Towards a new paradigm of dust structure in AGN: Dissecting the mid-IR emission of Circinus galaxy

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with

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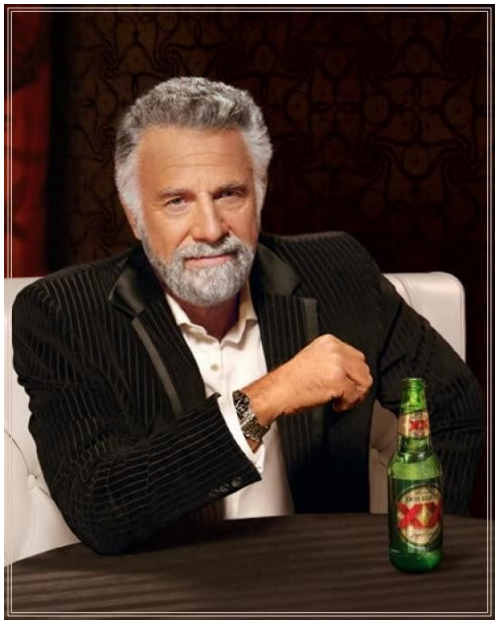
illustration: M. Kornmesser (ESO)

“I don’t always study AGN. But when I do, I prefer Circinus and NGC 1068”

– The Most Interesting Man in the World



TORUS 2018

The many faces of the AGN obscuration

Puerto Varas, Chile
10-14 December 2018

Models of thick turbulent gas disks with magnetocentrifugal winds in AGN and their application to Circinus and NGC 1068

Towards a new paradigm of dust structure in AGN: Dissecting the mid-IR emission of Circinus galaxy

The first IR/X-ray model of the circumnuclear environment of the Circinus Galaxy

Circumnuclear Multi-phase Gas in the Circinus Galaxy Revealed with ALMA

The compact molecular torus in the Circinus galaxy constrained by ALMA

X-Ray Spectral Model from Clumpy Torus and Its Application to Circinus Galaxy

The many 'faces' of the molecular torus of NGC1068

The counter rotating molecular torus in NGC1068

ALMA reveals a rotating dense molecular torus in NGC 1068

NUclei of GAlaxies (NUGA) resolved by ALMA

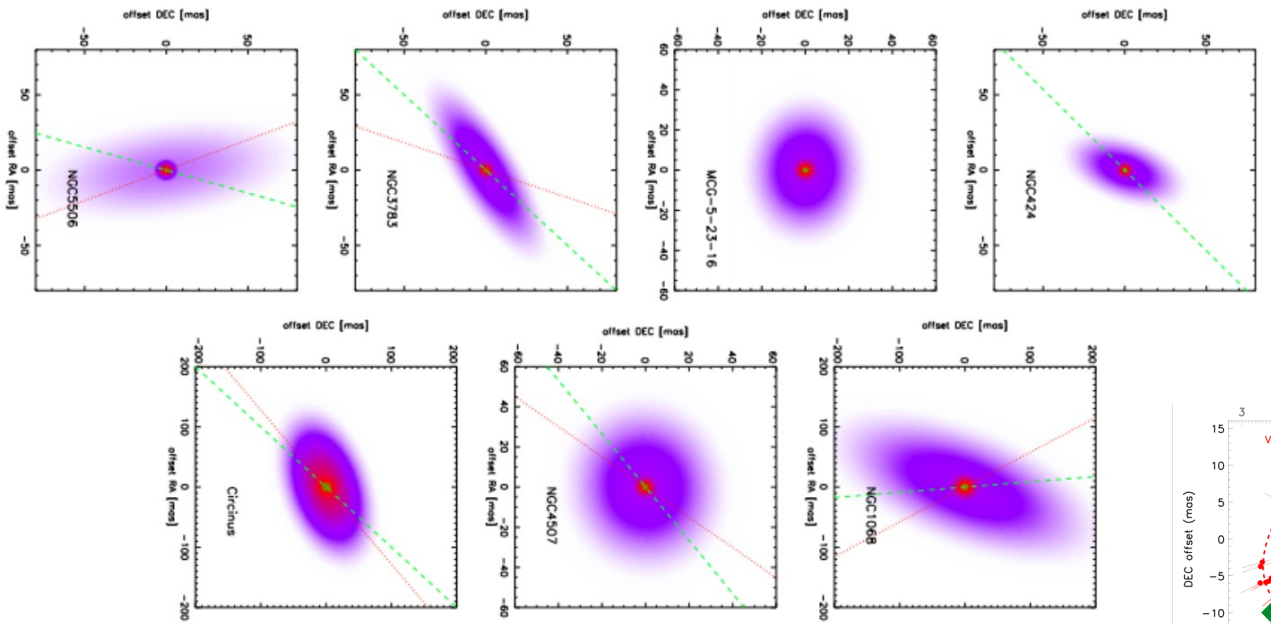
First successful MATISSE observations of NGC 1068

The dust and cloud distribution of the torus of NGC 1068

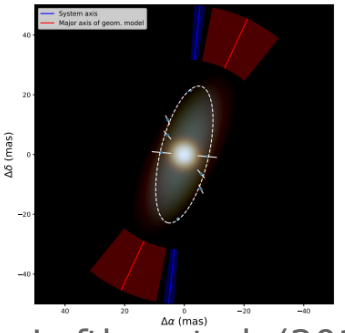
Investigating the nature and geometry of NGC 1068 through NuSTAR observations and future X-ray polarimetry

Models of thick turbulent gas disks with magnetocentrifugal winds in AGN and their application to Circinus and NGC 1068

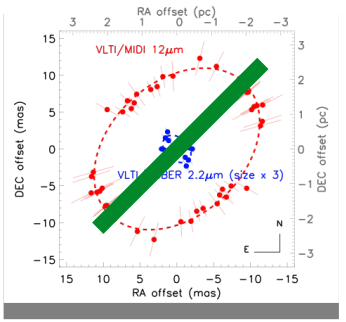
VLTI/MIDI: polar elongation on pc-scale



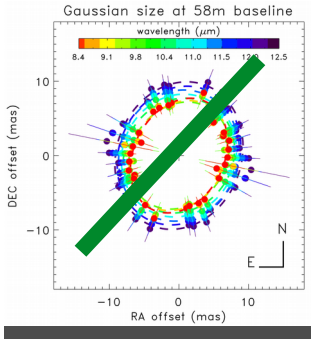
López Gonzaga et al. (2014)



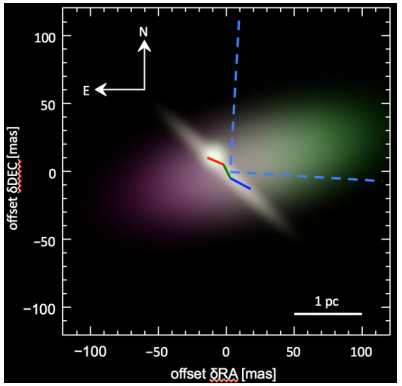
Leftley et al. (2018)



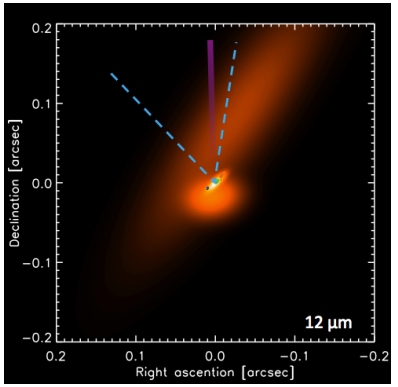
Hönig et al. (2013)



Hönig et al. (2012)



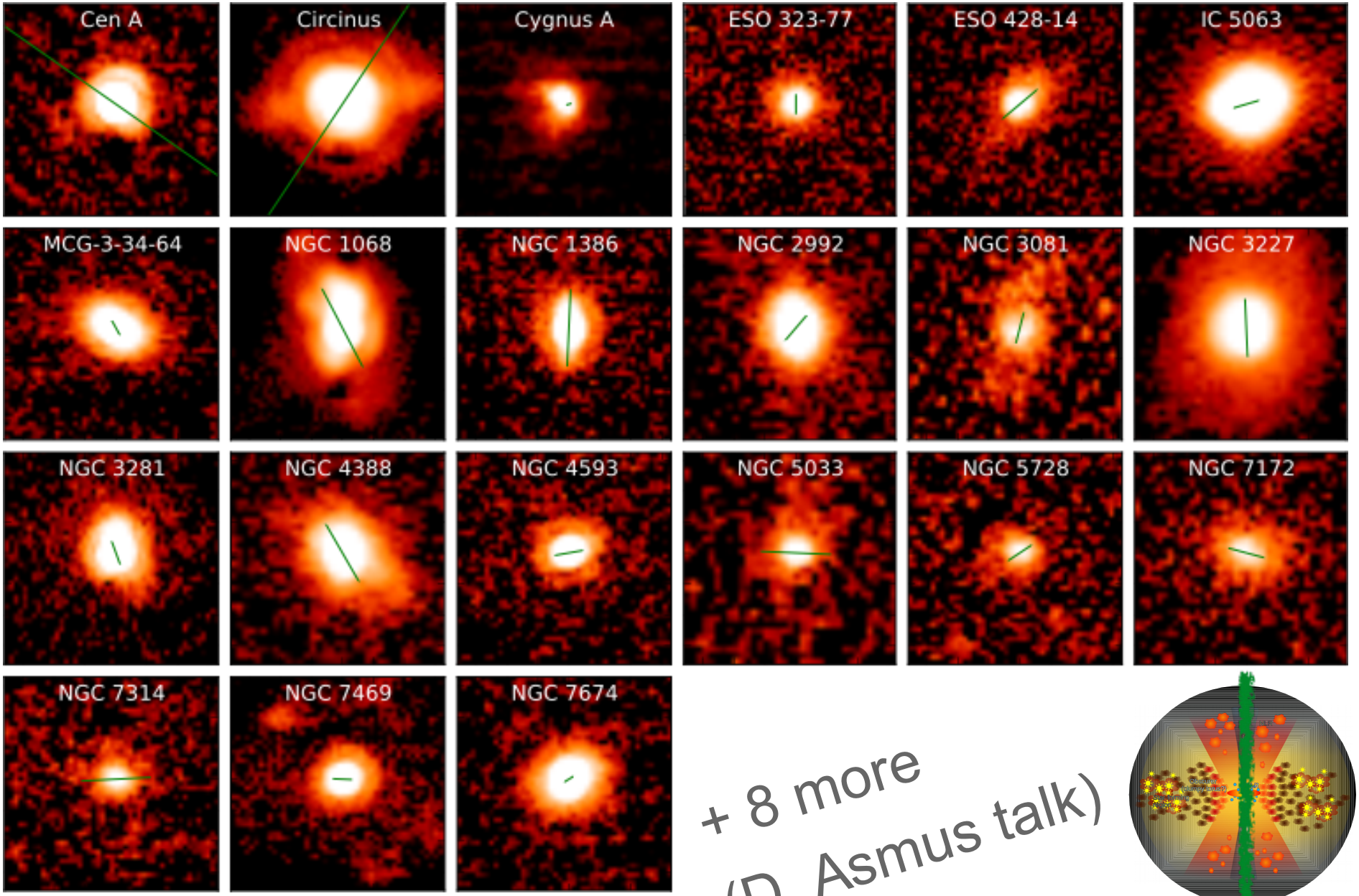
Circinus;
Tristram et al. (2014)



NGC 1068;
López Gonzaga et al. (2014)

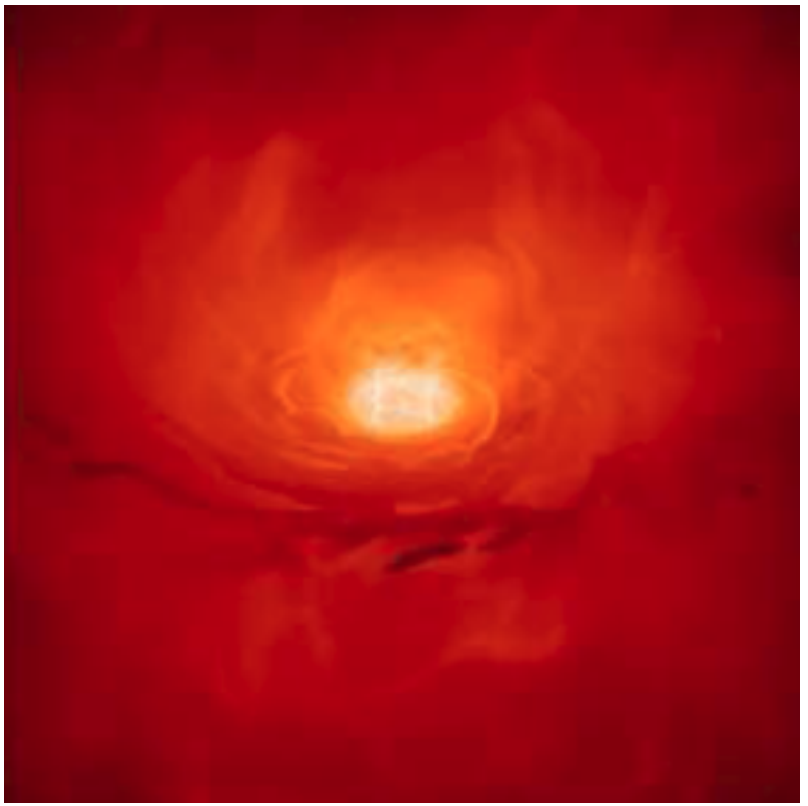
MIR polar elongation on 10s-100s pc scale

Asmus, Honig, Gandhi (2016)



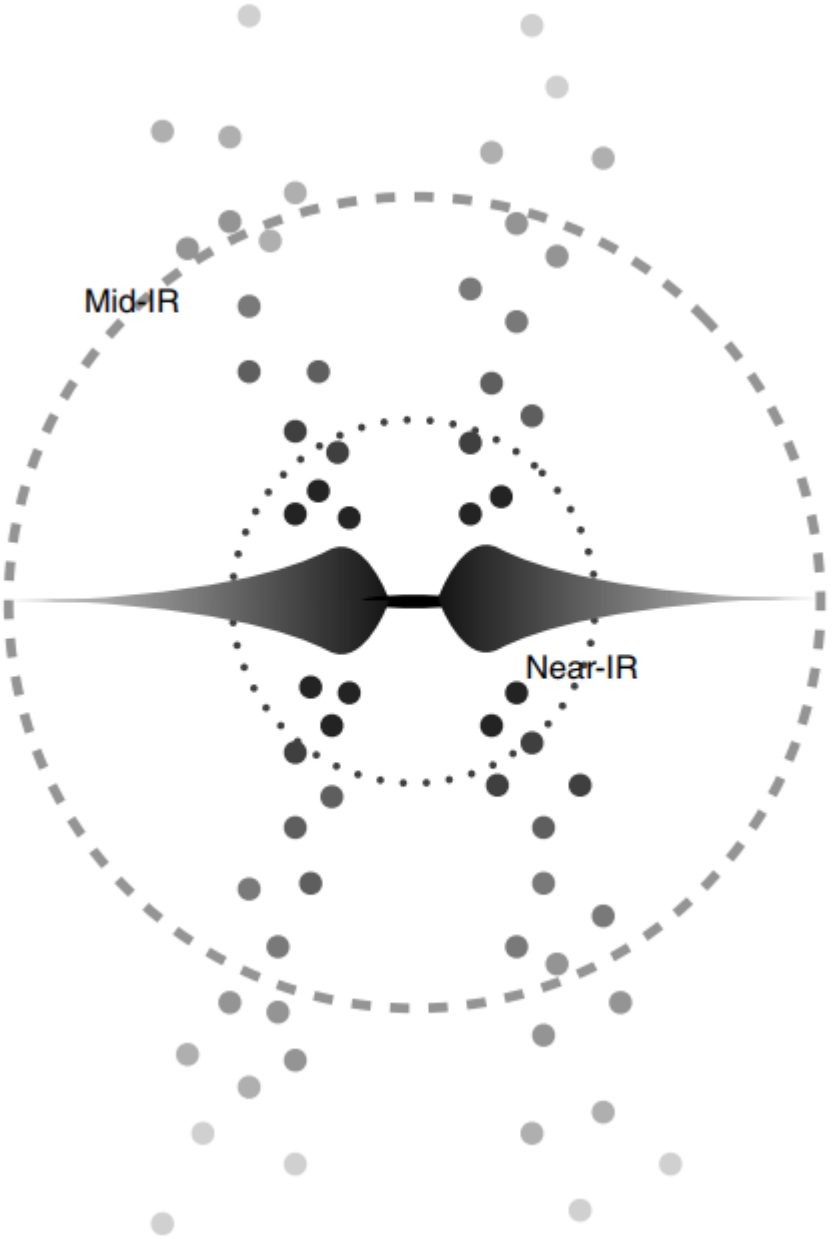
+ 8 more
(D. Asmus talk)

Polar elongation – inclined torus ?



Schartmann et al. (2014)

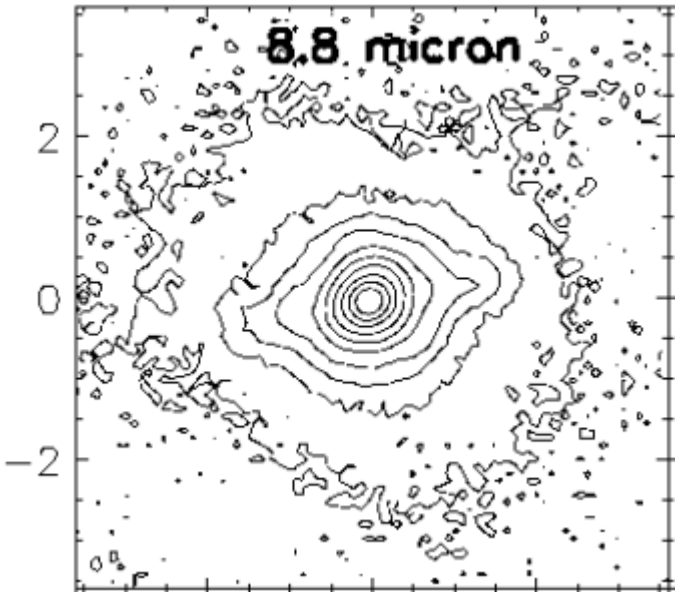
Polar elongation – dusty wind ?



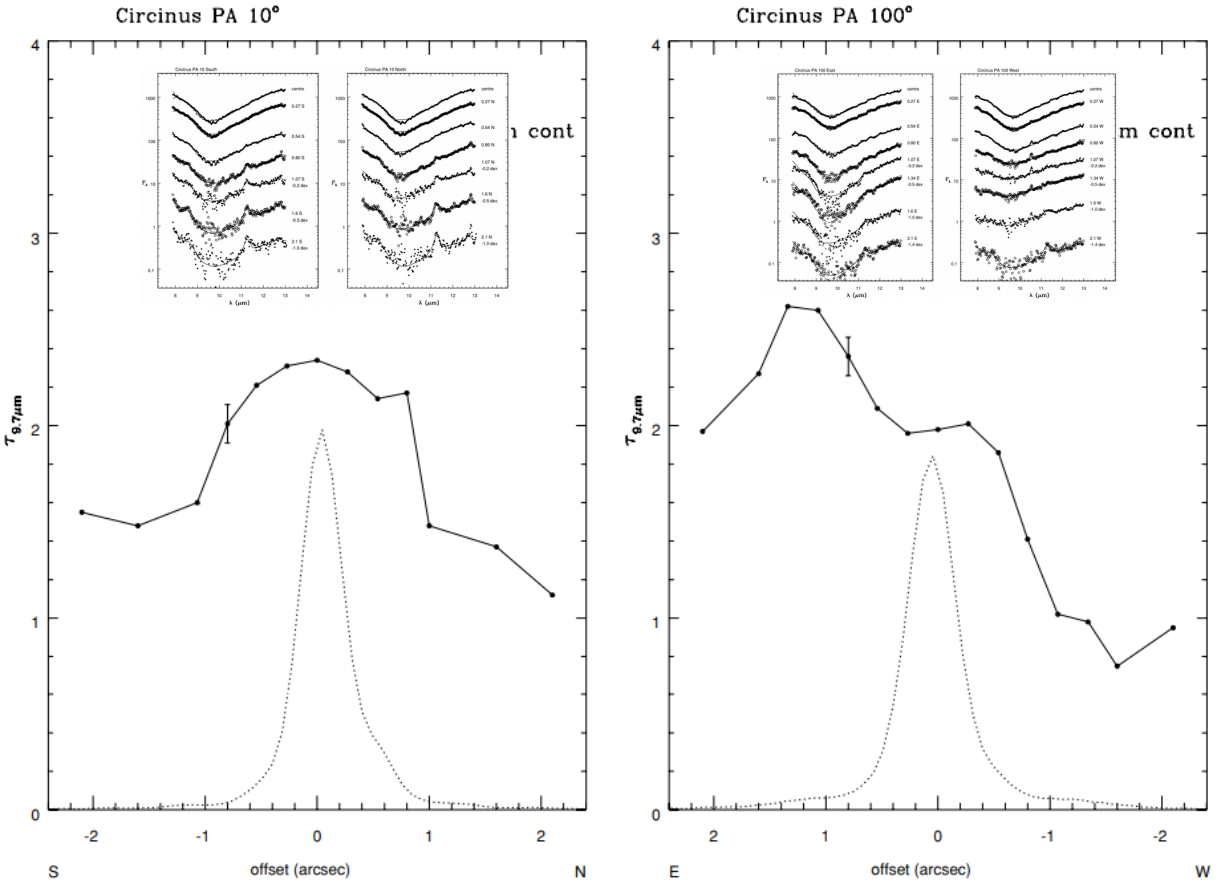
Honig et al. (2012)

Circinus extended emission and host galaxy extinction

Packham et al. 2005

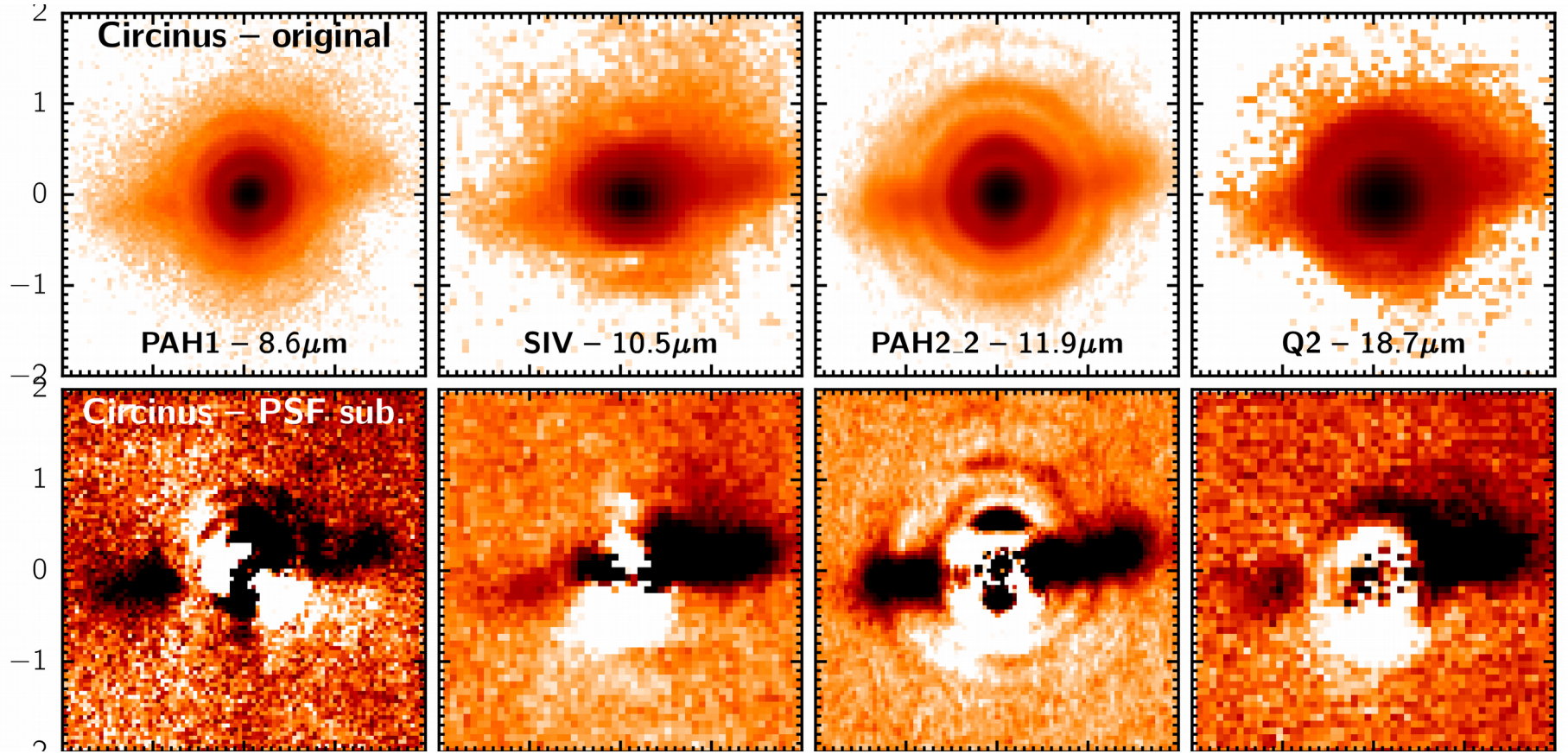


Roche et al. 2006



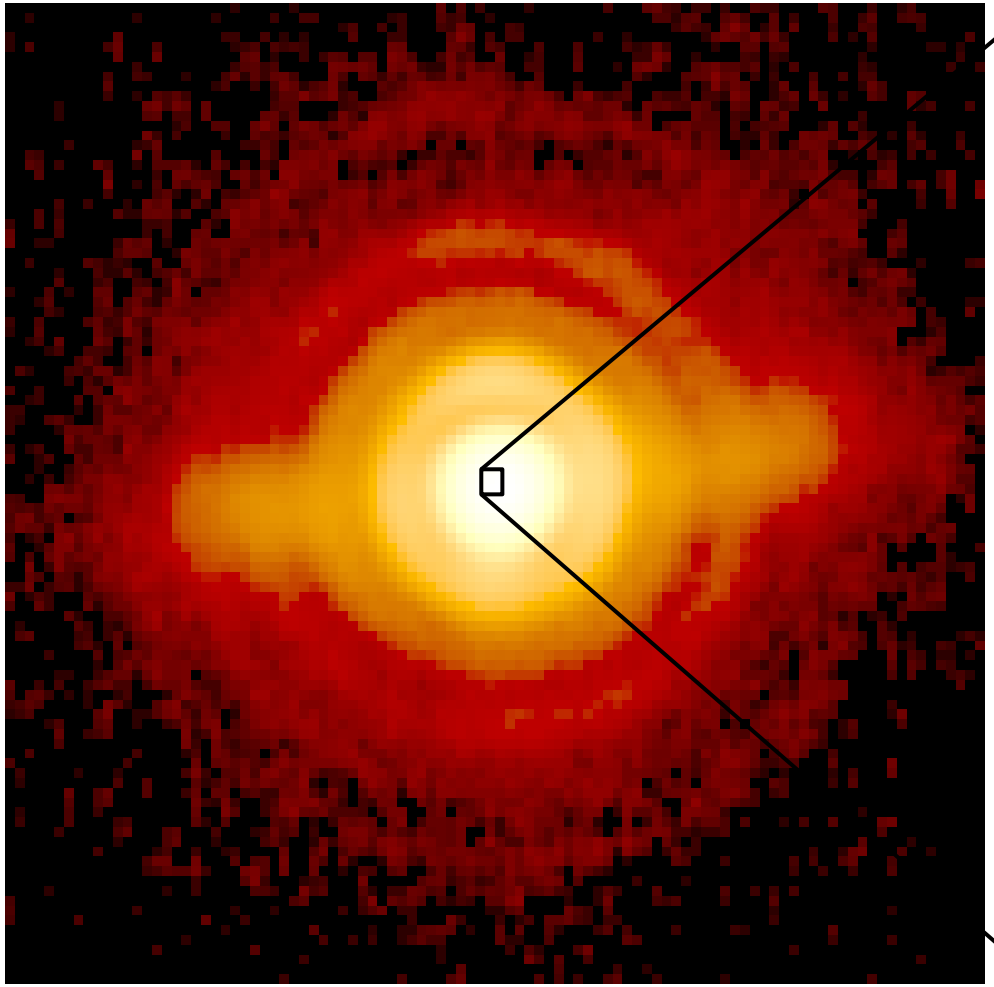
(Gemini South / T-Recs)

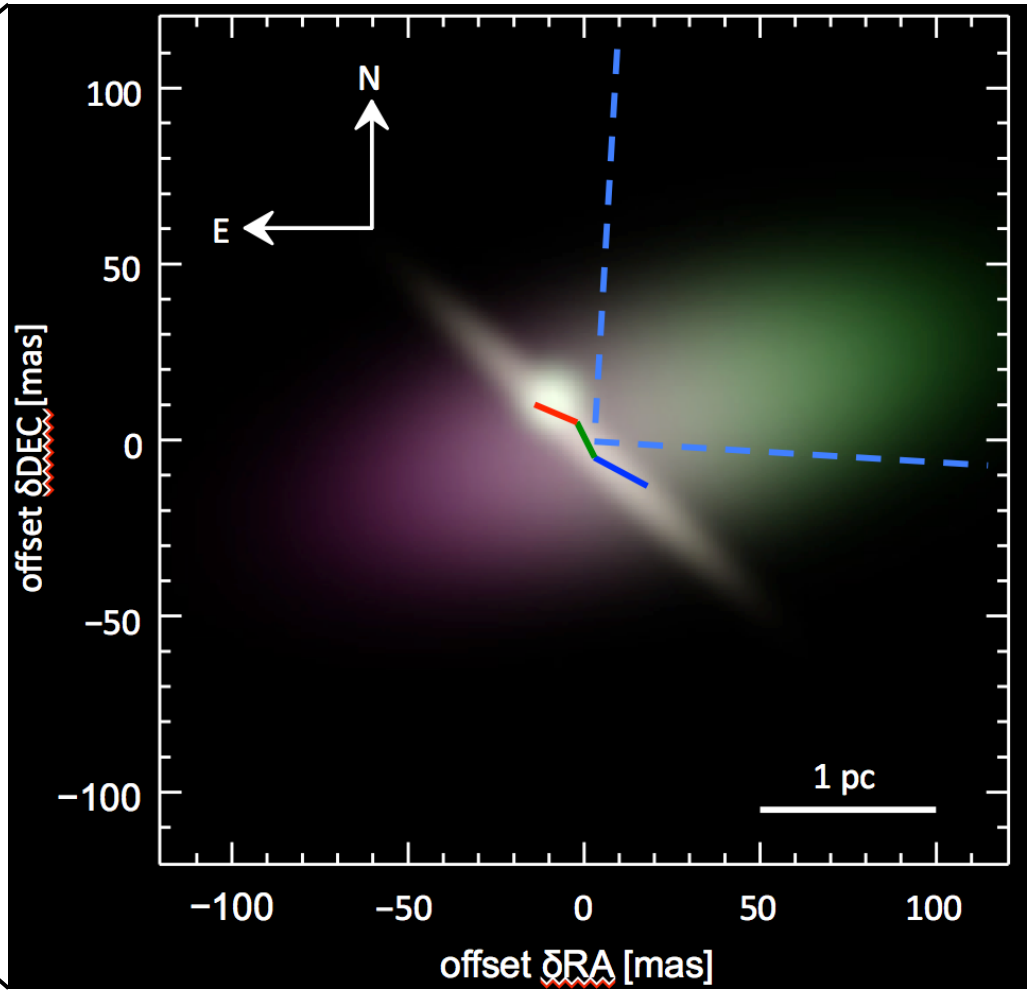
Circinus with VLT/VISIR



Stalevski, Asmus & Tristram (2017)

Circinus MIR emission

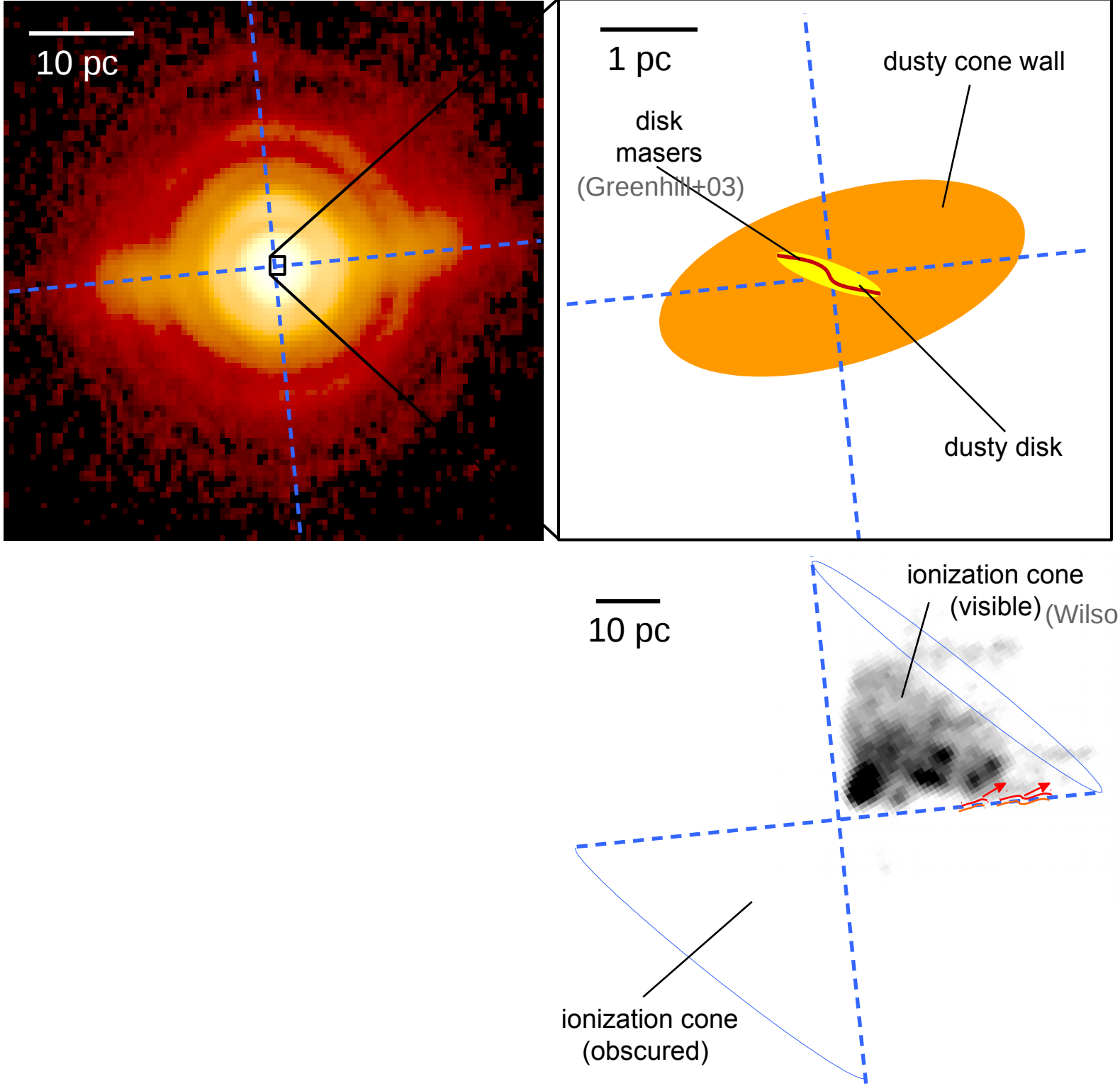


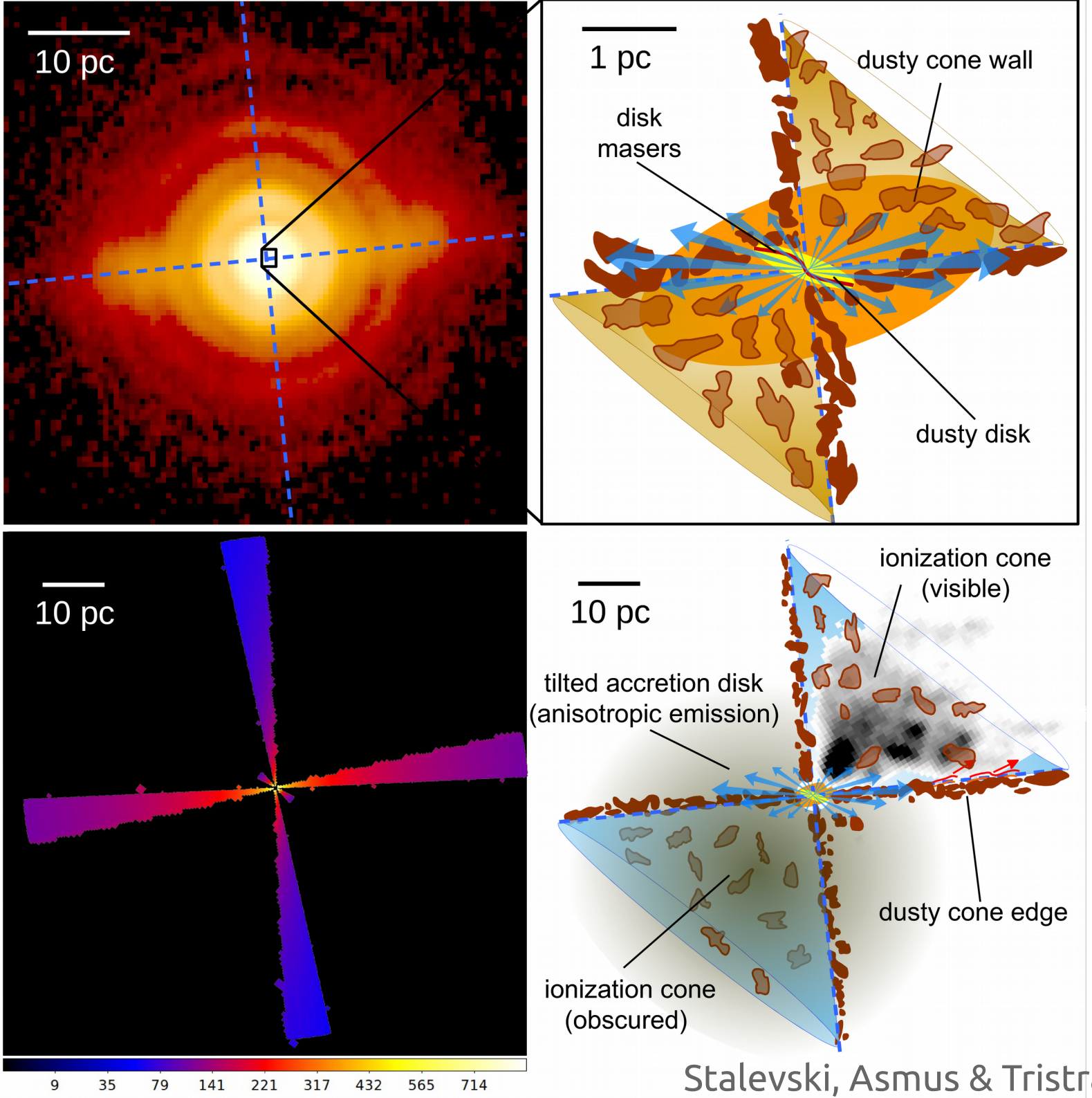


Stalevski, Asmus & Tristram (2017)

Tristram et al. (2014)

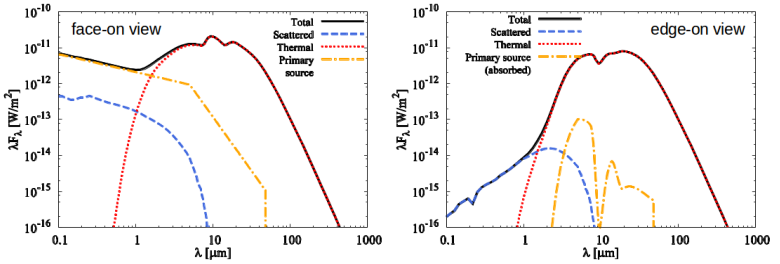
A prototype that does not look like a prototype!

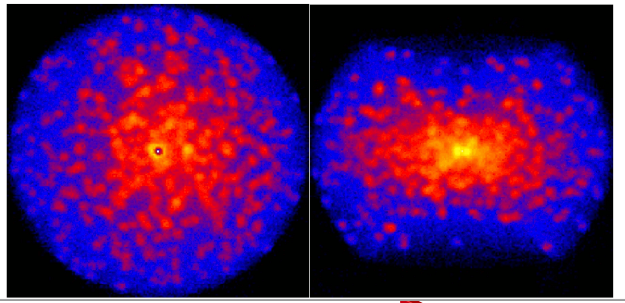

10 pc
1 pc
dusty cone wall
disk
masers
(Greenhill+03)
dusty disk
10 pc
ionization cone
(visible)
(Wilson+00)
ionization cone
(obscured)

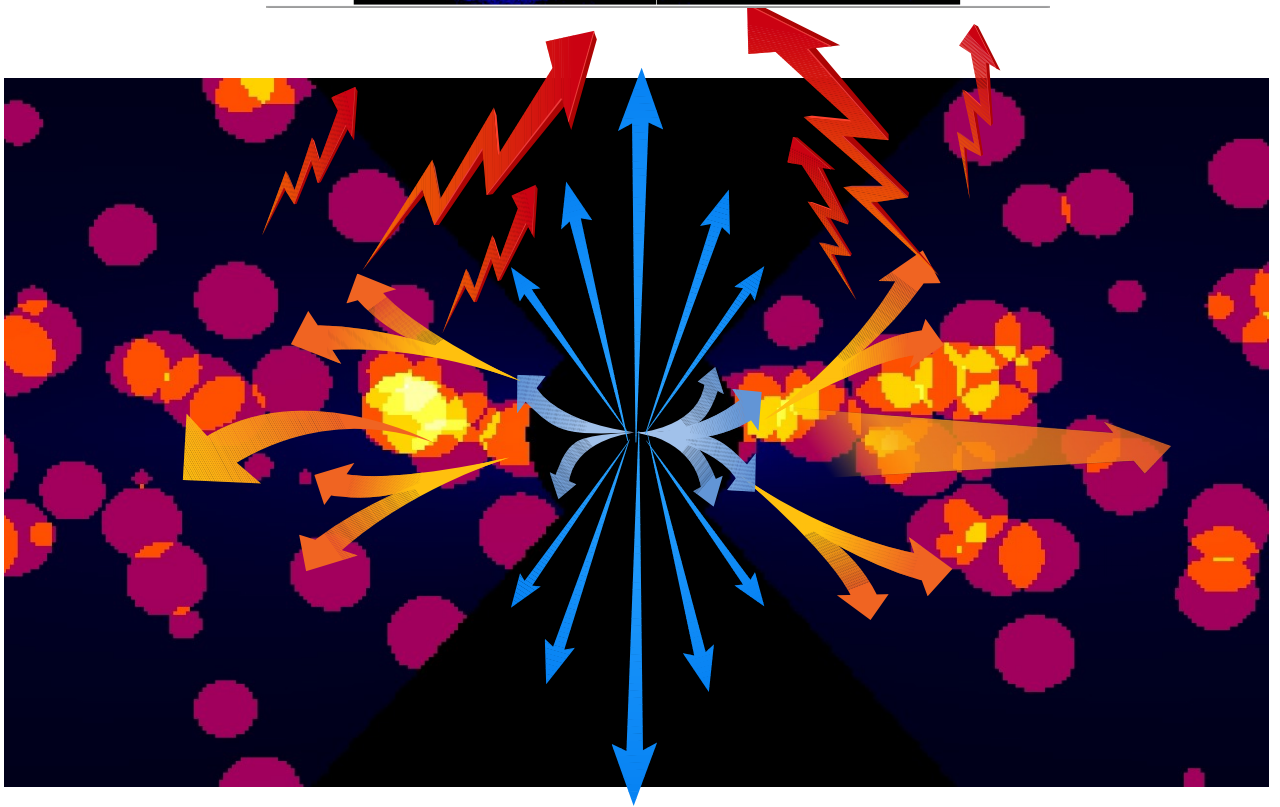


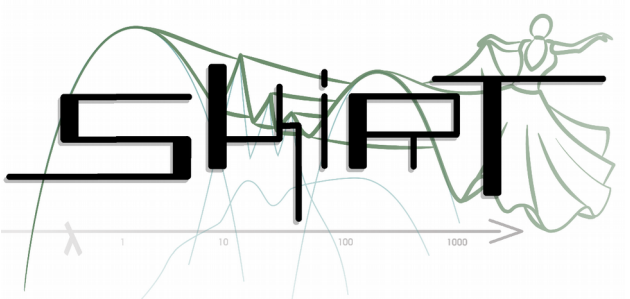
Stalevski, Asmus & Tristram (2017)

Monte Carlo radiative transfer









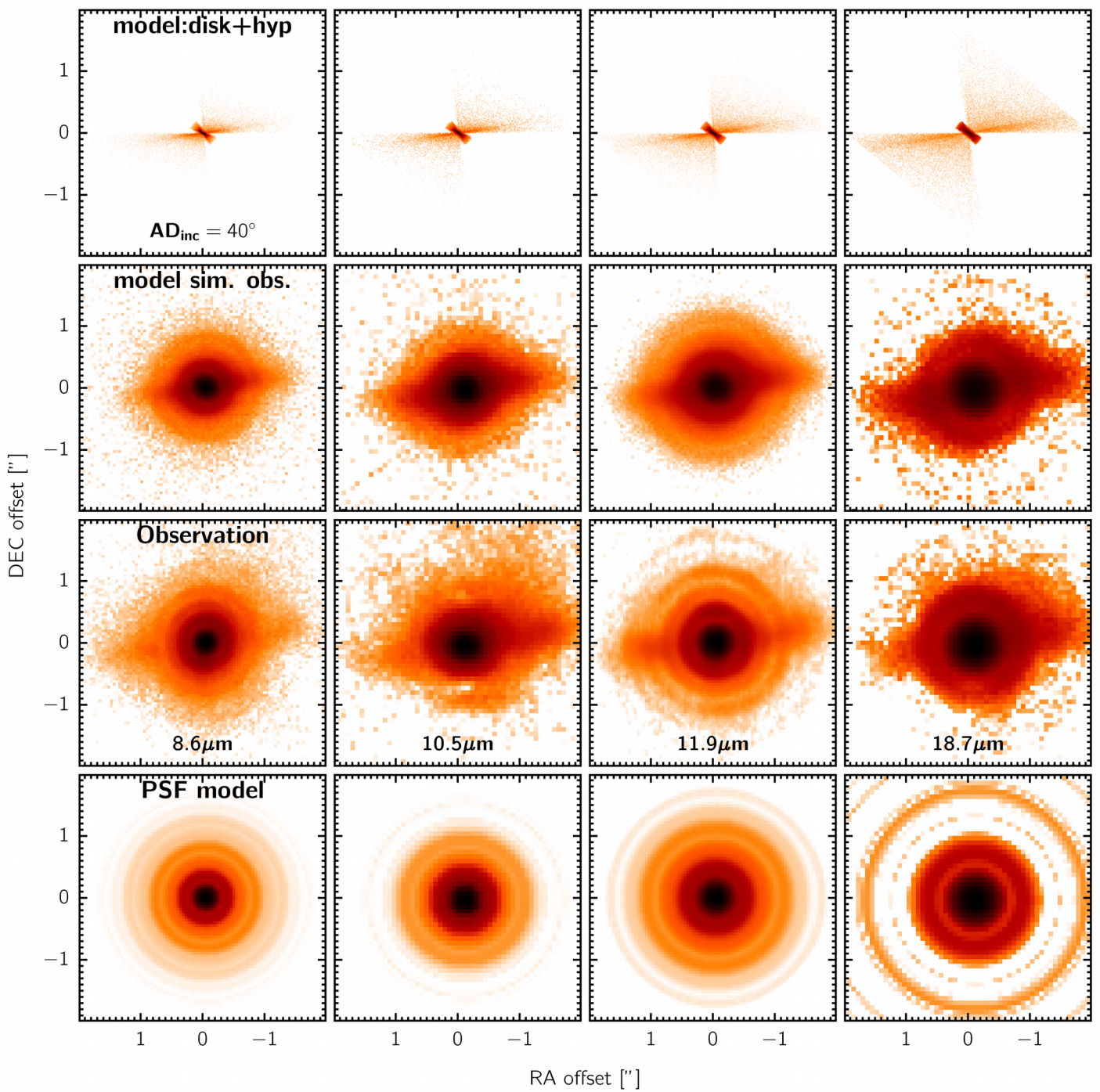
http://www.skirt.ugent.be

Baes+ 2011
Baes & Camps 2015
Camps & Baes 2015

Stalevski+ 2012, 2016

Good match with the MIR morphology

Stalevski, Asmus & Tristram (2017)



Model RT image

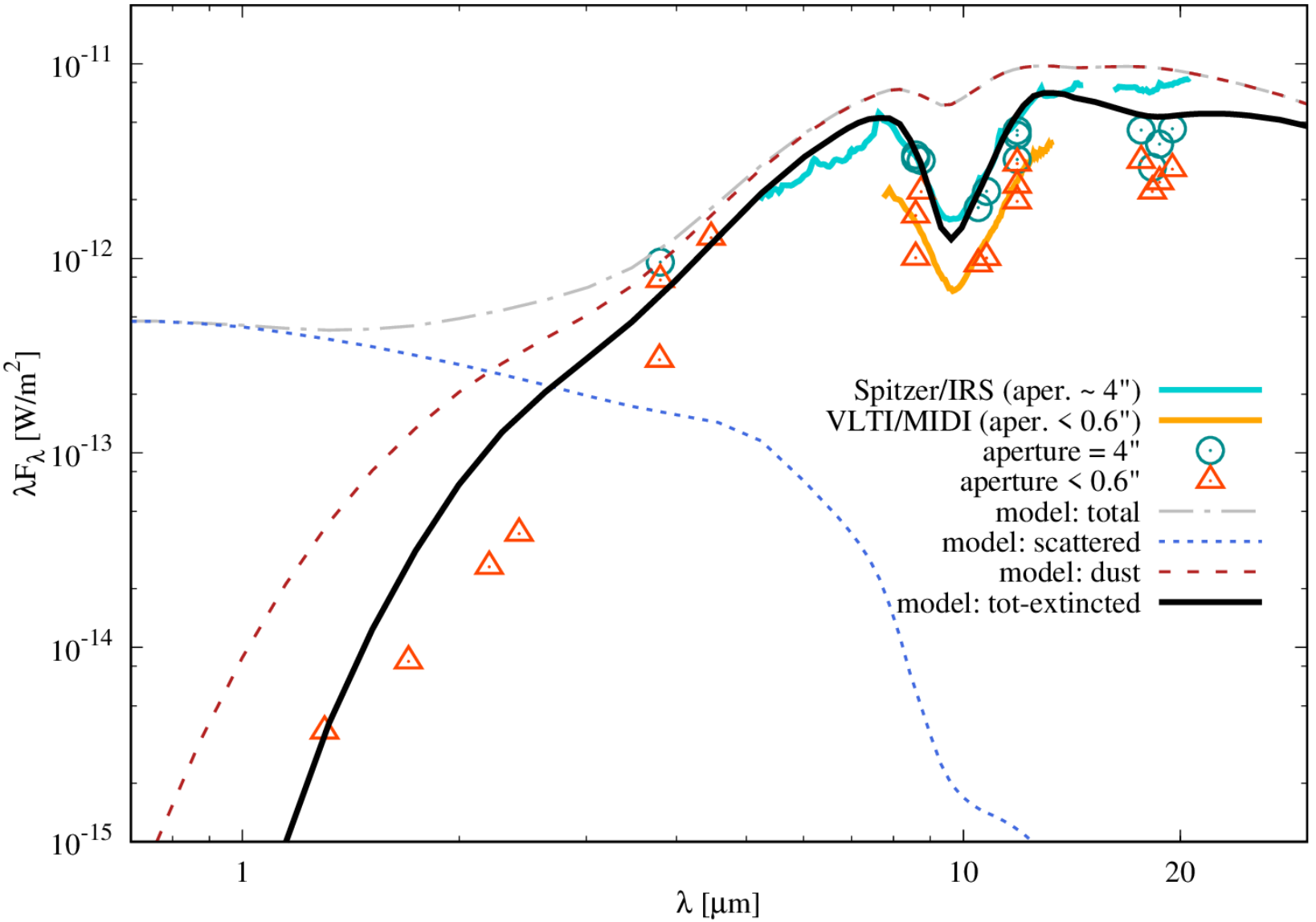
Synthetic obs. of the model

Observed images

PSF model

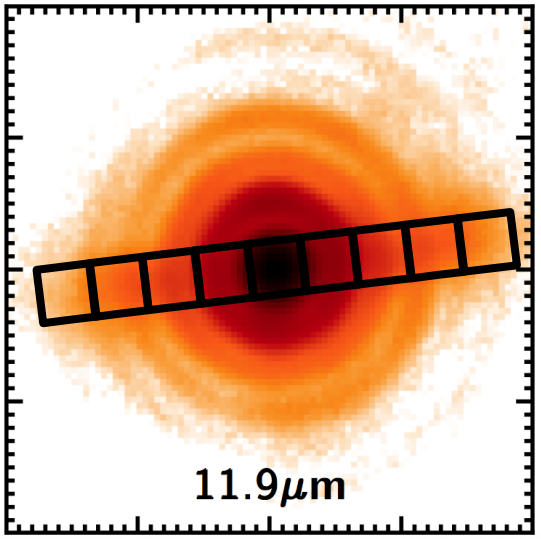
Good match with the SED

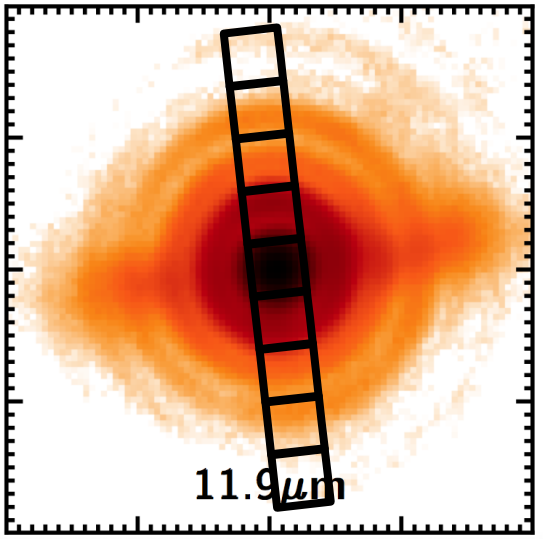
Stalevski, Asmus & Tristram (2017)

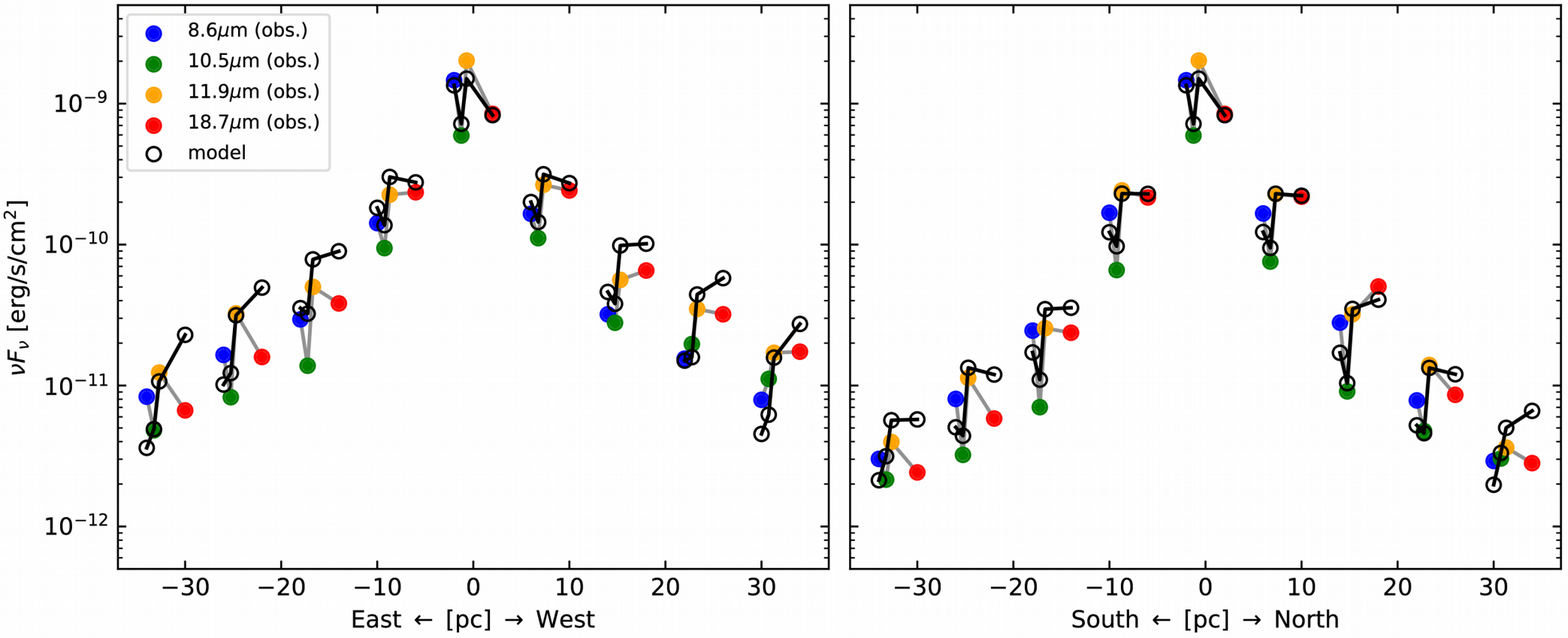


Good match with the resolved photometry

Stalevski, Asmus & Tristram (2017)

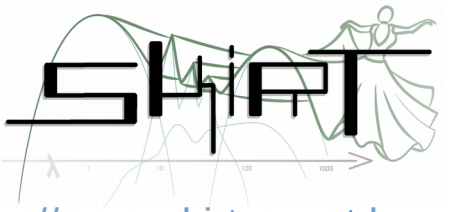




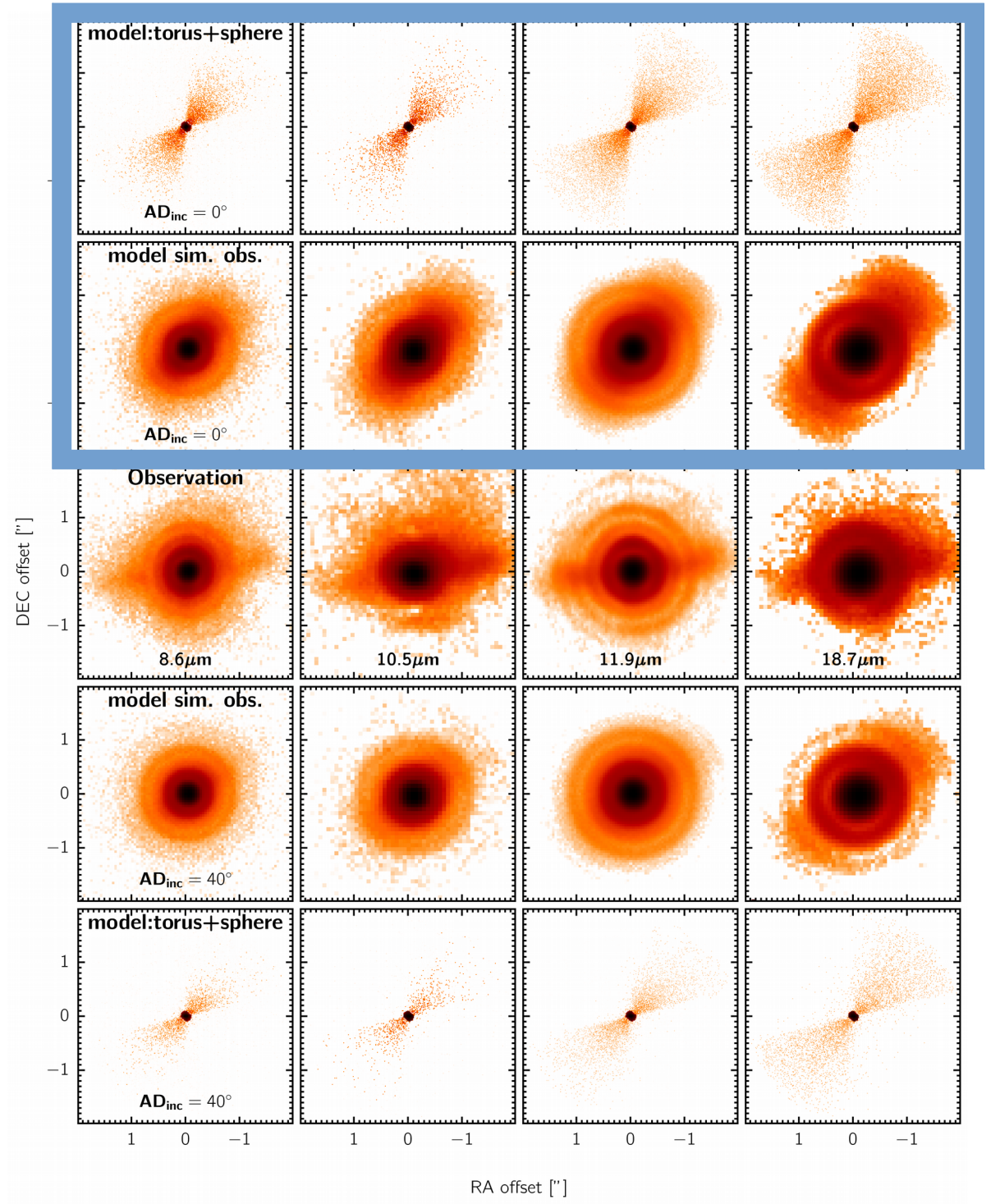


torus+sphere shell: does not work

Monte Carlo radiative transfer with



http://www.skirt.ugent.be

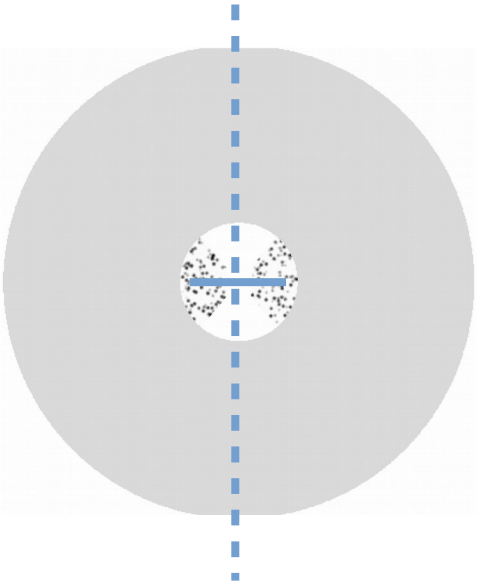


Model RT image

Aligned AD

Synthetic obs. of the model

Observed images



Synthetic obs. of the model

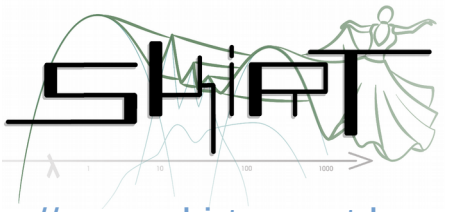
Tilted AD

Model RT image

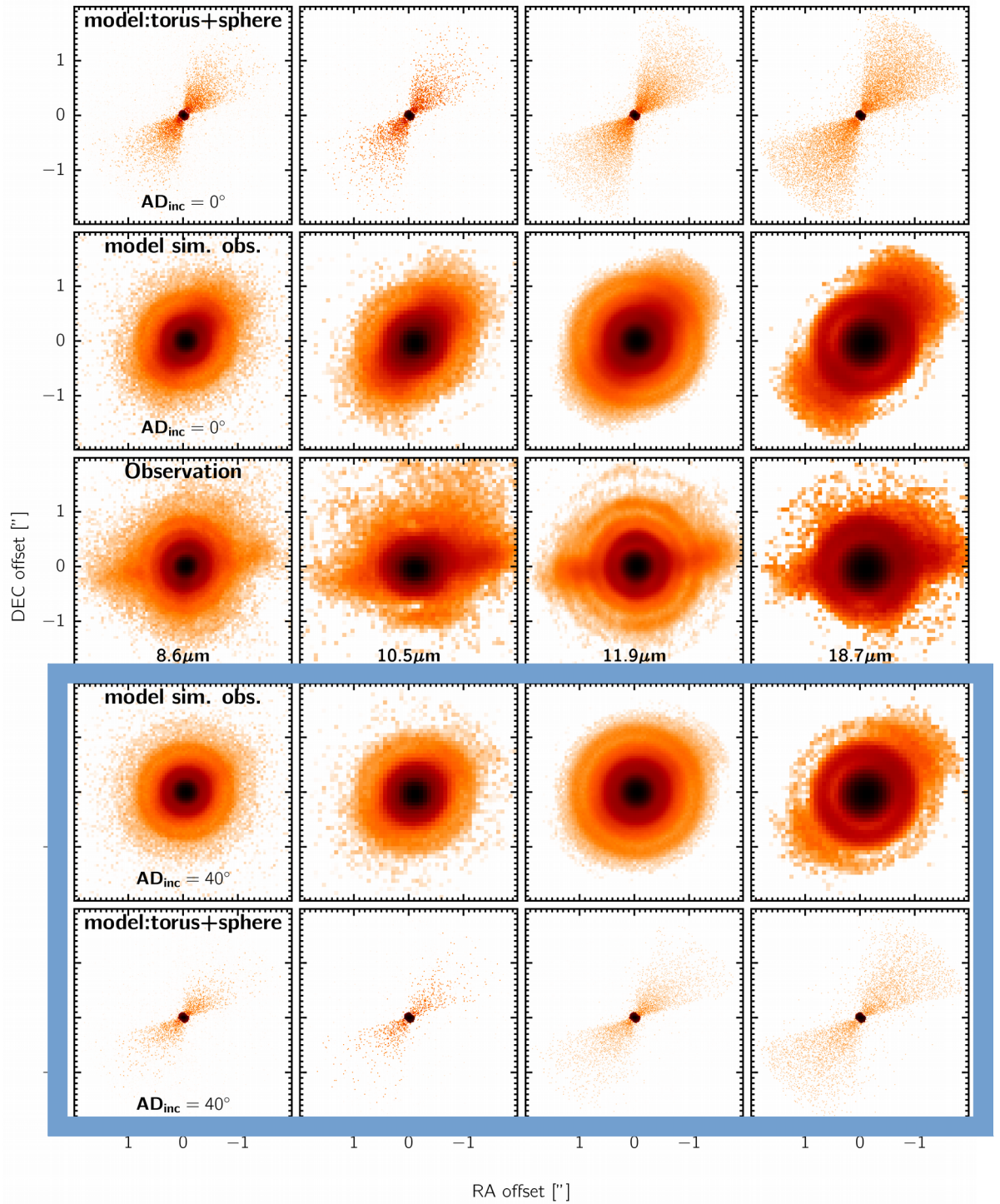
Stalevski, Asmus & Tristram (2017)

torus+sphere shell: does not work

Monte Carlo radiative transfer with



http://www.skirt.ugent.be

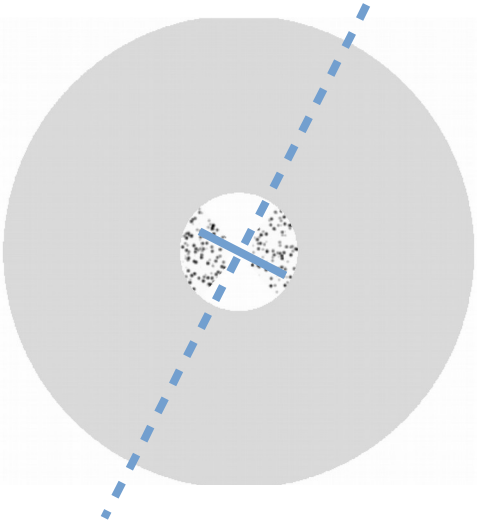


Model RT image

Aligned AD

Synthetic obs. of the model

Observed images



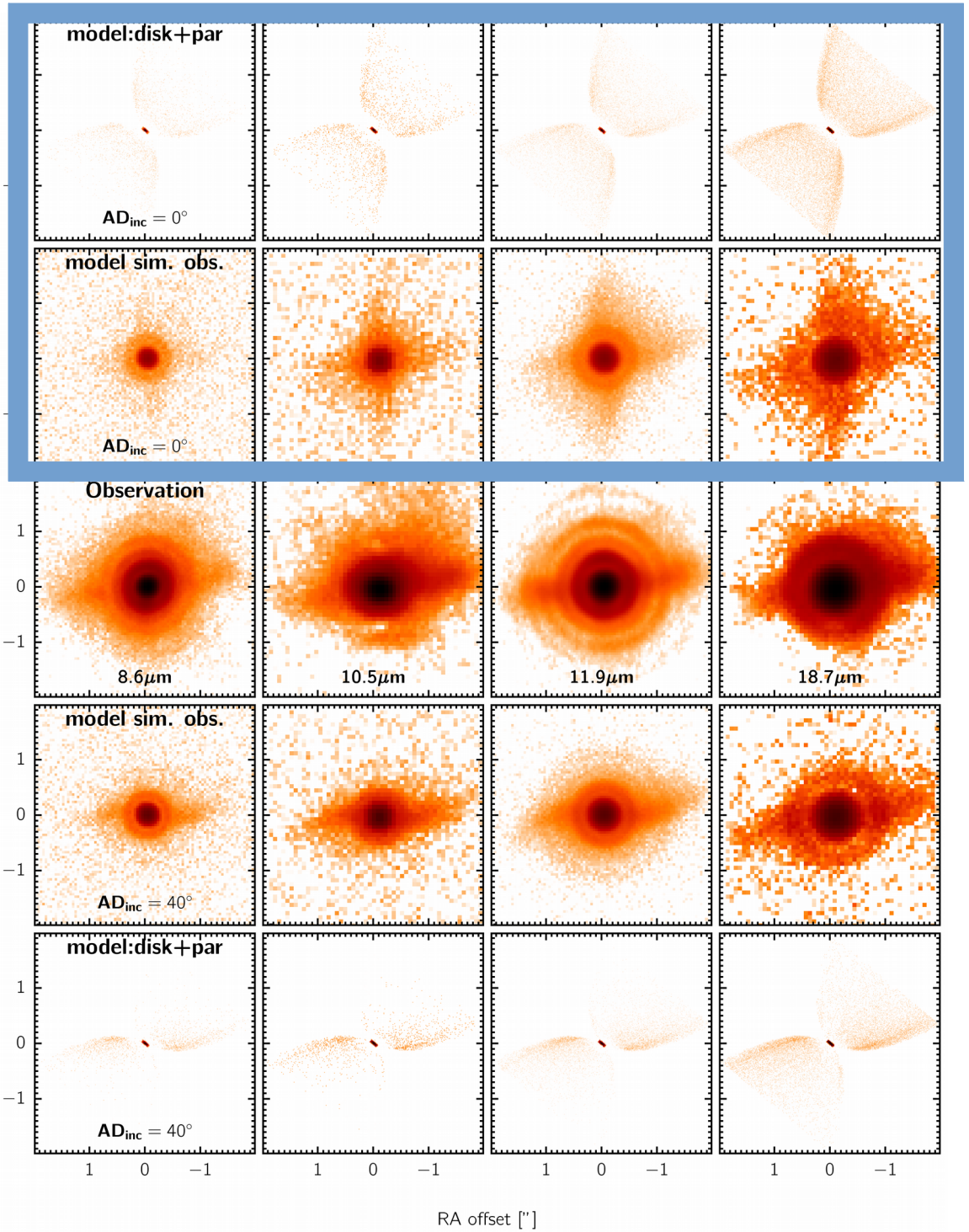
Synthetic obs. of the model

Tilted AD

Model RT image

Stalevski, Asmus & Tristram (2017)

disk+paraboloid: does not work



Model RT image

Synthetic obs. of the model

Aligned AD

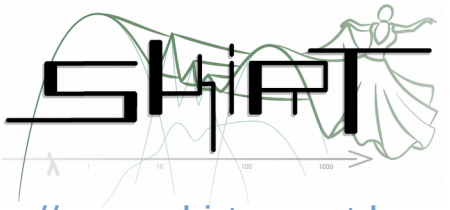
Observed images

Synthetic obs. of the model

Tilted AD

Model RT image

Monte Carlo radiative transfer with



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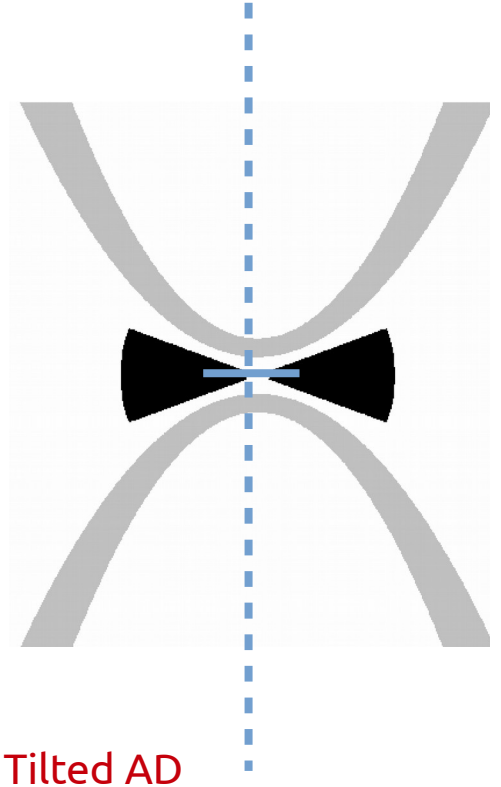
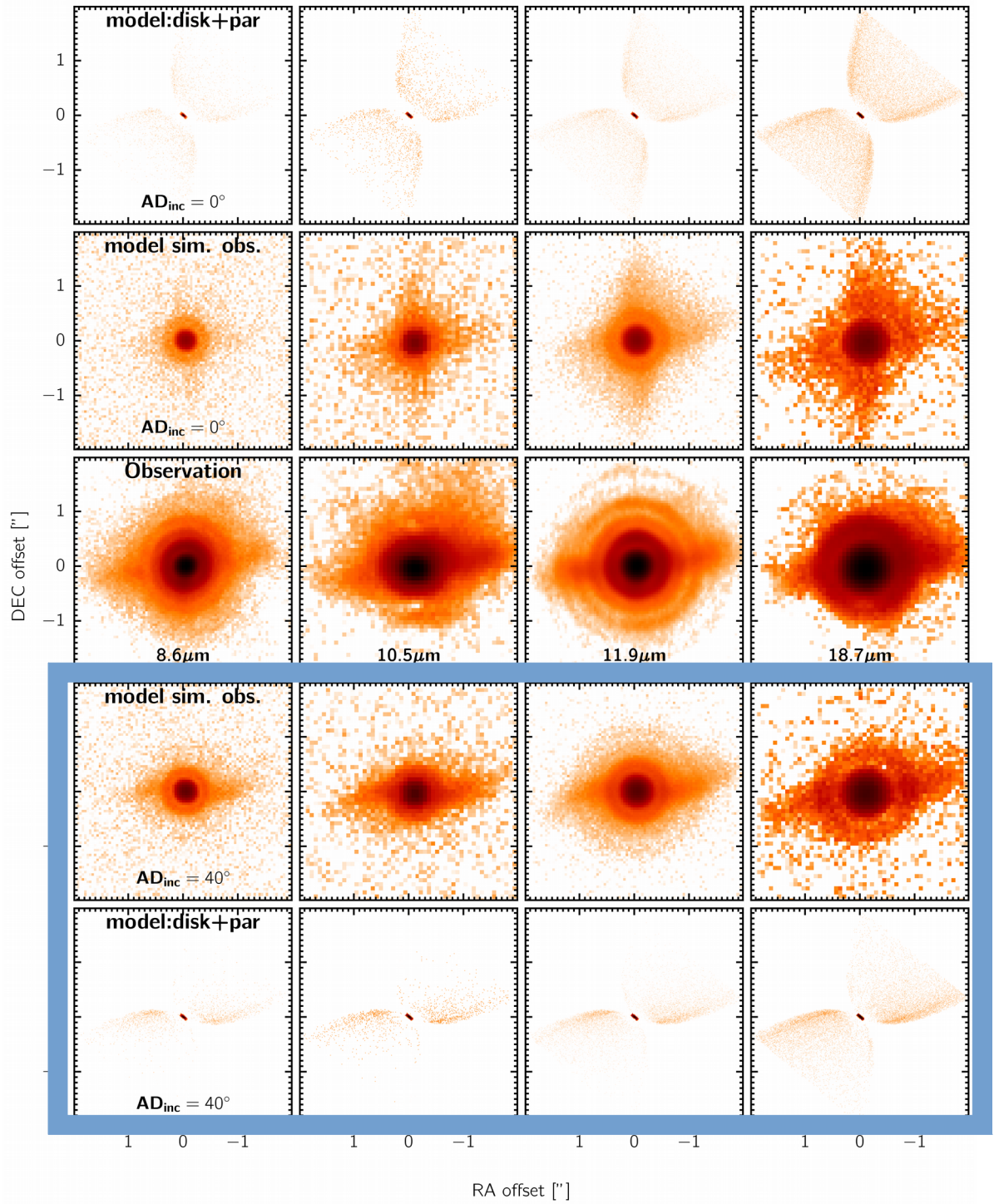


Stalevski, Asmus & Tristram (2017)

disk+paraboloid: does not work



Model RT image

Aligned AD

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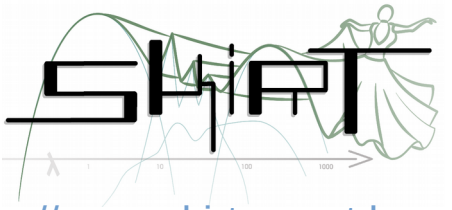
Tilted AD

Model RT image

Monte Carlo radiative transfer with



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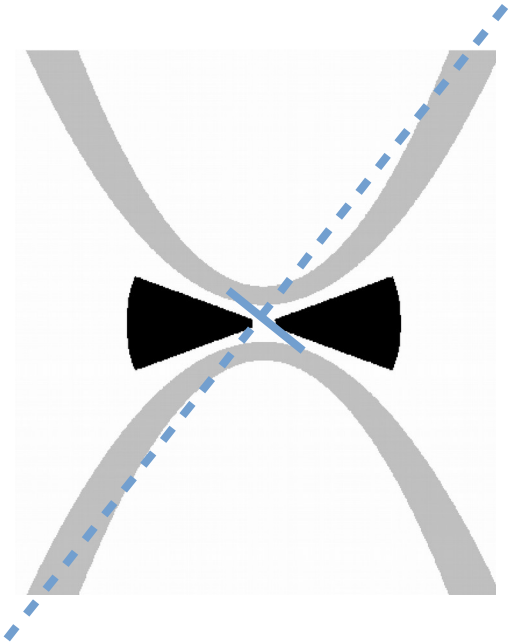
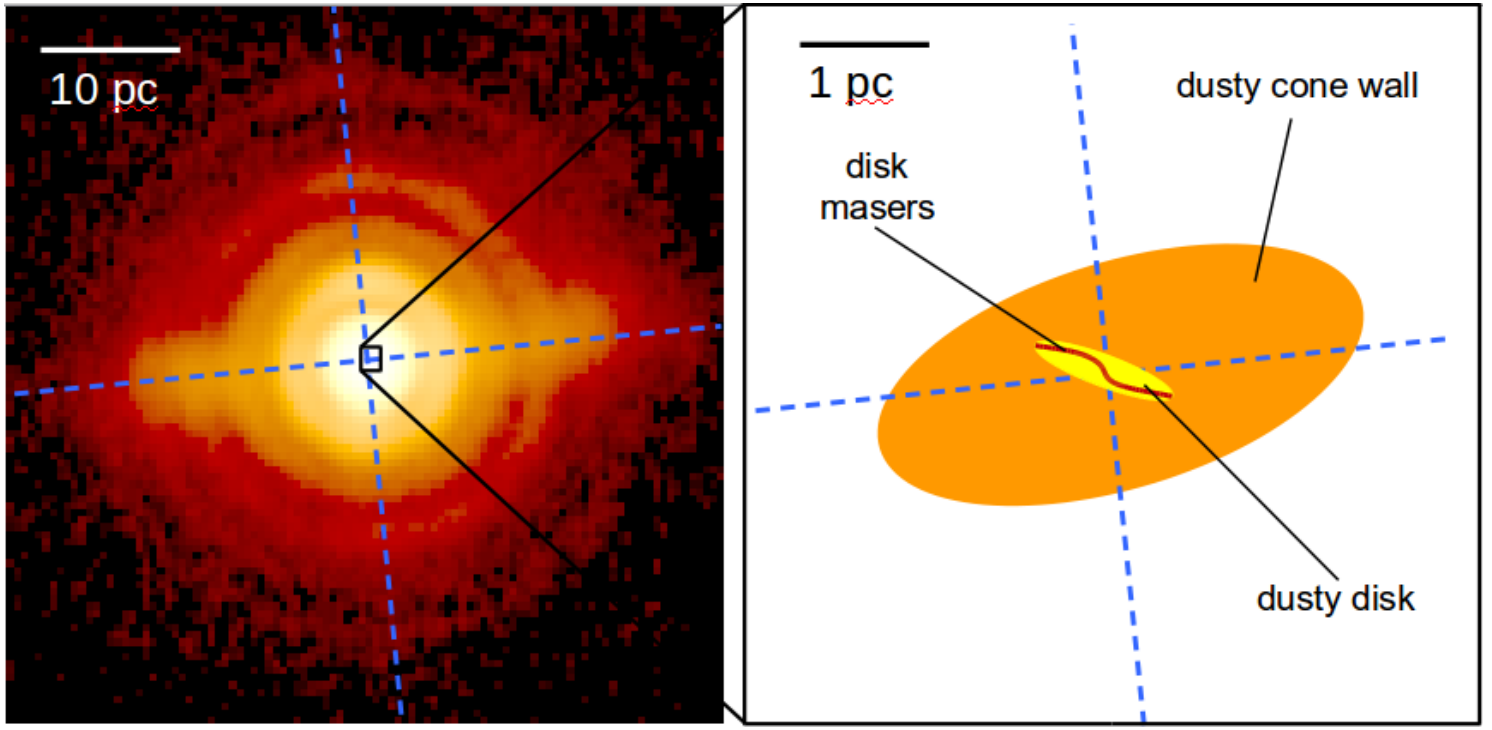
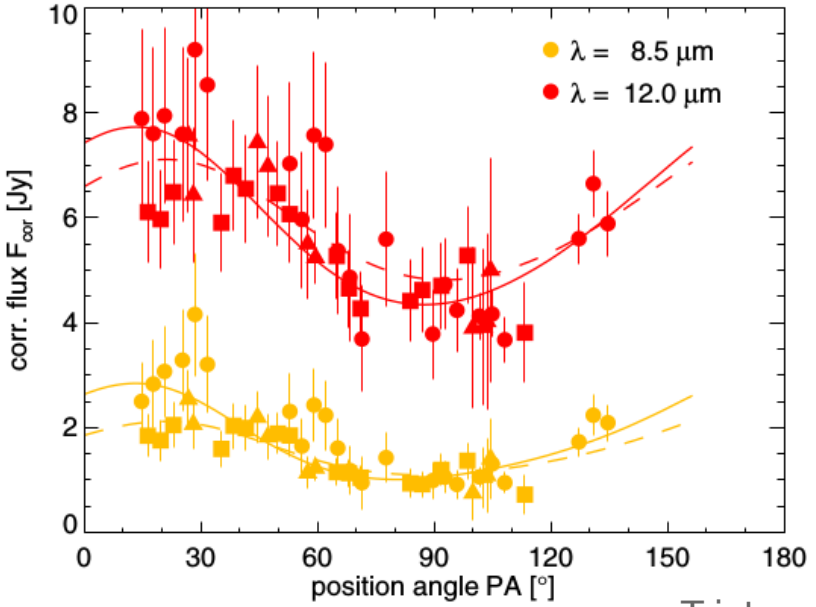
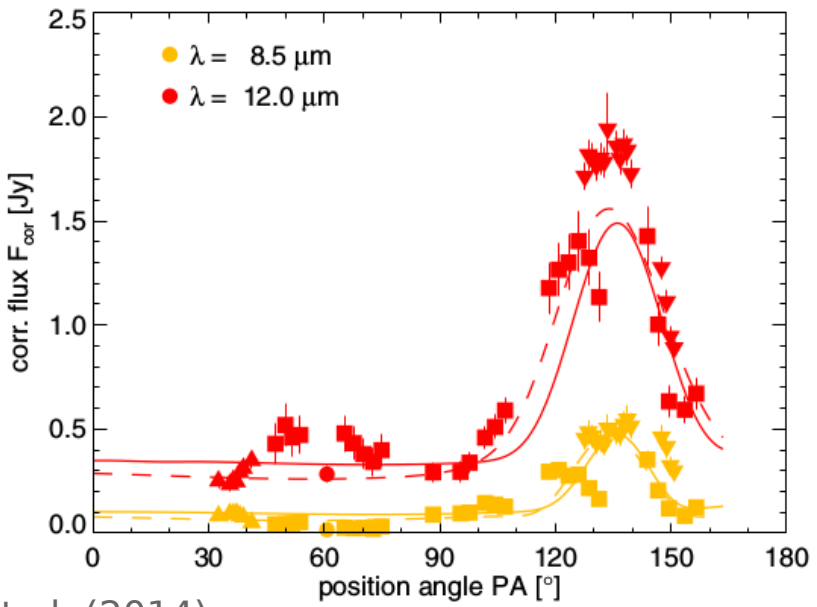


Stalevski, Asmus & Tristram (2017)

Zooming in with VLTI/MIDI



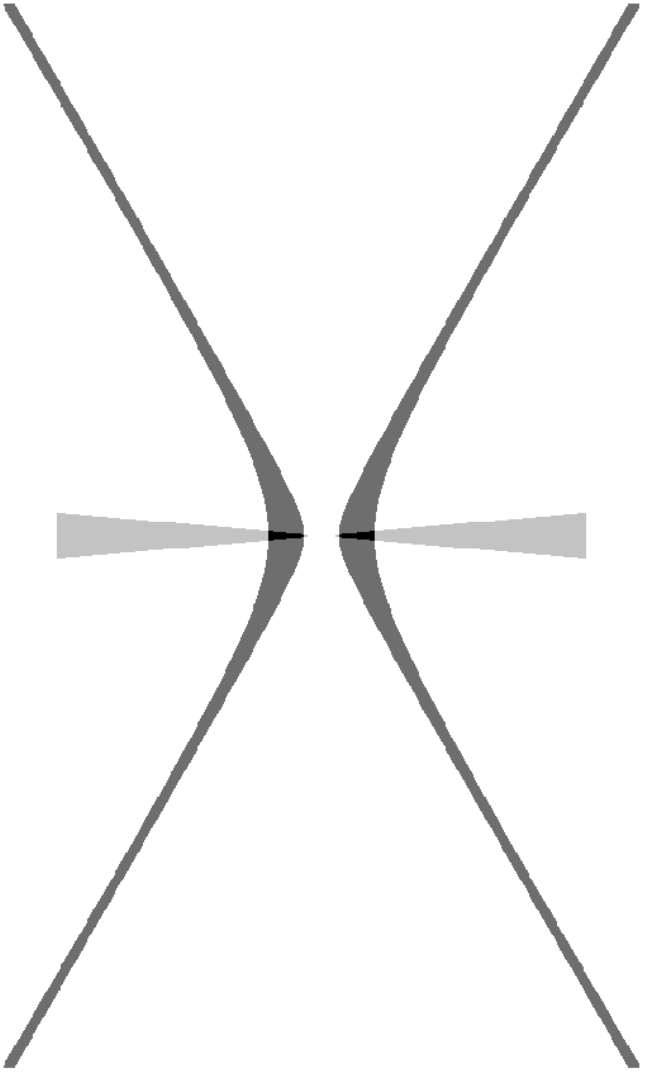




Tristram et al. (2014)

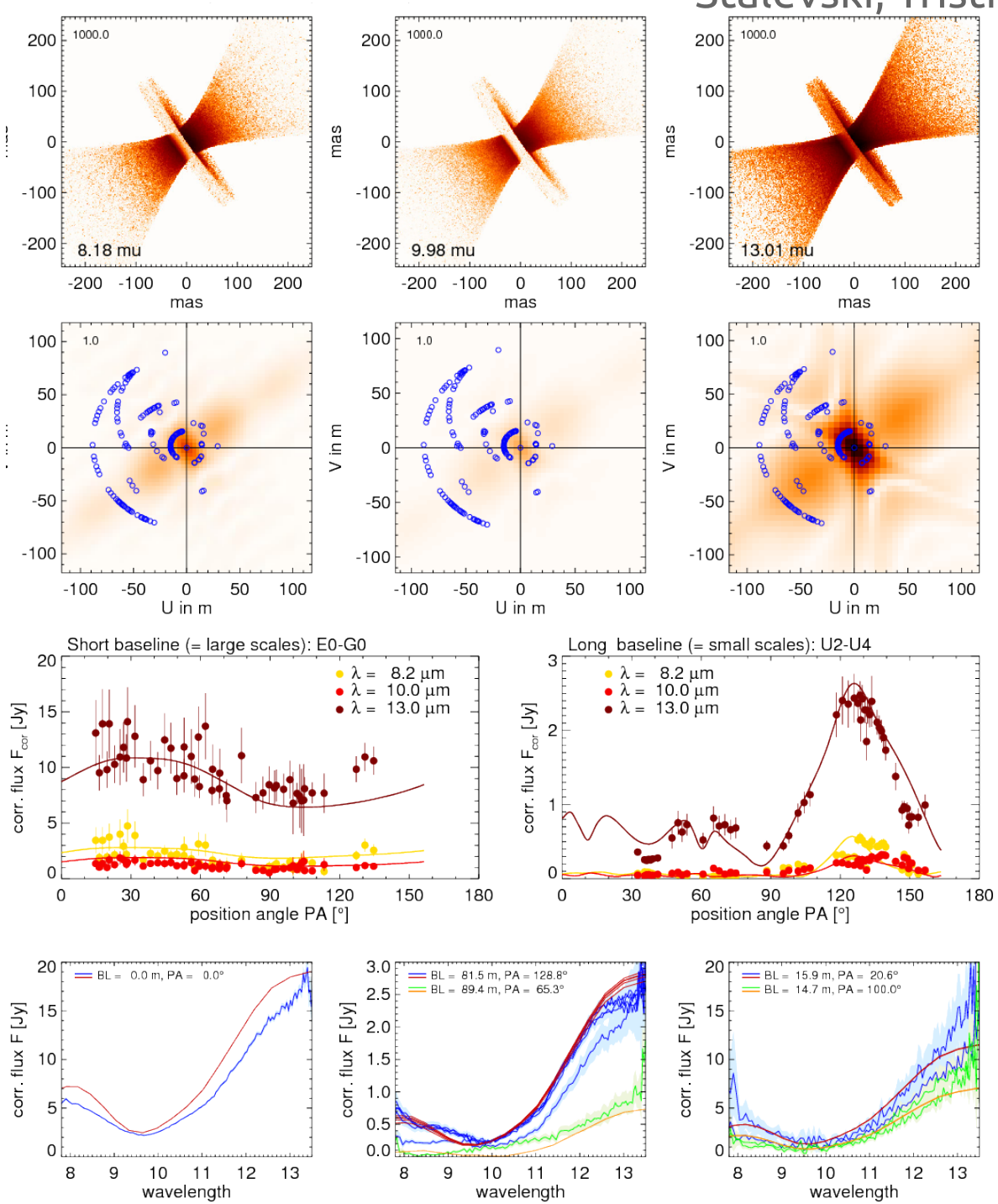
disk + hyperboloid polar wind

Stalevski, Tristram & Asmus, subm.



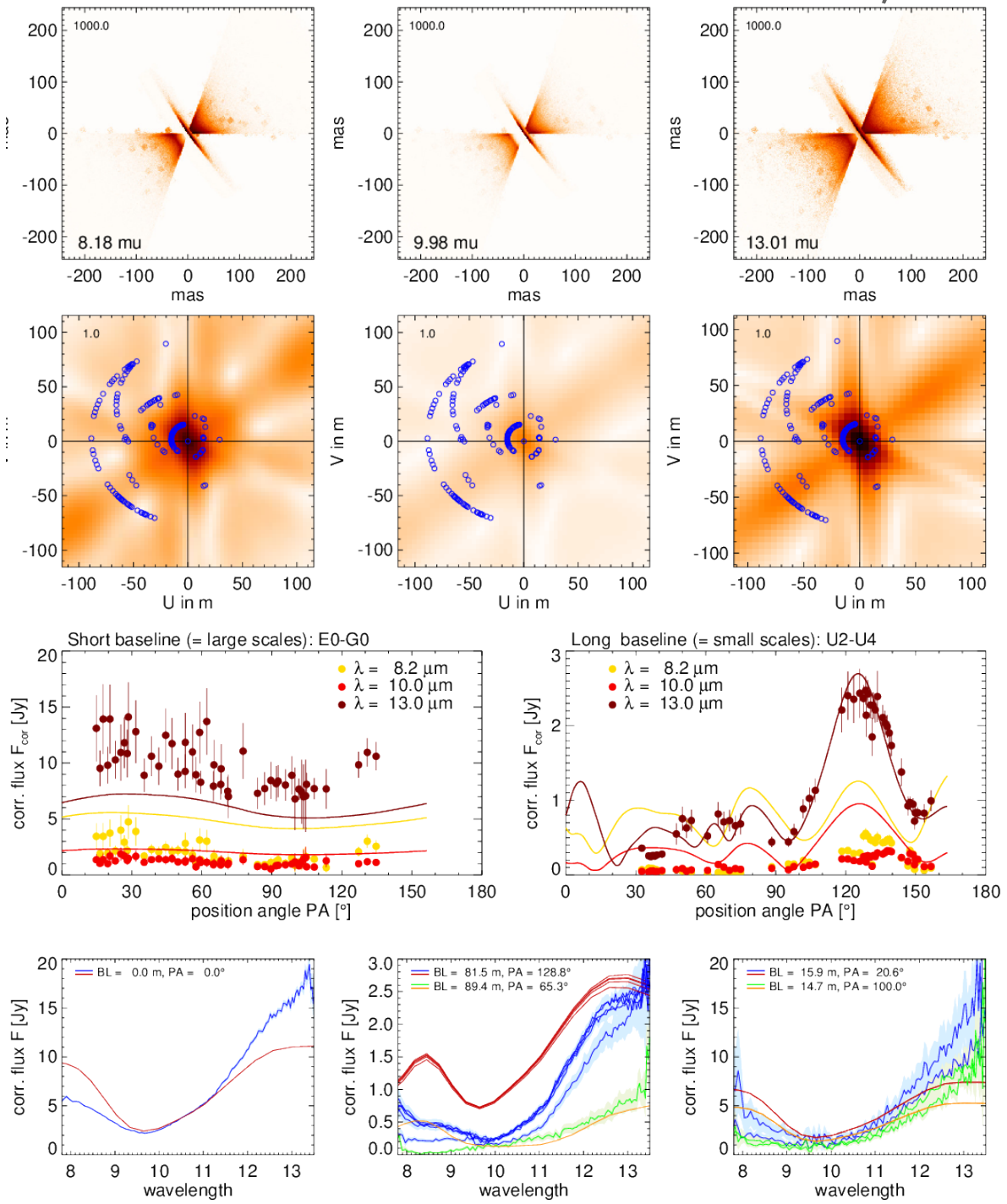
disk+hyp wind: good match with VLTI/MIDI

Stalevski, Tristram & Asmus, subm.



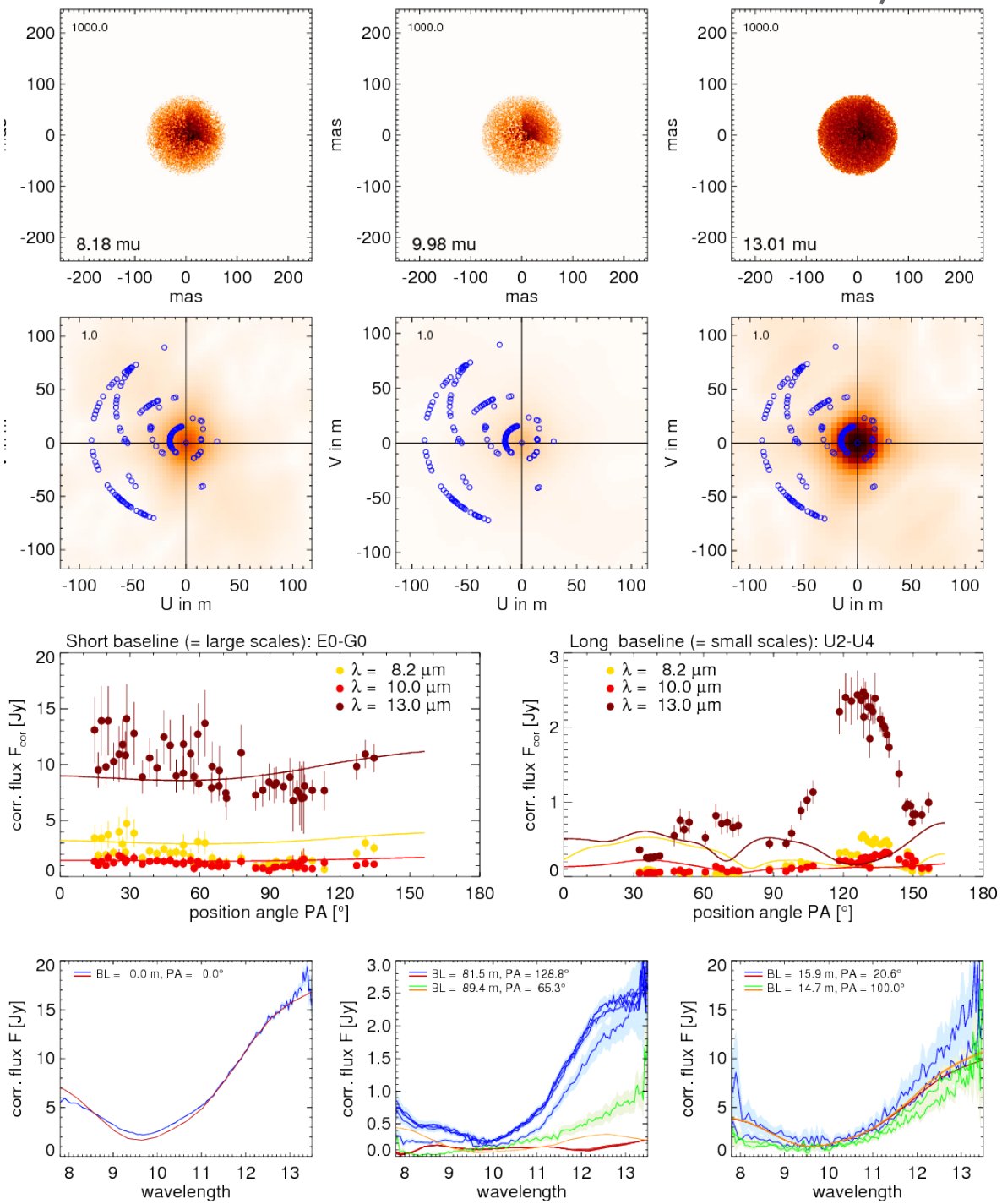
disk+cone wind: not so good match with VLTI/MIDI

Stalevski, Tristram & Asmus, subm.



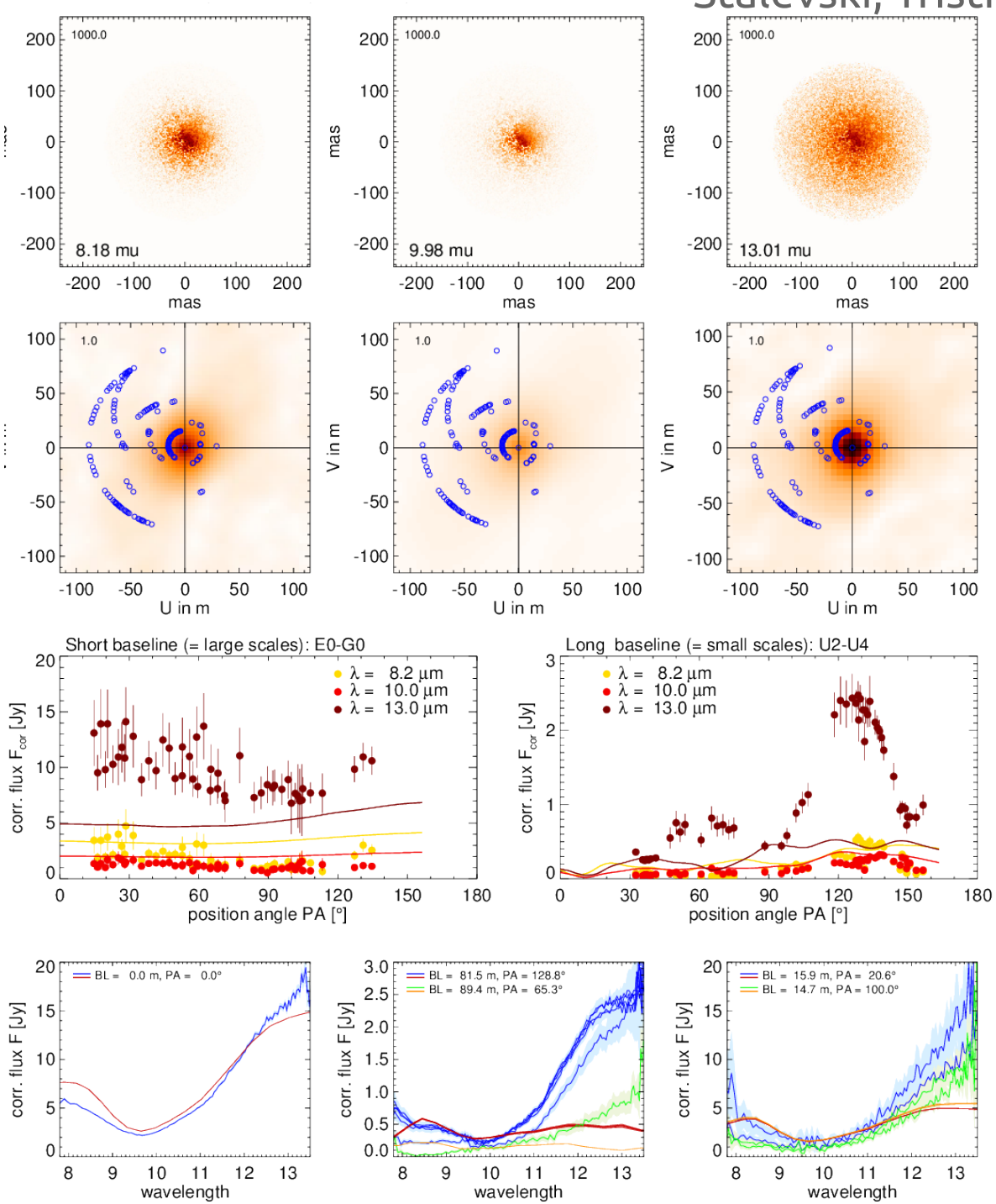
clumpy torus: doesn't work with VLTI/MIDI

Stalevski, Tristram & Asmus, subm.



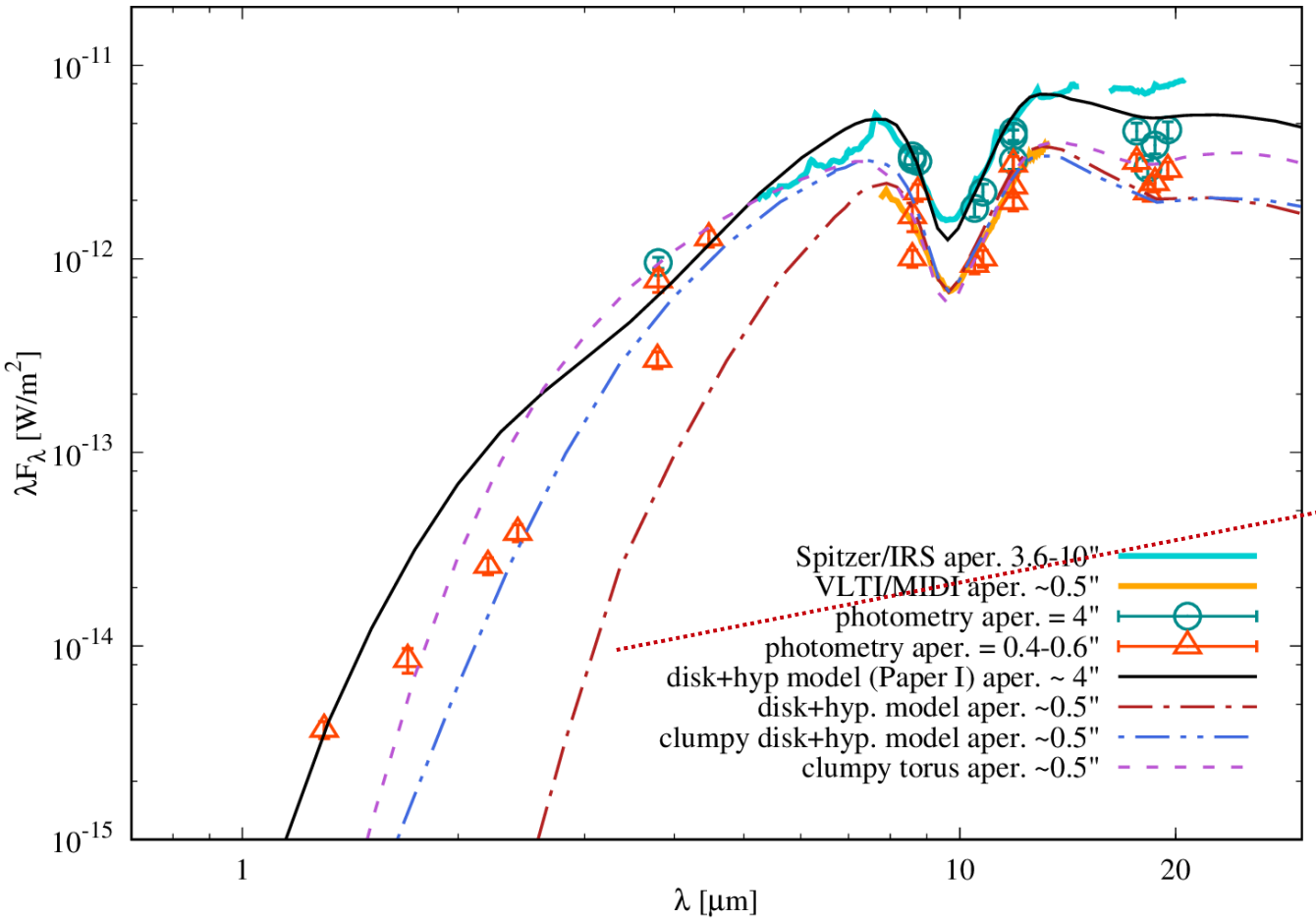
clumpy torus: doesn't work with VLTI/MIDI

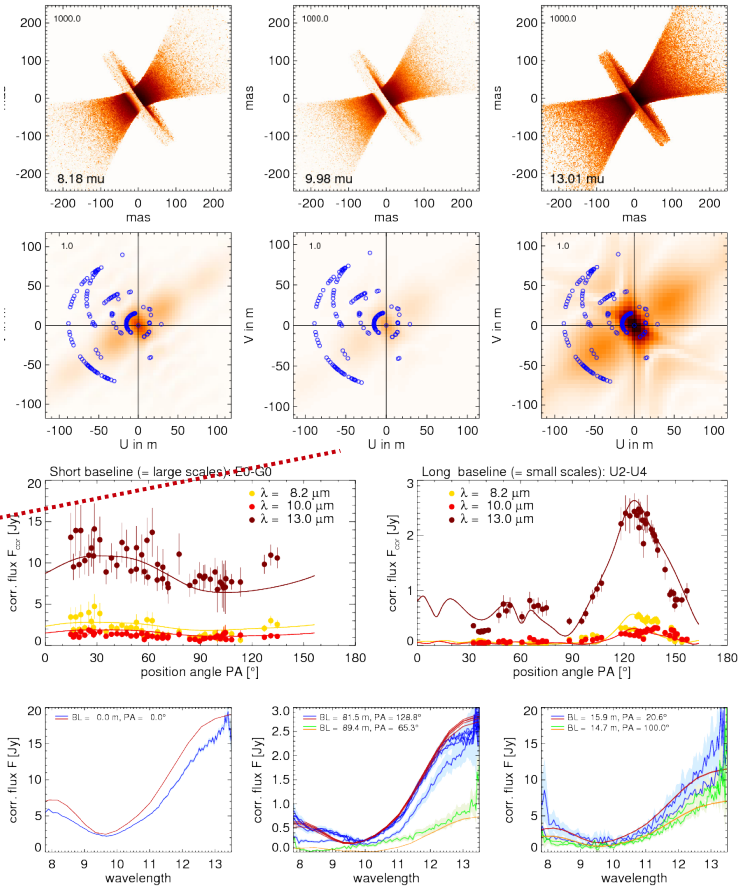
Stalevski, Tristram & Asmus, subm.



disk+wind

Stalevski, Tristram & Asmus, subm.



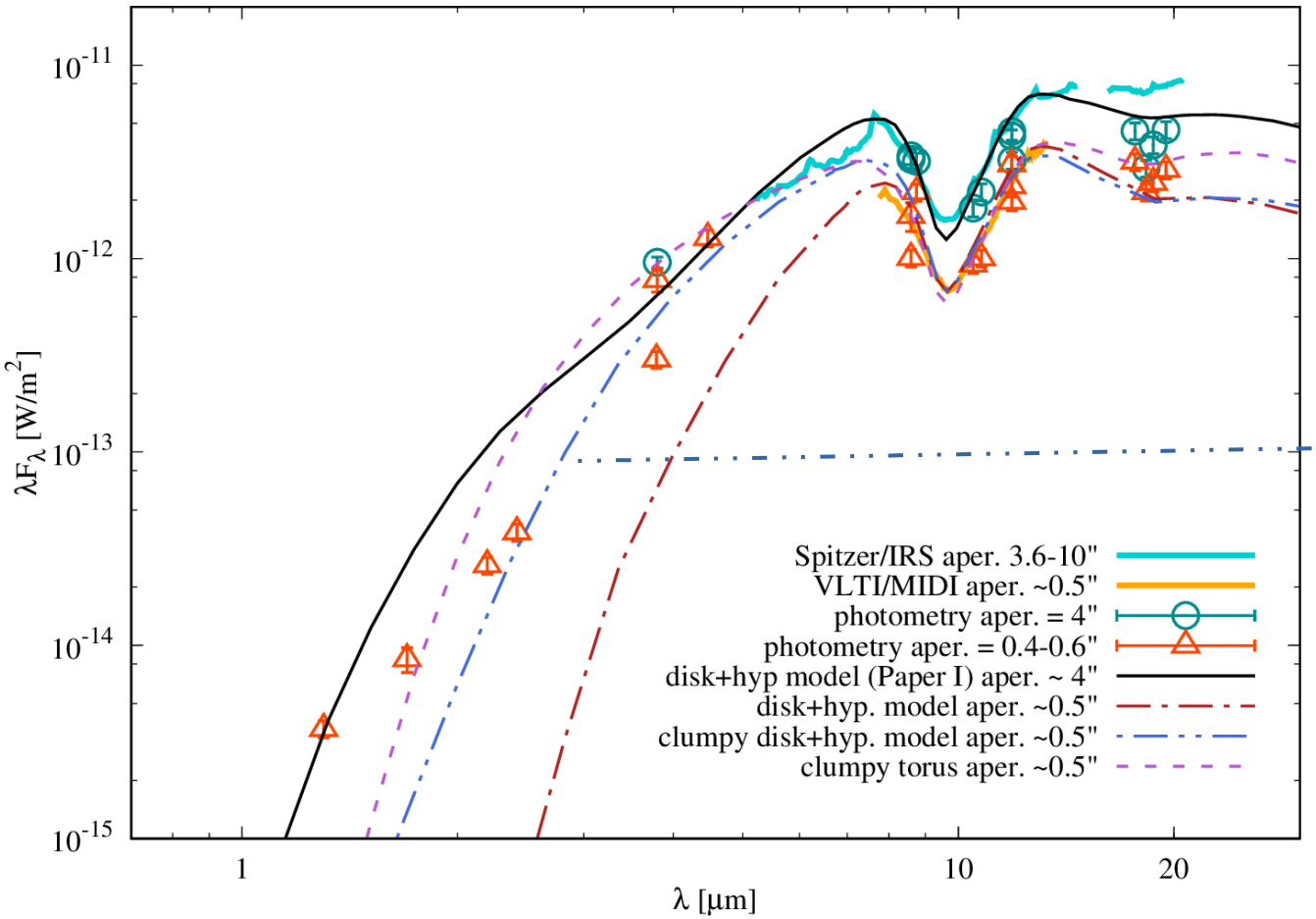


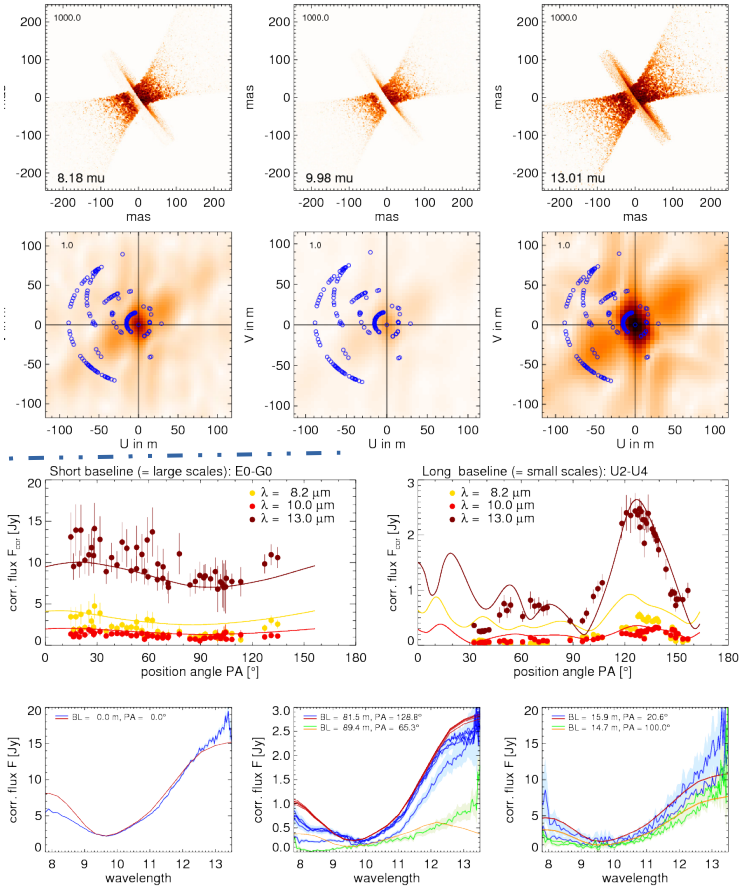
MIR good, NIR missing

VLTI/MIDI: good

disk+clumpy wind

Stalevski, Tristram & Asmus, subm.



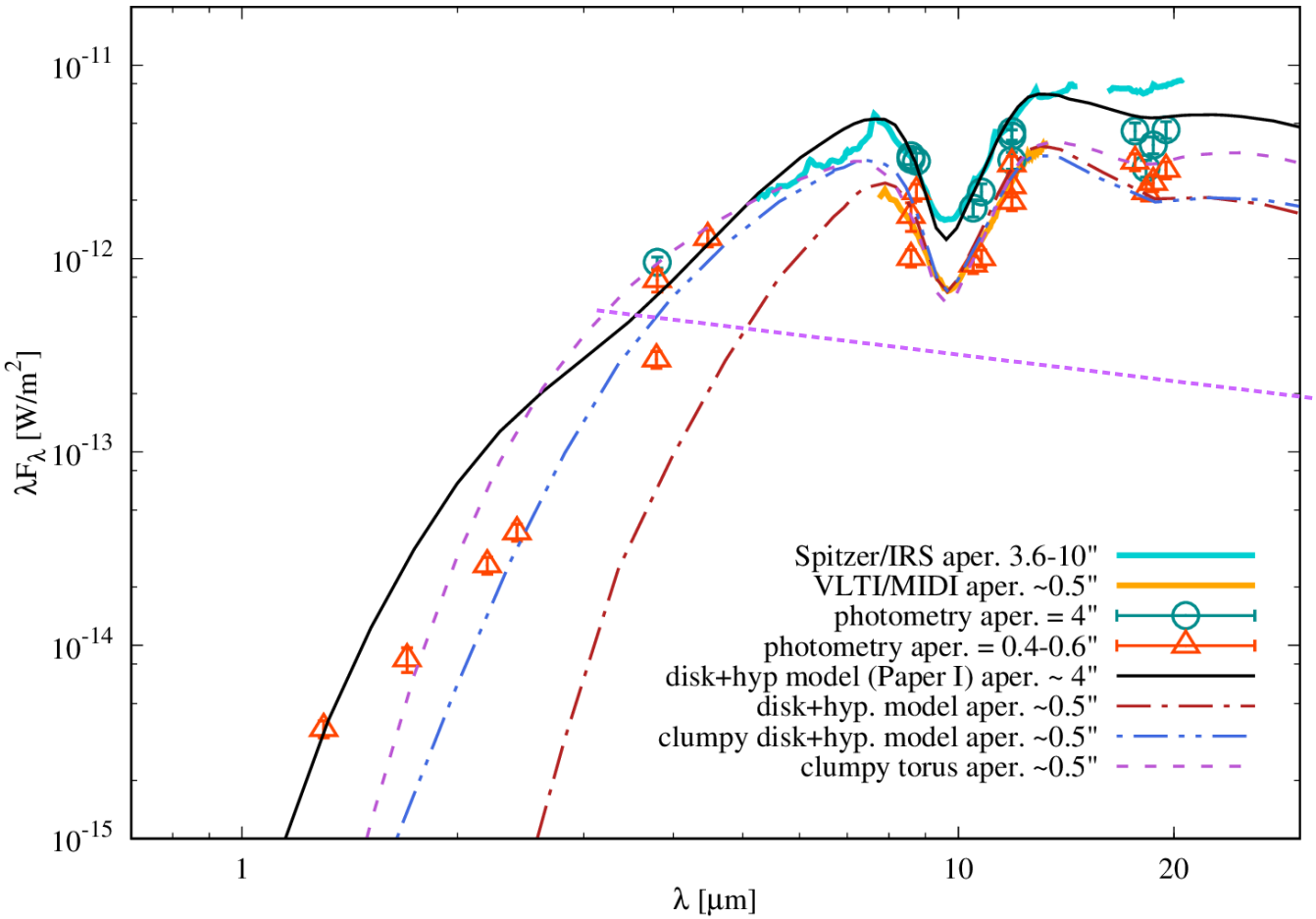


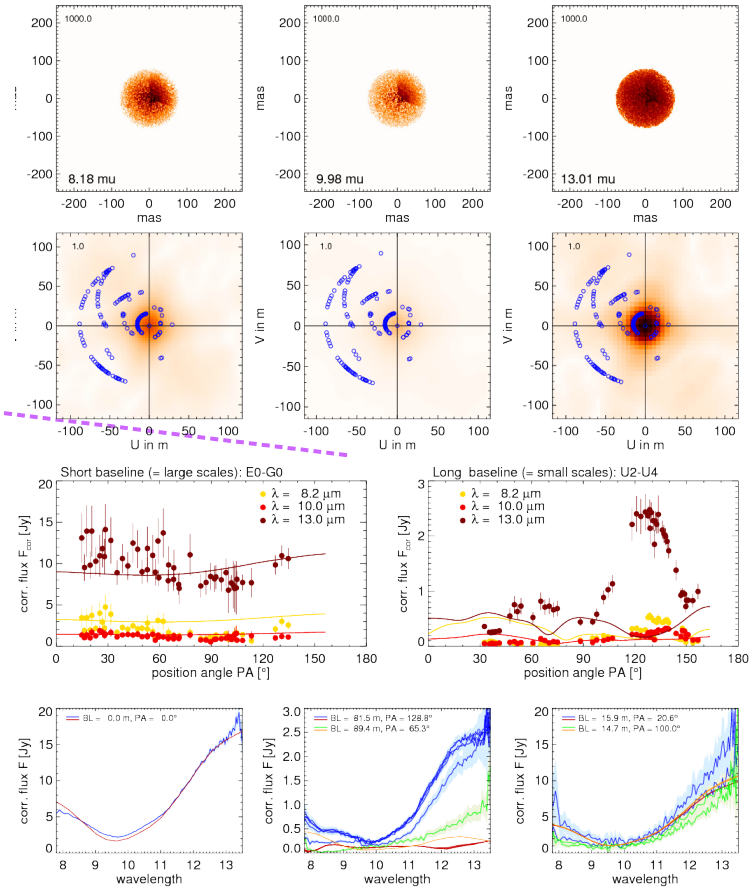
NIR-MIR: good

VLTI/MIDI: good

clumpy torus

Stalevski, Tristram & Asmus, subm.



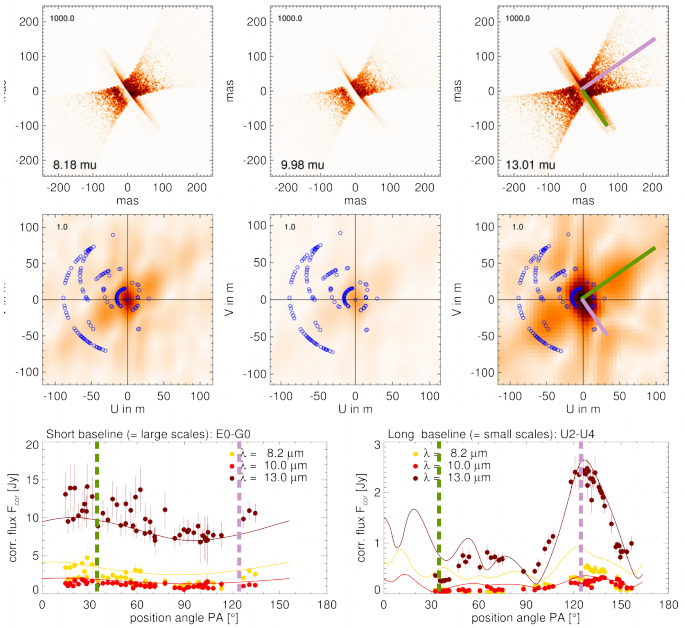


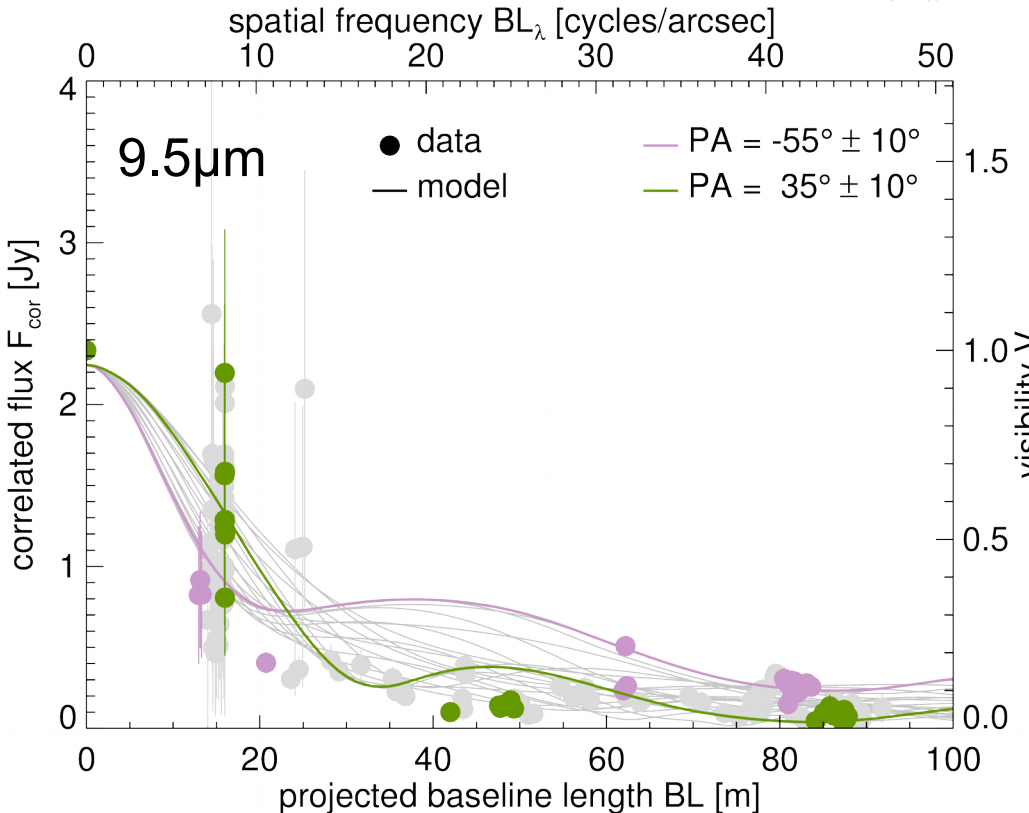
NIR-MIR: good

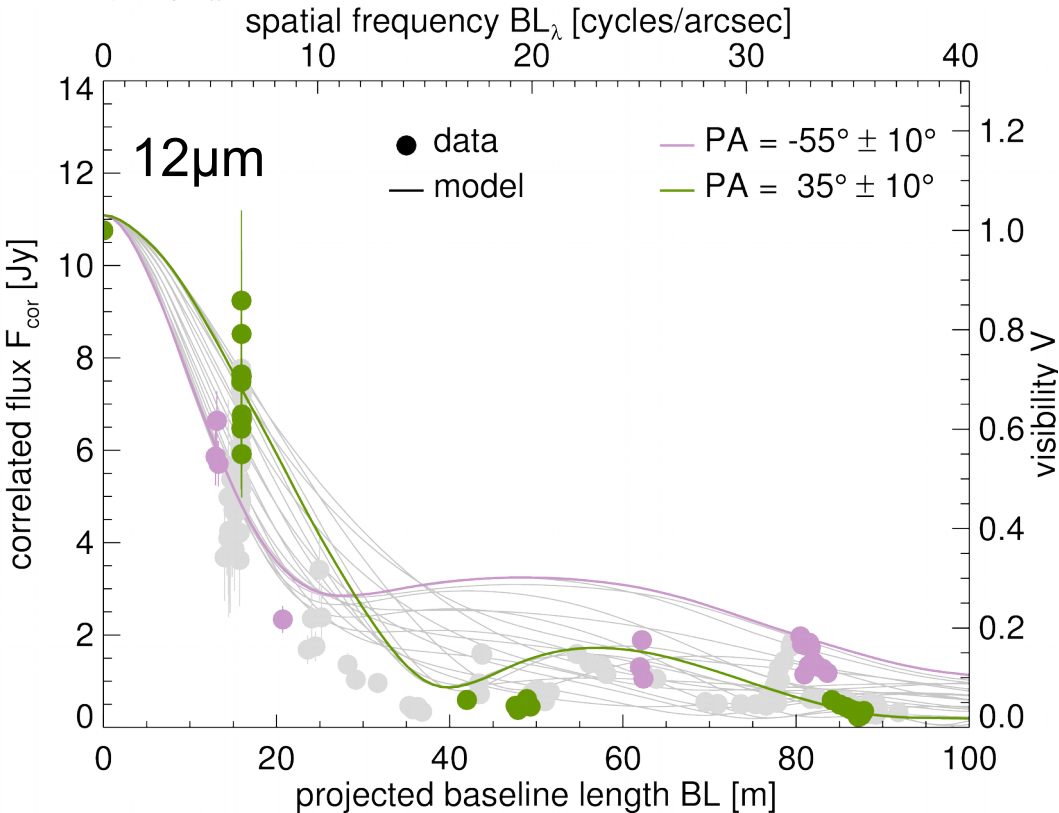
VLTI/MIDI: ugly

disk+ (clumpy) wind: good match with VLTI/MIDI

Stalevski, Tristram & Asmus, subm.

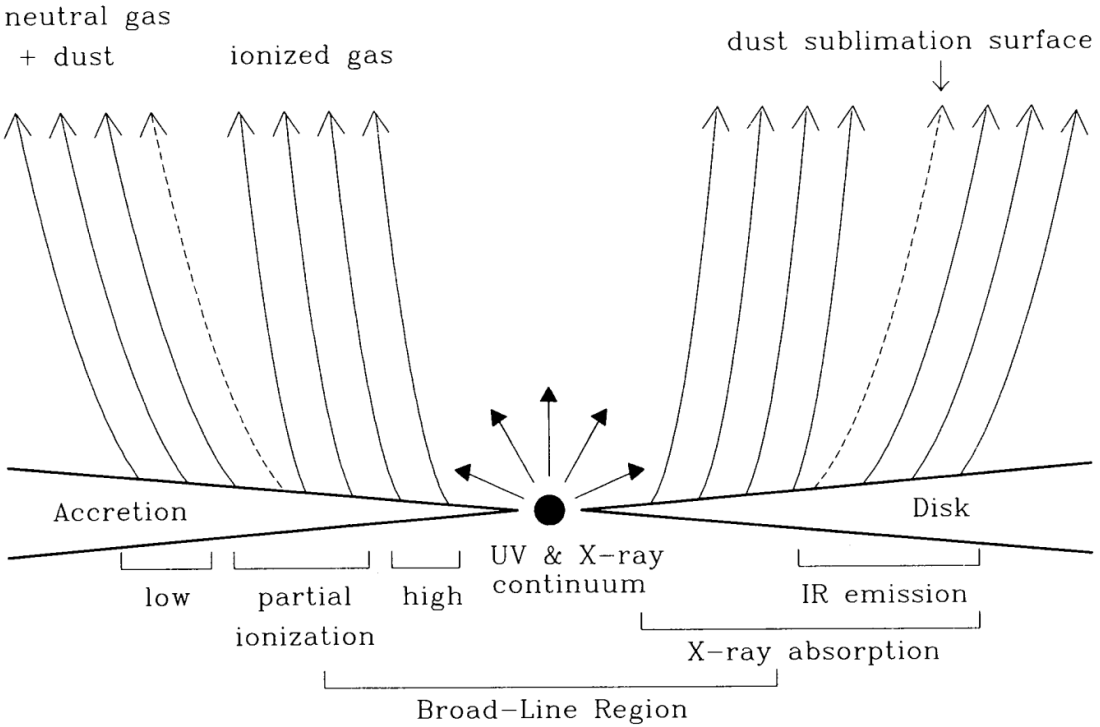


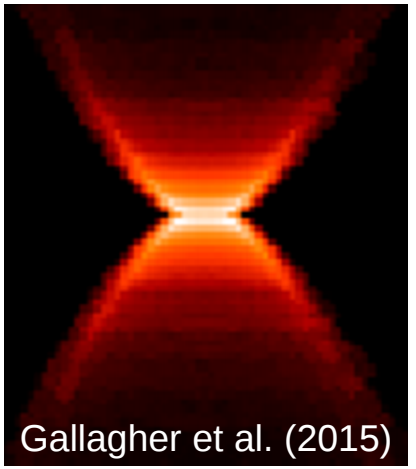


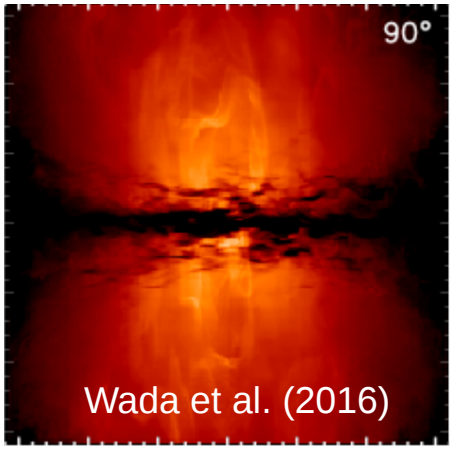


Radiation pressure driven dusty winds

Radiation pressure drives away the gas and dust from the accretion disk to the polar regions, leaving behind what may constitute the obscuring dusty disk/torus







[Konigl & Kartje (1994); Keating+ (2012); Roth et al. (2012); Gallagher+ (2015)]

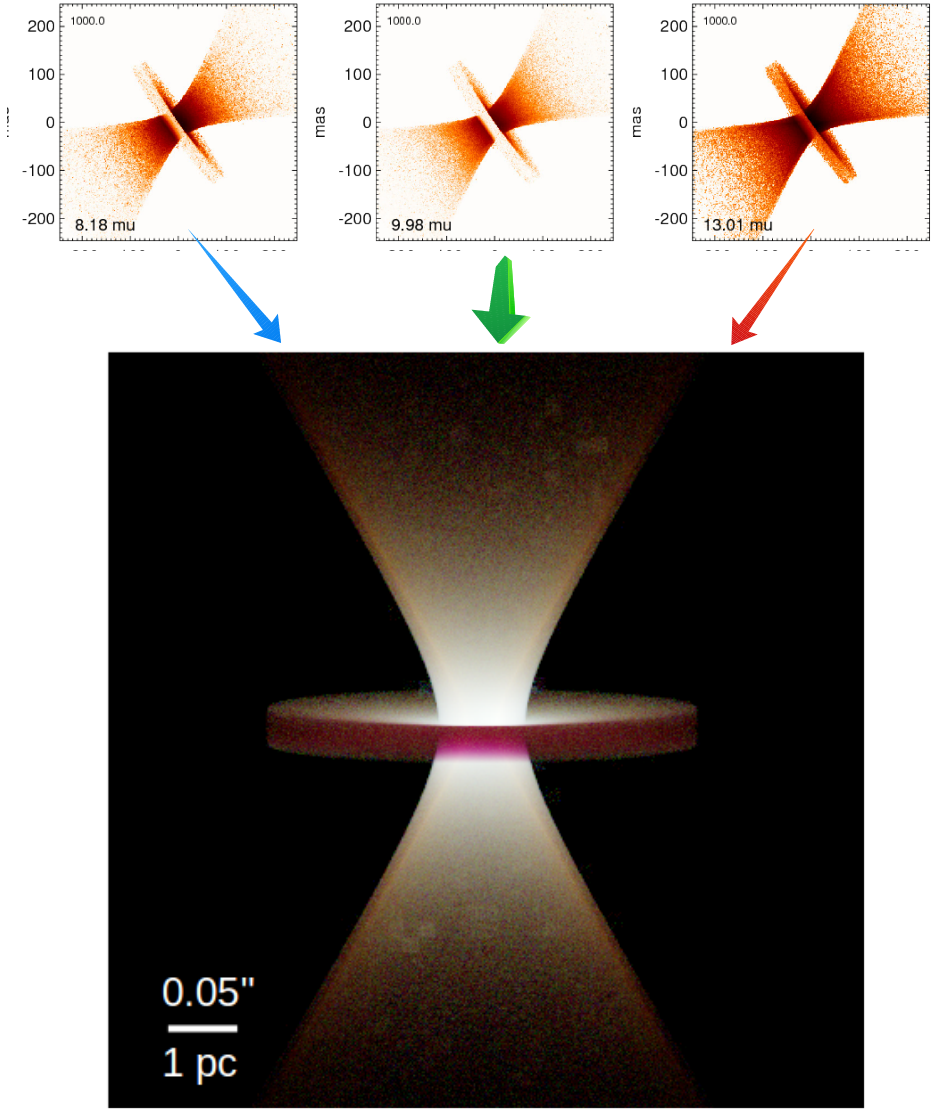
[Dorodnitsyn+ (2011, 2012); Dorodnitsyn & Kallman (2012); Dorodnitsyn+ (2016)]

[Wada (2012), Wada+ (2016), Chan & Krolik (2016, 2017), Vollmer et al. (2018)]

Conclusions

Stalevski, Asmus & Tristram (2017)
+
Stalevski, Tristram & Asmus, subm.

Dust in Circinus AGN: disk + wind



A prototype for polar dust AGN population