BASIC STATS
*) Number of years spent working on AGN/tori

106 responses
*) Preferred waveband (what you primarily work in or think about; yes, you have to pick one)

106 responses
*) What is the most typical spatial resolution you work with?

103 responses

- <0.1": 29.1%
- 0.1"-1": 39.8%
- >1": 31.1%
*) What is the most typical redshift / distance you work with?

103 responses

- 44.7%: z<0.01 (<45 Mpc)
- 35.9%: 0.01<z<0.1 (~45-450 Mpc)
- 13.6%: 0.1<z<1 (~450-6600 Mpc)
- 5.0%: z>1 (>6600 Mpc)
This questionnaire was...

104 responses

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Structure / Composition
*) How much hard evidence do we actually have for clumpiness of the torus?

104 responses

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None at all

Very Strong
*) Preferred waveband (what you primarily work in or think about; yes, you have to pick one)

106 responses

- Gamma-ray: 19.8%
- X-ray: 27.4%
- UV: 8.5%
- Optical/NIR: 9.4%
- MIR: 27.4%
- FIR/submm: 9.4%
- Radio: 8.5%
- Theoretical / modeling: 19.8%
*) What do you think is the dominant substructure of the torus?

103 responses

- **45.6%**: Smooth
- **12.6%**: Large clumps
- **11.7%**: Small clumps
- **11.7%**: Clumps + smooth
- **8.7%**: Filaments
- **11.7%**: Spiral arms
- **8.7%**: Warped disk
- **8.7%**: Unsure

- **a few clumps + dense and smooth + thin and hot + spiral arms beyond a few parsecs**
- **warped disk + clumpy wind**
- **we don't even know enough to guess; all of the above (except a...**
- **clumps of different size**
- **shells? turbulence?**
- **inflow–outflow**
*) The polar dust structures seen in the mid-infrared...

101 responses

- 22.8% are completely unrelated to the actual torus (e.g., merely some dust in the ionisation cone).
- 21.8% are a small part of the (larger) torus, e.g. only its inner directly illuminated walls.
- 29.7% delineate the actual obscuring structures in AGN which take a cone-like structure.
- 25.7% are a complete enigma to me; I have no idea whatsoever.
*) On what physical scales are the ionisation cones and winds from AGN collimated?

102 responses

- **29.4%** directly on scales of the accretion disk and broad line region
- **28.4%** on scales of the dust sublimation radius (sub-parsec scales)
- **15.7%** on scales of the torus (parsec scales)
- **13.7%** on larger scales (tens to hundreds of parsecs)
- **12.7%** I have no clue at all.
*) Are the obscurers at different wavelengths...

102 responses

- 84.3% connected?
- 9.8% unrelated?
- the same?
*) How generalizable are the results from observations of our favorite objects are (e.g., NGC 1068, NGC 4151, Circinus, ...)?

101 responses

- Not at all: 5 (5%)
- 1: 0 (0%)
- 2: 18 (17.8%)
- 3: 49 (48.5%)
- 4: 29 (28.7%)
- 5: 0 (0%)
Dynamics
*) Can we get away with describing the "torus" as...

102 responses

- 51% Intrinsically dynamic, even if approximately steady-state.
- 43.1% A nearly hydrostatic object.
- No, the "torus" is likely comprised of many structures, some static and some dynamic.
*) What is the dominant kinematic signature in the torus?

102 responses

- **40.2%**: accretion / inflow
- **32.4%**: outflow / wind
- **16.7%**: rotation + turbulence
- **I am not entirely sure. It could be a combination of things.**
- **Don’t know. All may have a role**
- **Rotation + outflow/wind**
*) What is the primary cause of the kinematic signature in the torus environment?

- 33.3% the supermassive black hole
- 45.5% radiation pressure
- 2.7% stellar winds
- 2.0% supernovae
- 1.0% SMBH for rotation, radiation pressure
- 1.0% the supermassive black hole for infl...[truncated]
- 1.0% SMBH+radiation pressure
- 1.0% disk winds
- 1.0% depends on what wavelengths/spati...[truncated]
- 1.0% all of the above?
- 1.0% There is no single cause: gravity of...[truncated]
- 1.0% magneto-centrifugal wind + rotating...
- 1.0% combination of the above
- 1.0% the supermassive black hole + radia...[truncated]
- 1.0% Again, I am not entirely sure at this...[truncated]
- 1.0% combination of gravity and radiation...[truncated]
- 1.0% angular momentum conservation
- 1.0% Unknown
- 1.0% Angular momentum conservation
*) What is the best way to probe the kinematics of the torus?

96 responses

- 53.1% VLBI of water masers
- 15.6% velocity mapping of molecular material
- monitoring variability in the obscuration
- VLBI of molecular & atomic materials
- all of the above together
- Every density regime will require different techniques
- masers and ALMA molecular gas
- need multiple
- everything
- UV absorption and emission lines
- Nothing. Best to give up now.
- all of the above (and any more that could be added)
- I cannot give a objective response here
- All of the above.
- interferometry
- All of the above
- depends on which scale size
Reprocessing + Variability
*) Where does the high column density absorption material seen in the X-ray band primarily arise from?

100 responses

- 40%: kpc scales (host gas, dust lanes, etc.)
- 34%: pc scales ("torus")
- 22%: sub-pc scales (broad line region)
- 1%: more than one of the above
- 1%: none of the above
*) Where does the high extinction material seen in the optical/NIR band primarily arise from?

98 responses

- kpc scales (host gas, dust lanes, etc.)
- pc scales ("torus")
- sub-pc scales (broad line region)
- more than one of the above
- none of the above
*) What is the main reason for X-ray changing-look AGN?

99 responses

- Intrinsic variability of the AGN, i.e. changes of the accretion rate.
- Moving clouds in the torus or BLR.
- Disappearance or reappearance of the torus.
*) What is the main reason for optical changing-look AGN (e.g., broad to narrow lines and the other way around)?

97 responses

- Intrinsic variability of the AGN, i.e. changes of the accretion rate. (55.7%)
- Moving clouds in the torus or BLR. (41.2%)
- Disappearance or reappearance of the torus.
Evolution+Parameter Space
*) How well do you think we currently measure the distribution of inner radii of the torus?

97 responses

*) How well do you think we currently *model* the distribution of inner radii of the torus?

98 responses
*) How well do you think we currently measure the distribution of outer radii of the torus?

96 responses

![Bar chart showing responses to the first question.]

*) How well do you think we currently *model* the distribution of outer radii of the torus?

97 responses

![Bar chart showing responses to the second question.]

*) How well do you think we currently measure the distribution of torus shapes [H(R)]?

93 responses

*) How well do you think we currently *model* the distribution of torus shapes [H(R)]?

96 responses
*) How well do you think we currently measure the distribution of torus total mass?

95 responses

Not at all | Very Well
---|---
10 (10.5%) | 1 (1.1%)
34 (35.8%) | 9 (9.5%)
41 (43.2%) |

*) How well do you think we currently *model* the distribution of torus total mass?

97 responses

Not at all | Very Well
---|---
9 (9.3%) | 0 (0%)
30 (30.9%) | 6 (6.2%)
52 (53.6%) |
* How well do you think we currently measure the distribution of torus large scale magnetic field?

93 responses

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<td>37 (39.8%)</td>
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* How well do you think we currently *model* the distribution of torus large scale magnetic field?

95 responses

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*) How well do you think we currently measure the distribution of torus dust composition?

94 responses

*) How well do you think we currently *model* the distribution of torus dust composition?

94 responses
*) How well do you think we currently measure the distribution of torus molecular composition?

95 responses

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*) How well do you think we currently *model* the distribution of torus molecular composition?

95 responses

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There are reasonable measurements of trends with luminosity and redshift, but there’s no reason why there shouldn’t be trends with other parameters as well. Some galaxies seem to host a myriad of molecular species, have more obscuration, rather than others. I set luminosity as the primary difference among them (Eddington ratio, radiation pressure). Luminosity and properties (mass, rate, etc) of stuff coming in from circumnuclear scales.

There are reasonable measurements of trends with luminosity and redshift, but there’s no reason why there shouldn’t be trends with other parameters as well.

- External accretion from outside the torus: 4 (4.2%)
- Type 1, type 2 and perhaps Eddington ratio: 1 (1%)
- Merger stage: 1 (1%)
- Redshift: 1 (1%)
- Eddington ratio: 1 (1%)
- Luminosity: 1 (1%)
- Black hole mass: 1 (1%)

96 responses
*) Are there any AGN where the torus does not exist?

93 responses

- Yes, below some accretion/luminosity threshold: 49 (52.7%)
- Yes, above some accretion/luminosity threshold: 28 (30.1%)
- No: 25 (26.9%)
*) Are there any AGN where the broad line region does not exist ("true type 2s")? 

95 responses

- Yes: 44.2%
- No, at least above some accretion threshold: 43.2%
- No: 12.6%
Evolution + Parameter Space
*) How closely related are the AGN activity, torus, and host properties?

99 responses

None at all

Very Strong

1 (1%)

18 (18.2%)

28 (28.3%)

42 (42.4%)

10 (10.1%)
*) Do AGN winds strongly impact...
97 responses

- the broad line clouds? 53 (54.6%)
- the torus? 52 (53.6%)
- the host galaxy? 49 (50.5%)
- question is too general, is yes & no. 1 (1%)
- my chances of future funding 1 (1%)
- At least one sort of AGN wind likely has... 1 (1%)
- none of them 1 (1%)
- more than one of the above 1 (1%)
*) How clear is it to you what the torus is and what it is not?

102 responses

Not at all

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*) The torus (aka the molecular & dusty obscurer on parsec scales) ...

100 responses

- ... is a rather well defined and distinct physical structure.
- ... forms in a crude region of space between the broad line region and the inner galaxy.
- ... is not really a tangible structure within an AGN.
Torus of the Future
*) What are we most fundamentally lacking to advance our understanding of the torus?

101 responses

- 77.2%: more direct constraints from observations / observing facilities
- 16.8%: complexity of theory / simulations
- 6%: both better observations and theory.
- 5%: both modelling and observations
- 4%: both of the above
- 2%: both
*) What do you think is the single most fundamental missing current (~3 yr window) observation that would help us better understand the torus and its environment?

95 responses

- High sensitivity X-ray imaging on >50 pc scales (38.9%)
- High spectral resolution X-ray instruments (33.7%)
- High sensitivity IFU observations of ionisation cone structure and energetics on >1 pc scales (11.6%)
- High sensitivity MIR imaging on ~1 pc scales
- High sensitivity, spatially resolved molecular line kinematics on ~1 pc scales
- Simultaneous observations at different wavelengths near-IR VLTI measurements with GRAVITY combined with molecular kinematics on ~1 pc scales
- MIR interferometry imaging on sub-pc scales
- All of the above. We need a complete picture.
- Both MIR and molecular lines
- No single observation, many: IFU observations, MIR imaging, spatially resolved cold dust and molecular gas kinematics
- Near-IR imaging on 0.1-0.01 pc scales
*) 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

- High sensitivity X-ray imaging on sub-pc scales
- High sensitivity MIR IFU obs on sub-pc scales
- High sensitivity, spatially resolved molecular line kinematics on sub-pc scales
- near-IR interferometry
- near-IR interferometry (GRAVITY)
- I am pessimistic until we have something to falsify
- Multi-wavelength concurrent observations.
- High sensitivity NIR imaging on ~1 pc scales
- all of the above
- N/A
*) In what direction should simulations/modeling push most? Where will the most fruitful efforts go?

98 responses

- multiwavelength (X-ray to submm & molecules) 36.7%
- higher resolution and dynamic range 40.8%
- more physically based (radiation pressure, magnetic-fields, SNe, star formation, ...)
- Monitoring of state changes, where we can probe the disappearance and reappearance of BLR and innermost torus 10.2%
- higher resolution/dynamic range and a lot more physics
- Model diversity
- All options above are relevant
- more than one of the above
- identifying what mechanism truly makes the torus geometrically thick since none of the current candidates is completely satisfactory