ELT/METIS and the AGN torus



Leo Burtscher for the METIS collaboration

http://metis.strw.leidenuniv.nl



Eidgemössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich Science & Technology Facilities Council UK Astronomy Technology Centre





centra multidisciplinary centre for astrophysics

@ELT METIS

Great expectations...

*) What do you think is the single most fundamental missing future (~30 yr window) observation that would help us better understand the torus and its environment?

96 responses



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But what exactly do you mean with "MIR"...?









2h integrations of two planets with radius 1 R_{Earth} (0.5, 1 AU)





Nasmyth platform



To put it in perspective...

METIS



To put it in perspective...

METIS





ME SIN MULIShell

Diffraction-limited imaging and spectroscopy in L,M,N (Q) bands High spectral resolution IFU (R ~ 100,000) in L and M bands Angular resolution: 23 mas (3.5 µm) / 65 mas (10 µm)



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ME SIN CLUSHE

Diffraction-limited imaging and spectroscopy in L,M,N (Q) bands High spectral resolution IFU (R ~ 100,000) in L and M bands Angular resolution: 23 mas (3.5 µm) / 65 mas (10 µm)





Geballe+ 2009

AGN science questions

What is the physical size and structure of the AGN-heated dust?

What is the composition of the dust?

How much warm dust is there in non-active galaxies and can potentially past AGN phases be detected?

> How is energy fed back from the AGN to the host galaxy?

What is the kinematics of the ionised (and molecular?) gas in the nuclei of active galaxies?



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Lopez Gonzaga+ 2014







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Garcia-Burillo+ 2016





Number of observable sources



Note: All AGN lines will be resolved at the METIS (LMS) resolution of 3 km/s which will decrease the sensitivity.

Sensitivity



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Sensitivity



http://bit.ly/SimMETIS

SimMETIS

<> Code	(!) Issues 8	1 Pull requests 0	Projects 0	🔳 Wiki	Insights							
Branch: master - SimMETIS / notebooks / simulate_image.ipynb						Find	Find file Co		path			
astroleo minor changes to documentation										on 29	Oct	
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717 lines (716 sloc) 203 KB Raw Blame							History			Ī		
	N-band s	simulation of	image so	urce								
In [41]:	<pre>import numpy from astropy import simmer import glob</pre>	as np .io import fits tis as sim										
In [2]:	from matplot from matplot %matplotlib	lib import pyplot lib.colors import inline	as plt LogNorm									
	This notebook d	emonstrates how to run	a simulation with		hen the sourc	e structure	s is provi	ded in th	e shane o	fone	or	

several images. Each image is associated with a spectrum. The resulting Source object can be thought of as a cube, which is the sum of the images weighted with their associated spectrum.

http://bit.ly/SimMETIS

SimMETIS

Setting up the source

The source is a simulation of an AGN torus from Schartmann et al., MNRAS, 445, 3878 (2014). It is provided in the form of an image, where pixel values are given in Jy/pixel at a wavelength of 12 micron:

```
In [49]: with fits.open("sd0615_image_l12_i090_p000.fits") as inhdul:
    sourceimg = inhdul[0].data
    sourcehdr = inhdul[0].header
    print("Pixel unit:", sourcehdr['BUNIT'])
    print("Wavelength:", sourcehdr['LAMBDA1'])
    Pixel unit: JY/PIXEL
    Wavelength: 1.2e-05
```

```
In [5]: fig, ax = plt.subplots(1, 1, figsize=(6, 6))
ax.imshow(sourceimg[120:401, 120:401], norm=LogNorm(), origin='lower')
```

Out[5]: <matplotlib.image.AxesImage at 0x10e9cdeb8>



http://bit.ly/SimMETIS

SimMETIS



Supports L,M,N, (Q) band imaging and high-resolution IFU spectroscopy in L,M; long-slit spectroscopy to be supported soon.

Challenges





Challenges





METIS in a nutshell



- Diffraction-limited imaging and spectroscopy in L,M,N (Q) bands
- High spectral resolution IFU (R ~ 100,000) in L and M bands
- Angular resolution: 23 mas (3.5 μ m) / 65 mas (10 μ m)
- 100's of AGNs
- Torus morphology (polar dust, ...) & kinematics at ALMA resolution with the sensitivity of Spitzer (continuum) or JWST (lines).
- PDR: May 2019
- Anticipated first light: 2025