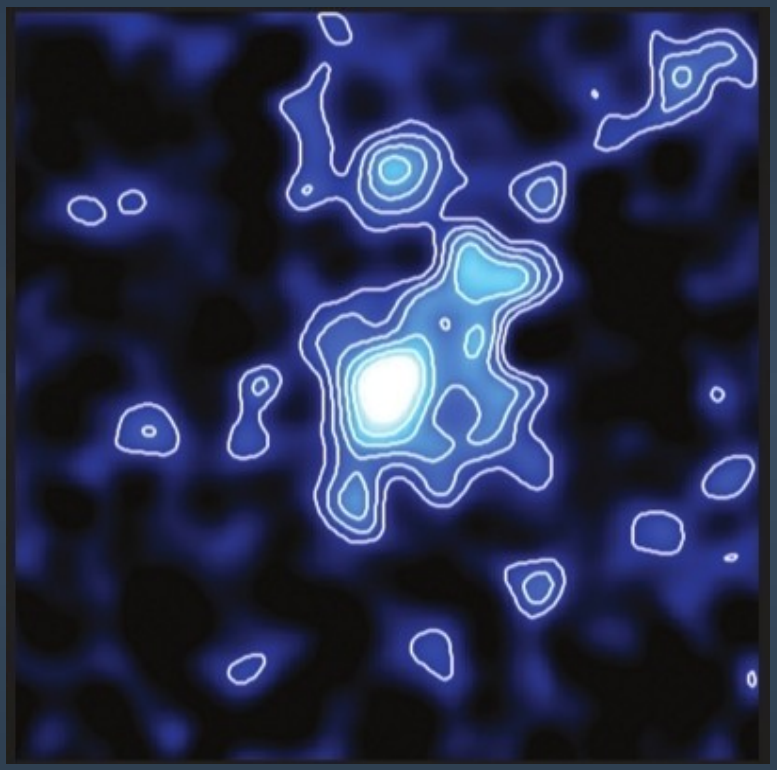
K-band Luminosity as a Mass Proxy



Stellar Mass Map
from K-band Luminosity



Total Mass Map
from Gravitational Lensing

Sample

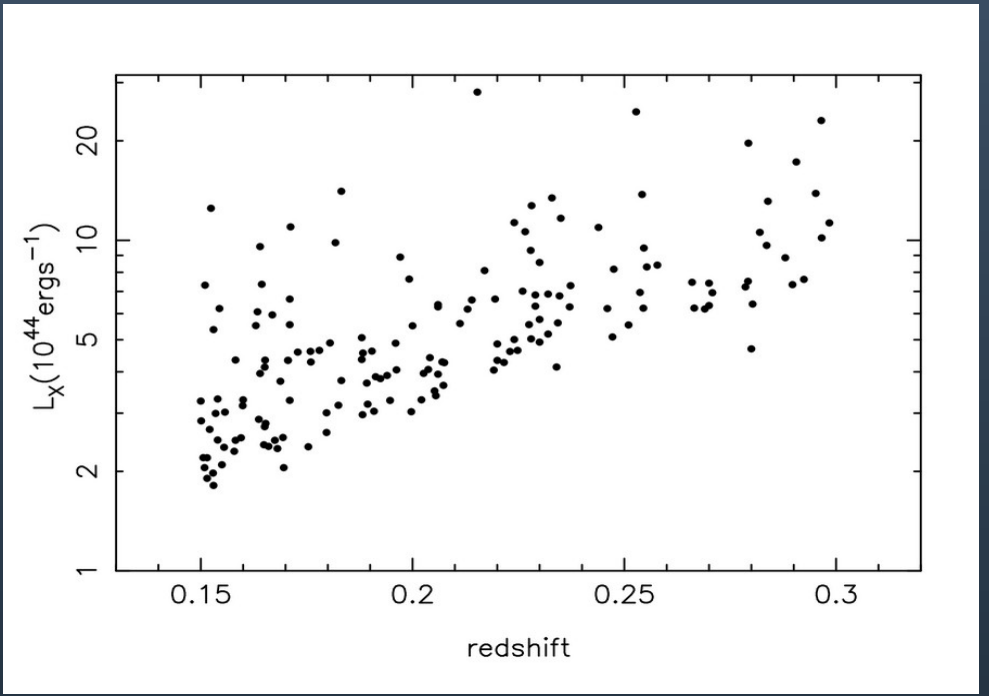
Representative sample of 17 X-ray luminous clusters

LoCuSS
Local Cluster Substructure Survey

Drawn from LoCuSS "High-L_x" sample

Clusters at 0.15<z<0.3

(same sample as Marrone et al. 2012)

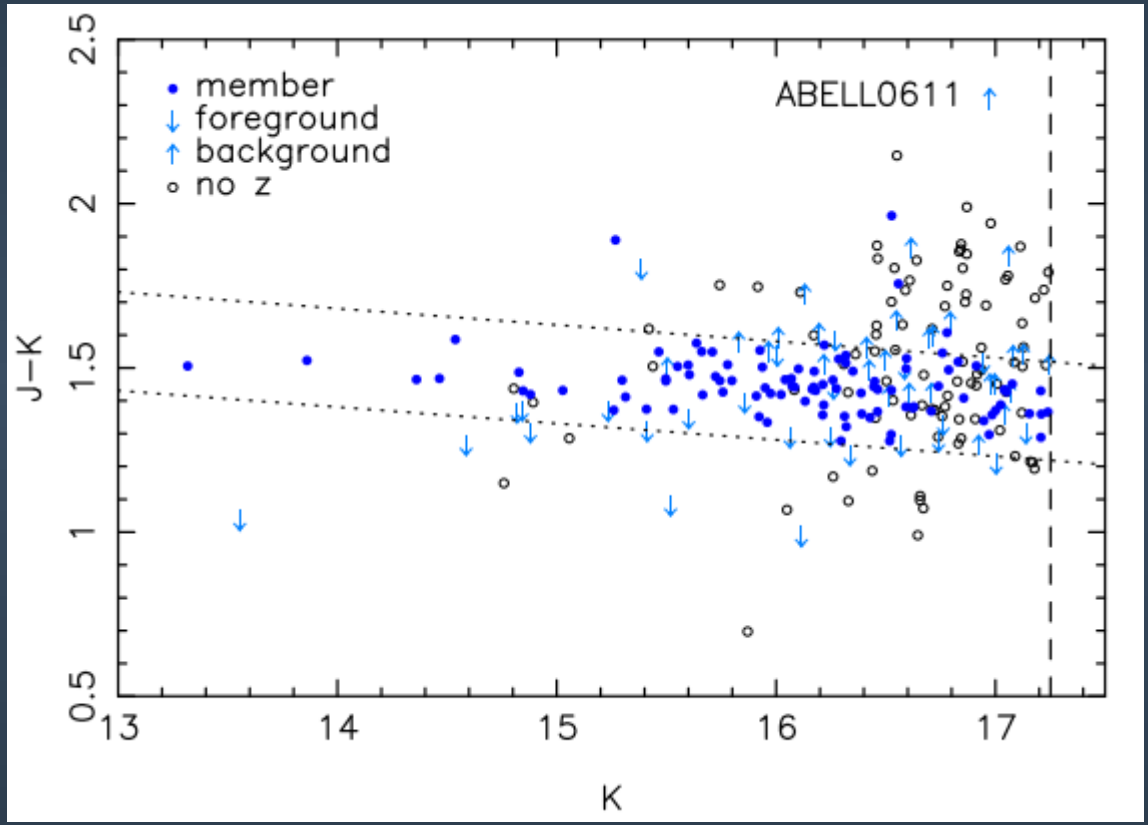


Data

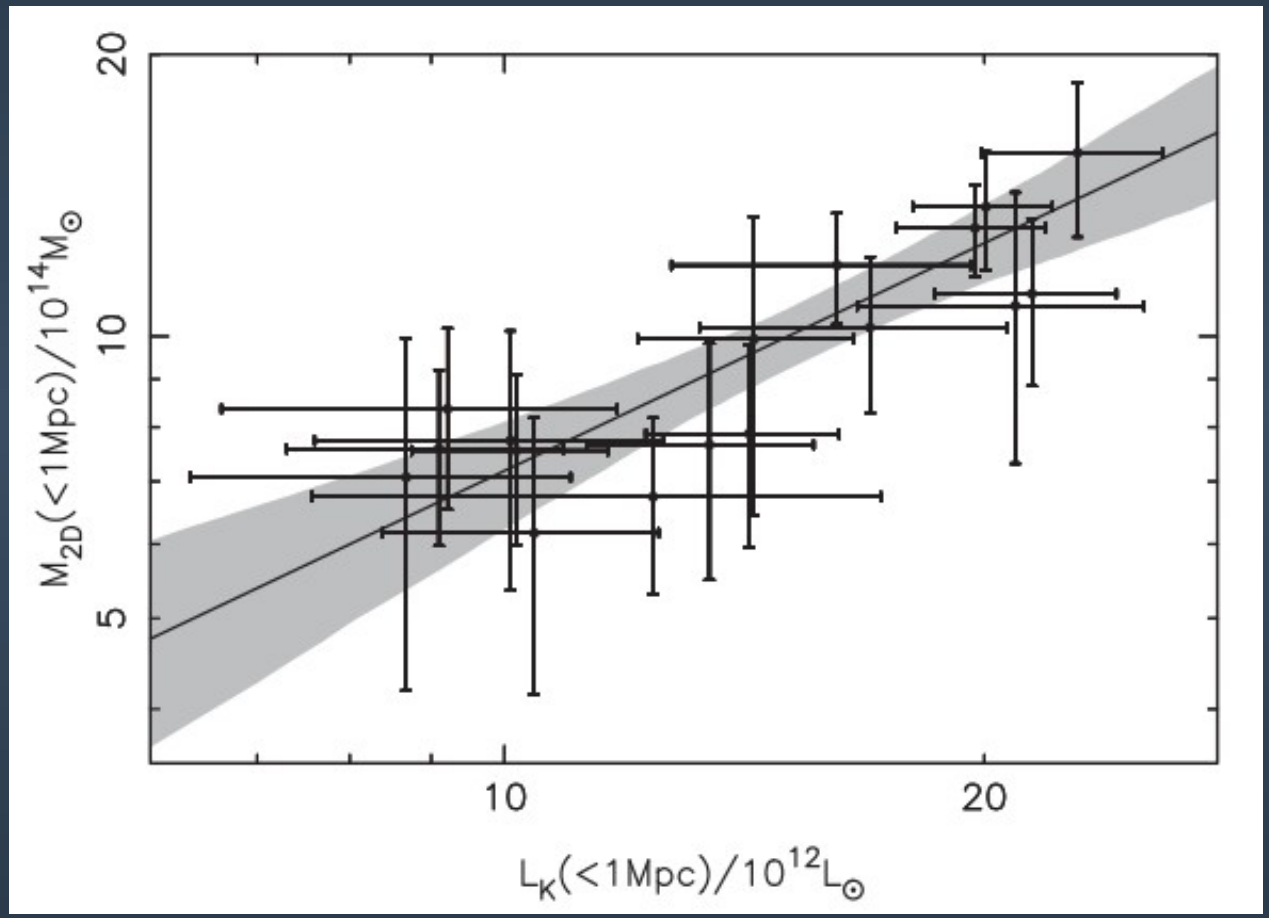
- Weak-lensing masses from Okabe et al. 2010
  - Subaru Suprime-Cam
  - Both projected 2D and deprojected 3D masses
- J/K-band data
  - UKIRT / WFCAM to J ~ 18, K ~ 19, count down to K*+1.5
- Spectroscopic data as part of ACReS
  - MMT / Hectospec
  - 75% complete – statistically unbiased targetting

From Photometry to L_K

- K-band data
- Radius
- 75% spectroscopic coverage
- Faint end correction

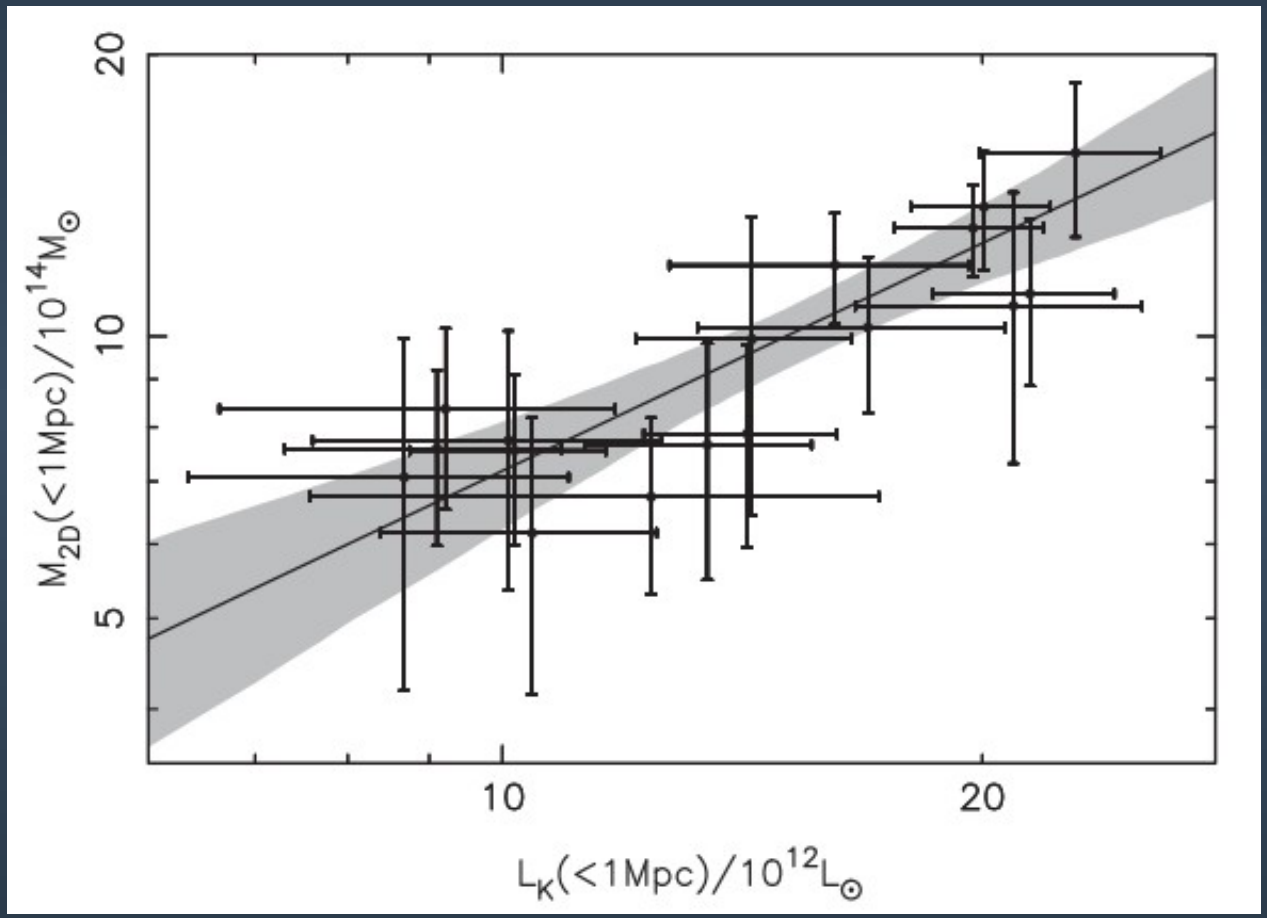


2D M_{WL} – L_K Relation within 1Mpc



$M_{WL} \alpha L_K^{0.83\pm0.26}$ scatter $\sigma_{lnM|L} = 10\pm6\%$

2D M_{WL} – L_K Relation within 1Mpc



$M_{WL} \alpha L_K^{0.83\pm0.26}$

scatter $\sigma_{lnM|L} = 10\pm6\%$

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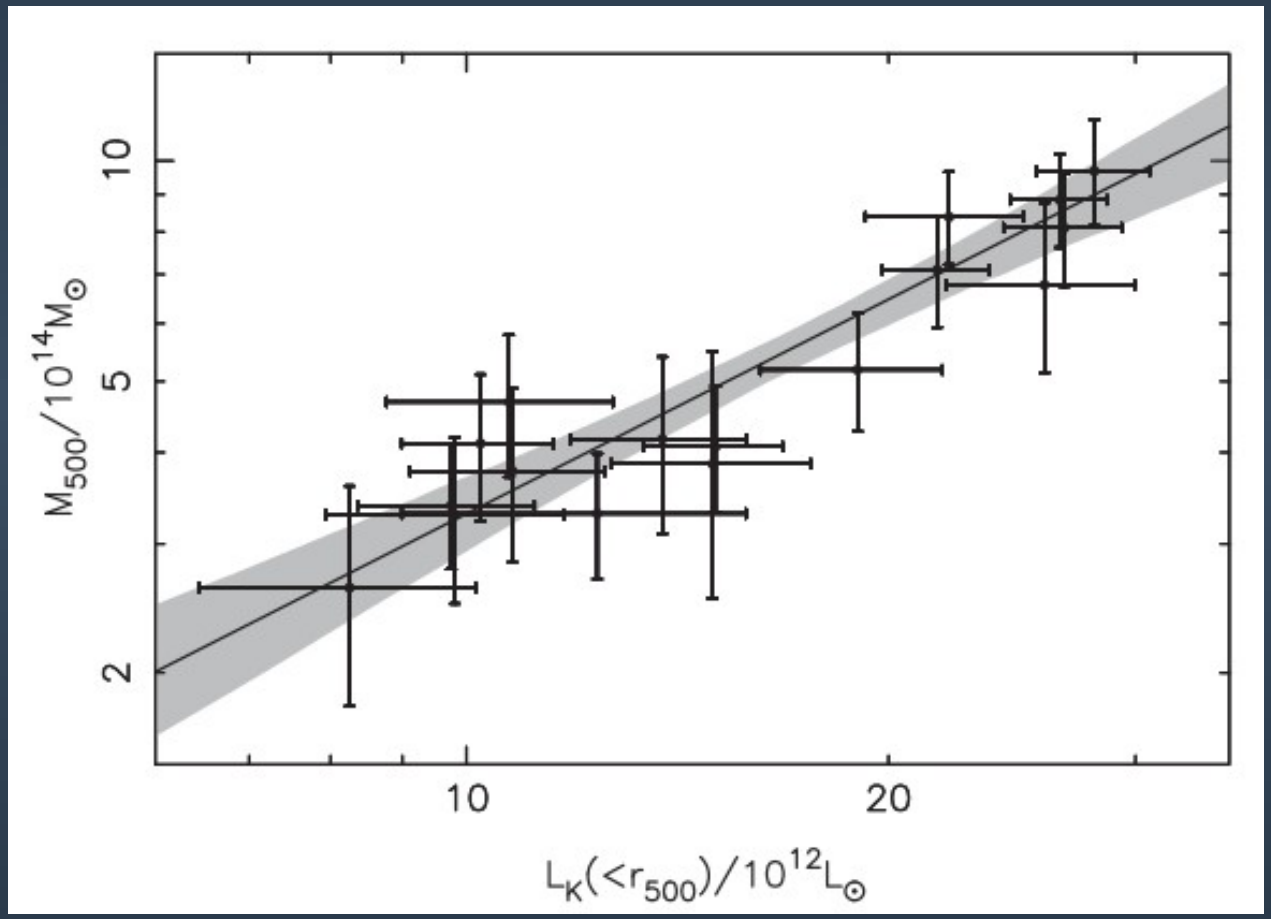
3D M_{WL} – L_K Relation within r_{500}



$M_{WL} \alpha L_K^{0.97\pm0.17}$ scatter $\sigma_{lnM|L} = 10\pm6\%$

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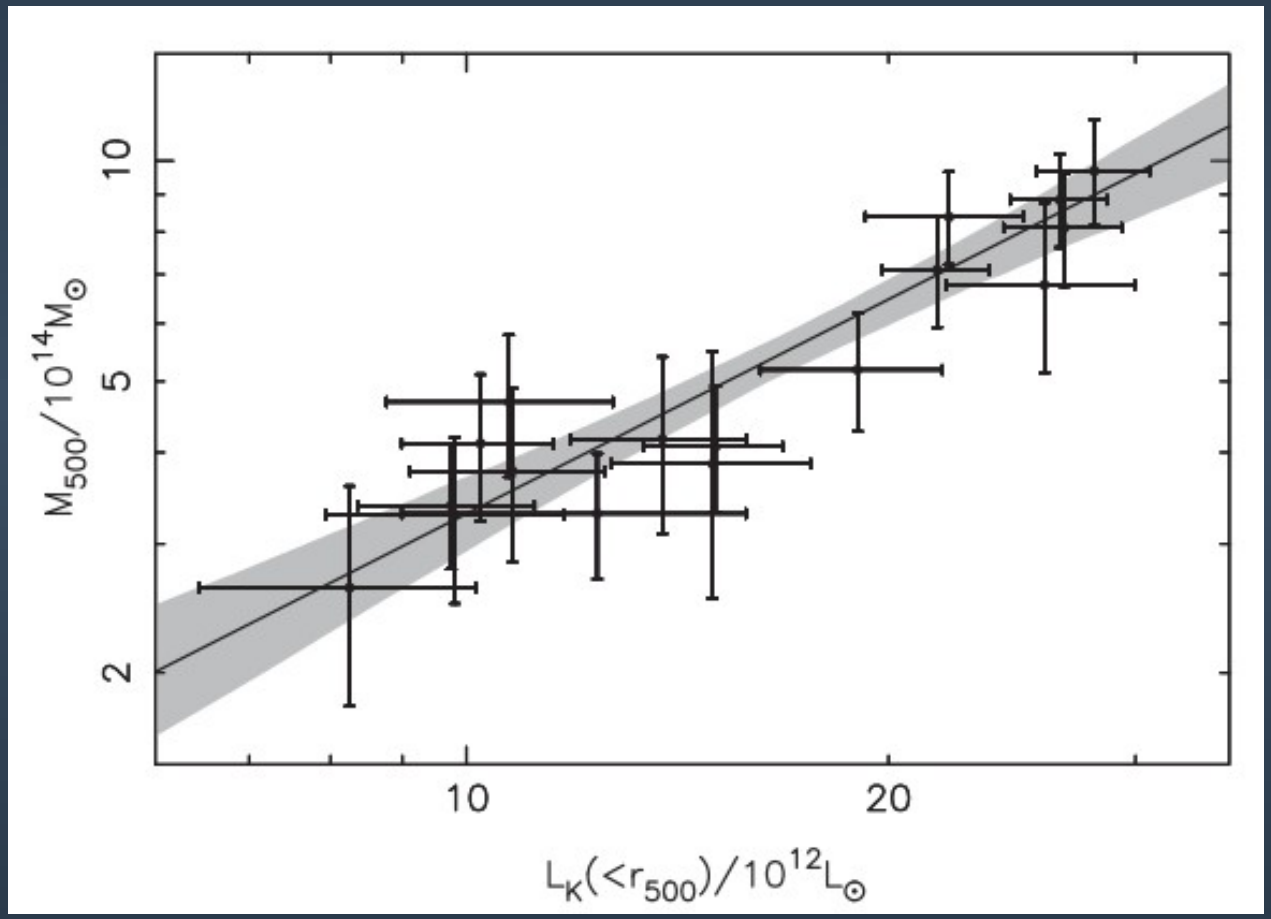
3D M_{WL} – L_K Relation within r_{500}



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scatter $\sigma_{lnM|L} = 10\pm6\%$

$M_{WL} - L_K$ Relation Summary

$M_{WL} \propto L_K^{b}$	1Mpc	r_{500}
2D	b = 0.83±0.26 σ = 10±6%	b = 0.96±0.21 σ =11±7%
3D	b = 0.80±0.20 σ = 8±5%	b = 0.97±0.17 σ = 10±6%

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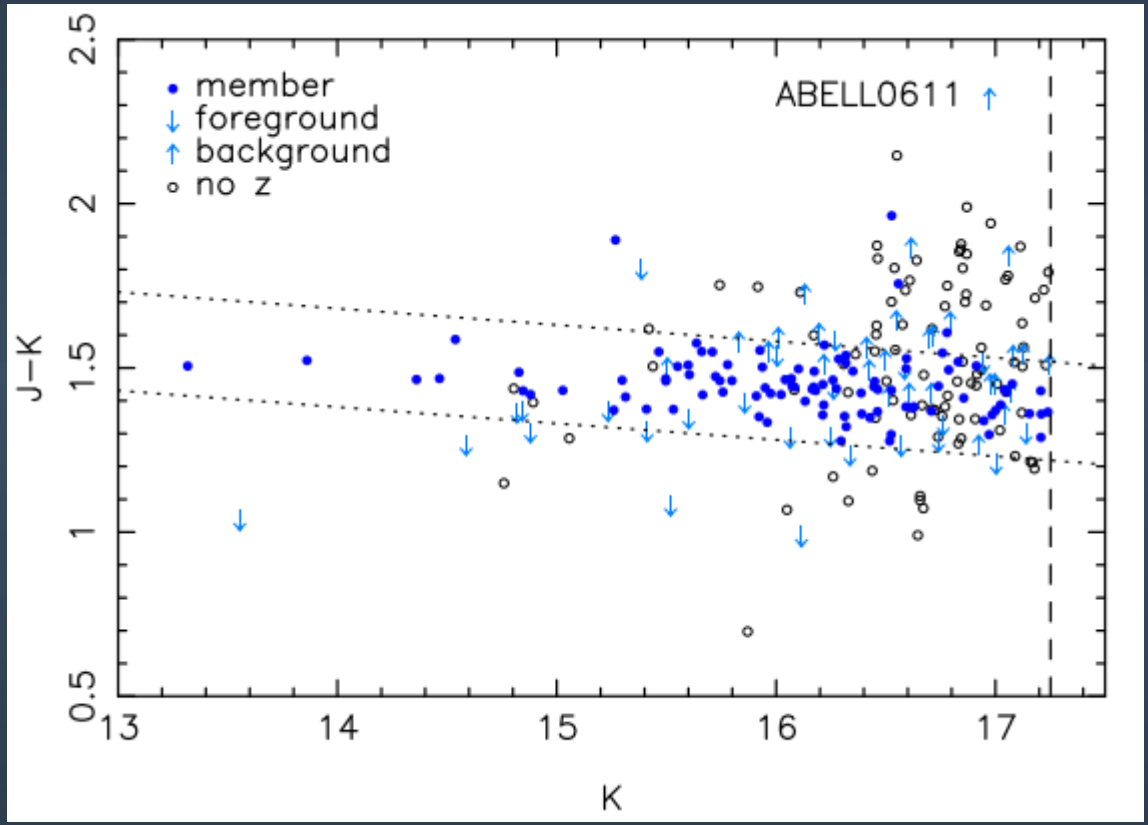
Low scatter independent of deprojection / radius

From Photometry to L_K

- K-band data
- Radius
- 75% spectroscopic coverage
- Faint end correction



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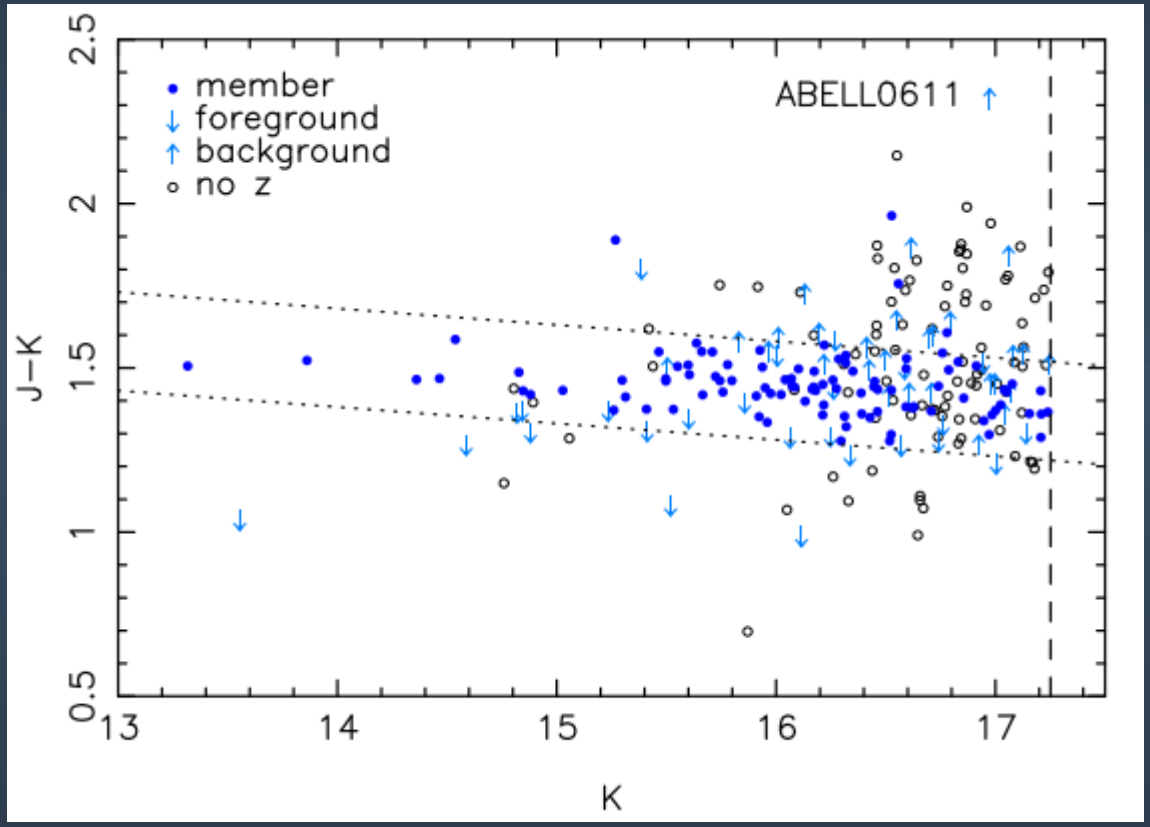

- Red-sequence selection

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From Photometry to L_K

- K-band data
- Radius
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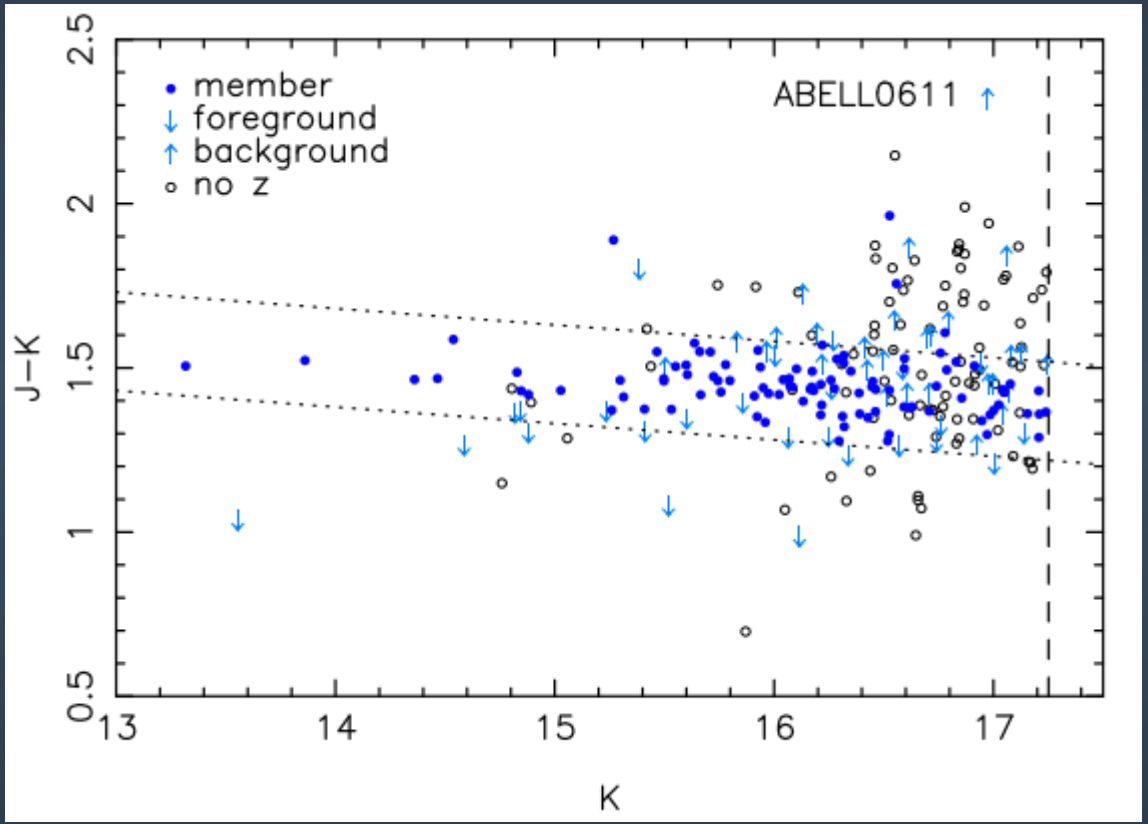

- Red-sequence selection

Low scatter NOT dependent on spectroscopic data

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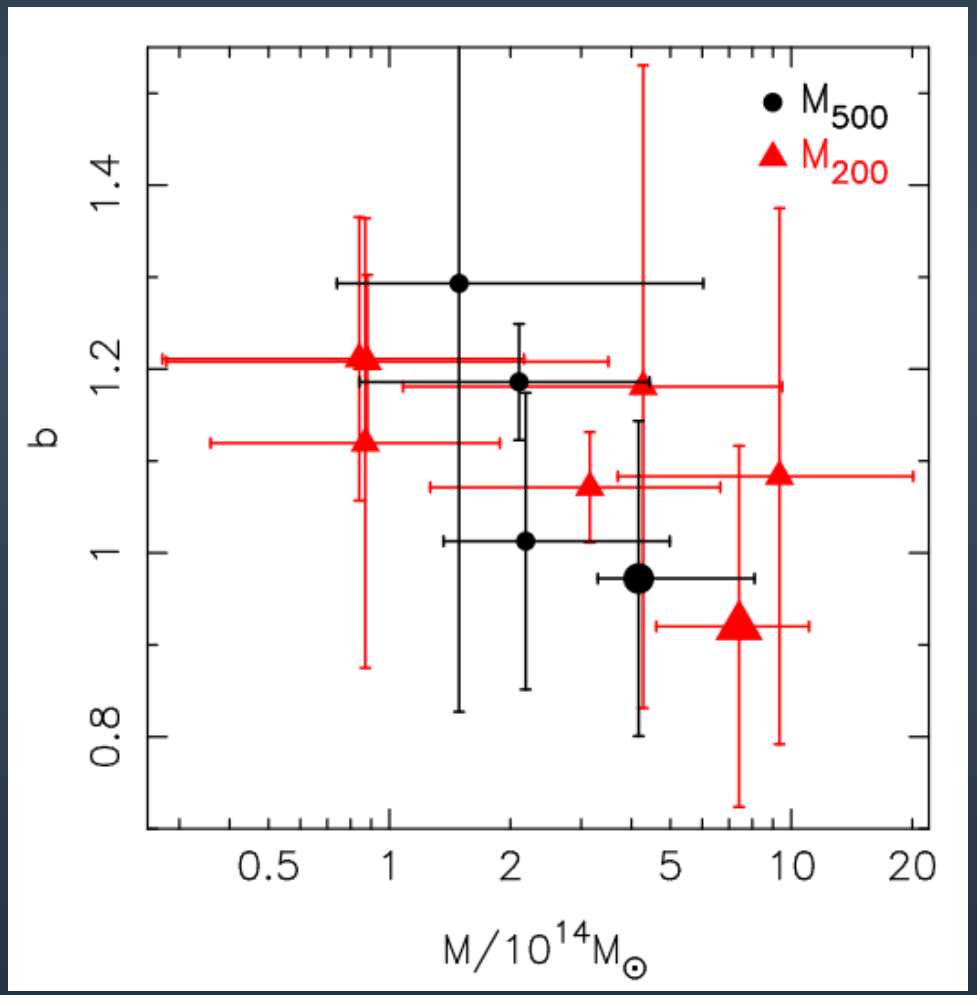
M_{WL} – L_K Relation within r_{500}

- Lower scatter than Lin, Mohr & Stanford 2003
  - 28%
  - Use a M – T_X relation
- Use M_X from Martino et al. 2014
  - Scatter increases to 25%
- Low scatter in M_{WL} - L_K relation due to correlated projection systematics

Evidence for Mass Dependence in the Relation



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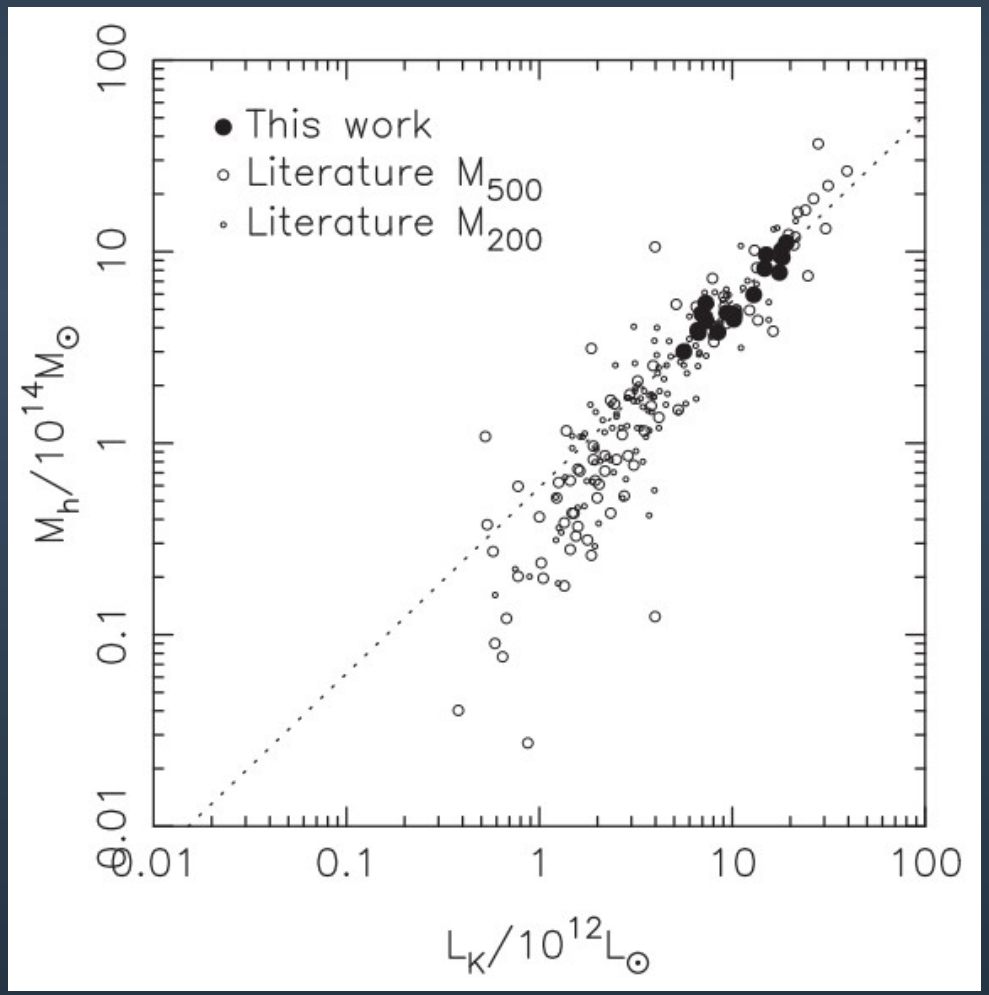

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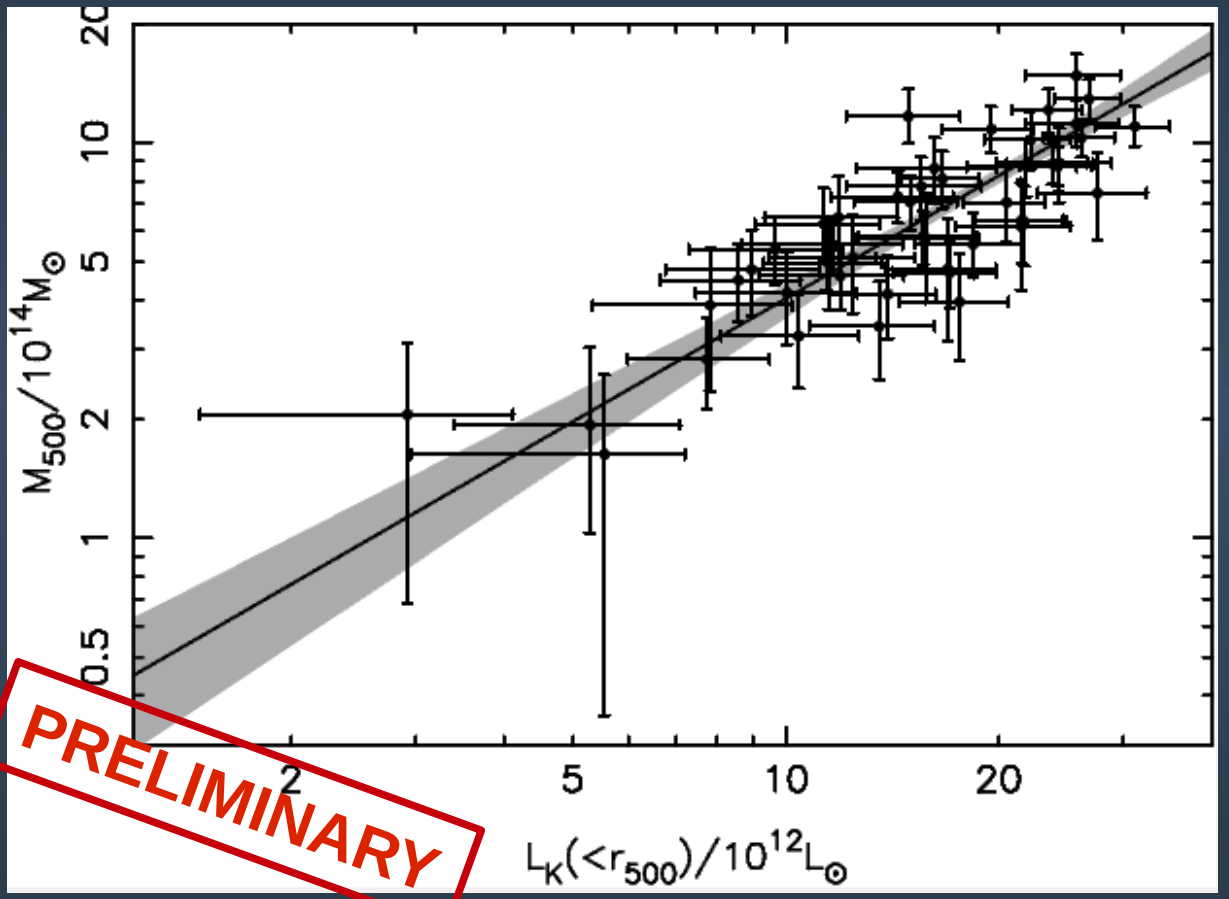
M_{WL} – L_K Relation for High-L_X Sample

50 clusters:
Complete
High-L_x sample

New masses:
Okabe et al. in prep.
(See GPS talk)



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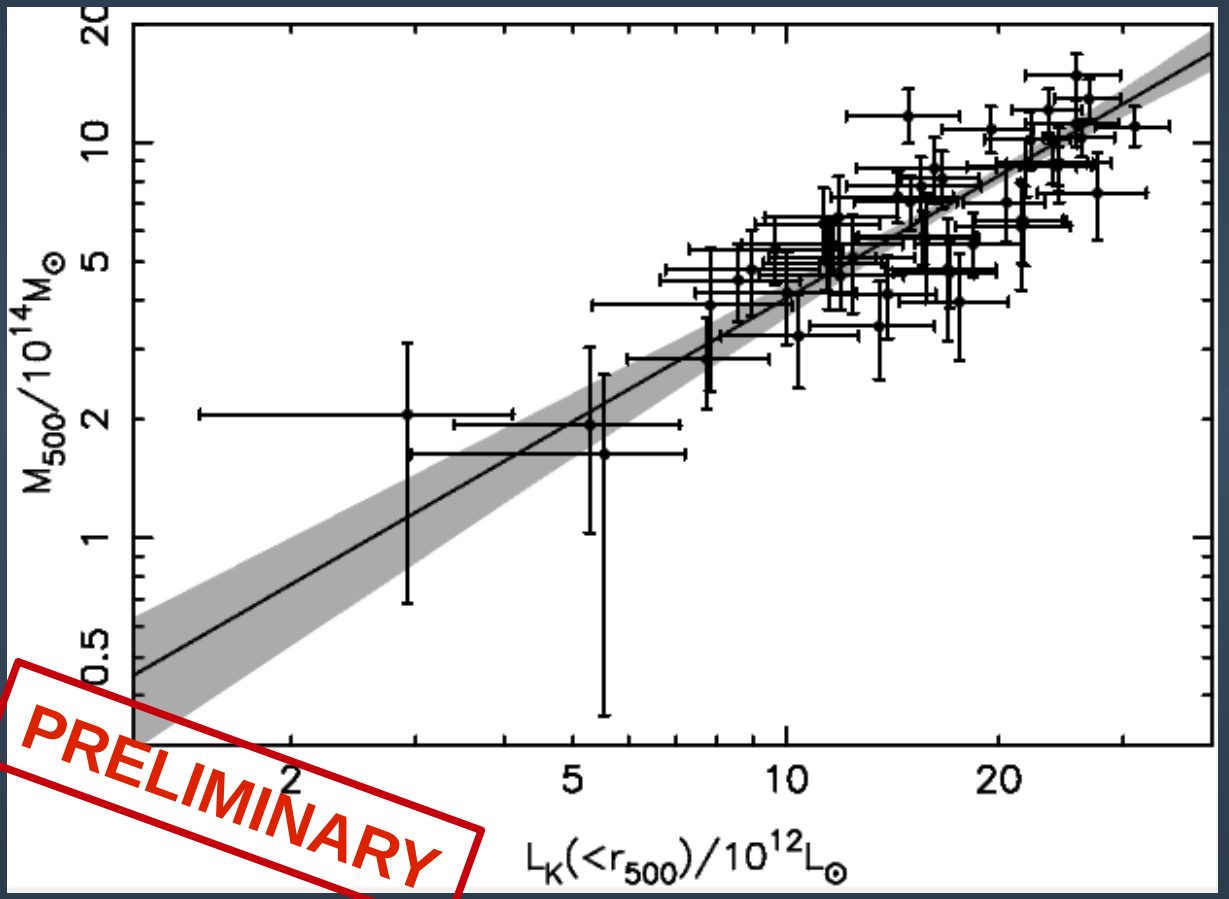

$M_{WL} \propto L_K^{0.98\pm0.14}$

scatter $\sigma_{\ln M|L} = 11\pm5\%$

Summary

- L_K is a promising M_{WL} proxy for future large, shallow surveys
  - Low scatter of ~10%
  - Scatter doesn't increase however the analysis is carried out – deprojection, radius, member selection
- The relation appears to be a function of mass
- Next steps:
  - Consider other mass proxies
  - Take into account selection effect, mass function, etc..