

AGN tori aren't alike

The VLT/MIDI AGN Large Programme

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MPE – Garching

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Sebastian Wolf*



Why study AGNs?

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AGNs are a part of galaxy evolution, e.g.

Merger > Star Formation > Obscured AGN > Quasar > Elliptical Galaxy

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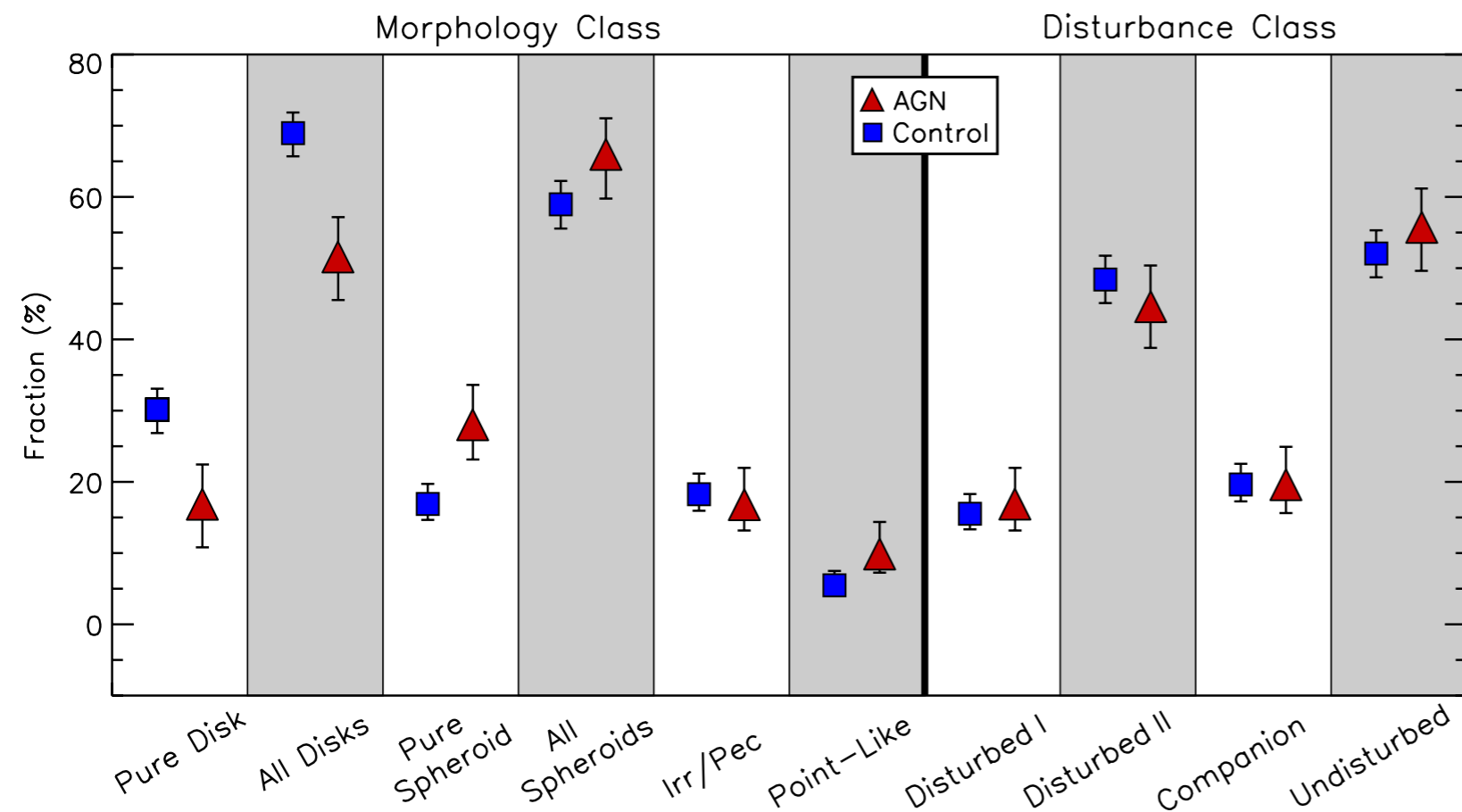
However: Unclear what causes AGN activity

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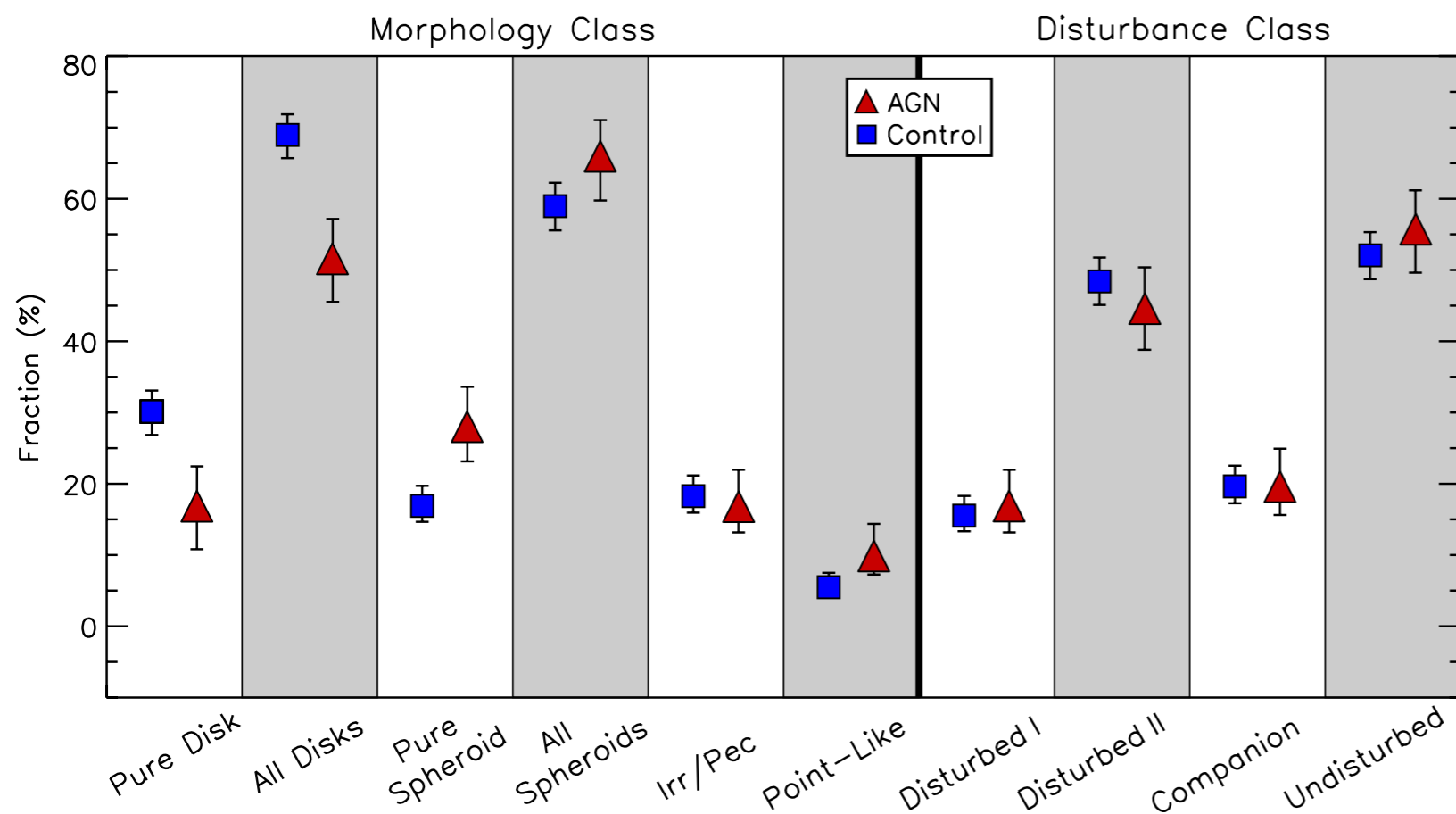


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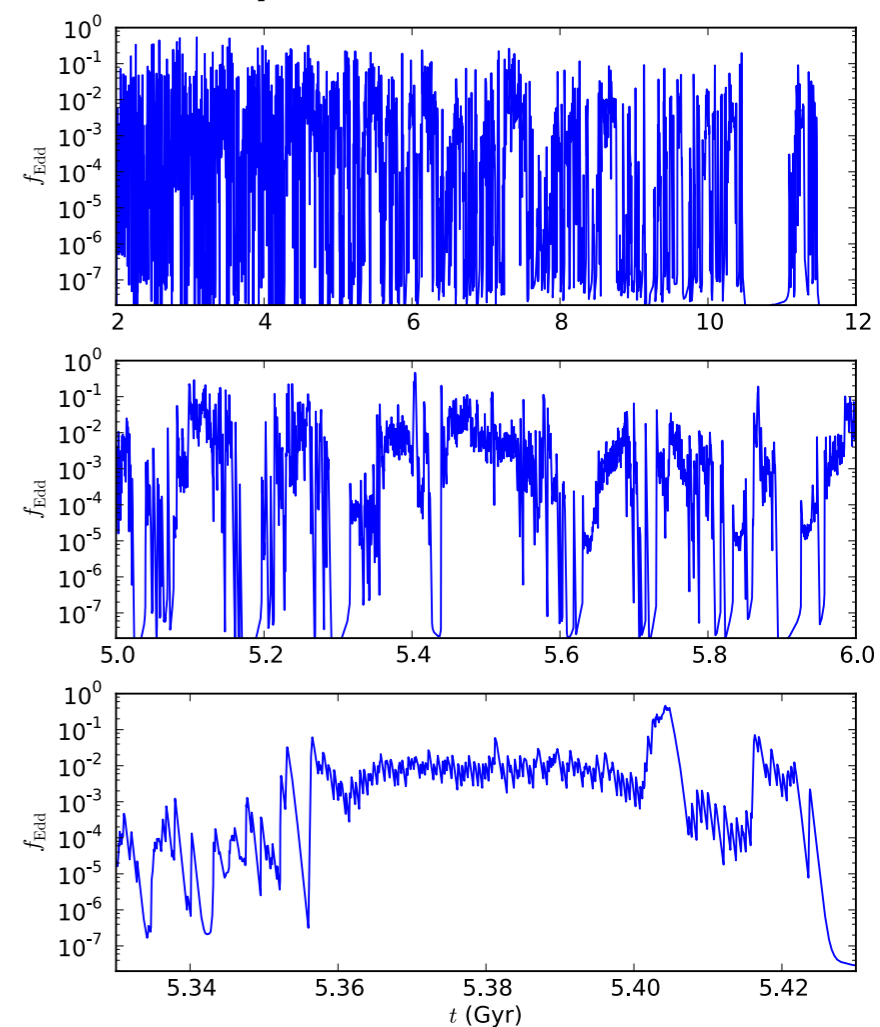
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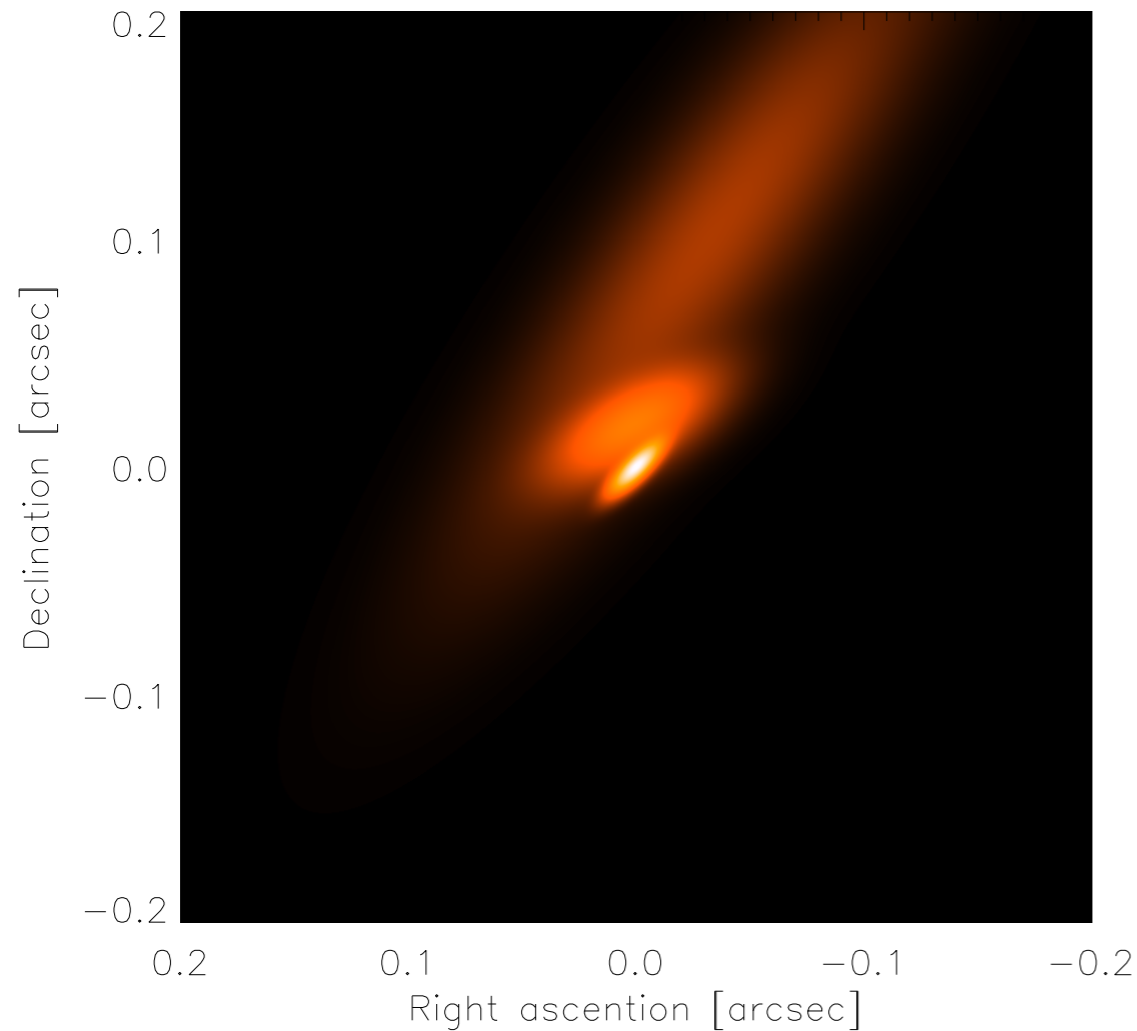
However: Unclear what causes AGN activity



Variability on „short“ timescales



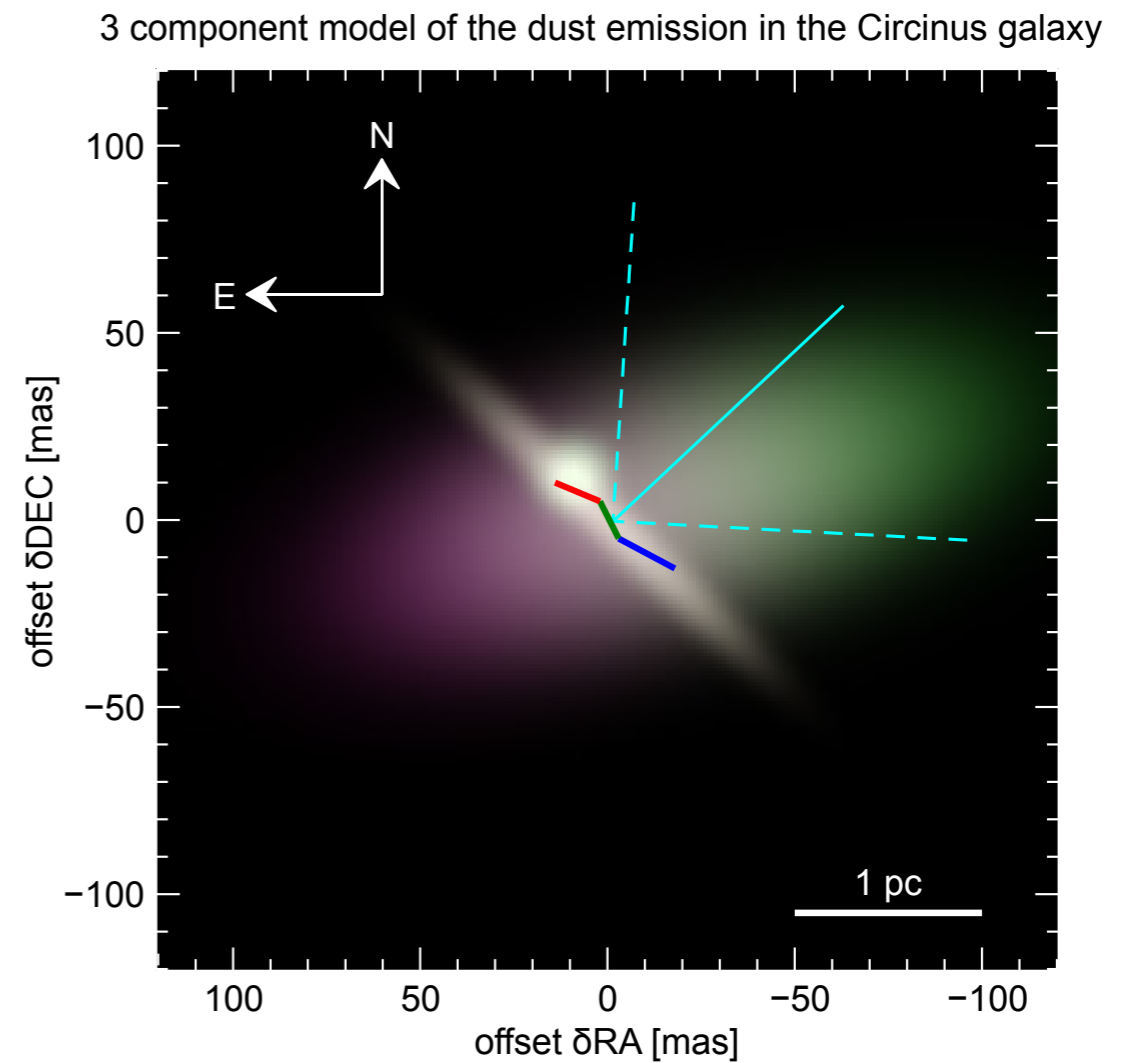
The best cases



NGC 1068

Jaffe+ 2004

Raban+ 2009, Lopez+ 2014

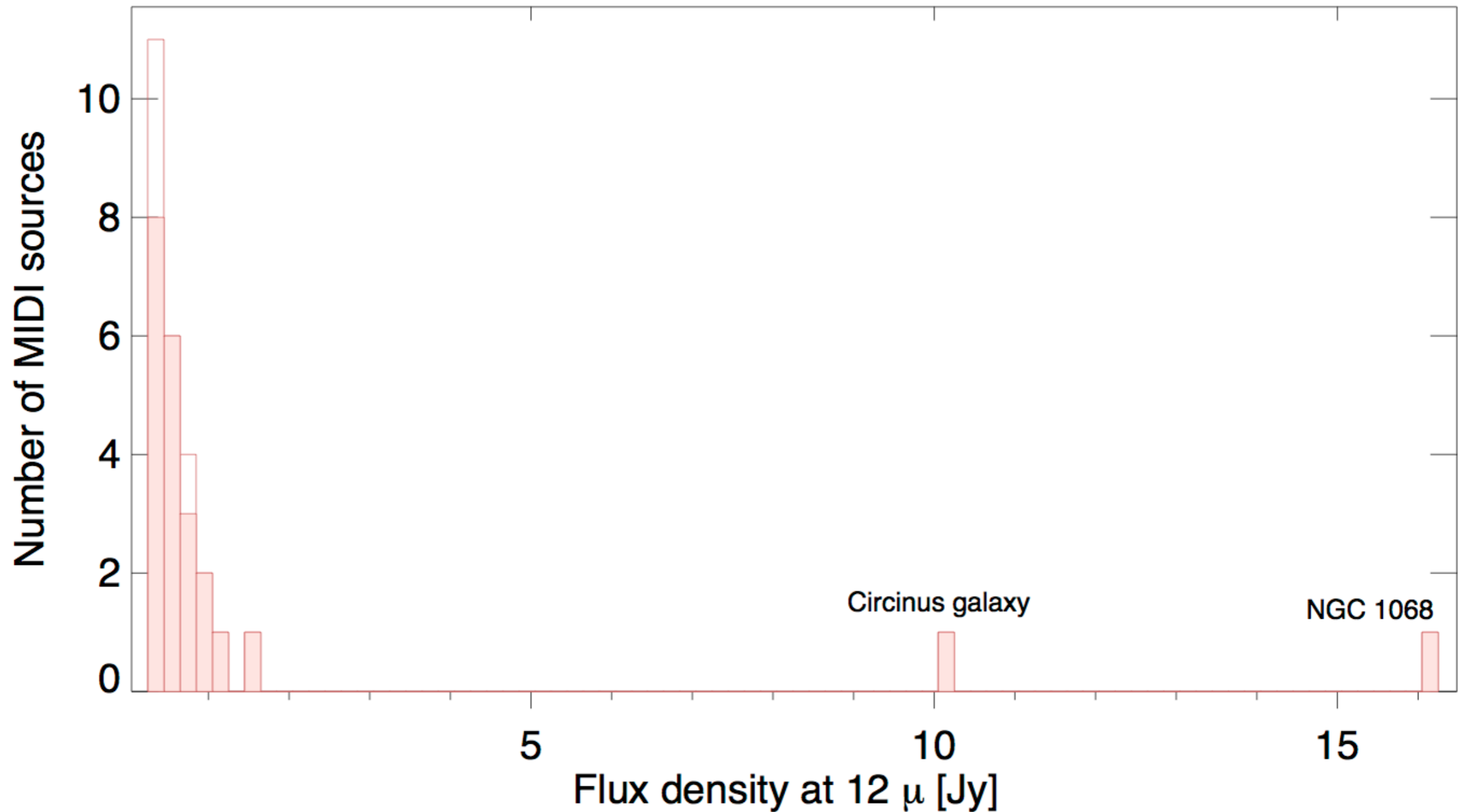


Circinus galaxy

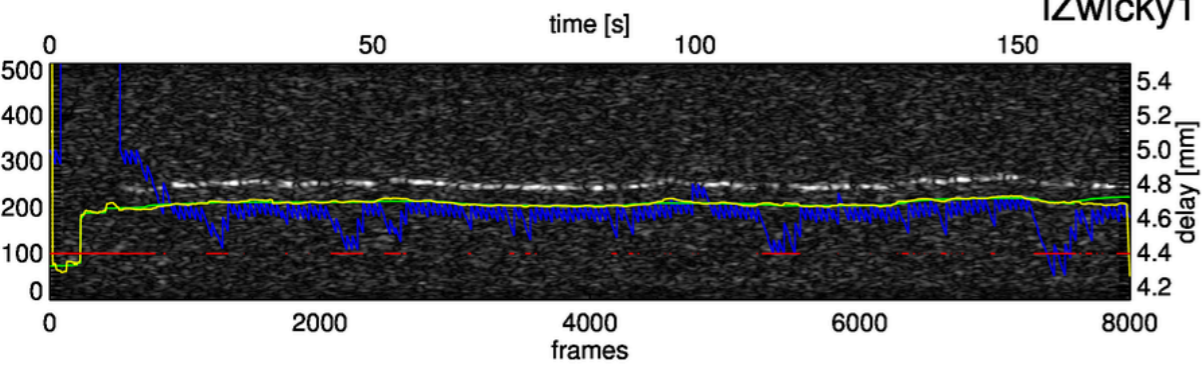
Tristram+ 2007

Tristram+ 2013

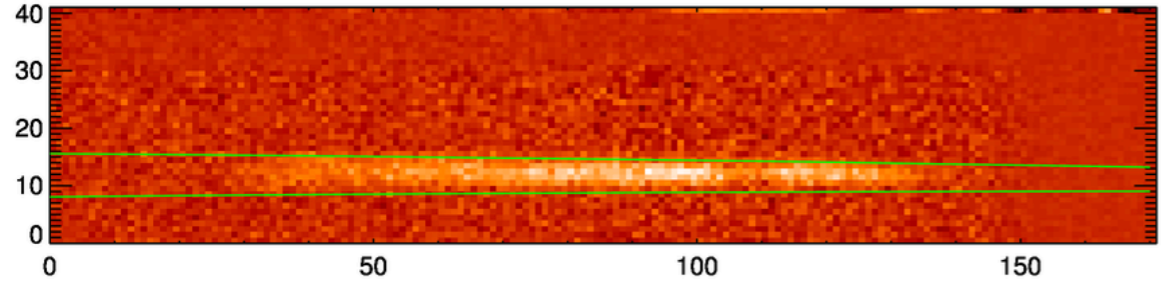
Building a large sample



IZwicky1

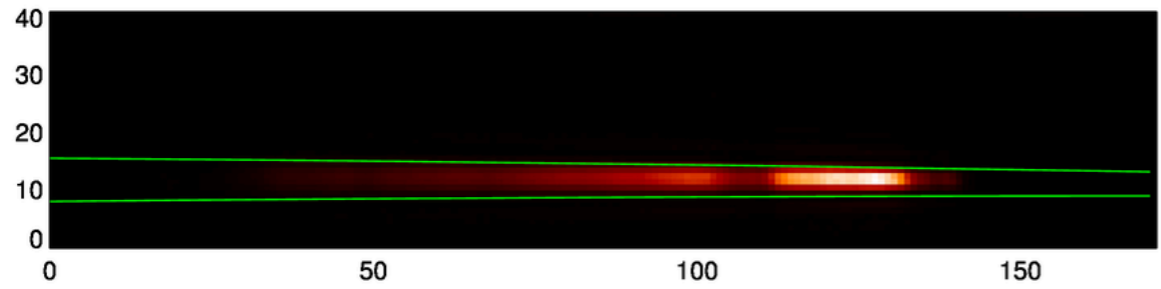


SCIENCE A+B TRACK --- float(DATA1-DATA2)
 IZwicky1 in the night of 2009-12-02 at 01:50:44 --- quality is good --- number of good frames is 5596

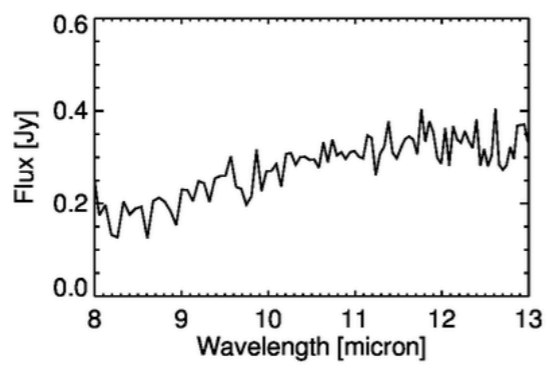
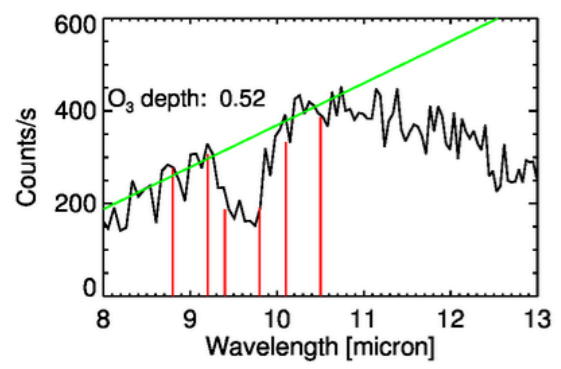
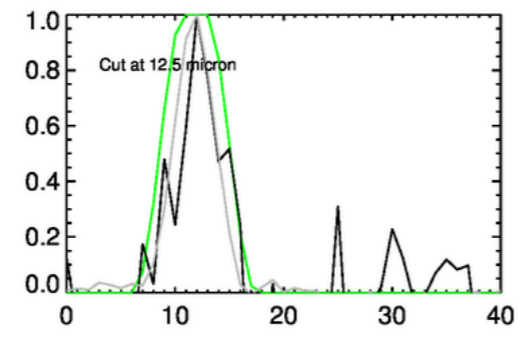
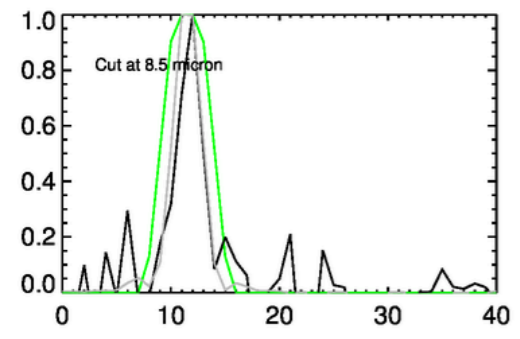


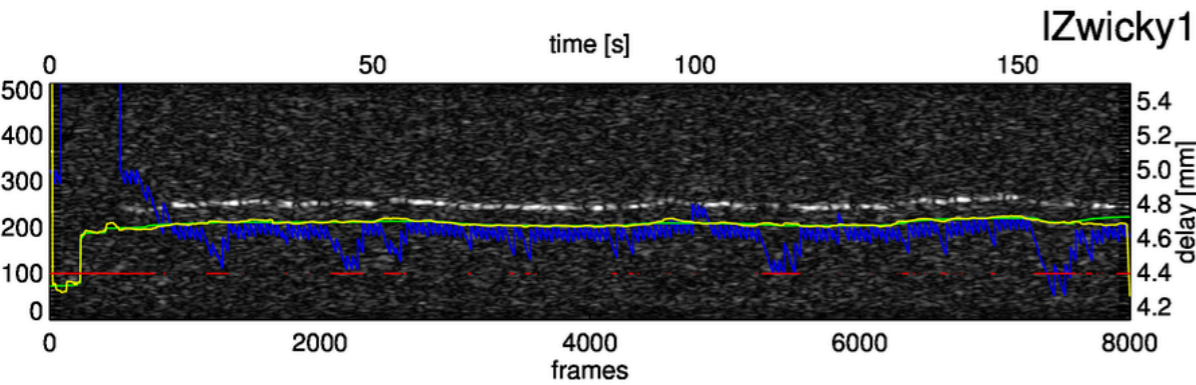
Science spectrum is shifted against cal mask by (DATA1/DATA2) 0.16, 0.15 px

CALIB A+B TRACK --- float(DATA1-DATA2)
 HD9138 in the night of 2009-12-02 at 02:43:22 --- quality is good --- number of good frames is 7522

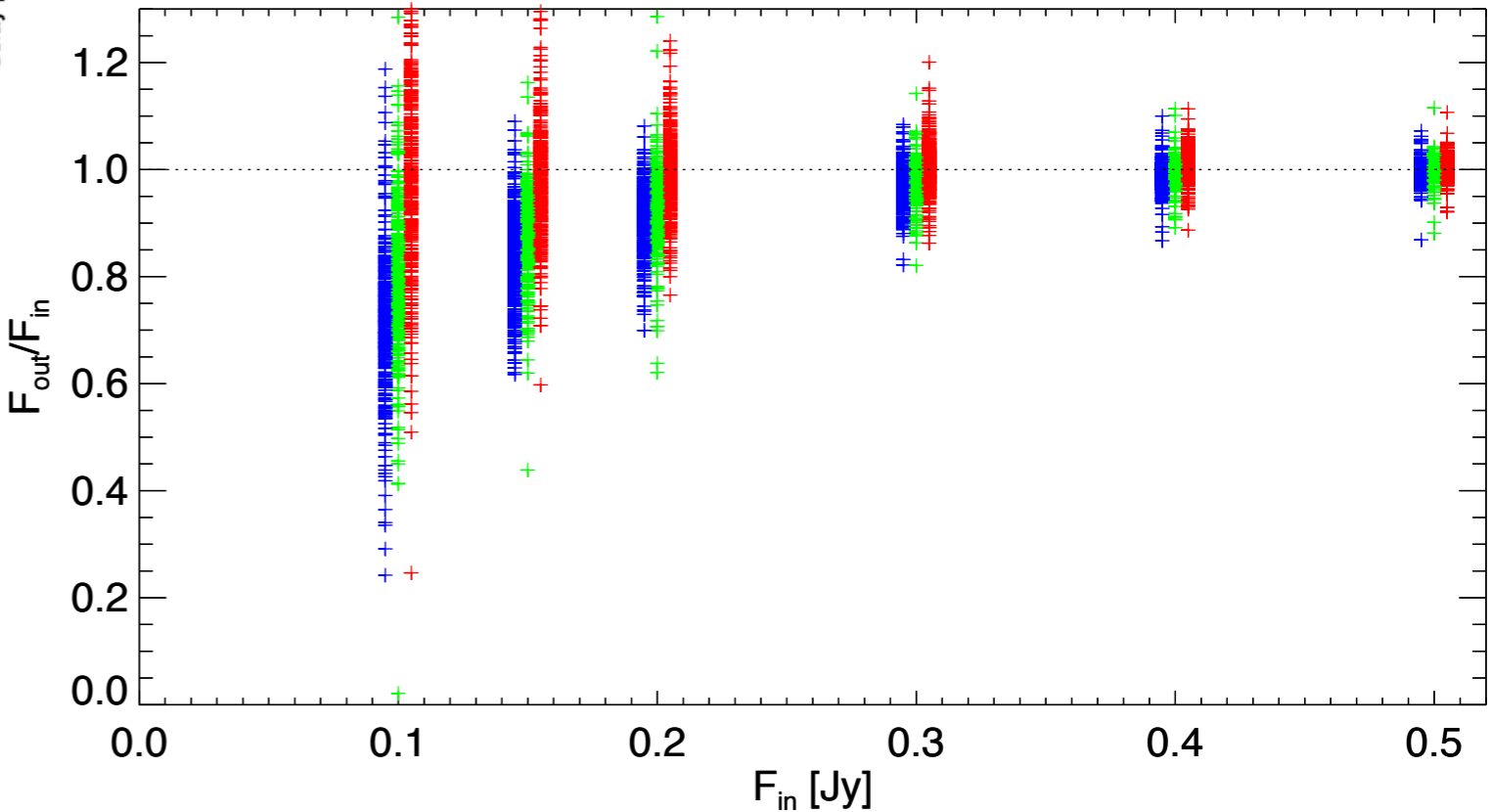


Science target airmass: 1.31200 Average DIMM seeing for science obs: 1.43000

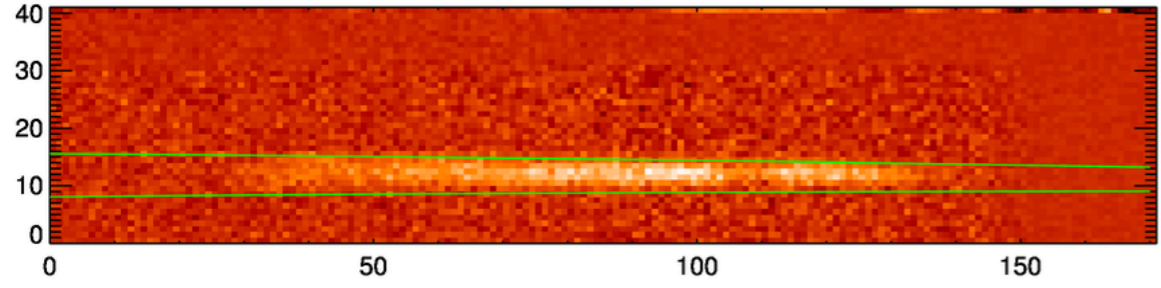




We had to learn to trust the data reduction

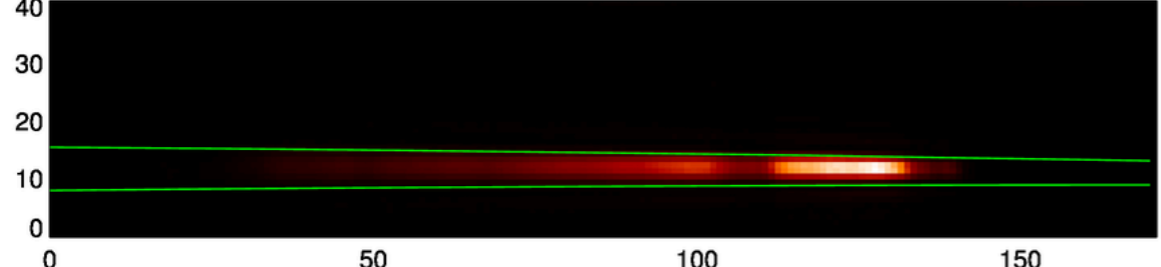


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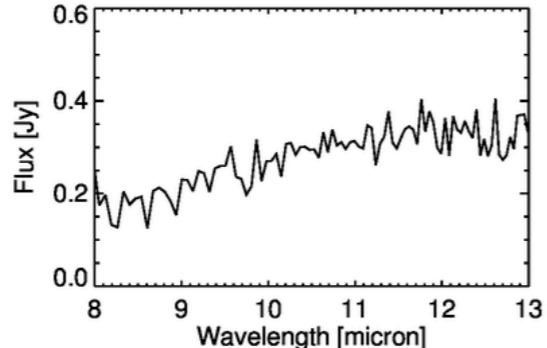
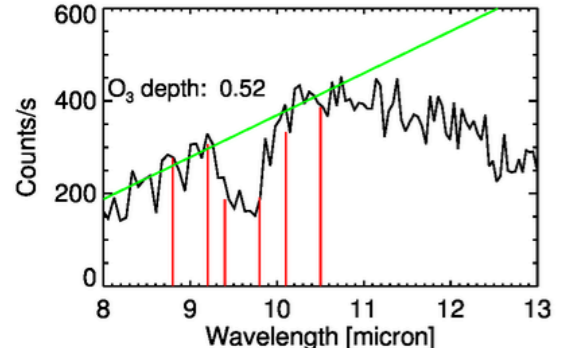
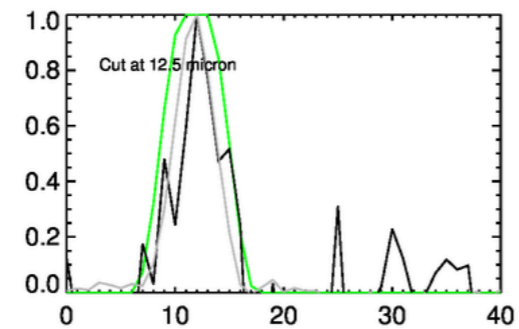
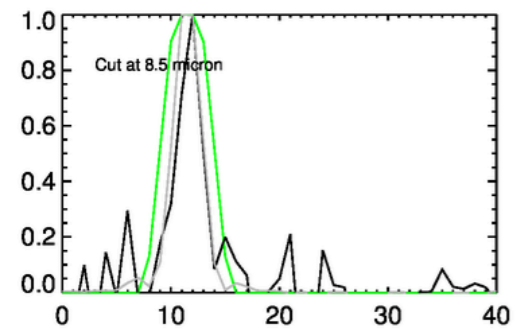
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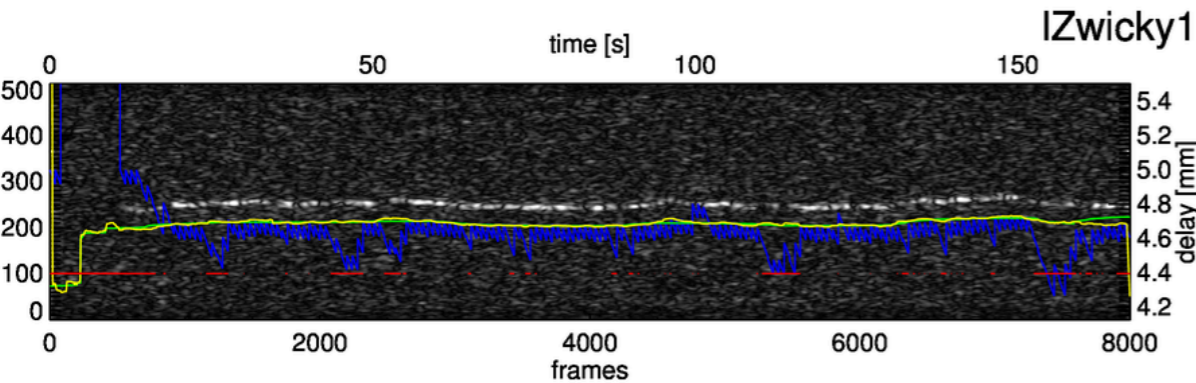
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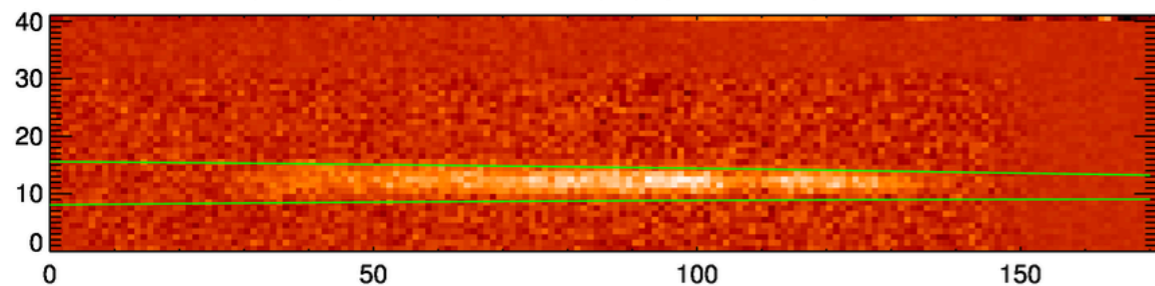
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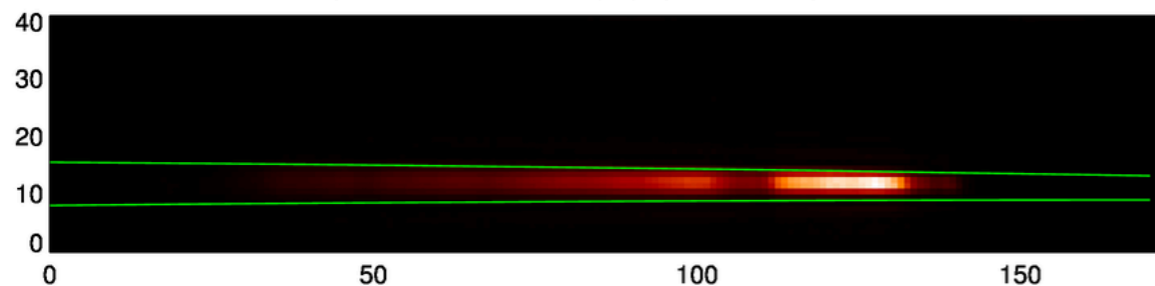


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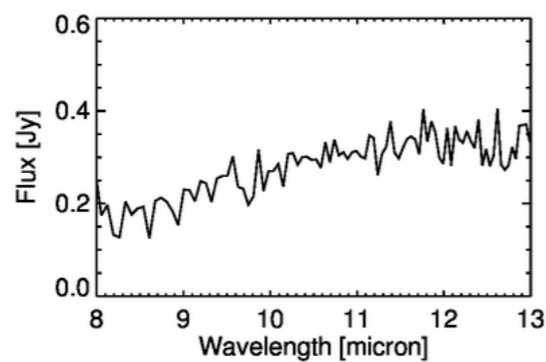
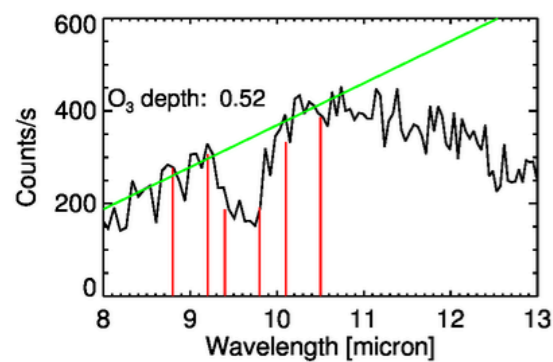
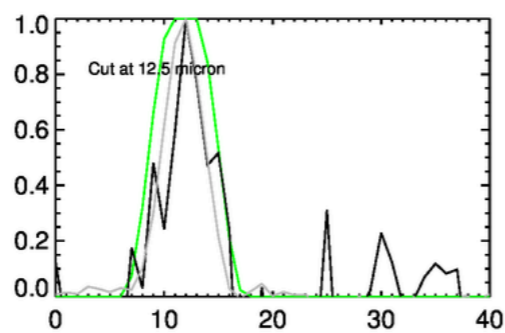
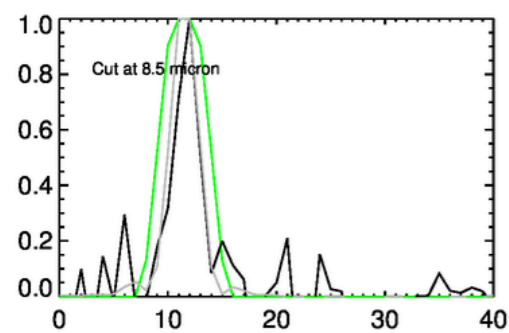
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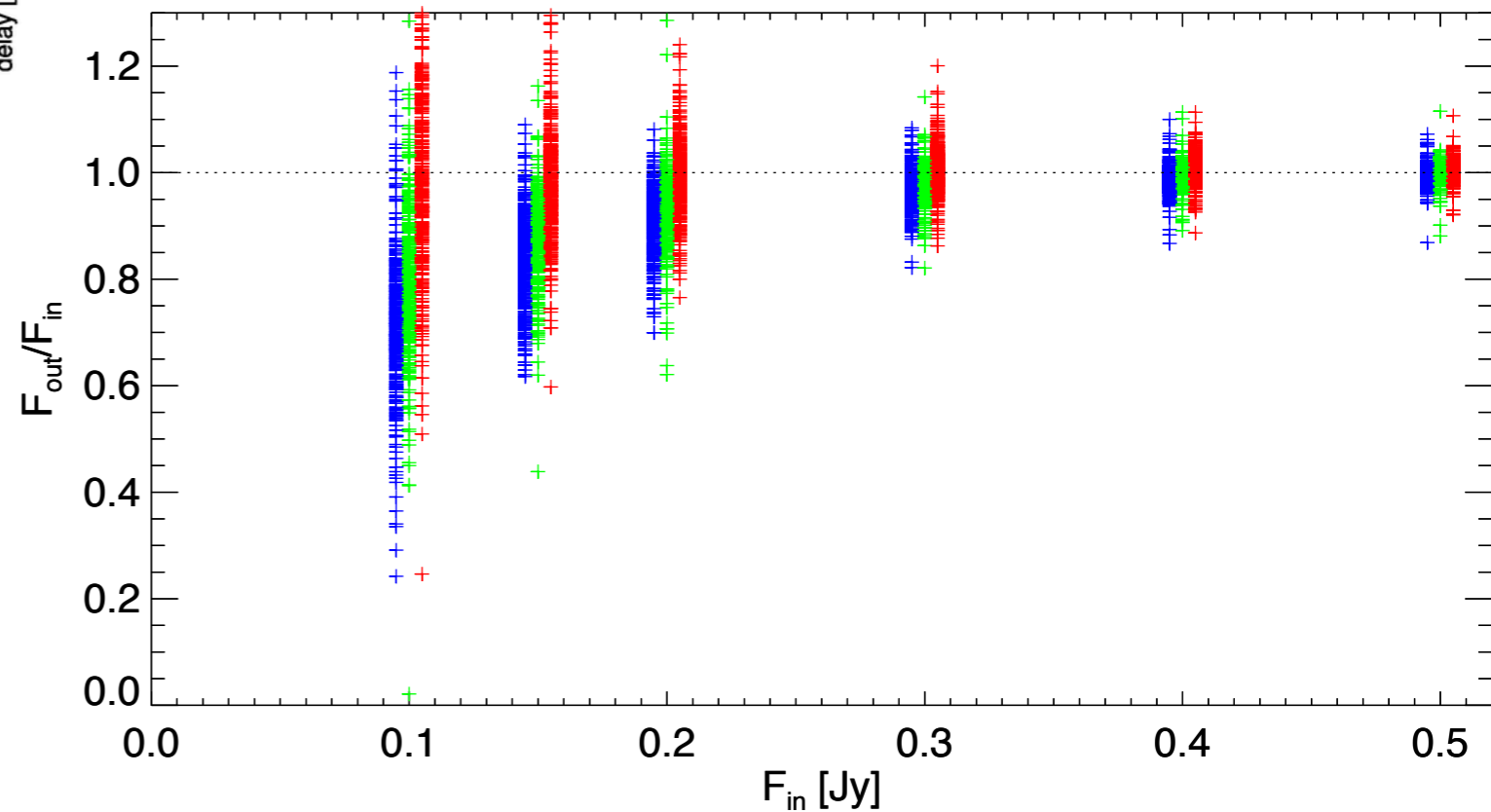


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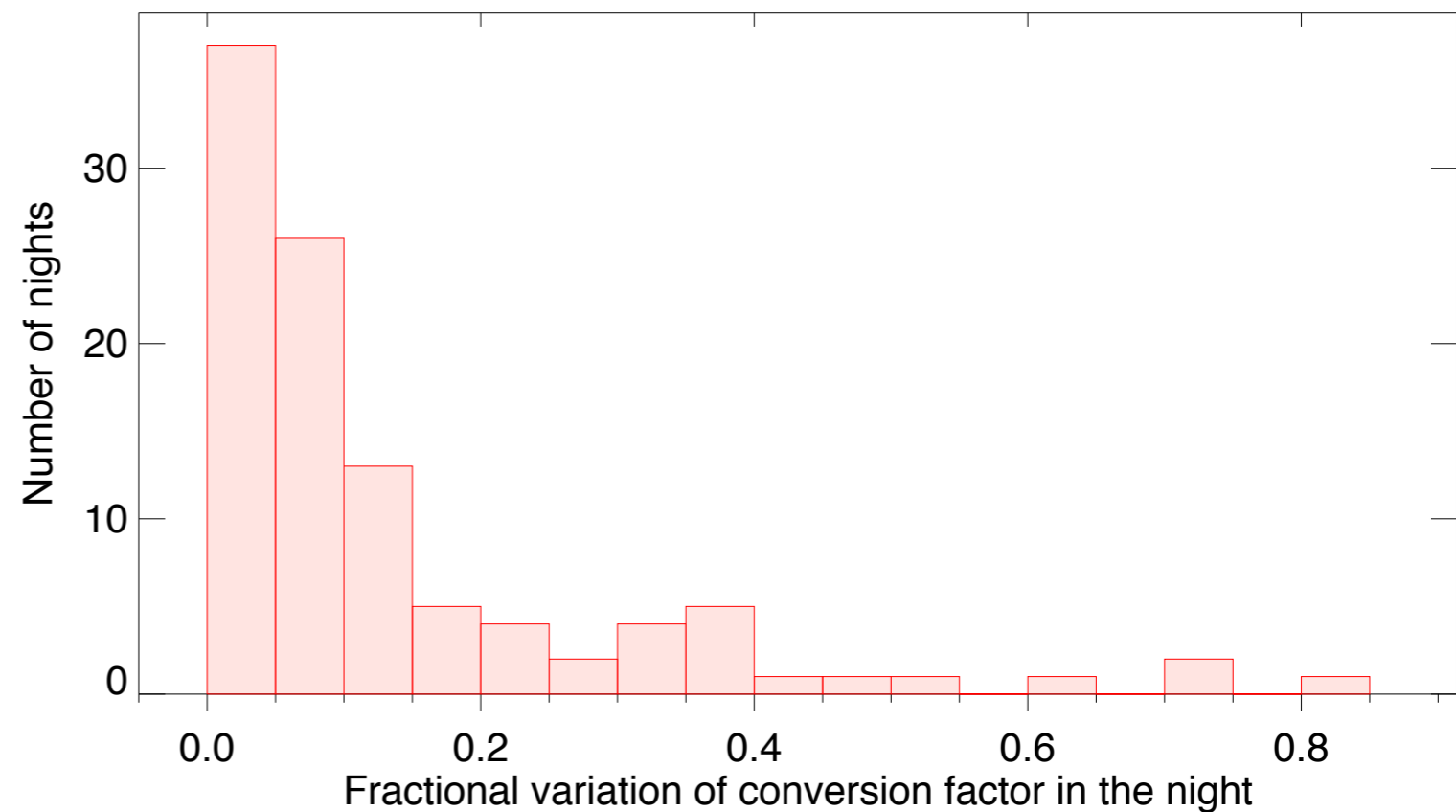
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We had to learn to trust the data reduction



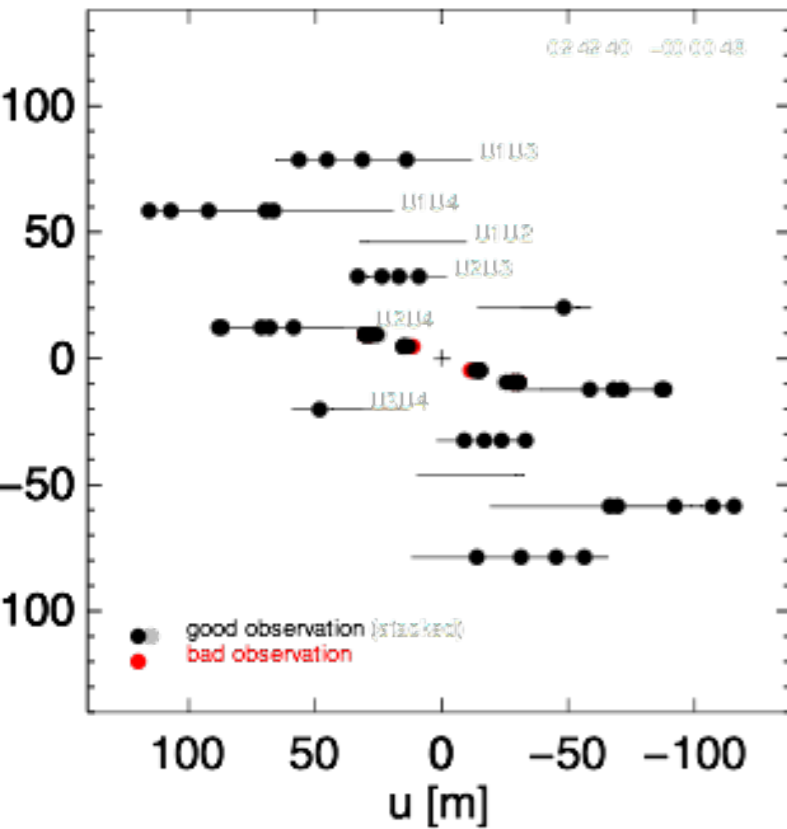
...and to trust in the new calibration scheme



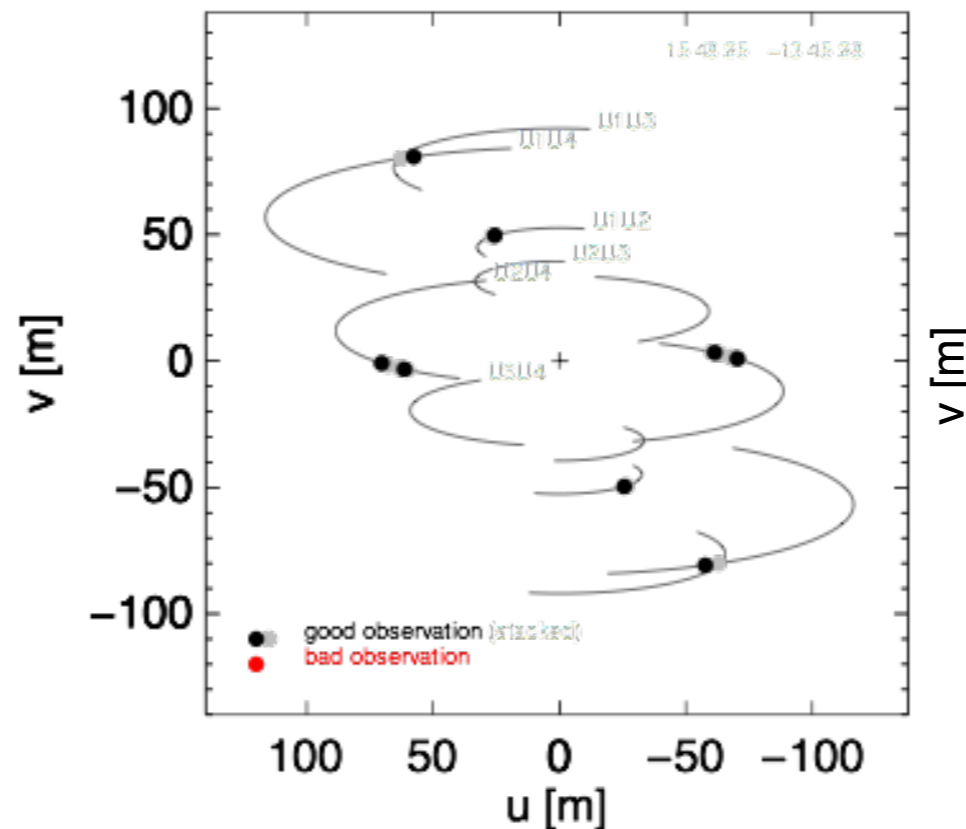
Burtscher+ 2012,2013

(u,v) coverages [Examples]

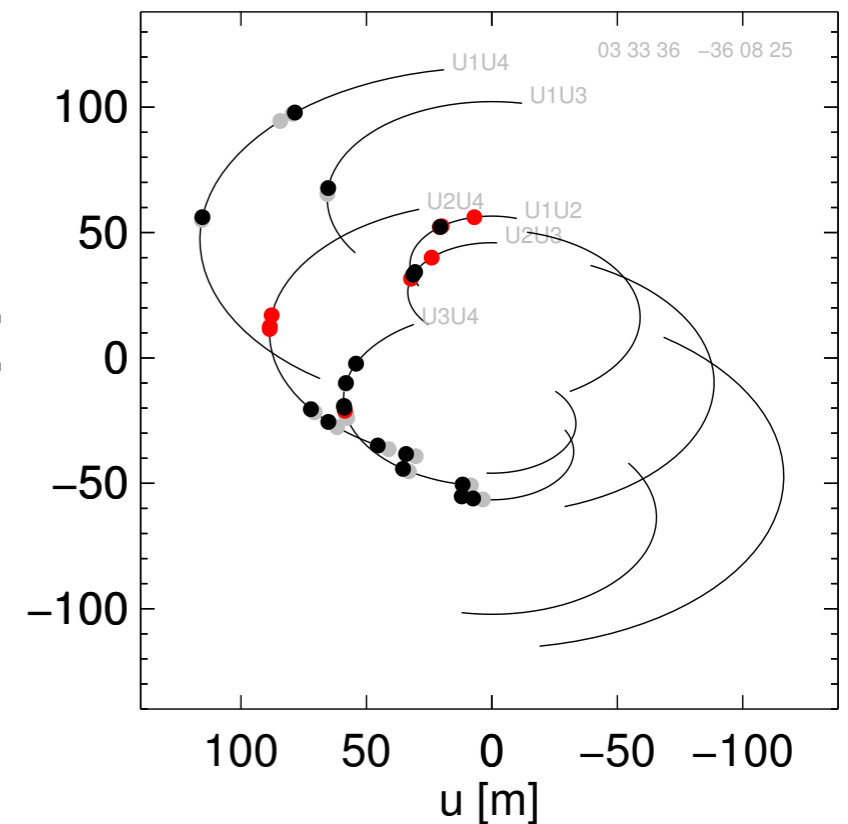
NGC1068



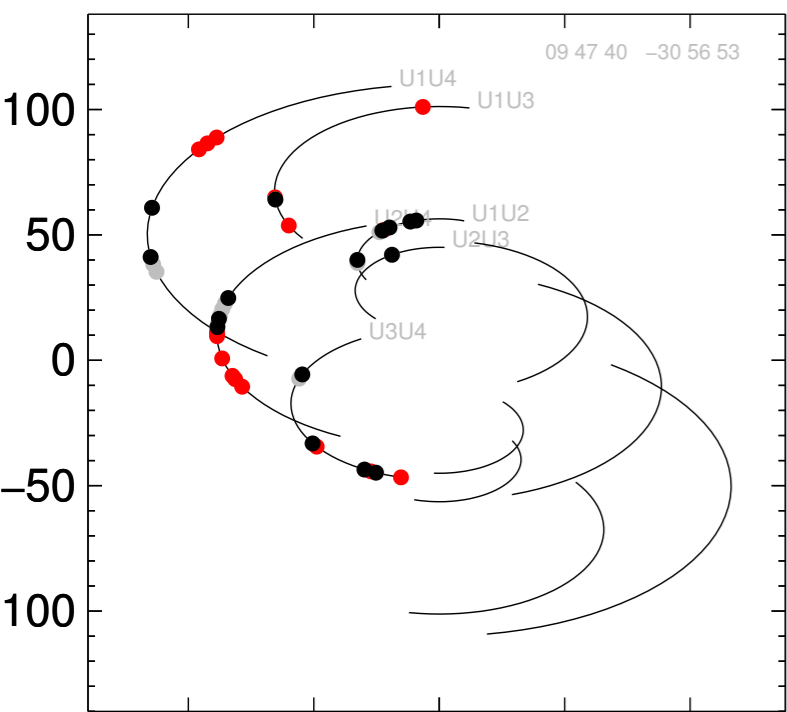
NGC5995



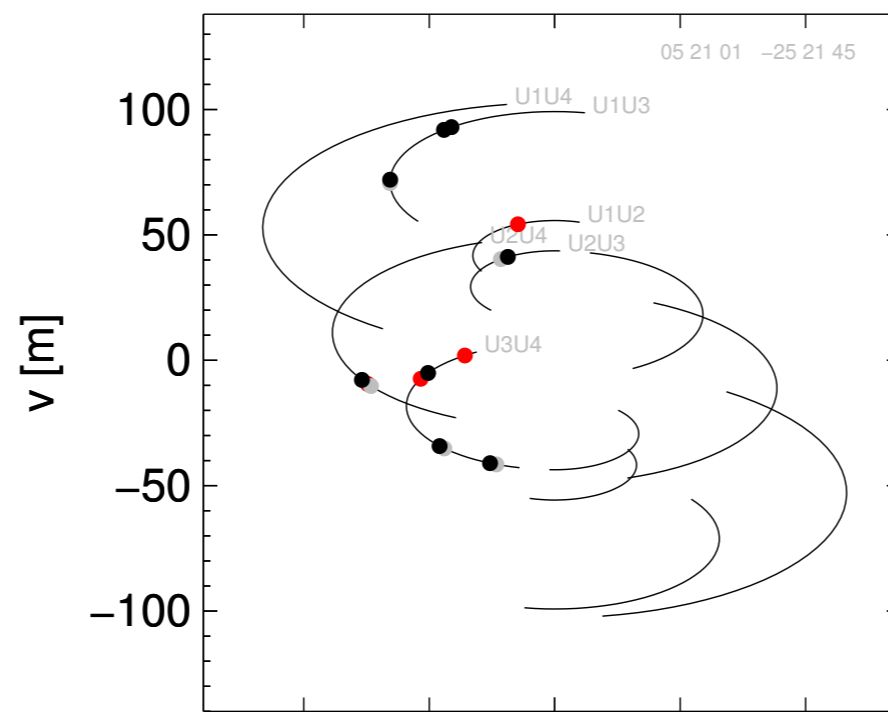
NGC1365



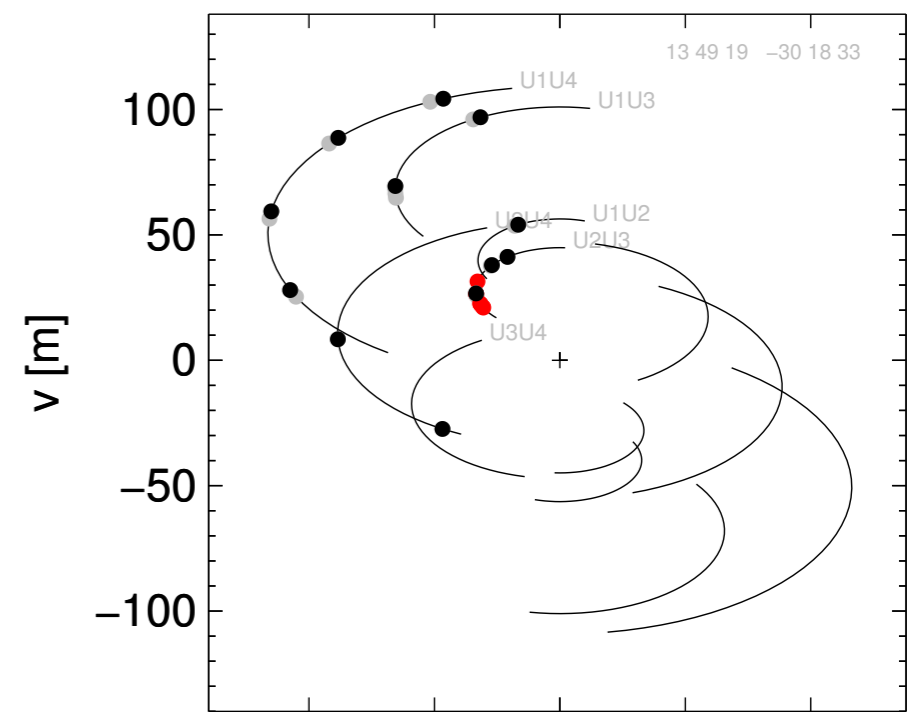
MCG-5-23-16



LEDA17155



IC4329A



Results on 23 AGNs

Diverse population, but mostly Seyfert galaxies with
 $10^{43} < L_{\text{MIR}} [\text{erg/s}] < 10^{44}$ $10 < D [\text{Mpc}] < 100$

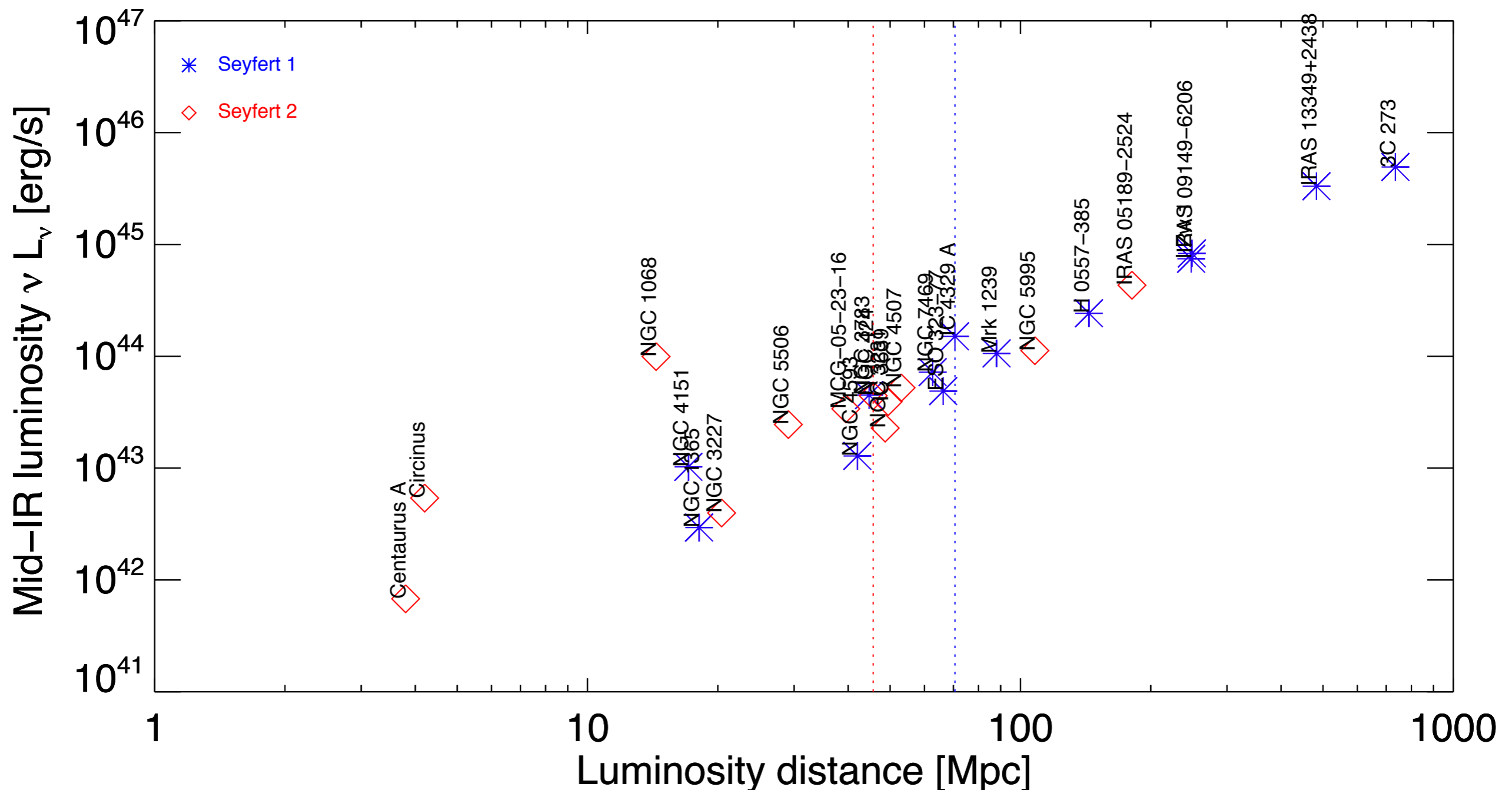
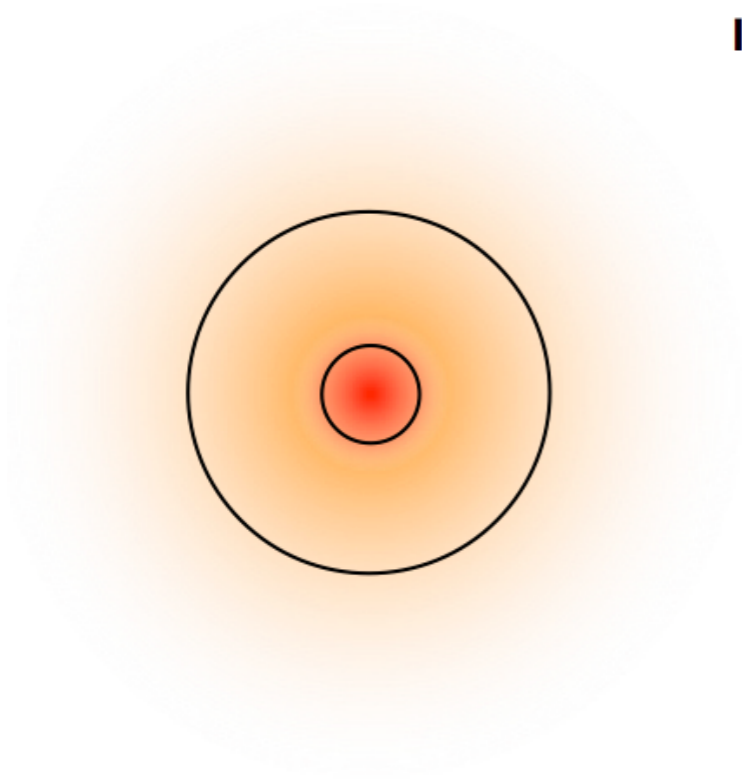


Image space (Intensity distribution)



resolved and
unresolved
(case 1)

Fourier space (Visibility)

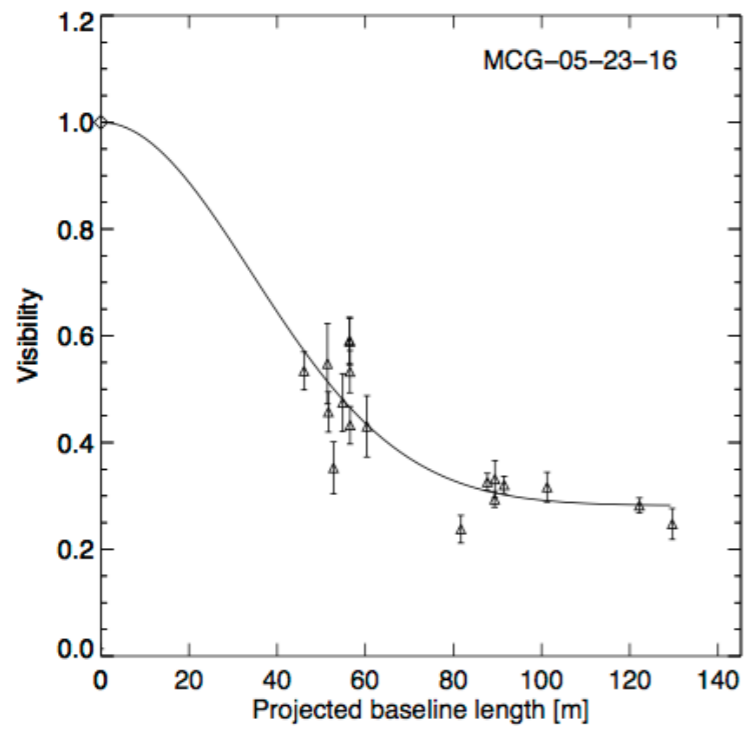
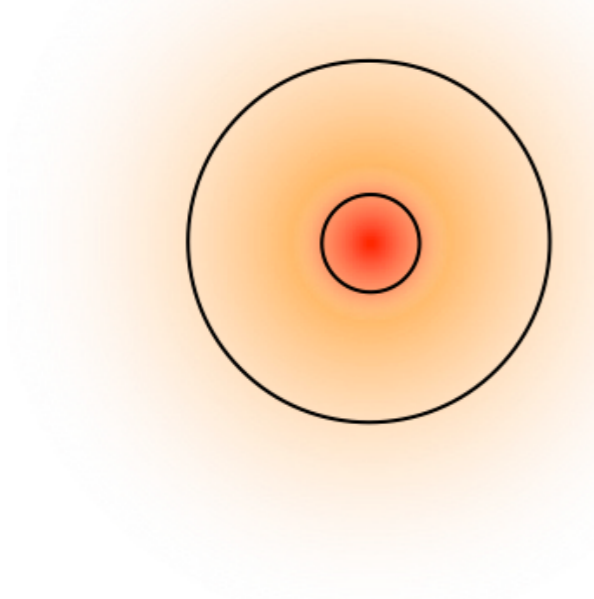
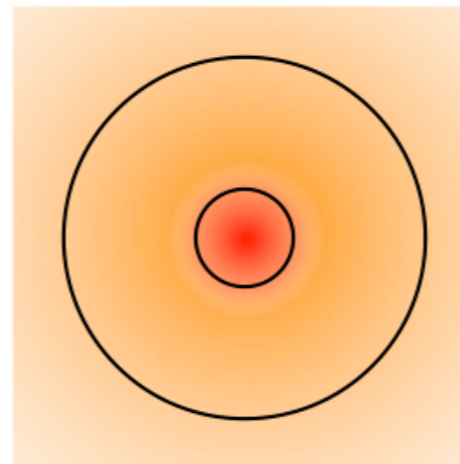


Image space (Intensity distribution)



**resolved and
unresolved
(case 1)**



**over-resolved and
unresolved
(case 2)**

Fourier space (Visibility)

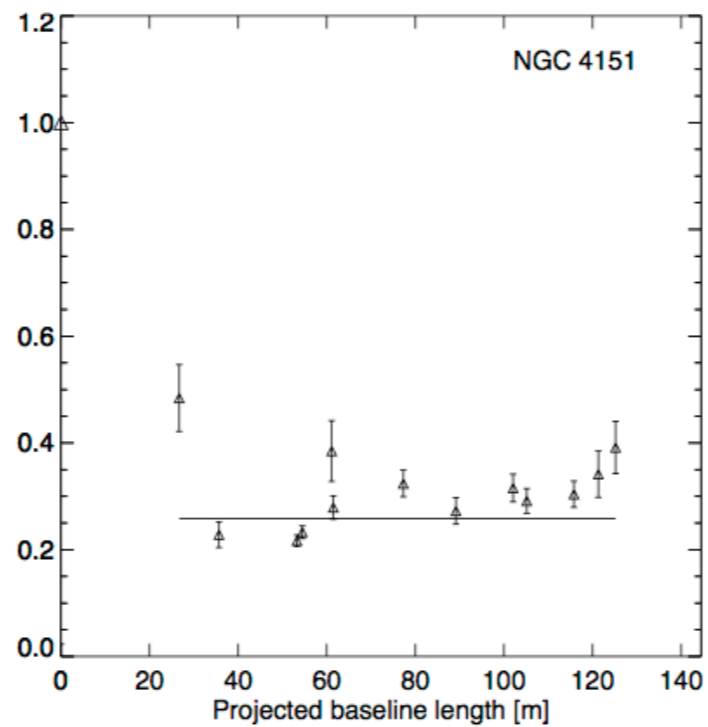
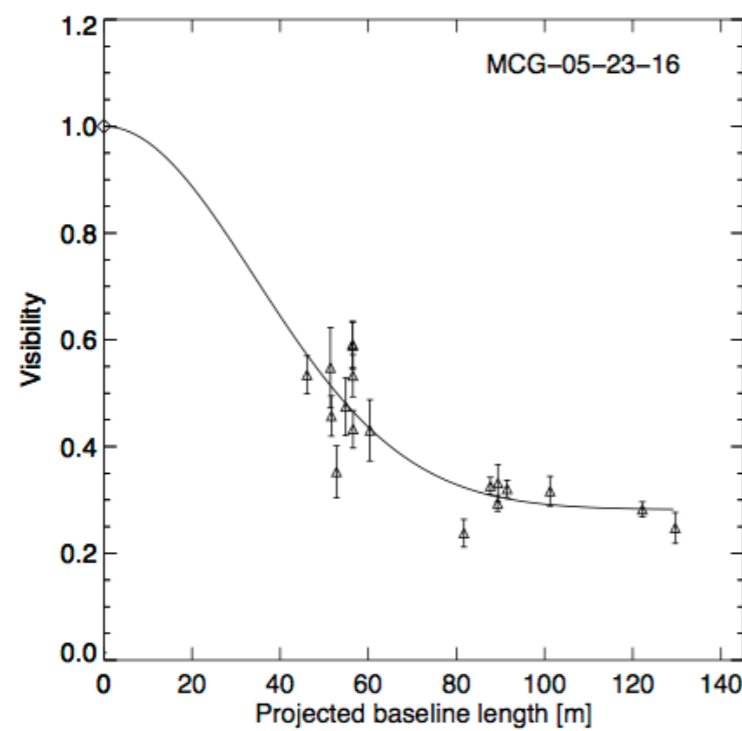
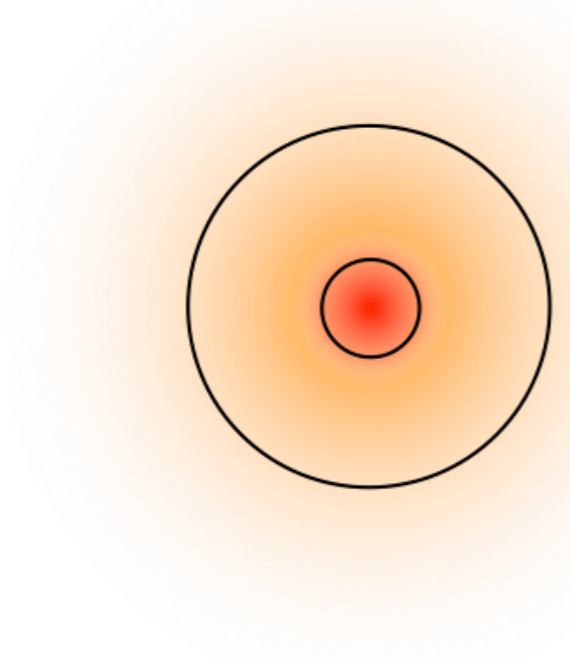
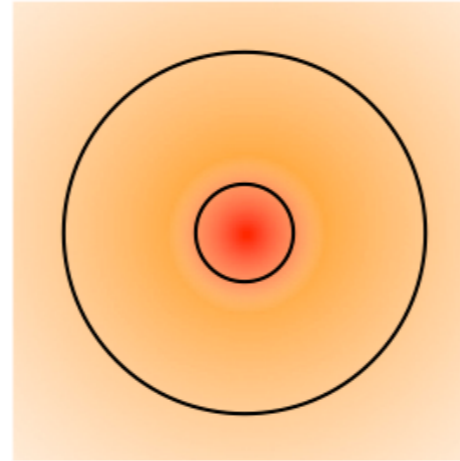


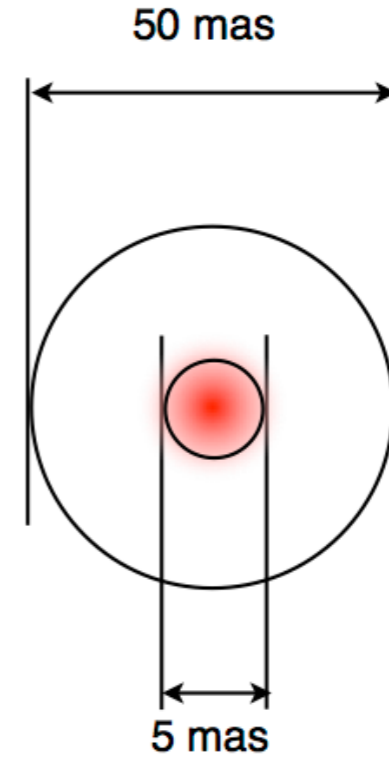
Image space (Intensity distribution)



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unresolved
(case 1)**

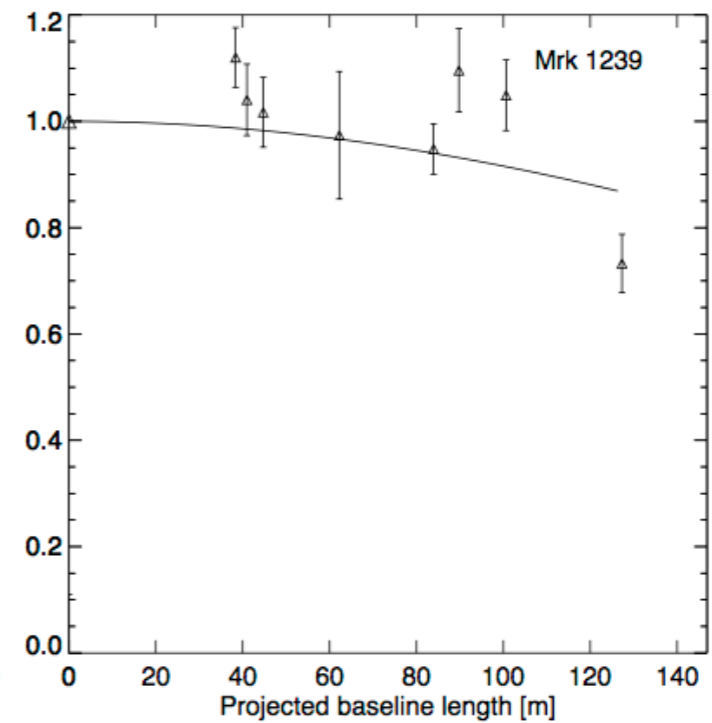
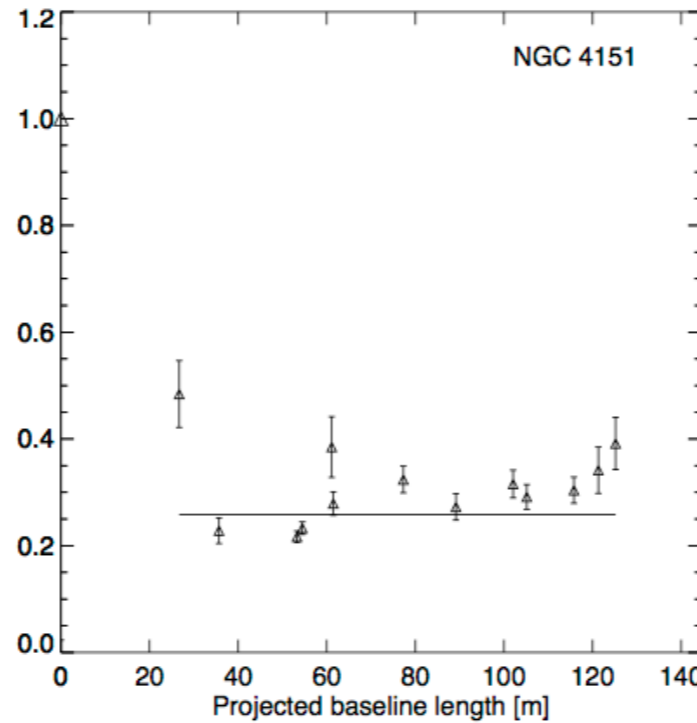
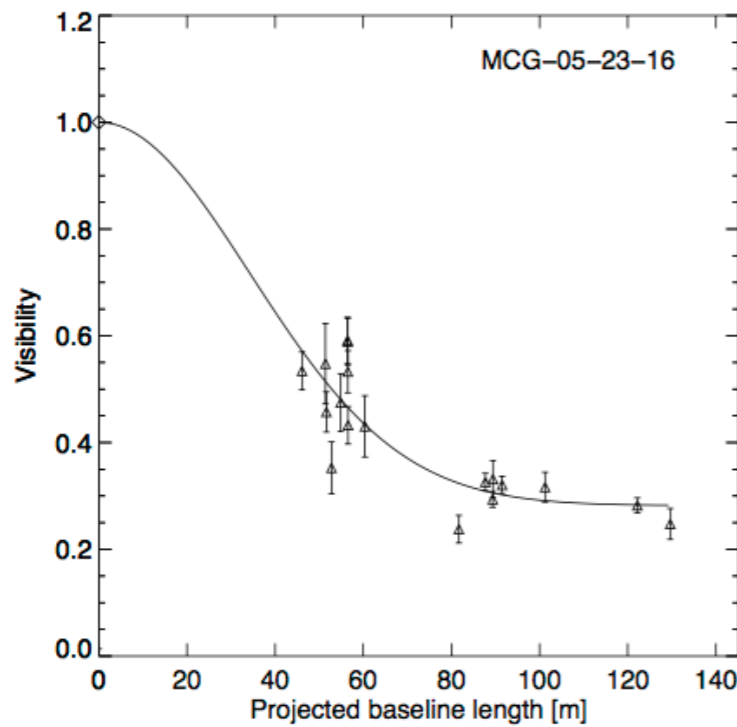


**over-resolved and
unresolved
(case 2)**



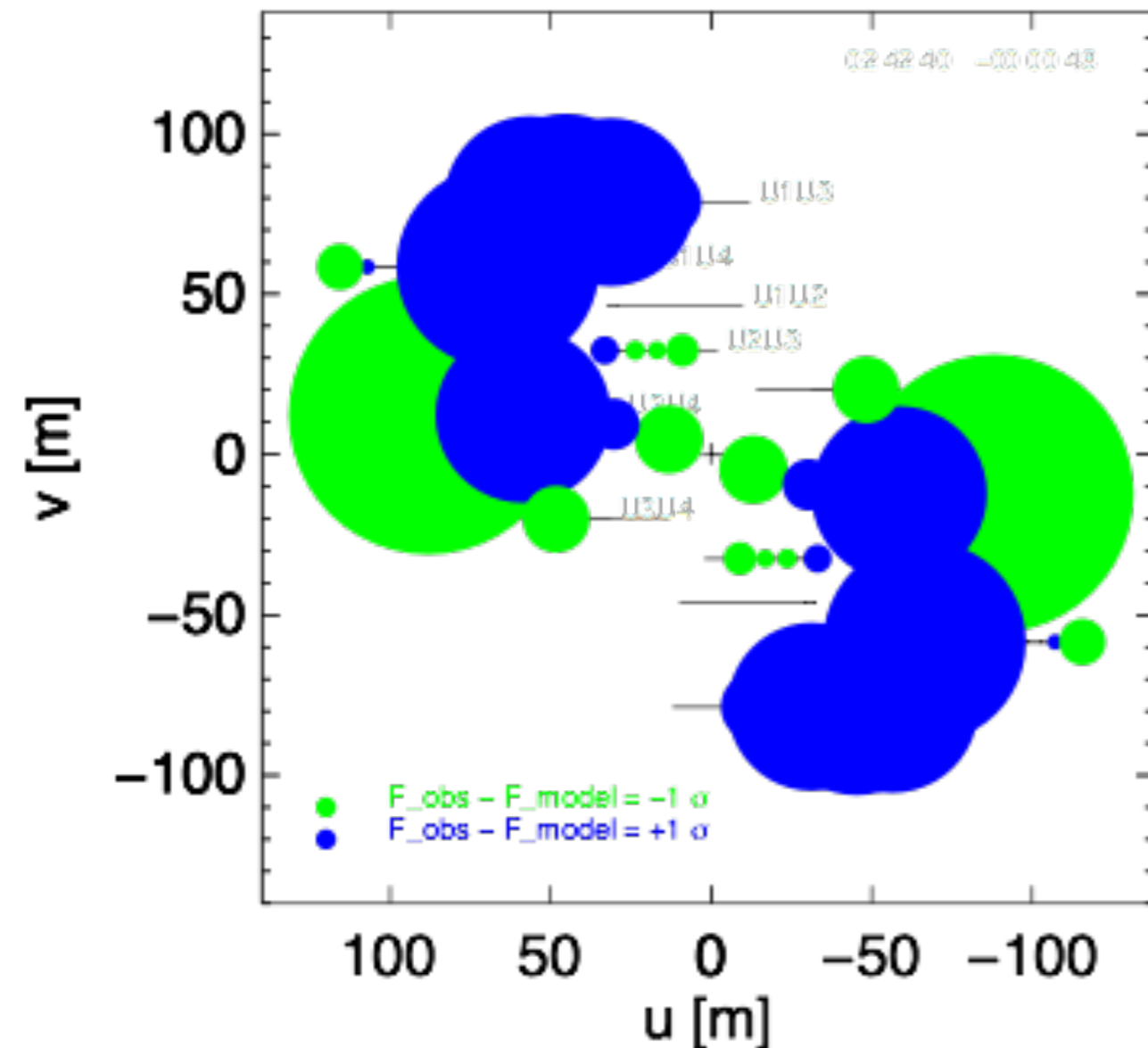
**essentially
unresolved
(case 3)**

Fourier space (Visibility)



Elongations?

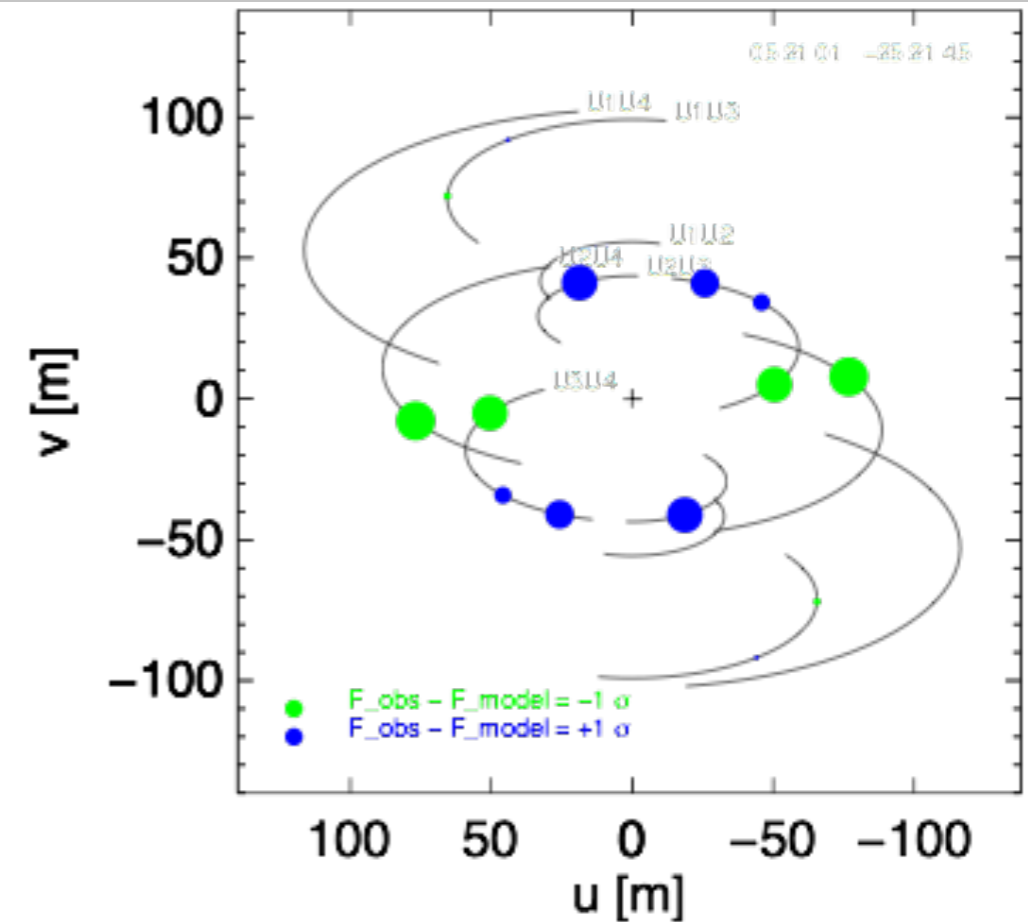
NGC1068



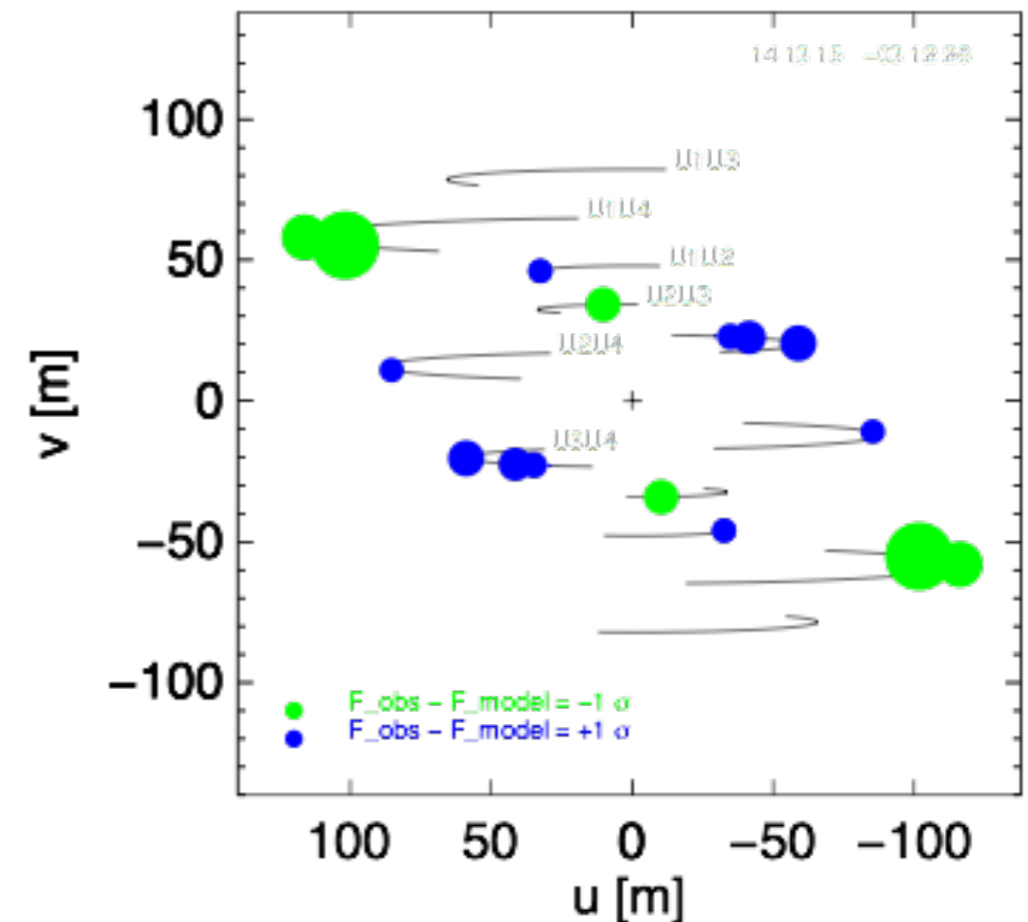
► Hard to detect in weak sources.

Lopez-Gonzaga+ in prep.; see also Hönig+ 2012, 2013

LEDA17155



NGC5506

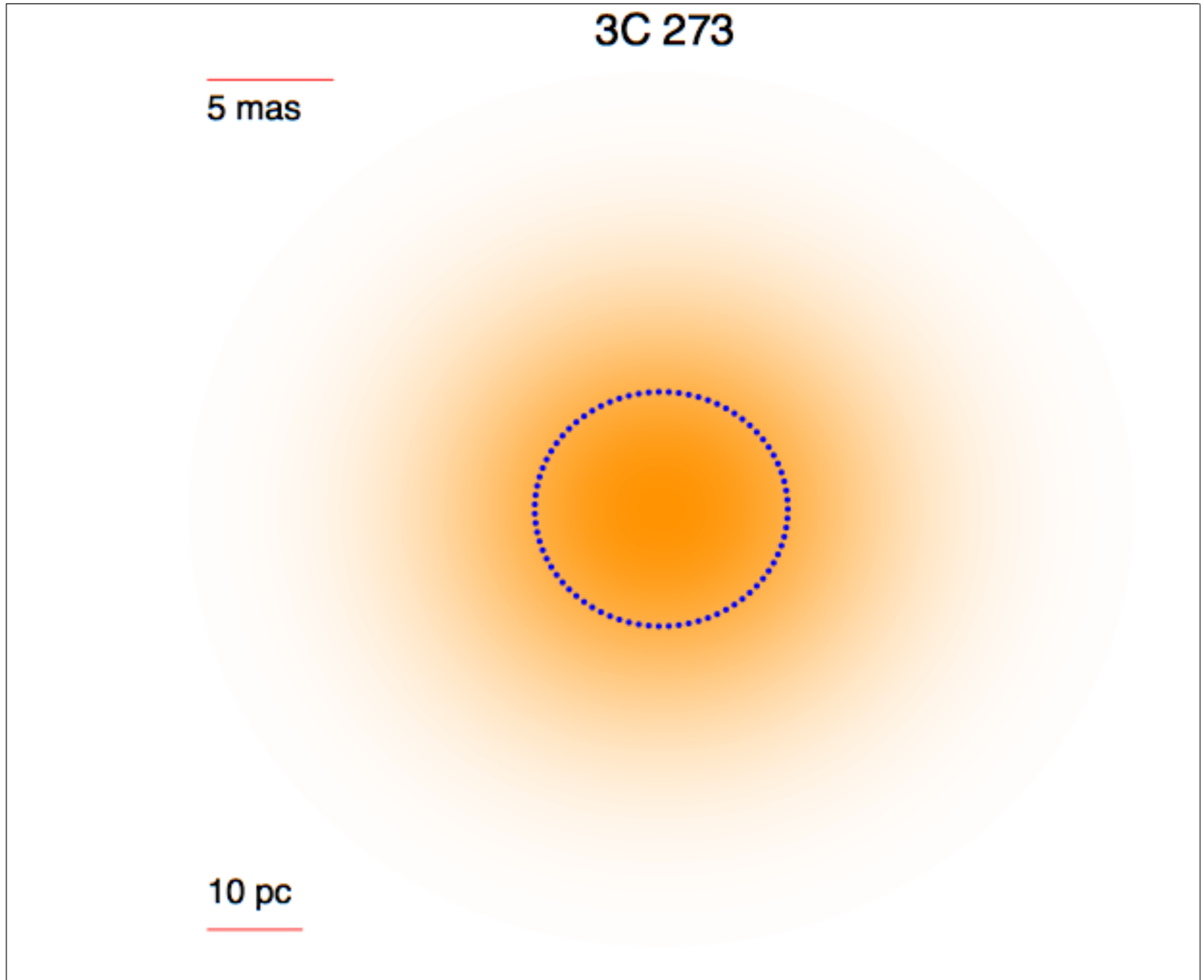


Centaurus A

5 mas

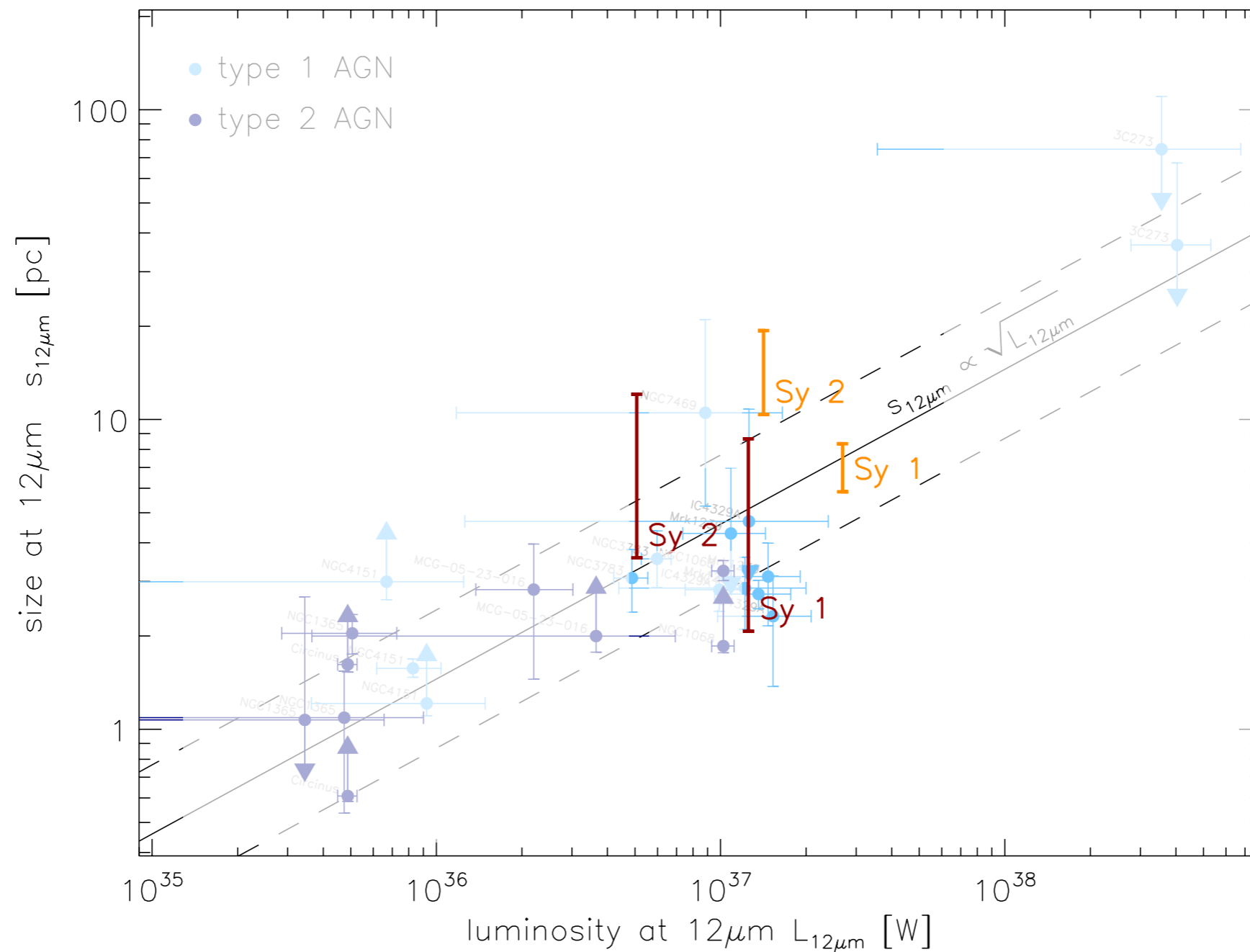


10 pc



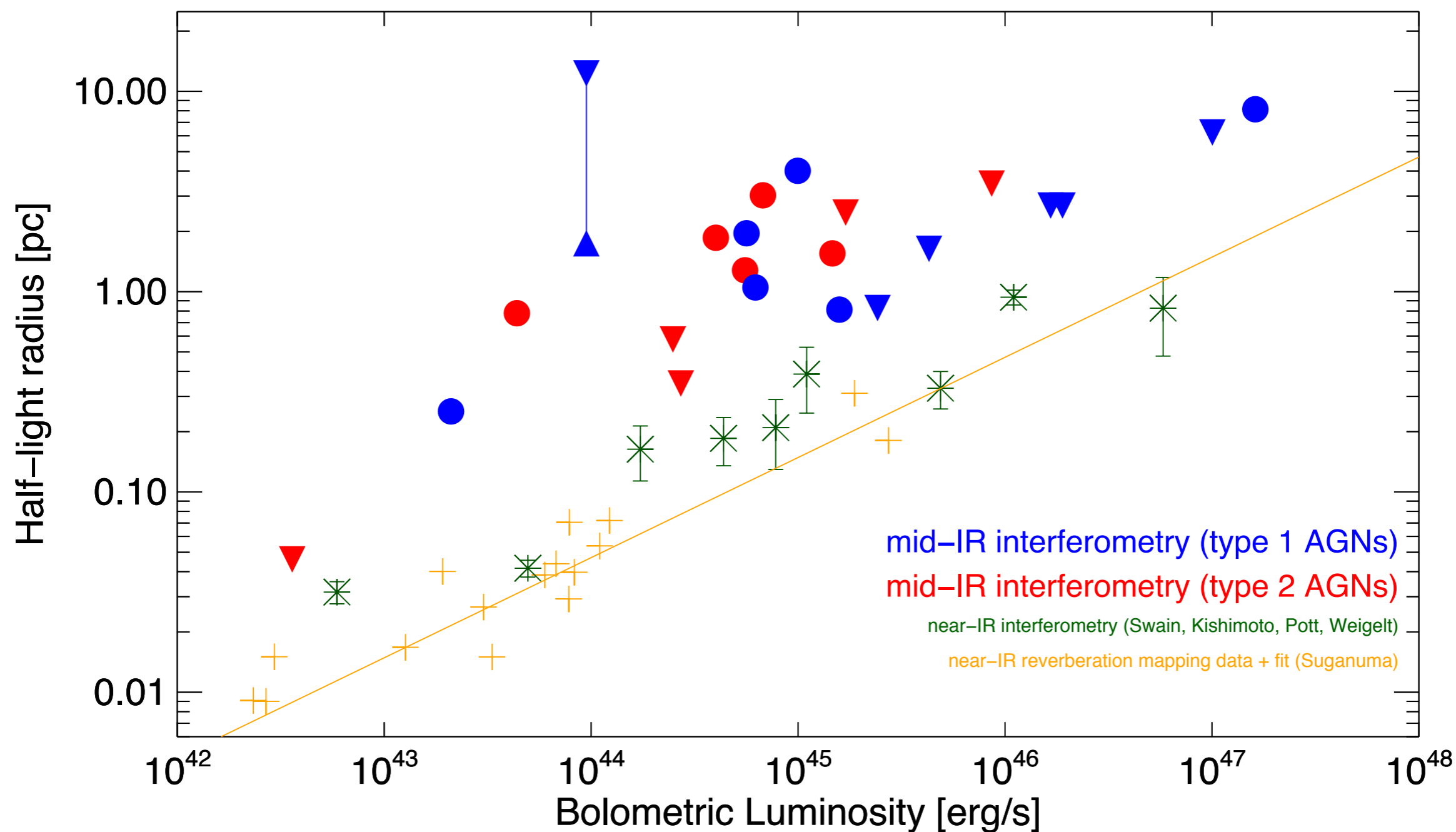
The size-luminosity relation

Tori appear larger when seen edge-on



The size-luminosity relation

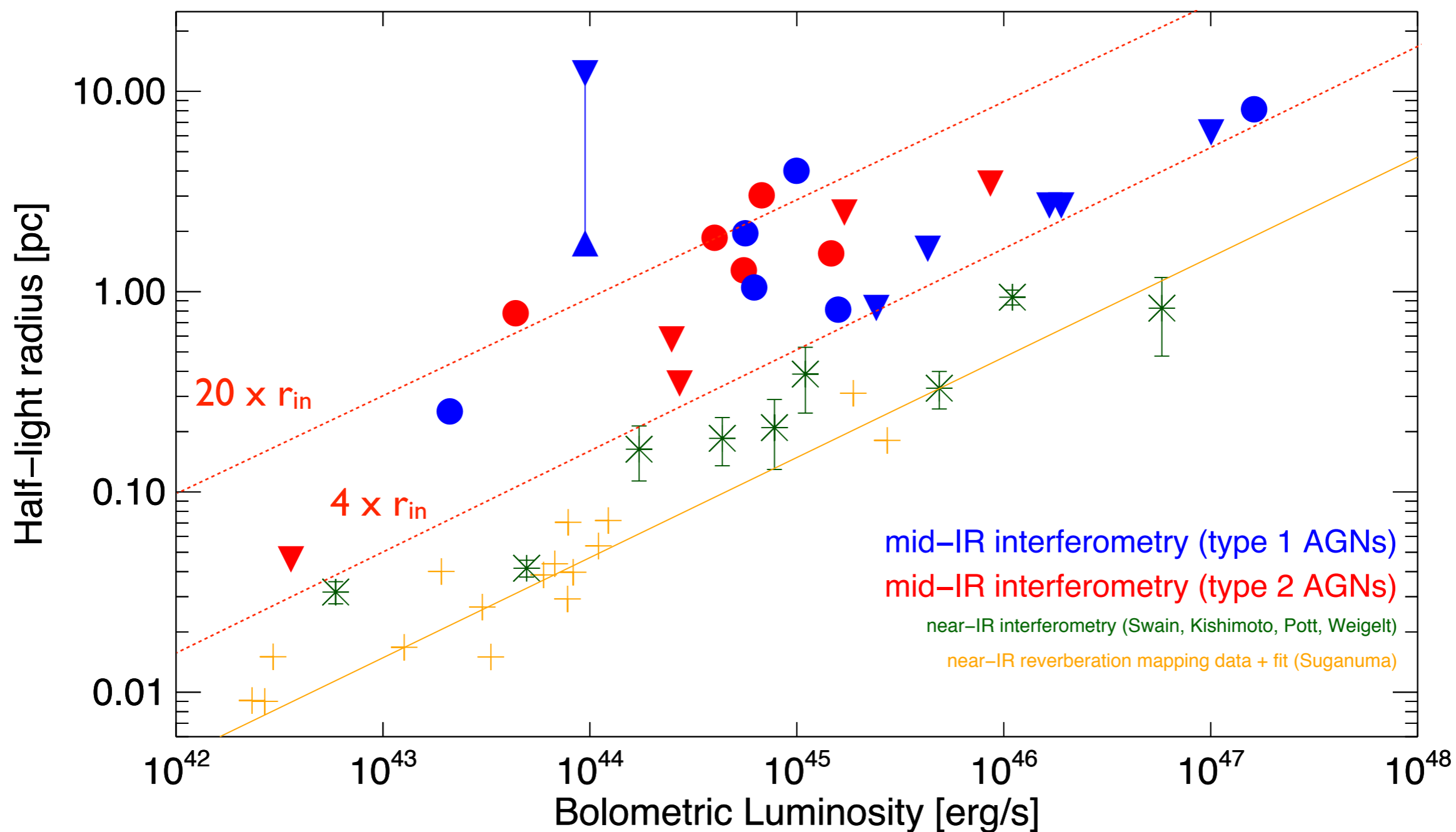
No difference type 1/2



The size-luminosity relation

No difference type 1/2

More scatter at 10 μm ?

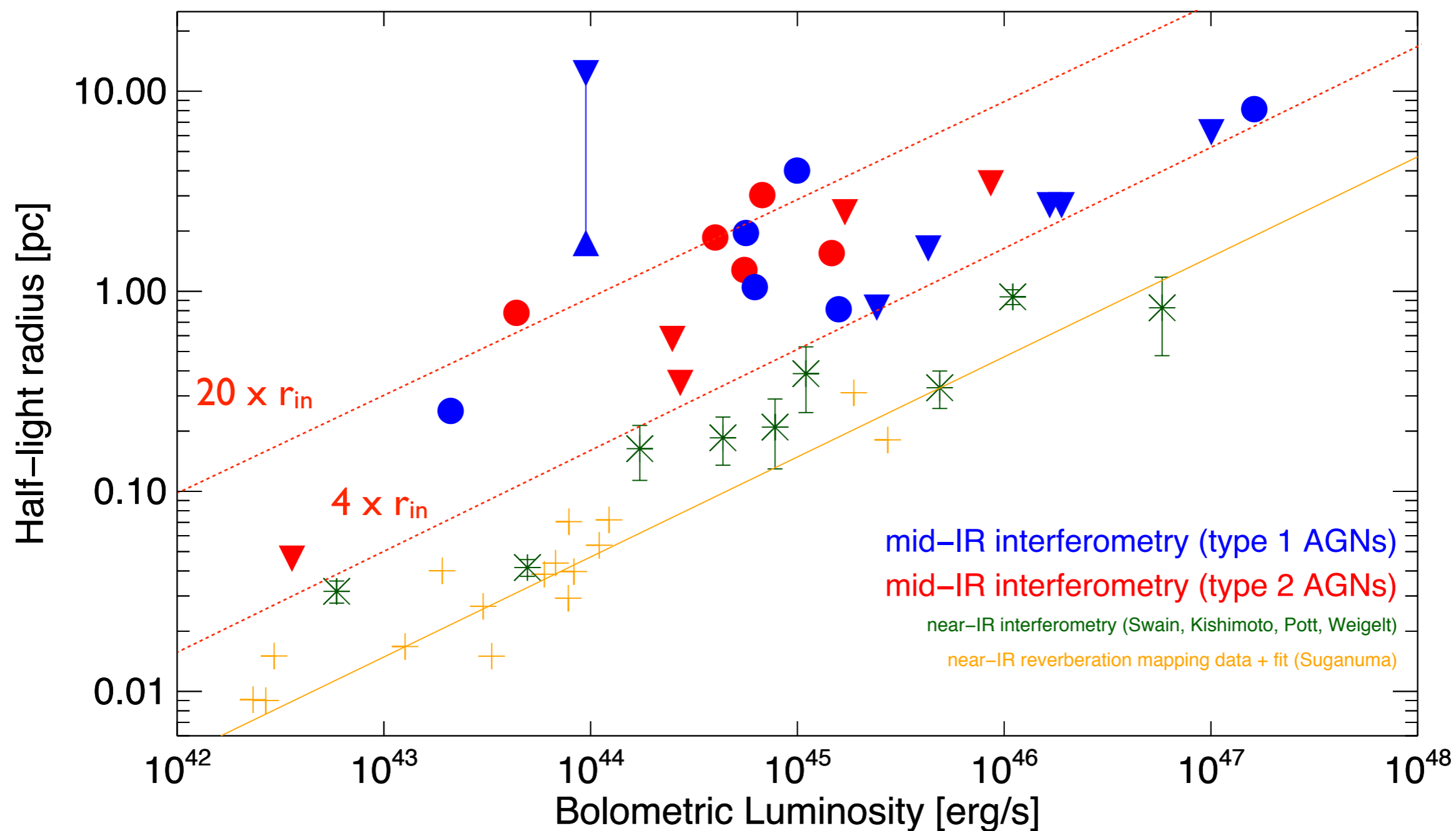


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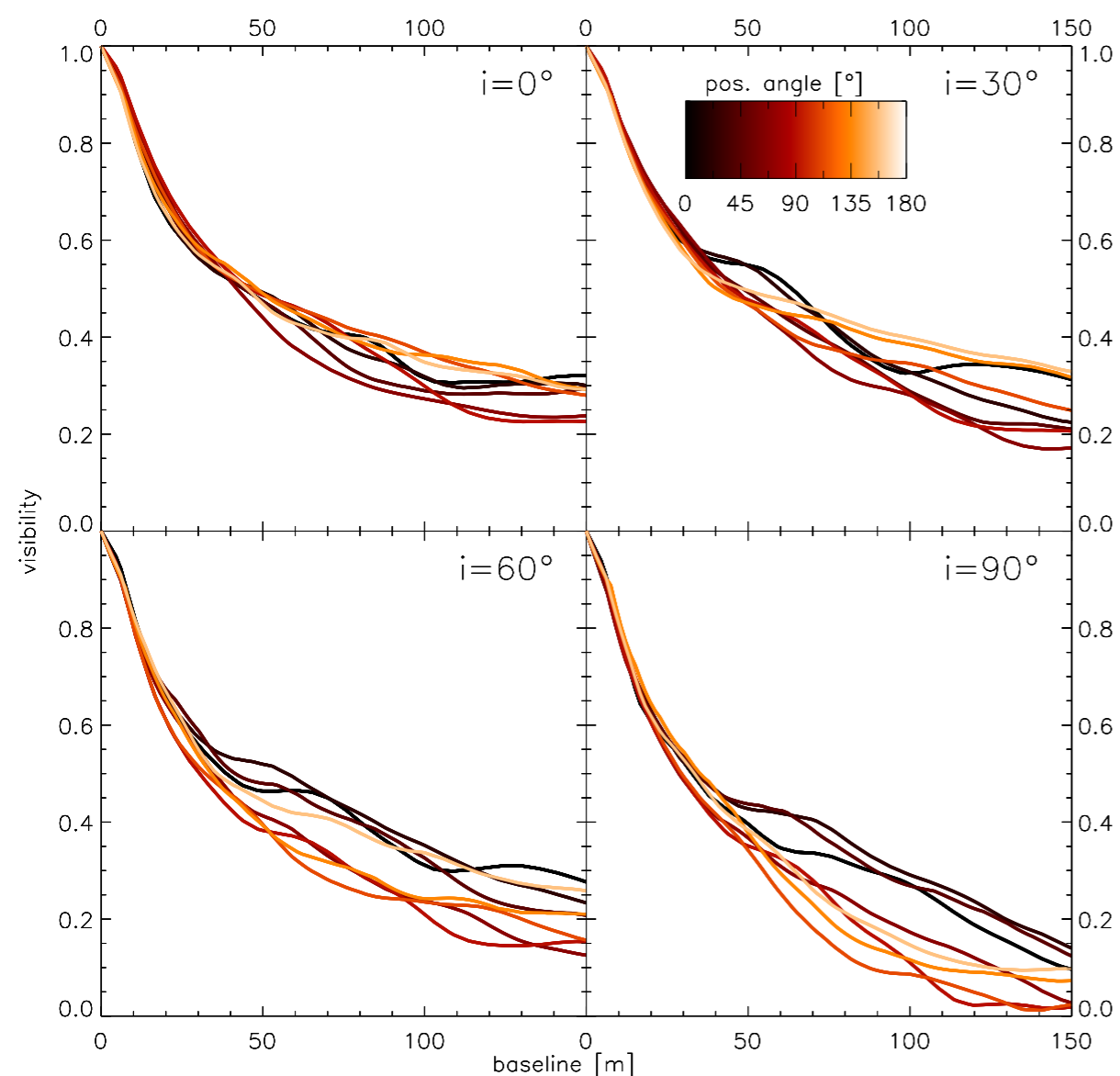
More scatter at 10 μm ?

Is size meaningful?



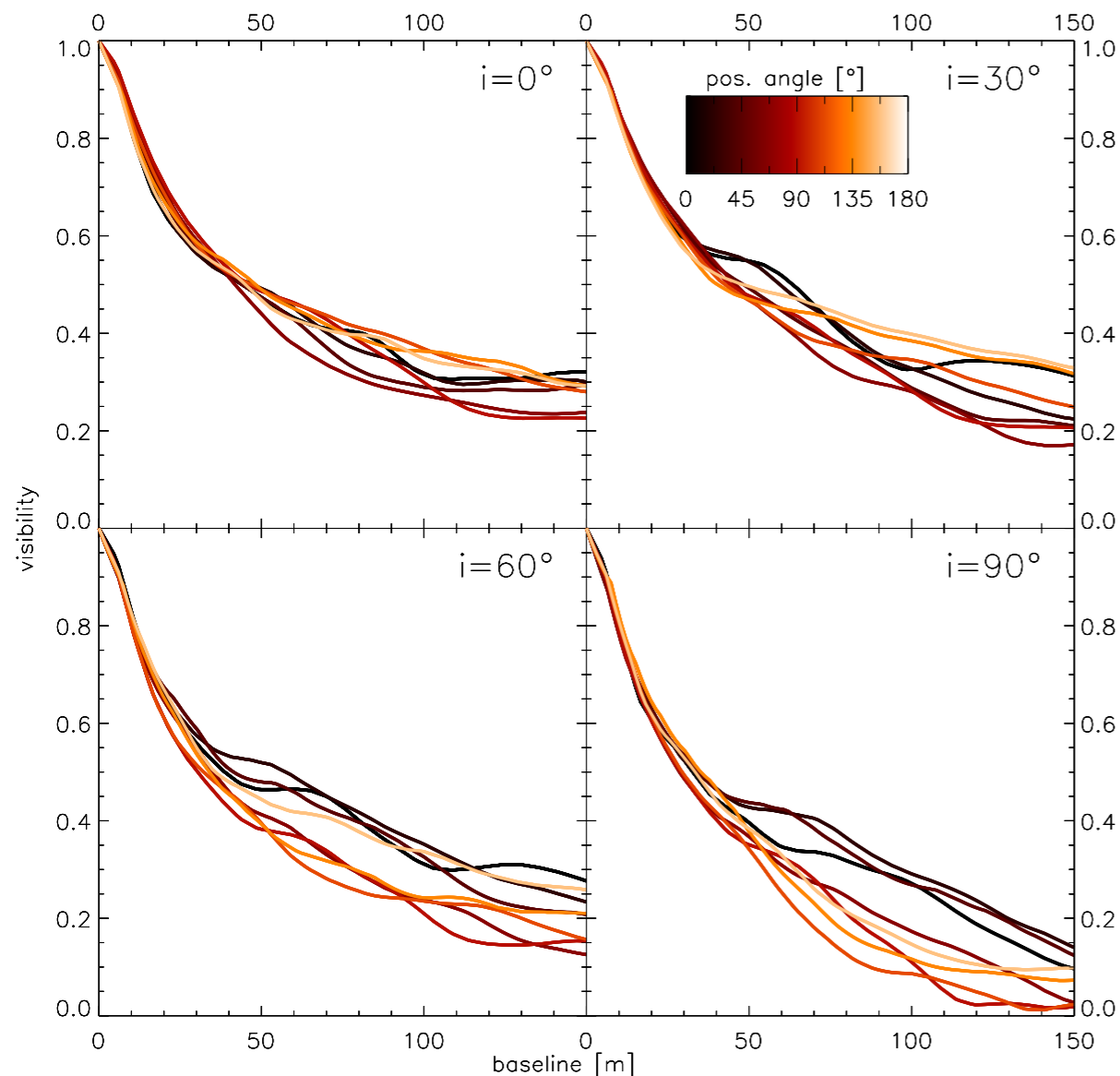
The fraction of unresolved flux

...does not depend much on inclination or position angle

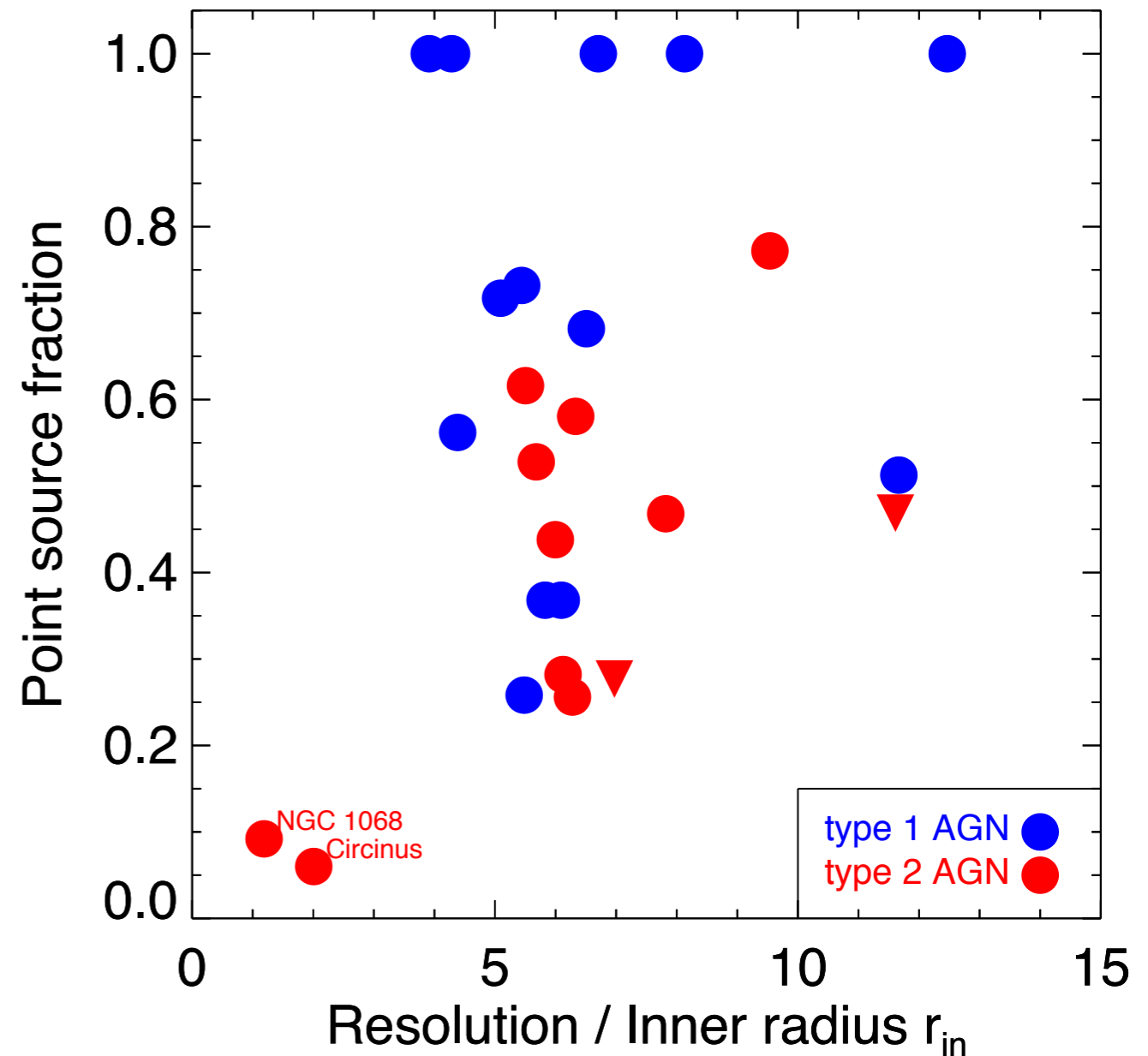


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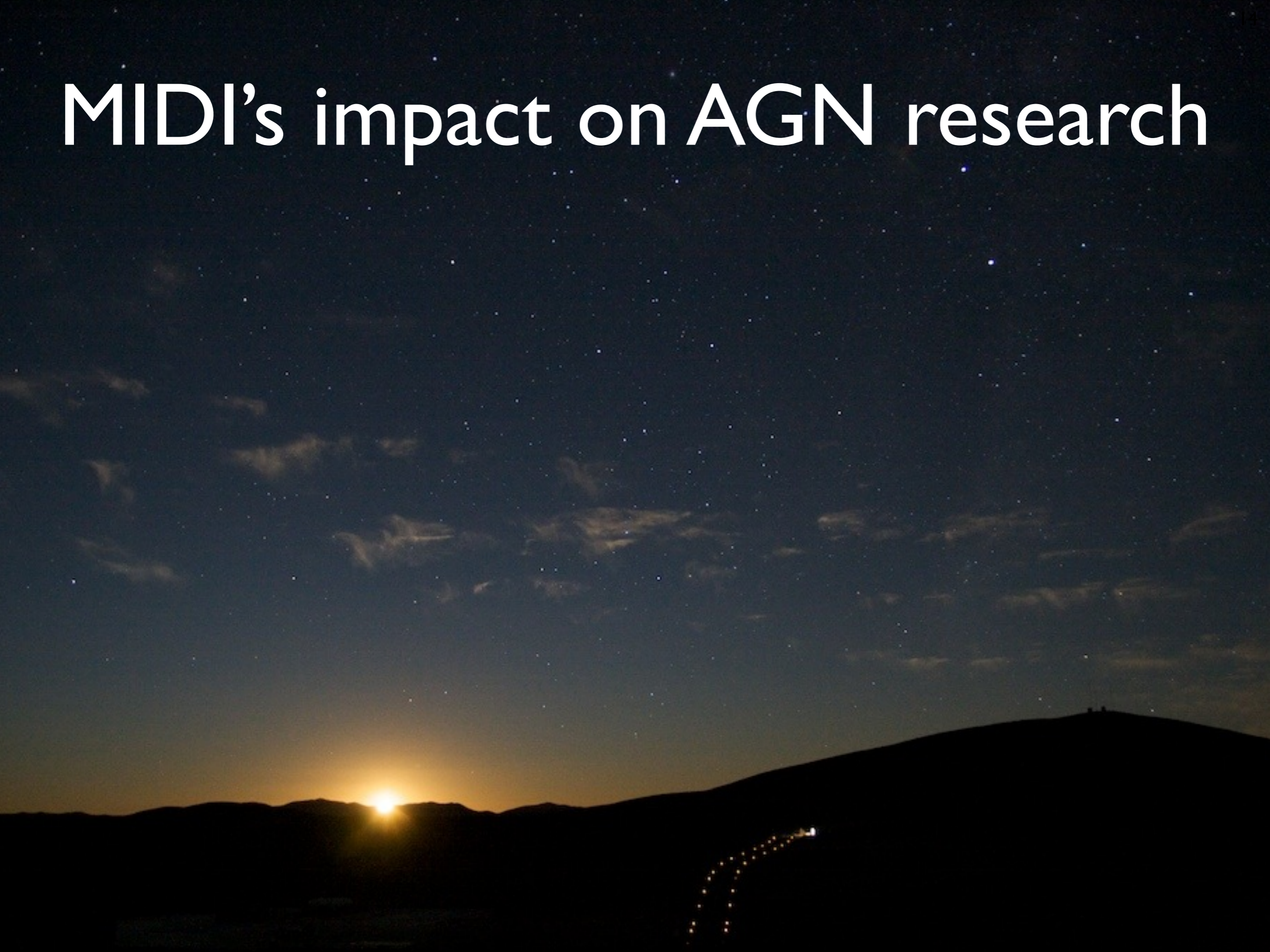
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But tori aren't alike, even when observed at similar resolution



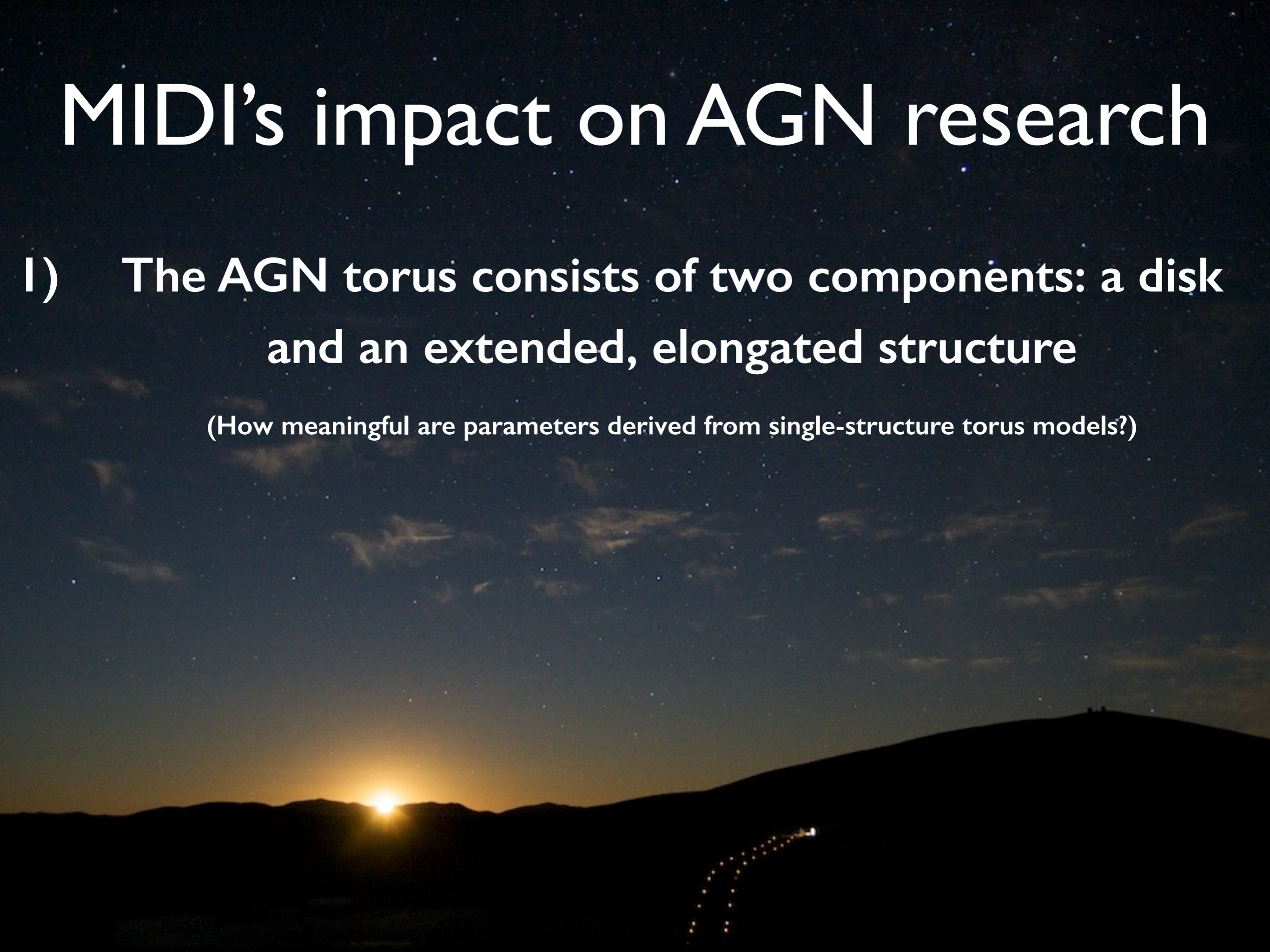
MIDI's impact on AGN research



MIDI's impact on AGN research

- I) The AGN torus consists of two components: a disk and an extended, elongated structure

(How meaningful are parameters derived from single-structure torus models?)



MIDI's impact on AGN research

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- 2) The disk seems to be connected to the maser disk.

MIDI's impact on AGN research

- 1) The AGN torus consists of two components: a disk and an extended, elongated structure

(How meaningful are parameters derived from single-structure torus models?)

- 2) The disk seems to be connected to the maser disk.

- 3) AGN tori aren't alike.