Peering through the veil: using hard X-ray spectroscopy to probe the circum-nuclear environment in NGC 3982

Cologne-Prague-Brno meeting 2022

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SRG/eROSITA
0.3-2.3 keV - RGB
IKI
MPE

Motivation - CXB

- the first cosmic background discovered (Giacconi+ 1962)
- residual diffuse emission
- largely isotropic emission
- extragalactic origin
- very wide range of wavelengths
- broad bump with peak at ~ 30 keV

Figure: Gilli, 2012

Motivation - CXB

- many individual unresolved point sources
- discrete AGNs with significant contribution from obscured AGN
- CXB predicts large fraction of heavily obscured AGN

Figure: Broadband X-ray spectrum of heavily obscured AGN

Obscured AGN

- unified model in optical classification

  see Antonucci 1993,
  Urry & Padovani 1995

- in X-rays obscured and unobscured AGN depending on the N_{H} of the obscuring circum-nuclear material

Compton-thin: $N_{\mathrm{H}} = 10^{22} - 10^{24}\ \mathrm{cm}^{-2}$

Compton-thick: $N_{\mathrm{H}} \geq 10^{24}\ \mathrm{cm}^{-2}$

Figure: Bill Saxton, NRAO/AUI/NSF

NGC 3982

- Seyfert 2 galaxy
- $z = 0.00371$, D $\sim$ 19 Mpc
- $\log M_{\rm BH} \sim 6 - 7\, M_\odot$
- EW Fe K$\alpha \gtrsim 1$ keV
- $\log L_{2-10{\rm keV,obs}}$ / erg s^{-1} = 39.8
- Compton-thick candidate

  see Guainazzi+ 2005,
  Kammoun+ 2020, Saade+ 2022

Figure: HST image of NGC 3982

Models

semi-infinite slab geometry: pexrav
Magdziarz & Zdziarski 1995

spherical geometry: borus02
Baloković+ 2018

toroidal geometry: mytorus, rxtorus
Yaqoob & Murphy 2010,
Paltani & Ricci 2017

clumpy geometry: uxclumpy
Buchner+ 2019

Models: physically-motivated table models

Xspec modelling

Posterior model realizations

Key parameter distributions

Asmus+ 2015

Conclusions

- intrinsic luminosity of NGC 3982 is up to 2 orders higher than the observed luminosity
- all models assuming different unique geometries predict Compton-thickness, but geometry dependent degeneracies should be taken into account
- with available data quality we cannot distinguish between different unique geometries

Future Work:

HEX-P

Madsen+ 2020

www.hexp.org

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Key parameters distributions

Prediction for $L_{2-10\mathrm{keV}}$ from L_{OIII}
Asmus+ 2015, Berney+ 2015, Woo & Urry 2002

Key parameters distributions

Figure: Distribution of λ_{Edd} for obscured AGN in local Universe from Ricci+ 2017

Key parameters distributions

Thompson scattering fraction

MASARYK
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