Performing detailed study of high-z IR galaxies: Galaxy-galaxy lenses in the *Herschel* HerMES survey

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with

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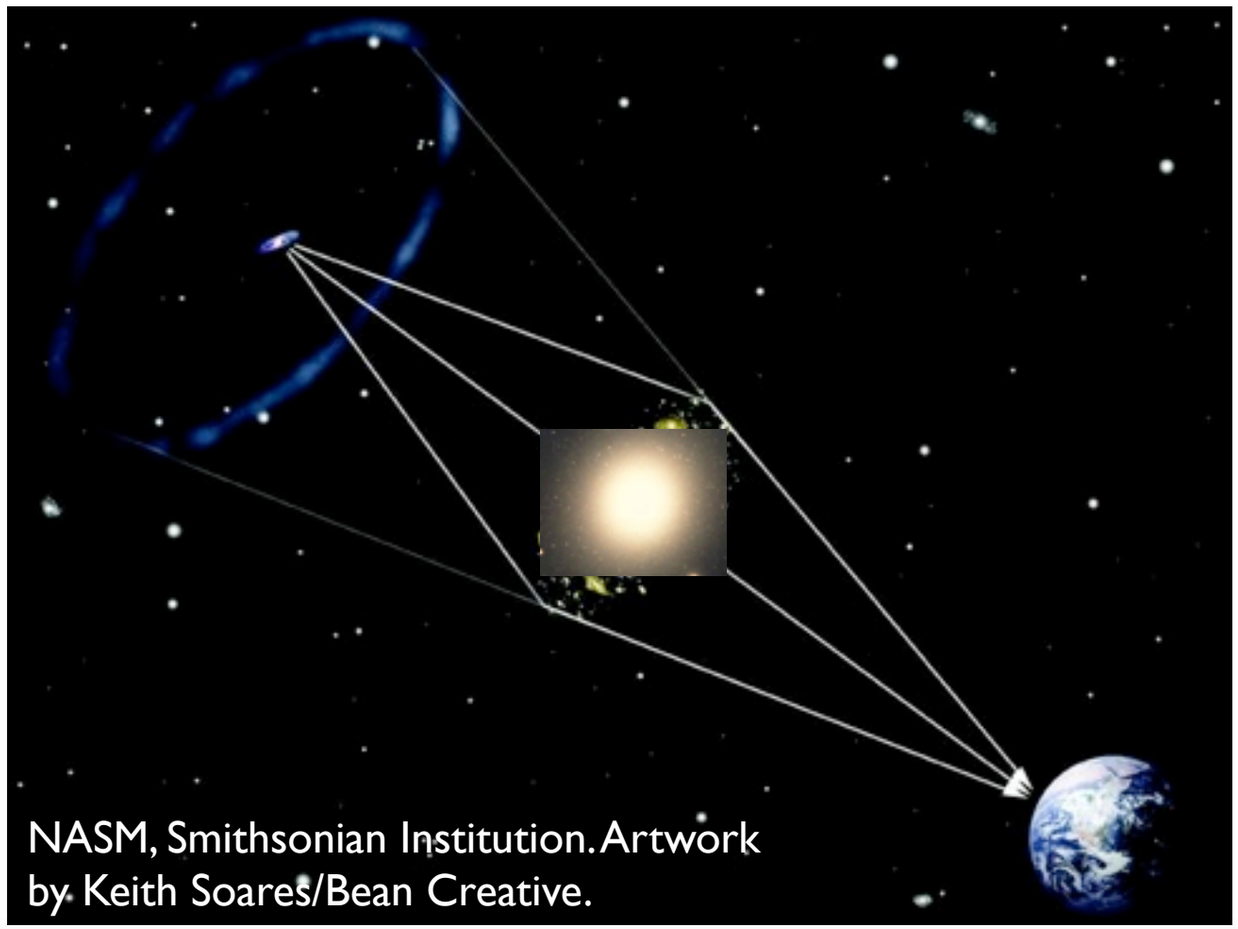
& the HerMES team

HERMES

Gravitational lensing

- Light affected by intervening mass (galaxy).
- Flux boosted (magnified) & distorted.
  - Useful for distant ULIRGs where optical reddening (& confusion) is important.
- Can study fainter objects than usually available.
- Allows gravitational studies of foreground galaxy



NASM, Smithsonian Institution. Artwork by Keith Soares/Bean Creative.

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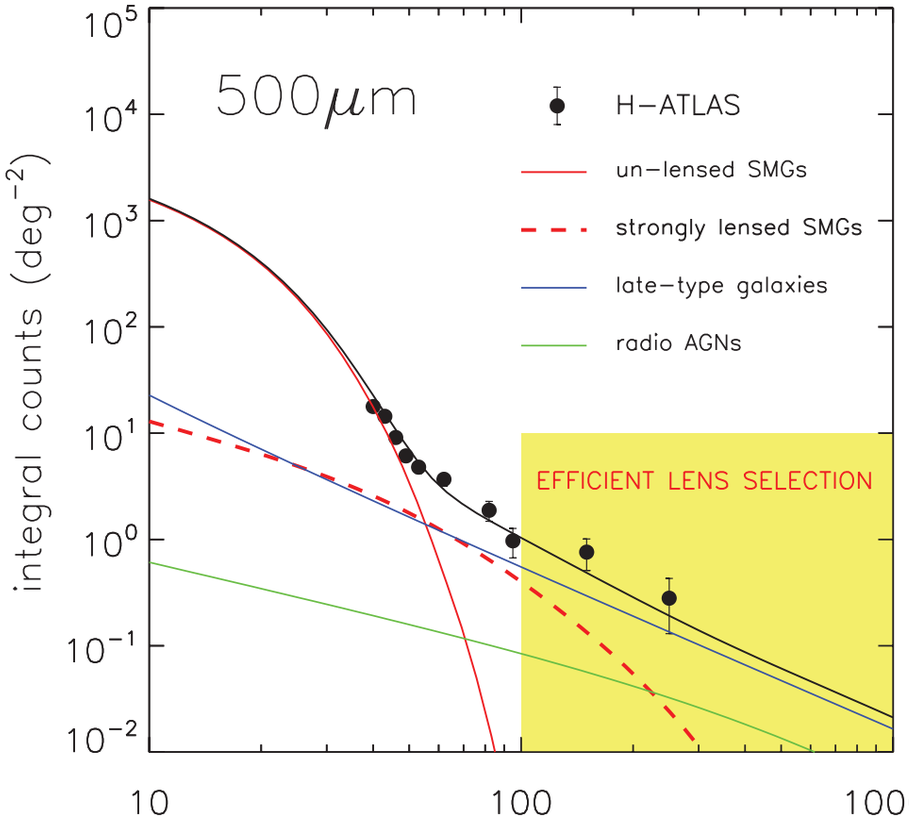
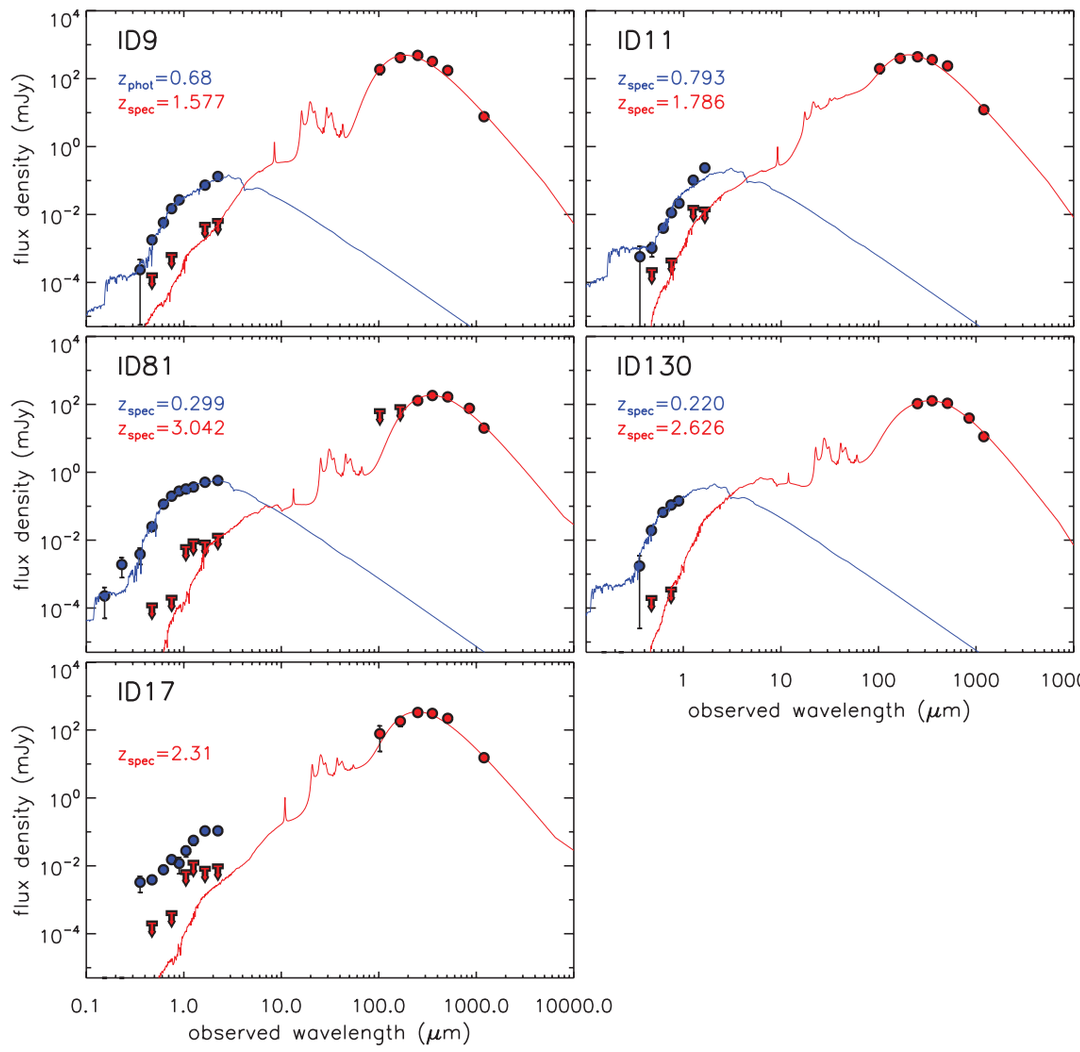
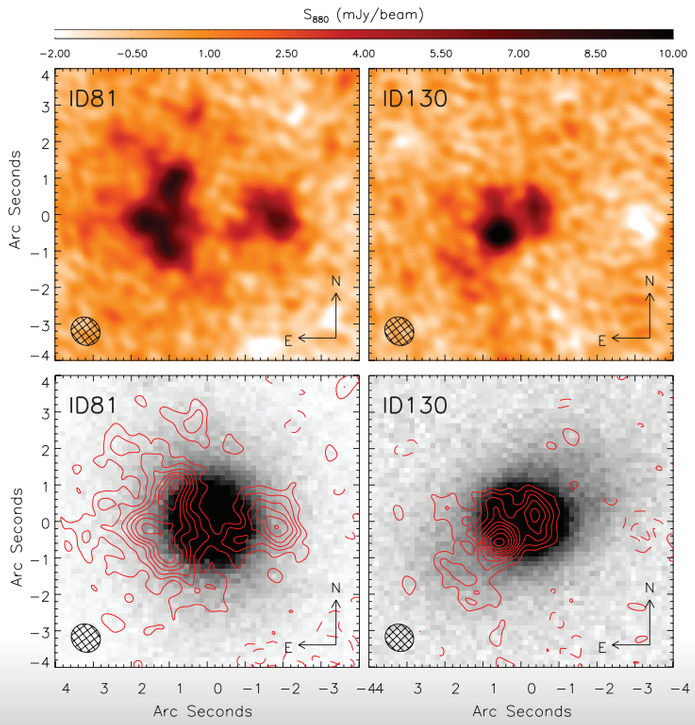
Submm galaxy-galaxy lensing







Figures from Negrello et al. 2010

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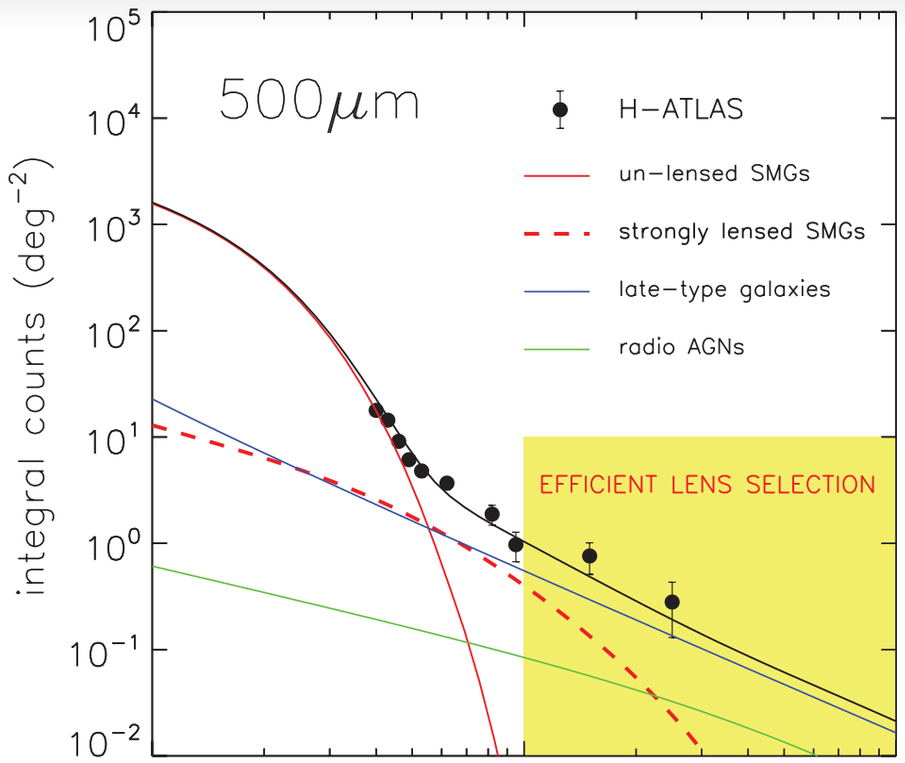
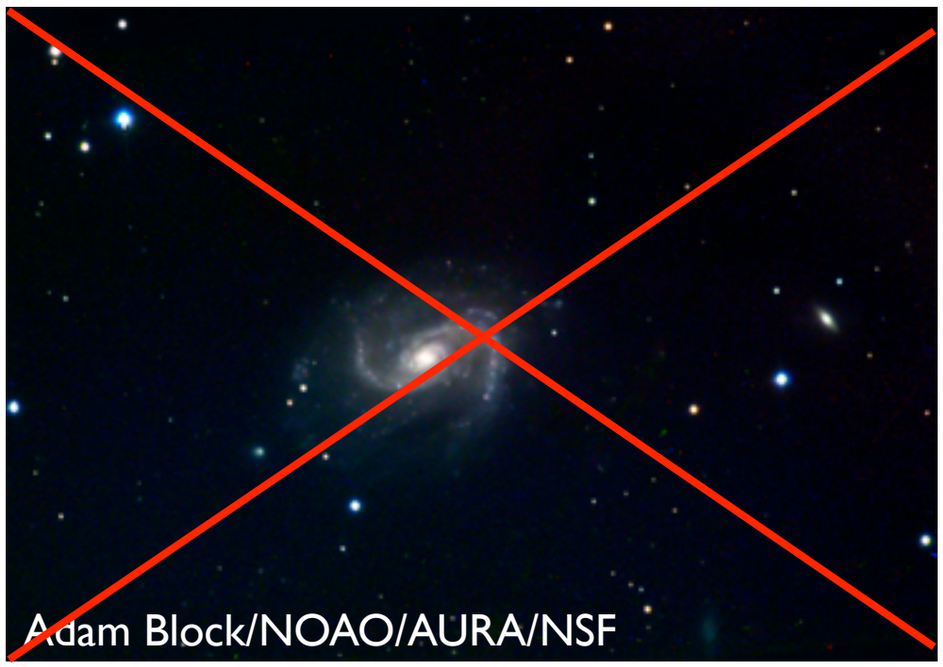
Candidate Selection

- $S_{500} \geq 80$mJy
- NOT local spiral in NED
- NOT radio AGN in NED





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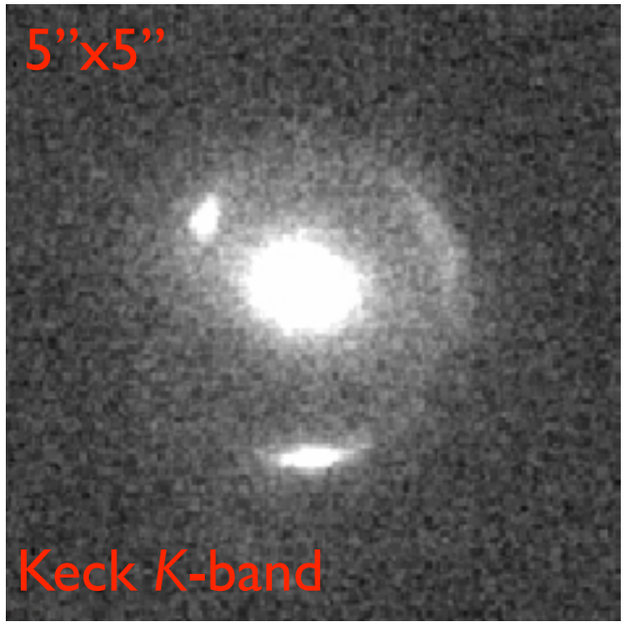
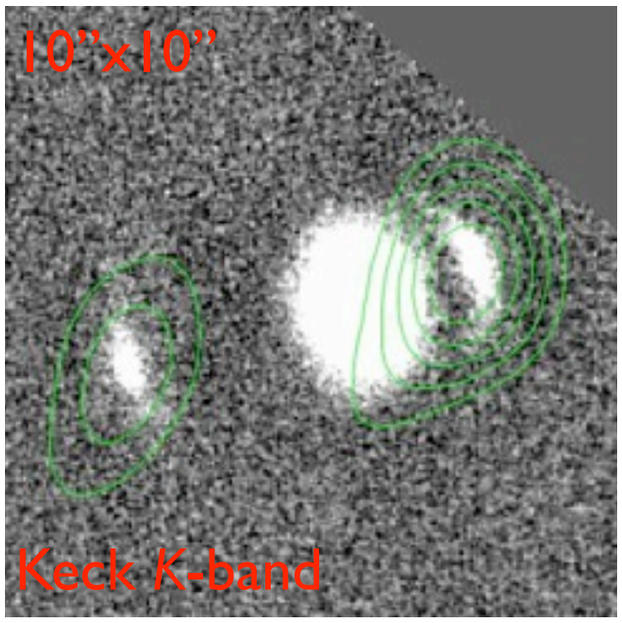
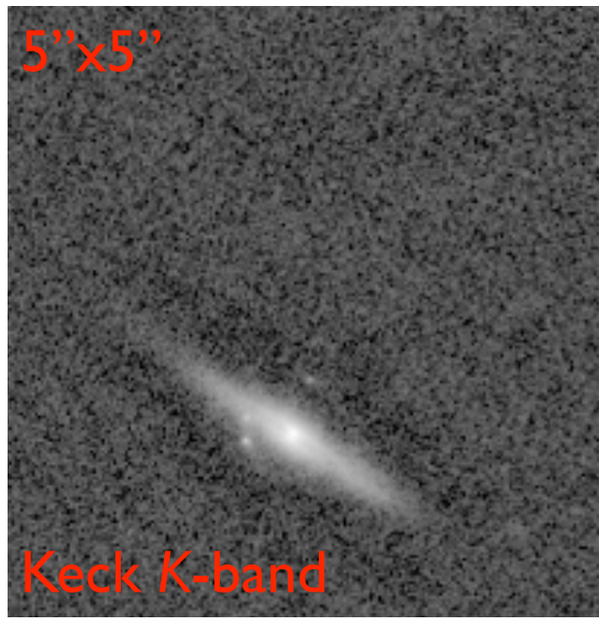
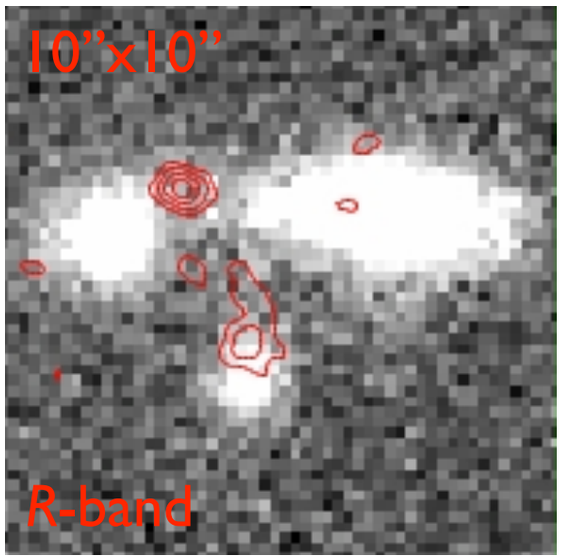
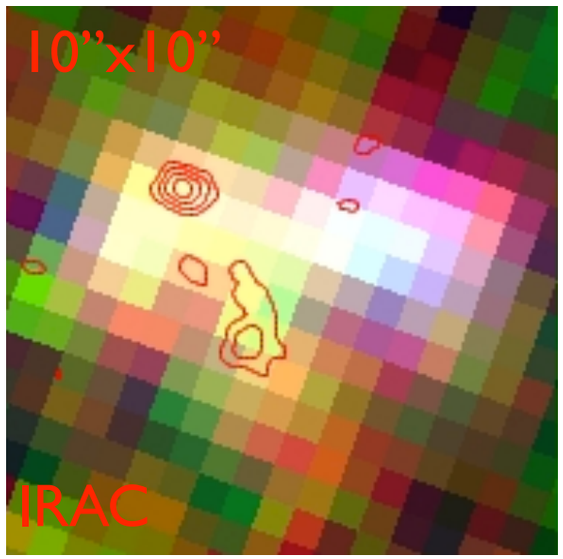
An assortment of candidates

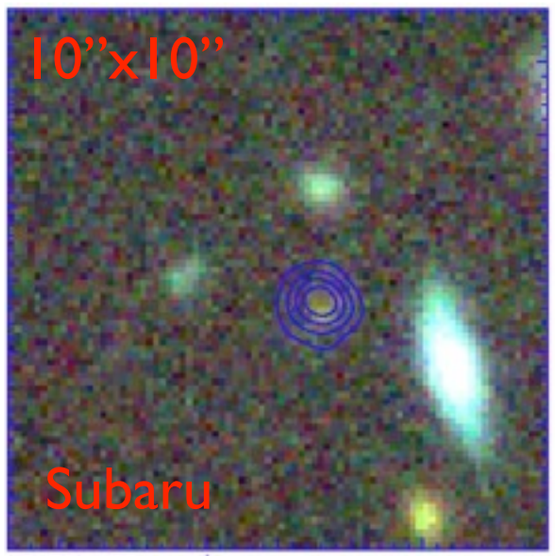


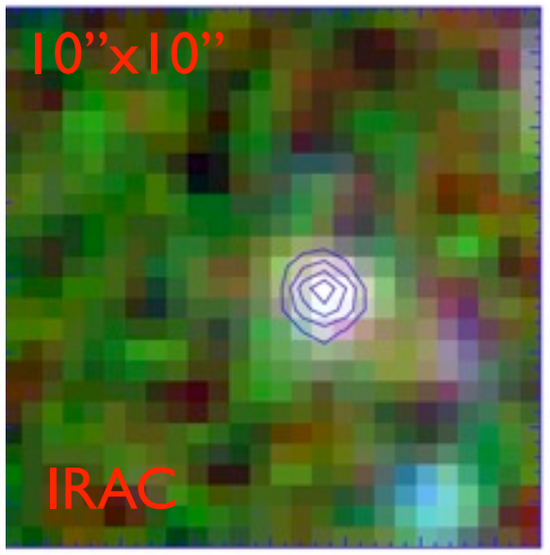












SXDF1100.001; Ikarashi et al. 2011

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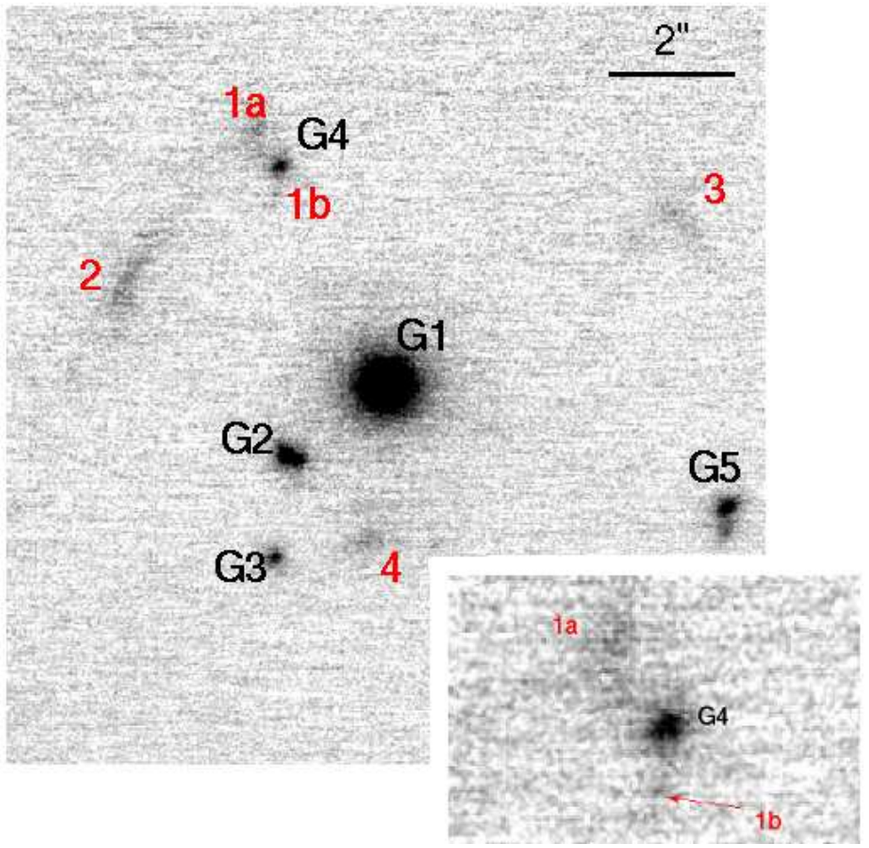
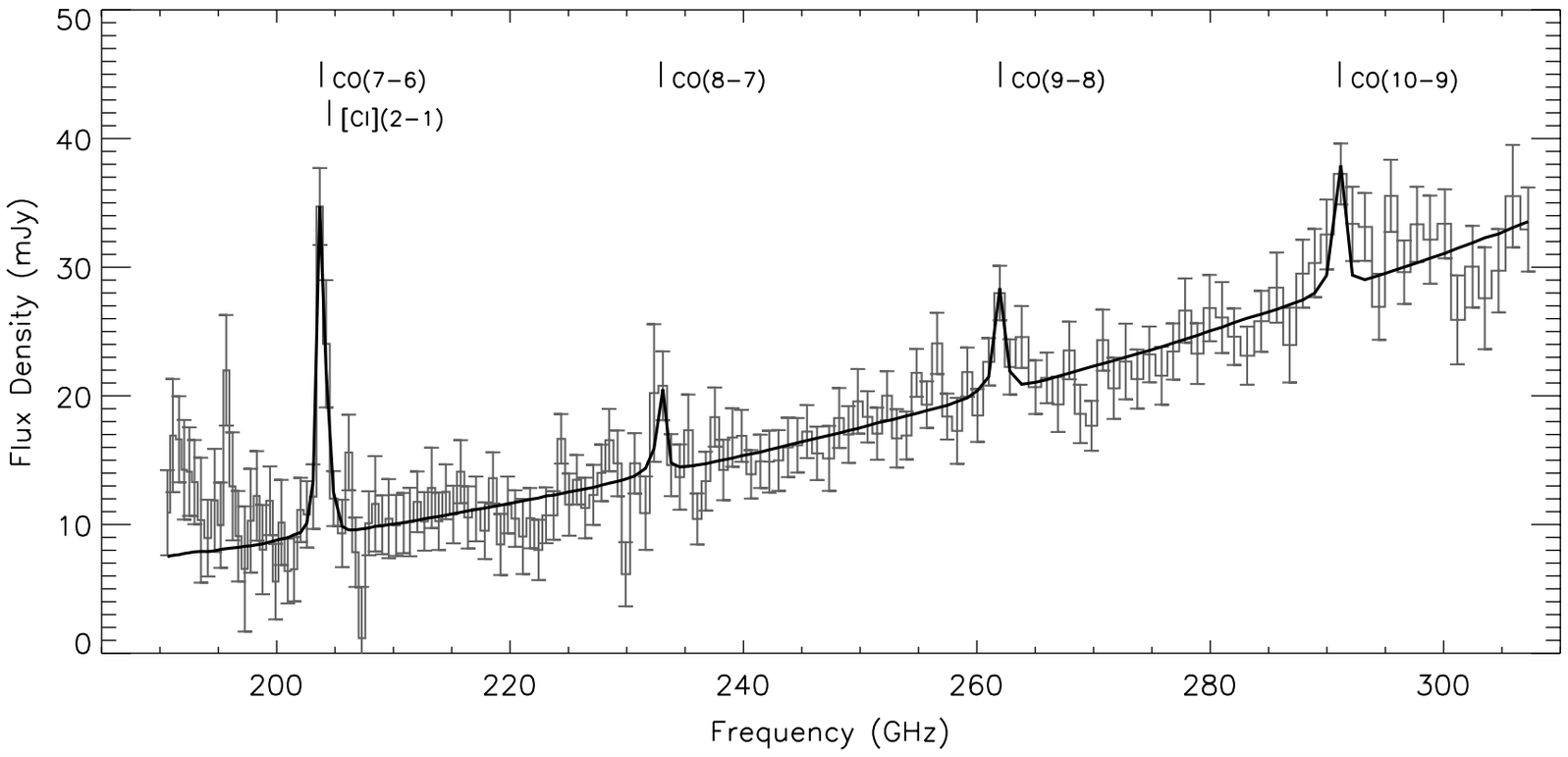
Example: Lockman01

see Conley et al. 2011, Scott et al. 2011, Gavazzi et al. 2011, Riechers et al. 2011

- S_{500}~250mJy
- z_{CO}=2.9; z_{G1}=0.6
- μ~11





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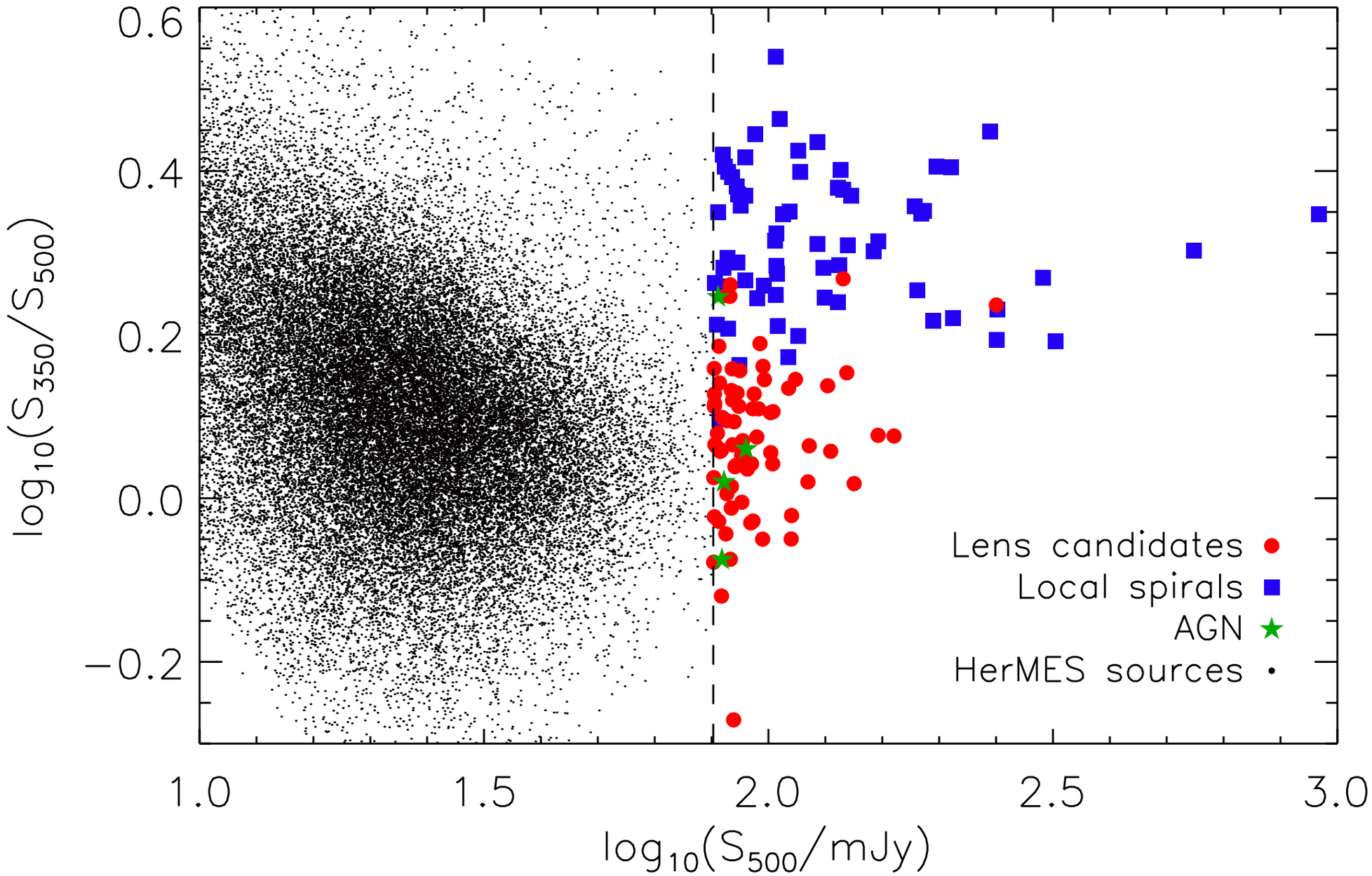
Lensed galaxies are usually red in the submm



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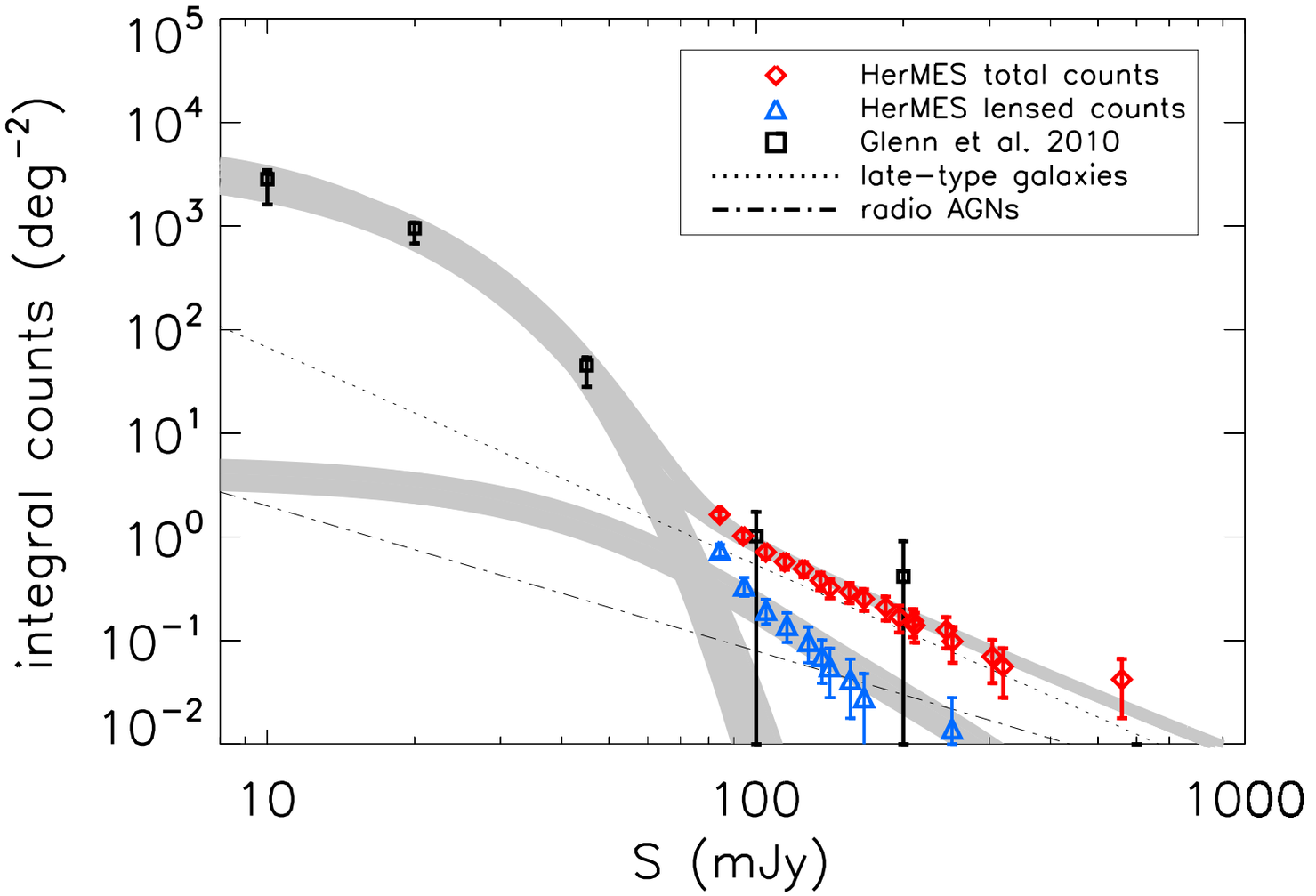
Modelling galaxy-galaxy lensing

- Consider NFW & SIS density profiles & lens "intrinsic" N(>S)
- "Intrinsic" N(>S) from Schechter function fit
- Parameters constrained by requiring fit to observed N(>S)
- μ>2 for "strong" lensing



Model will be testable with more data shortly

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(thanks to Francesco De Bernardis)

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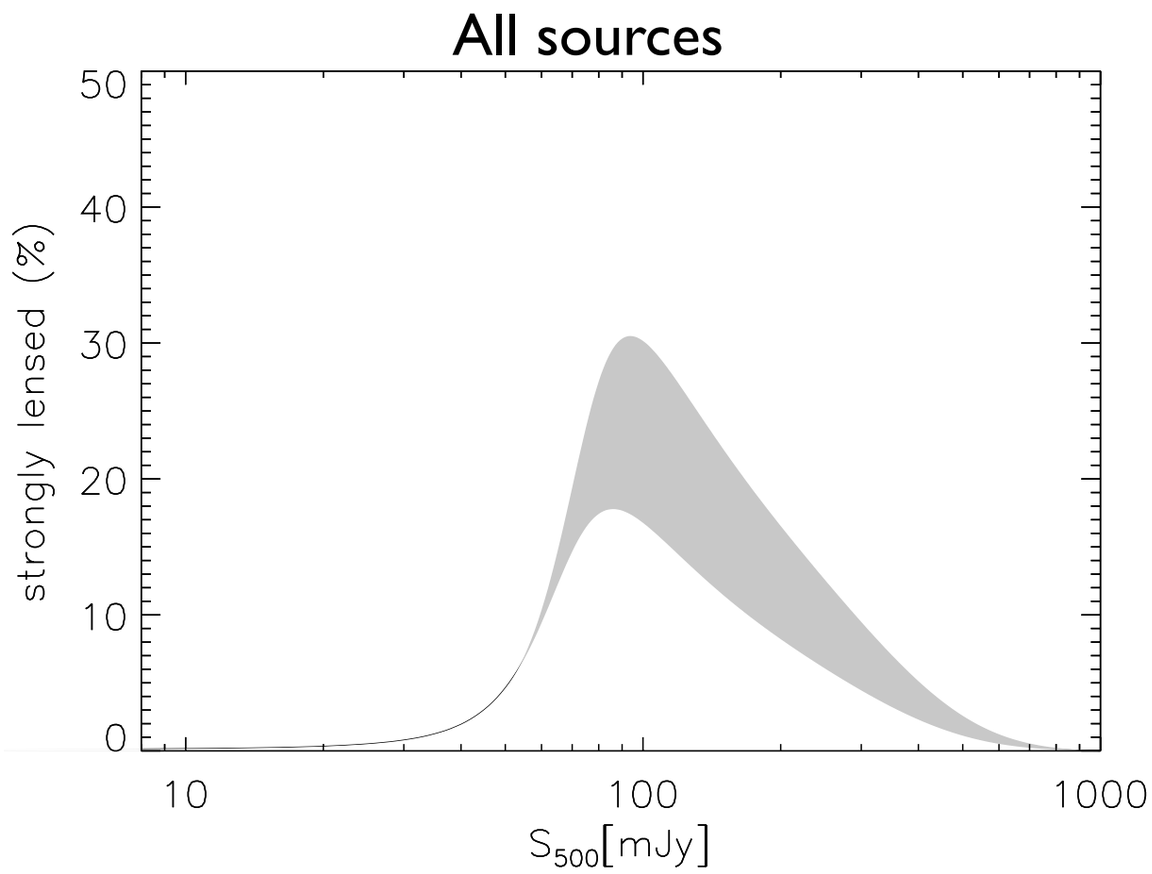
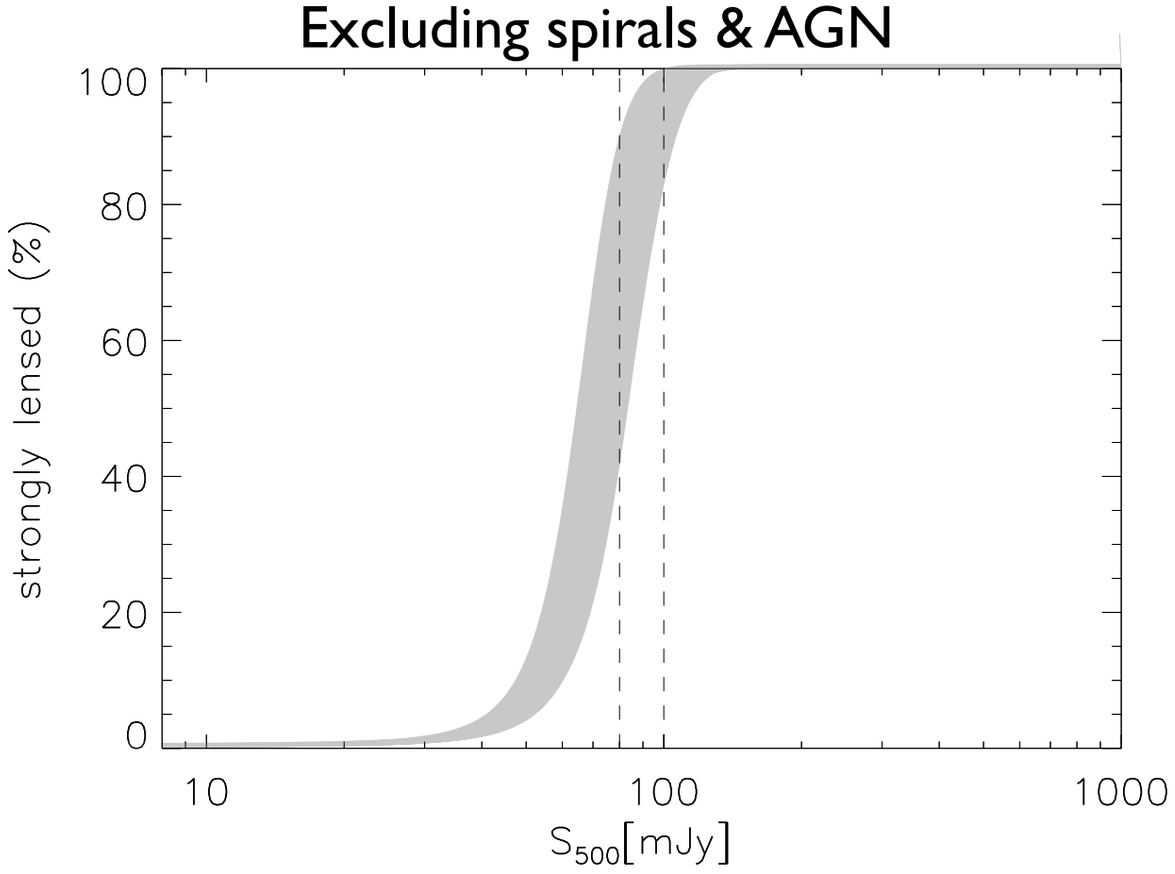
high% of candidates in the model are lensed, μ>2





(thanks to Francesco De Bernardis)

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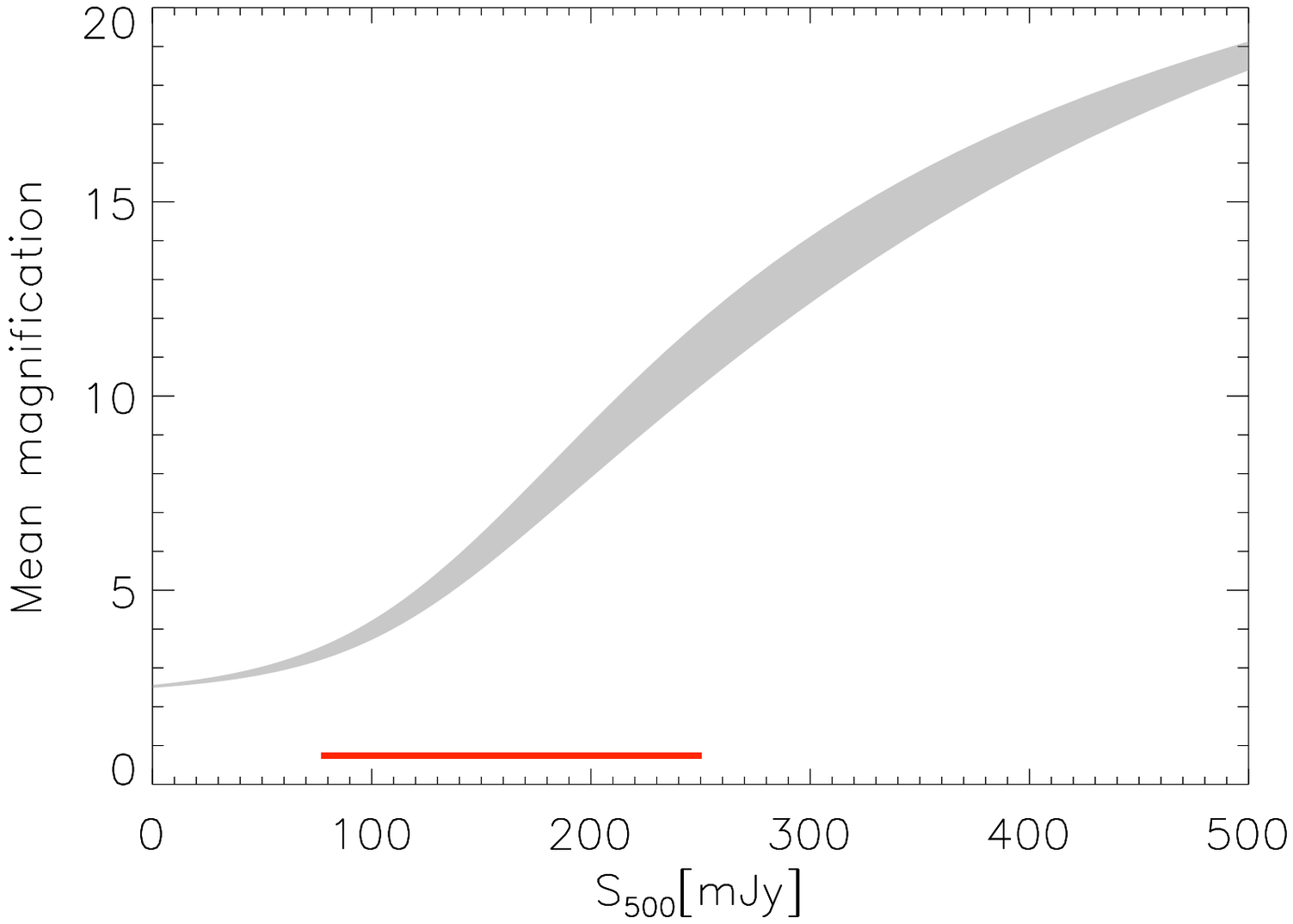
Average magnification in the model is ~5 for HerMES candidate fluxes



=> According to the model most SMG galaxy-galaxy lenses are intrinsically "normal" SMGs

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Conclusions

- Galaxy-galaxy lens candidates are efficiently selected in wide-field submm surveys with ~0.9 candidates deg^{-2} at S_{500}>80mJy.
- Simple models of lensing with NFW or SIS profiles can reproduce observed numbers of galaxy lens candidates.
- Models suggest that 40-90% of candidates are lensed by μ>2.
- Models suggest that most lensed galaxies selected by 500μm flux are intrinsically "normal" SMGs.
- With follow-up data, especially ALMA, we will be able to test and constrain the models.

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