



X-ray polarimetry of Seyferts and the nature of the hot corona

Francesco Ursini
(Roma Tre University)

with:

S. Bianchi, V. E. Gianolli, A. Ingram, A. Marinucci, G. Matt, D. Tagliacozzo
& the IXPE Science Team

The Restless Nature of AGN - Napoli 2023

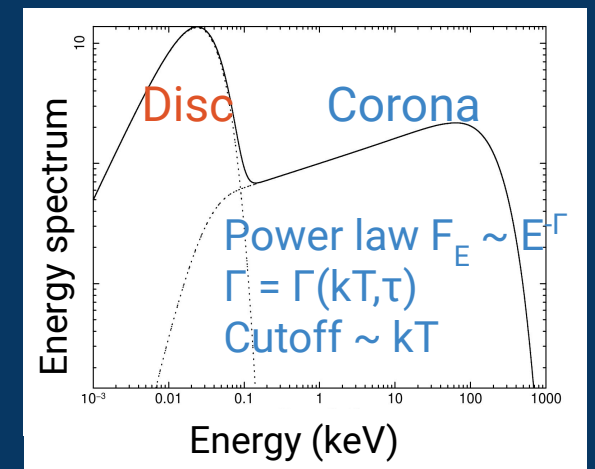
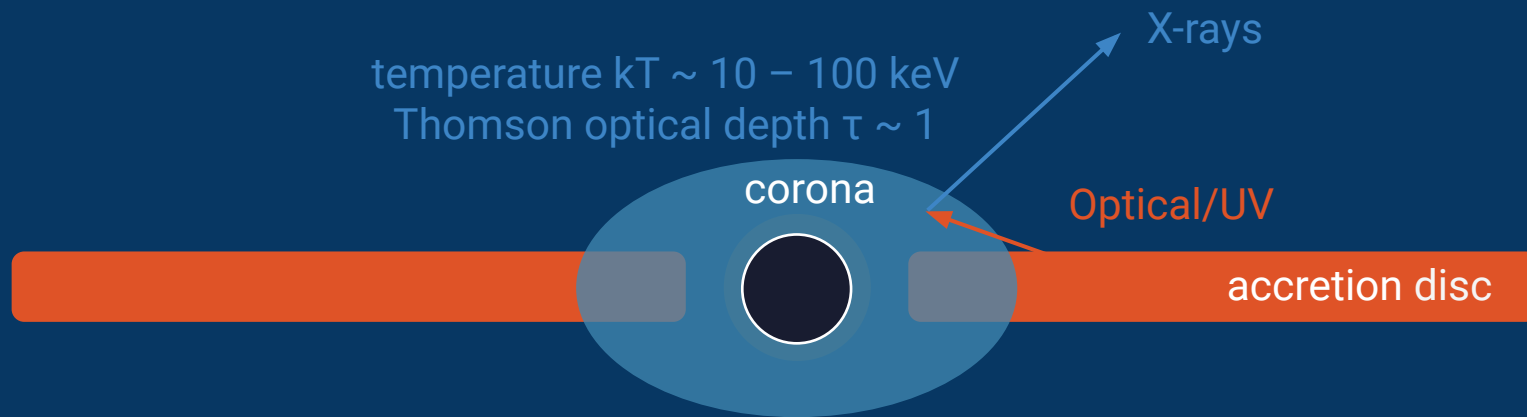


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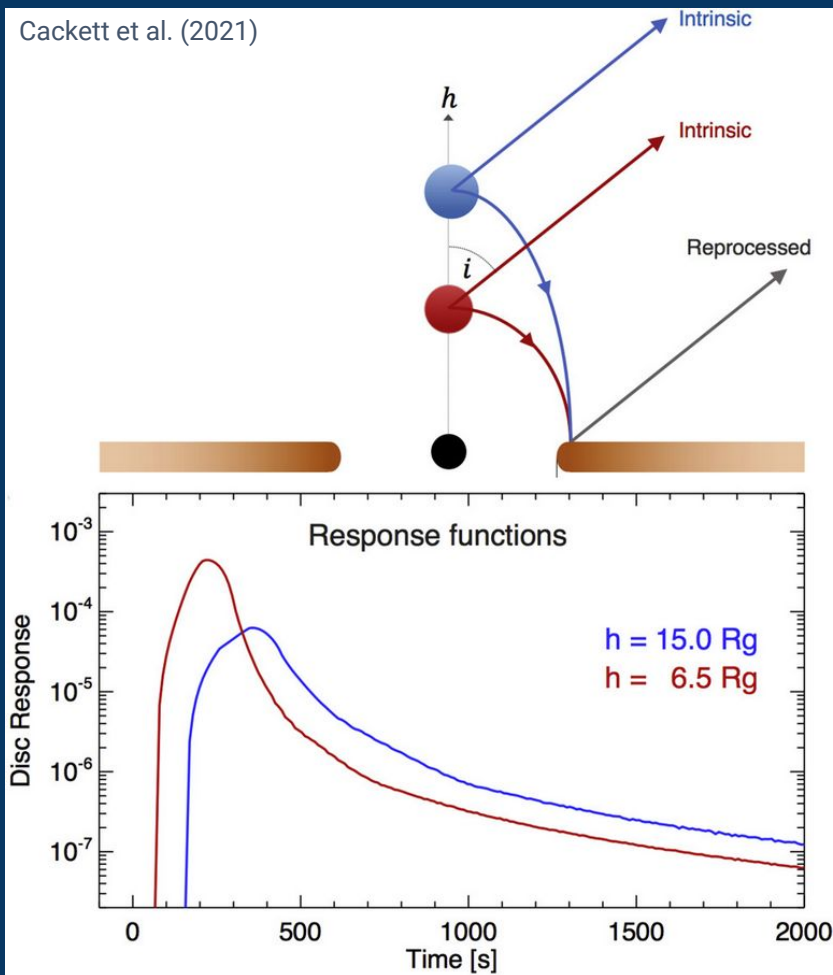
- ★ The Imaging X-ray Polarimetry Explorer (IXPE; Weisskopf+22, Soffitta+21) is the first mission dedicated to X-ray polarimetry and operates in the 2–8 keV band.

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- ★ The Imaging X-ray Polarimetry Explorer (IXPE; Weisskopf+22, Soffitta+21) is the first mission dedicated to X-ray polarimetry and operates in the 2–8 keV band.
- ★ One of the goals of IXPE is constraining the geometry of the hot corona of unobscured, radio-quiet AGN.



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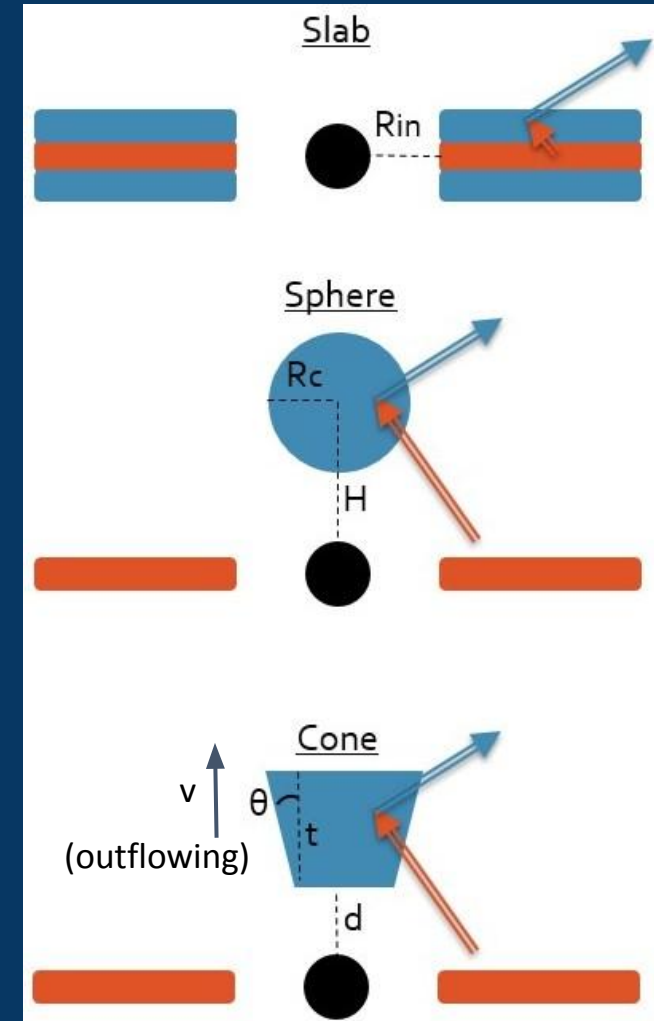
A “lamp-post” geometry is often assumed for the hot corona.

Reprocessing of X-rays emitted by the corona in the disc is a standard framework to interpret time lags. (see e.g. the review talks by McHardy and Mastroserio)

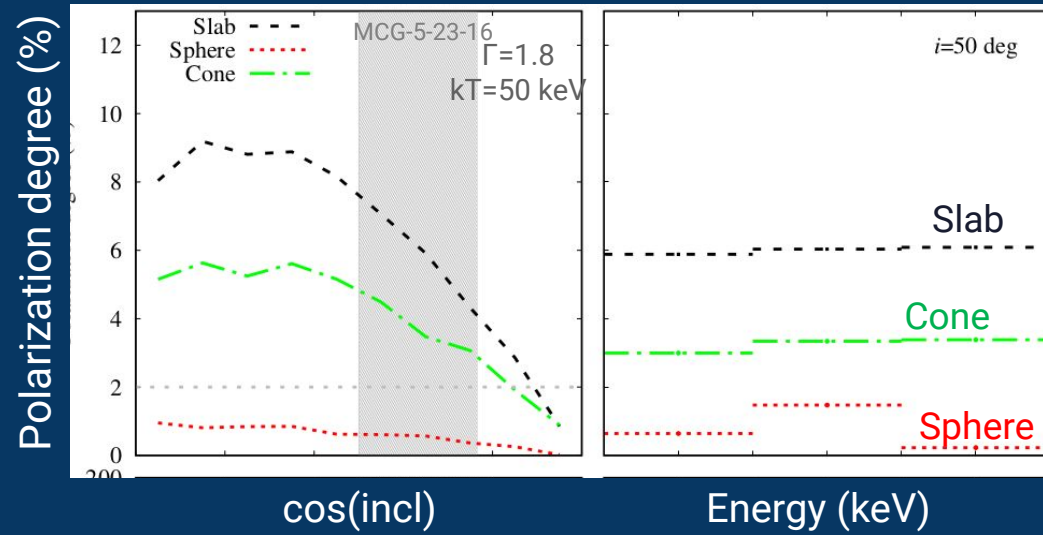
De Gouveia dal Pino et al. (2011)

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- ★ However, the geometry of the corona is poorly constrained.
- ★ X-ray spectroscopy is not sensitive to geometry, but polarimetry is! The polarization signal measures the deviation from spherical symmetry.
- ★ To simulate the expected X-ray polarization signal, we used the Monte-Carlo radiative transfer code MONK (Zhang et al. 2019), that calculates Comptonized spectra in Kerr spacetime.

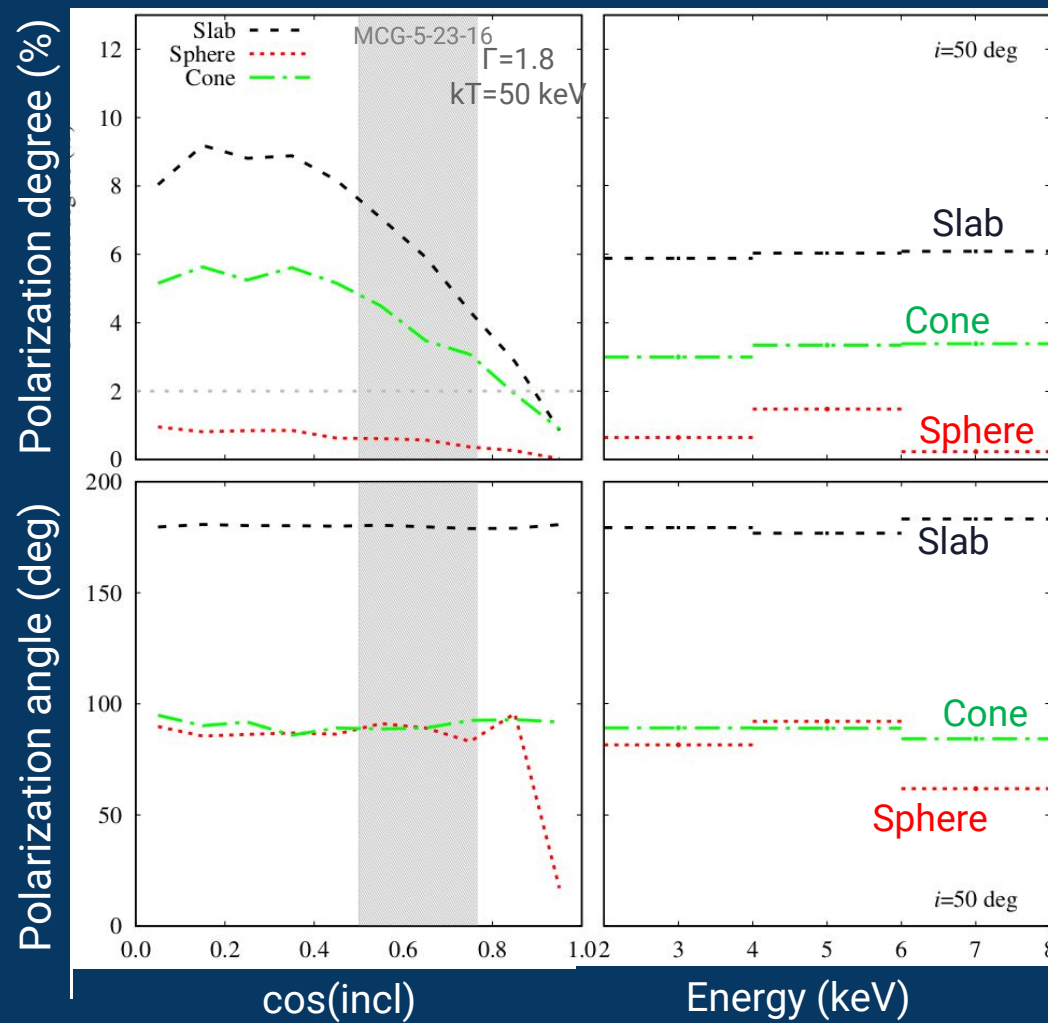


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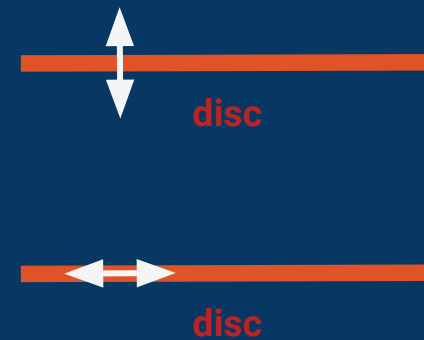


Ursini et al. (2022)

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Ursini et al. (2022)



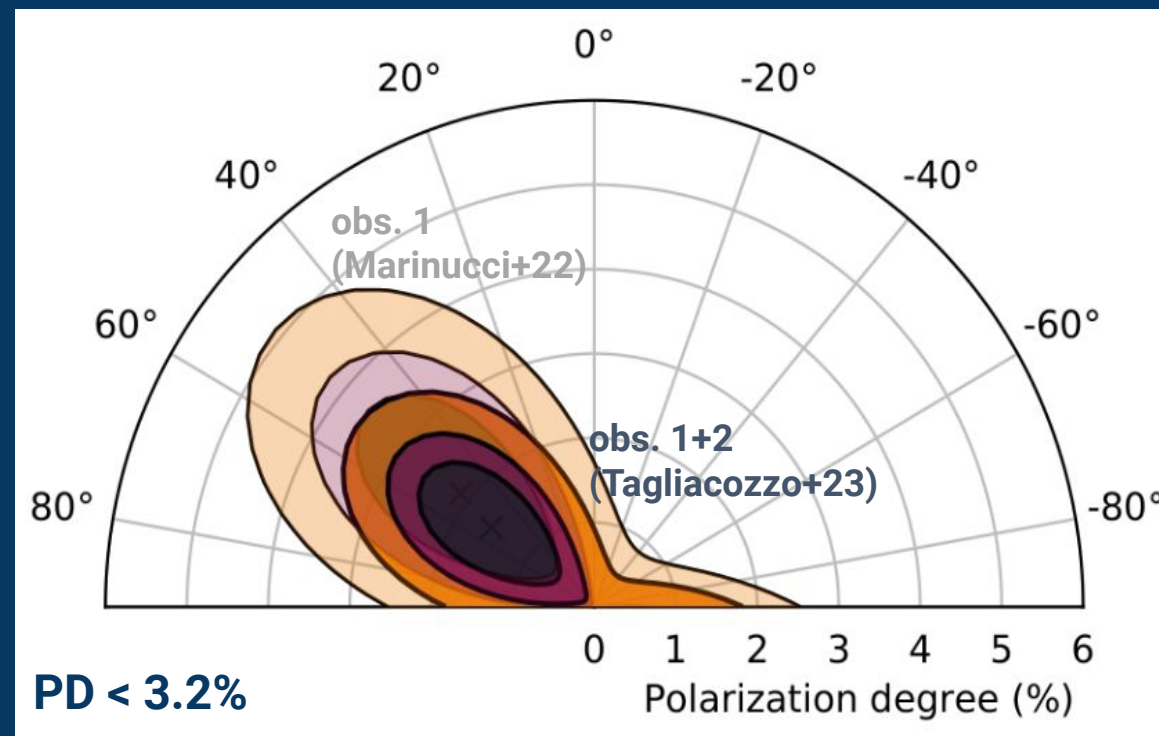
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IXPE observations

source	Obs date	Exposure (ks)	2–10 keV flux (cgs)
MCG-5-23-16 Marinucci et al. (2022) Tagliacozzo et al. (2023)	May 2022 Nov 2022	1300 (obs 1+2)	7.5e-11
IC 4329A Ingram et al. (2023.)	Jan 2023	470	8e-11
NGC 4151 Gianolli et al. (2023)	Dec 2022	630	1.6e-10

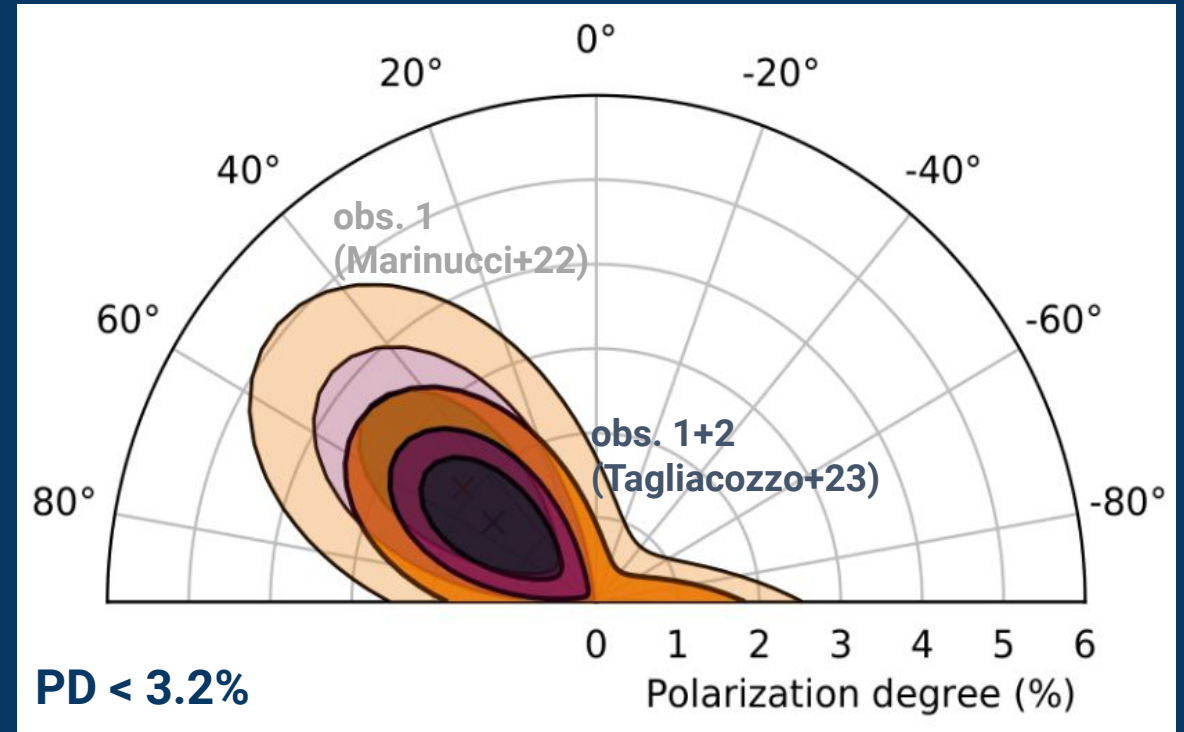
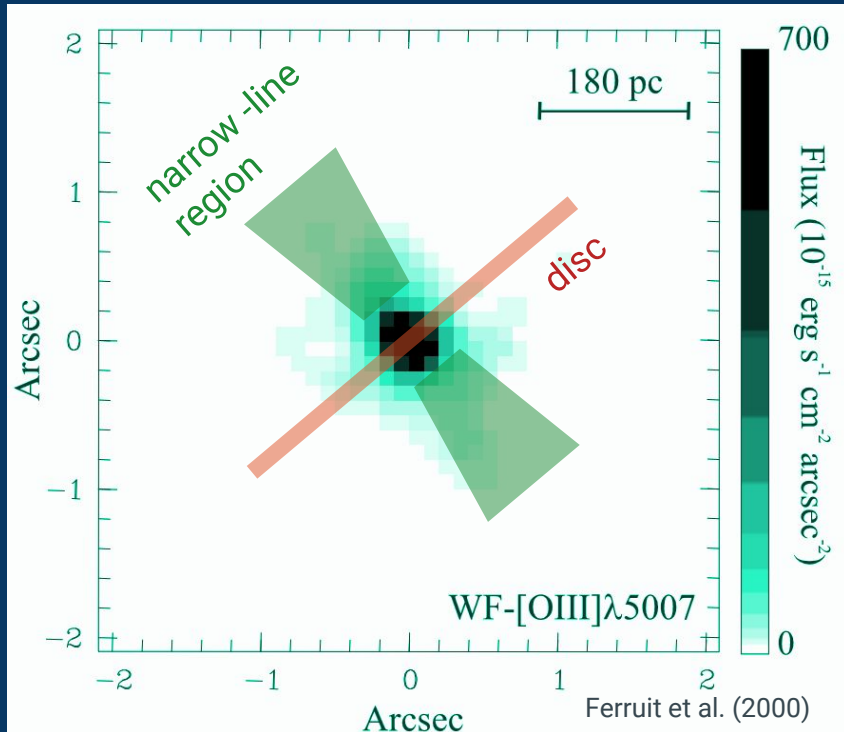
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MCG-5-23-16



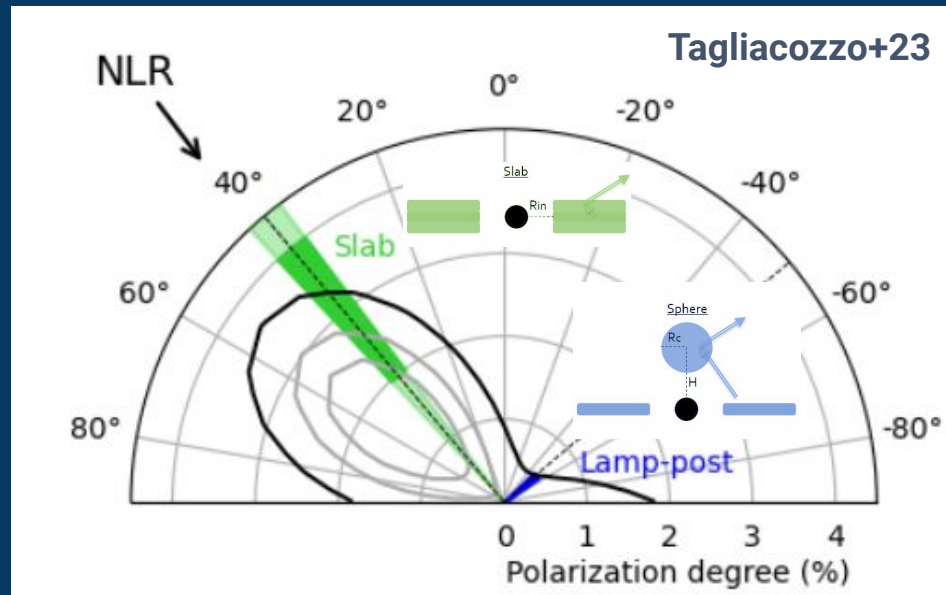
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MCG-5-23-16



PA preferentially aligned with the NLR

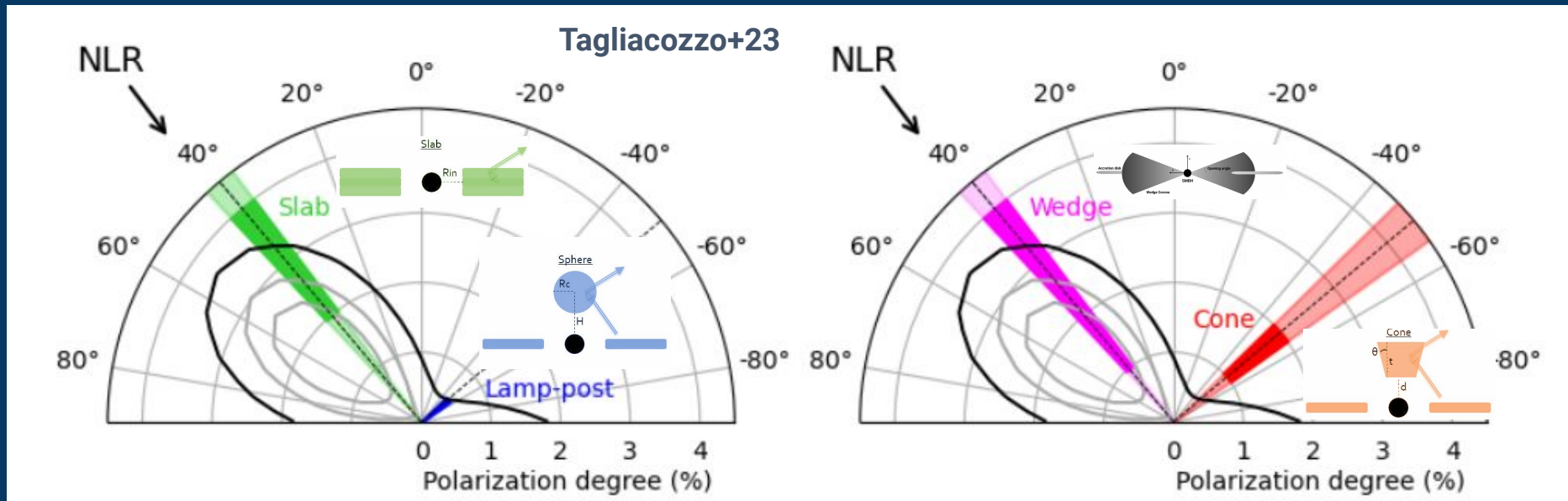
MCG-5-23-16



opaque colors = source inclination of 30–50° (Serafinelli et al. submitted)

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MCG-5-23-16



opaque colors = source inclination of 30–50° (Serafinelli et al. submitted)

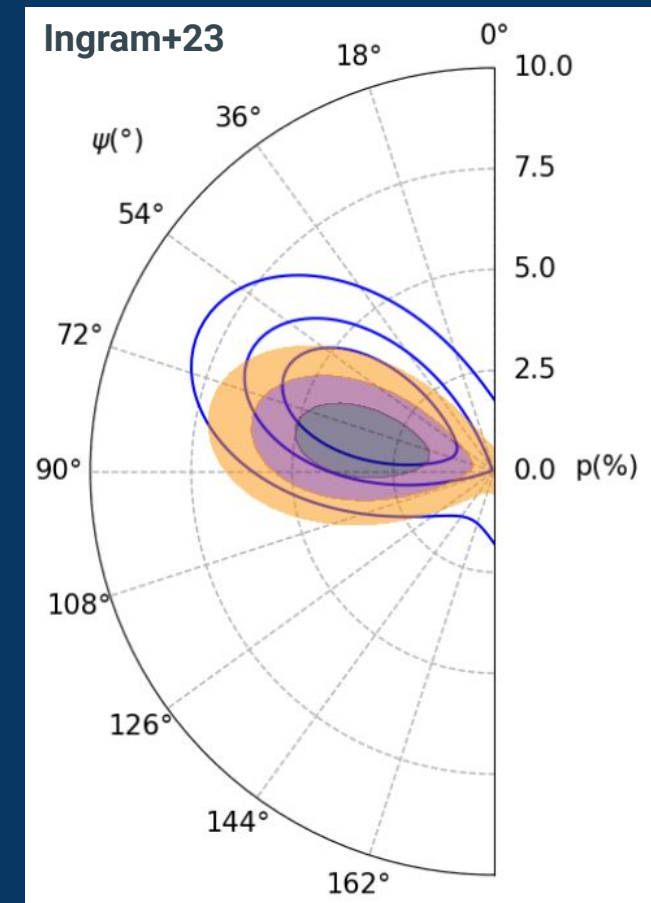
for the **wedge**, see Poutanen, Veledina & Zdziarski (2018)

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IC 4329A

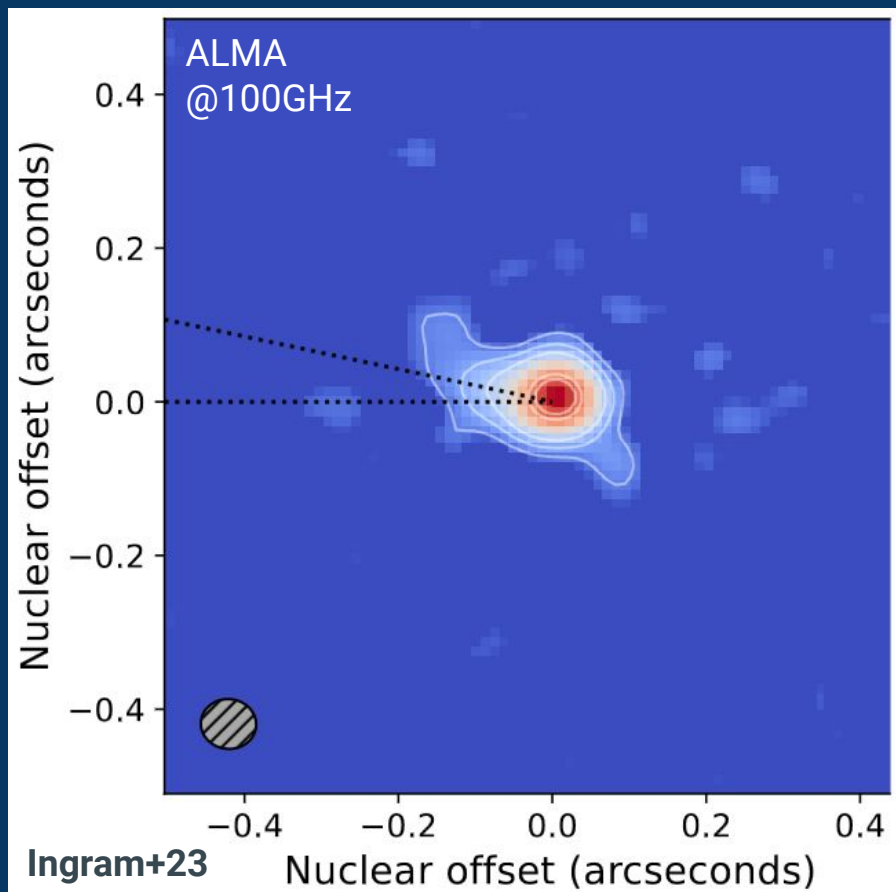
**PD = $(3.3 \pm 1.1)\%$
 2.97σ result**

PD < 6.2% at 3σ



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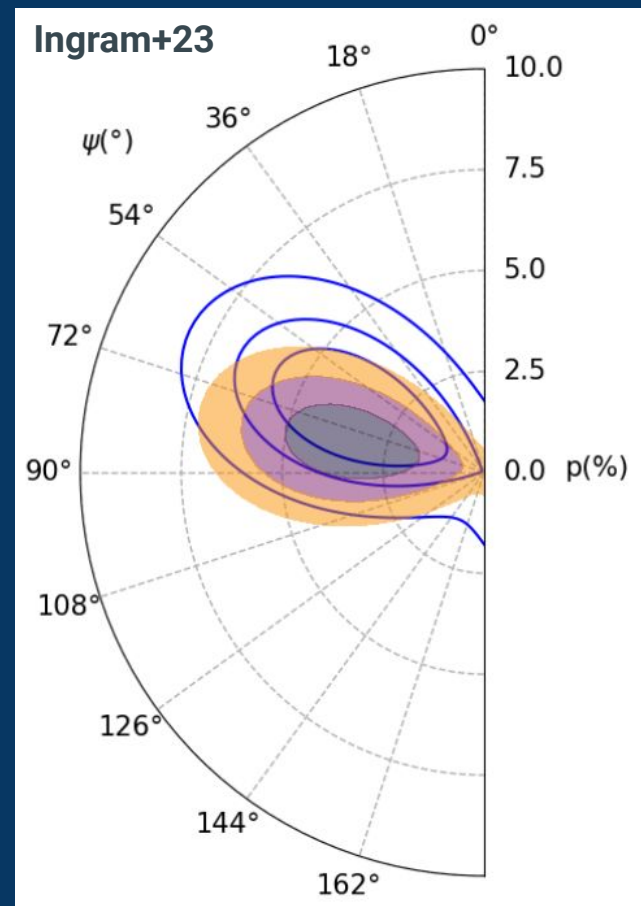
IC 4329A



**PD = $(3.3 \pm 1.1)\%$
2.97 σ result**

PD < 6.2% at 3 σ

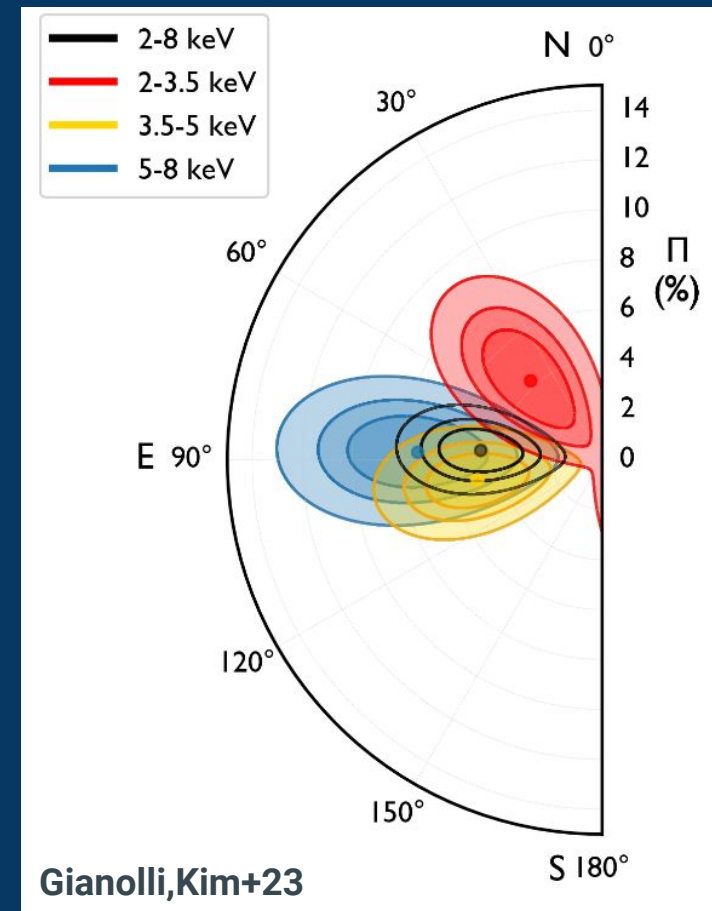
PA preferentially aligned with the radio jet



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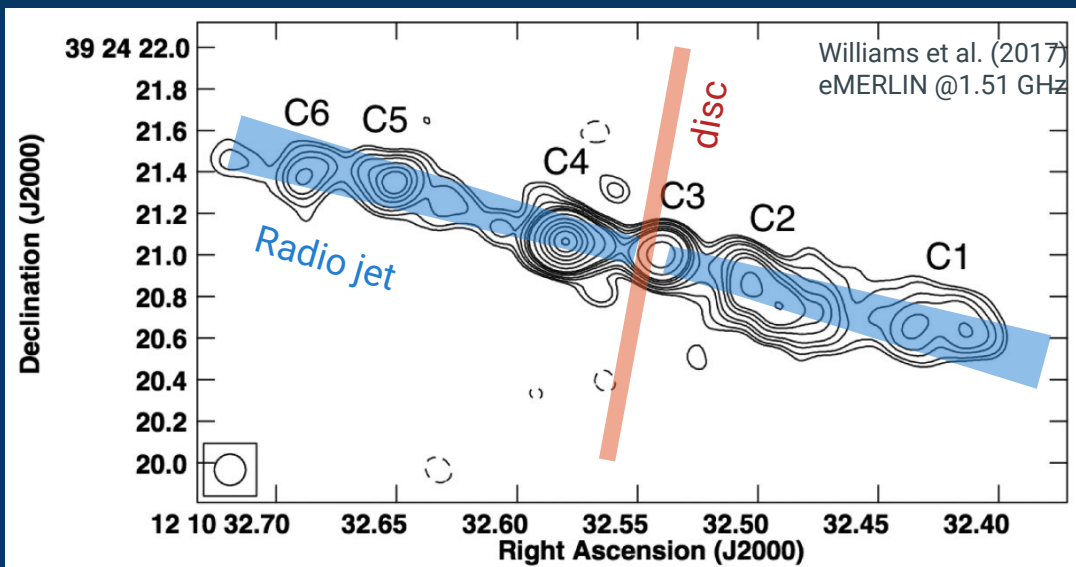
NGC 4151

PD = $(4.9 \pm 1.1)\%$
>4 σ detection!



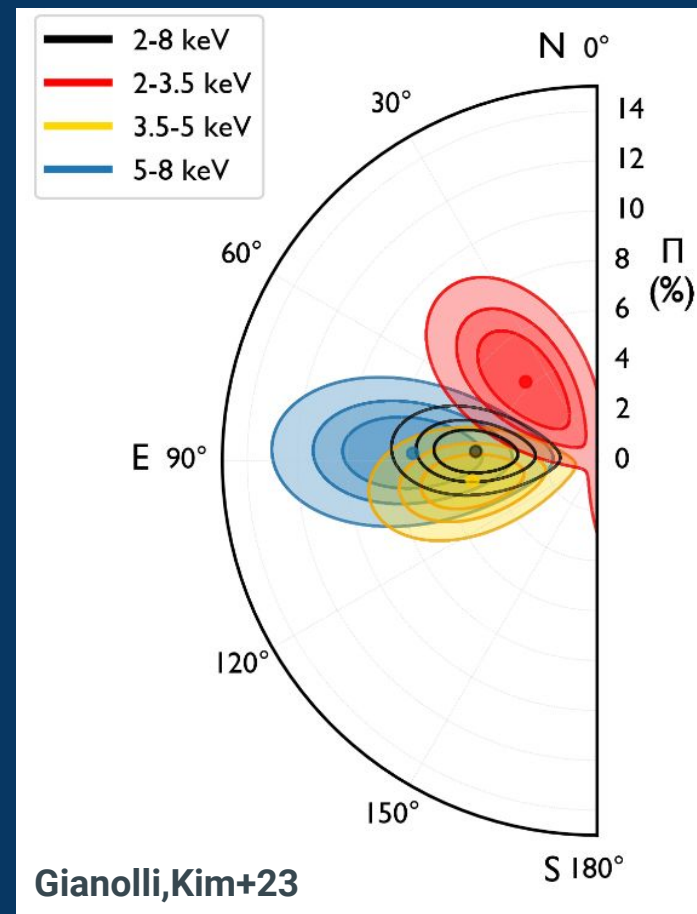
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NGC 4151



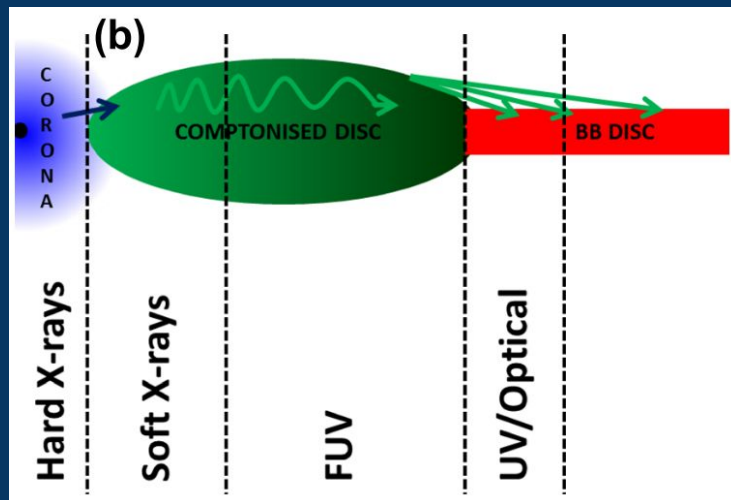
PD = $(4.9 \pm 1.1)\%$
>4 σ detection!

PA = $86^\circ \pm 7^\circ$
~consistent with the radio jet

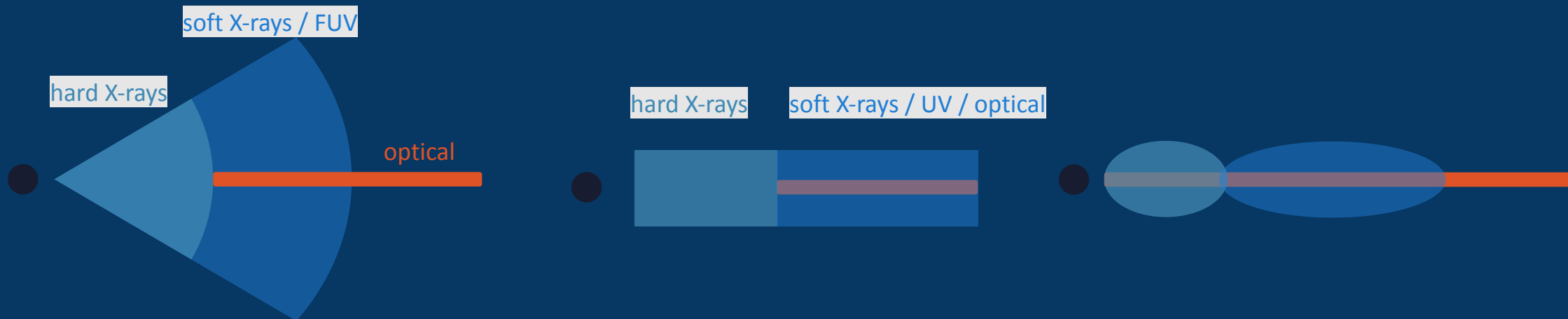


- ★ IXPE is providing the first measurements of X-ray polarization in AGN:
 - NGC 4151 → secure detection PD~5%, PA // disc axis
 - MCG-23-16 and IC 4329A → upper limits, anyway favoring PA //
- ★ A spherical corona is ruled out for NGC 4151.
- ★ Any geometry producing high PD and PA \perp disc axis is ruled out for all the three sources.
- ★ These results favor a radially extended corona in the plane of the disc, rather than a vertically extended corona on the disc axis.

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Gardner & Done (2017)
see also Edelson et al. (2017)



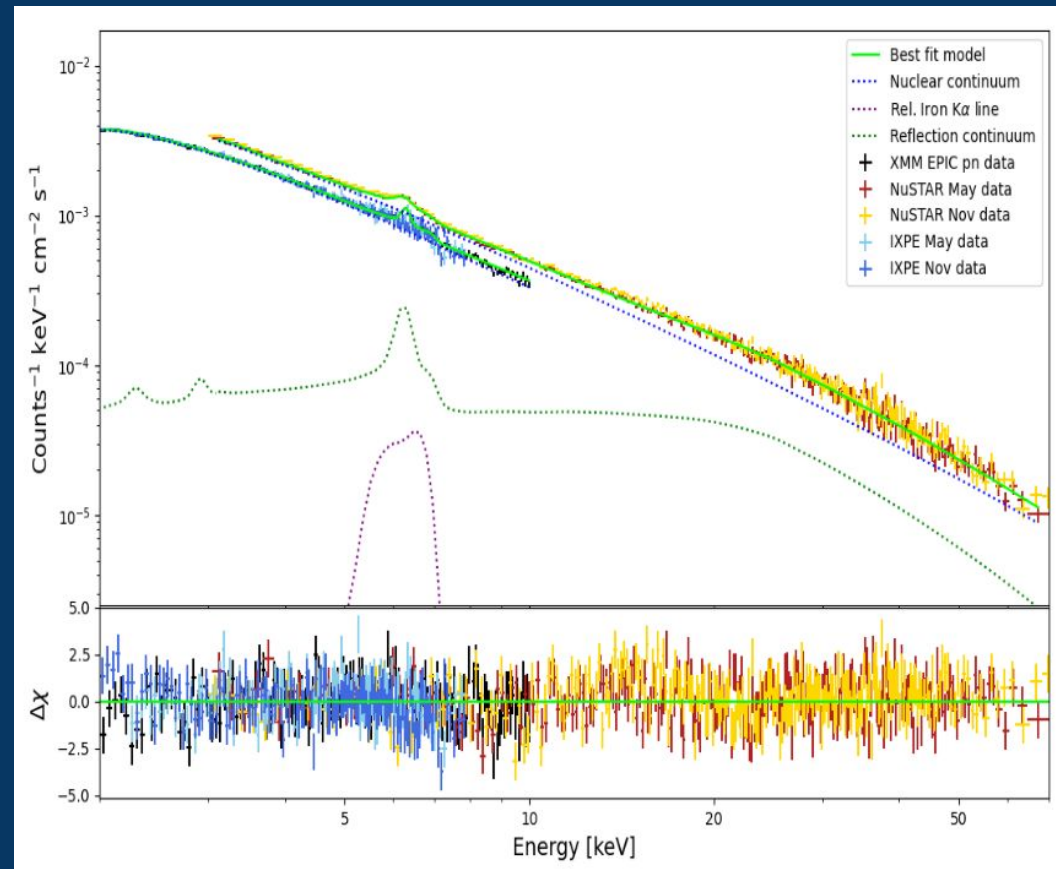


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Backup slides

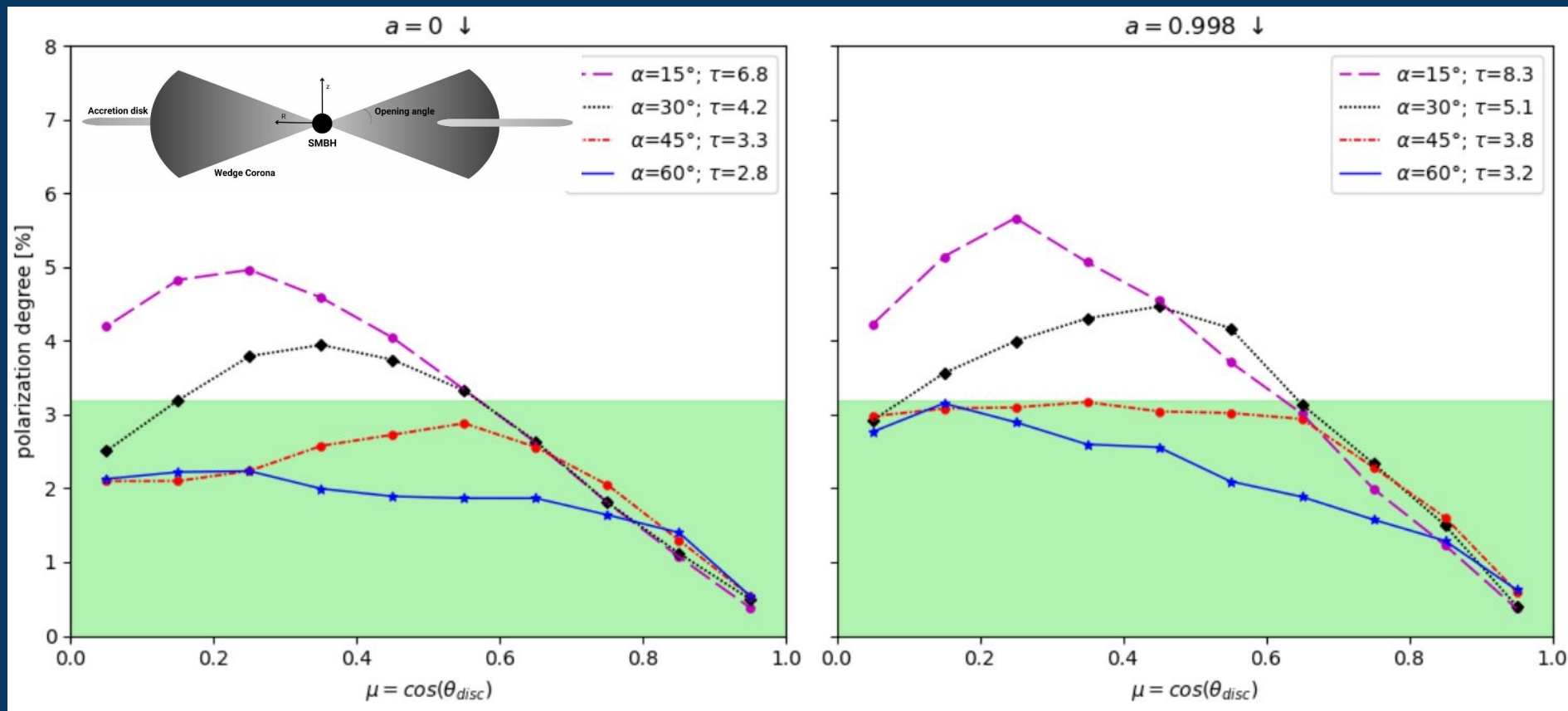
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MCG-5-23-16 spectral fit (Tagliacozzo+23)



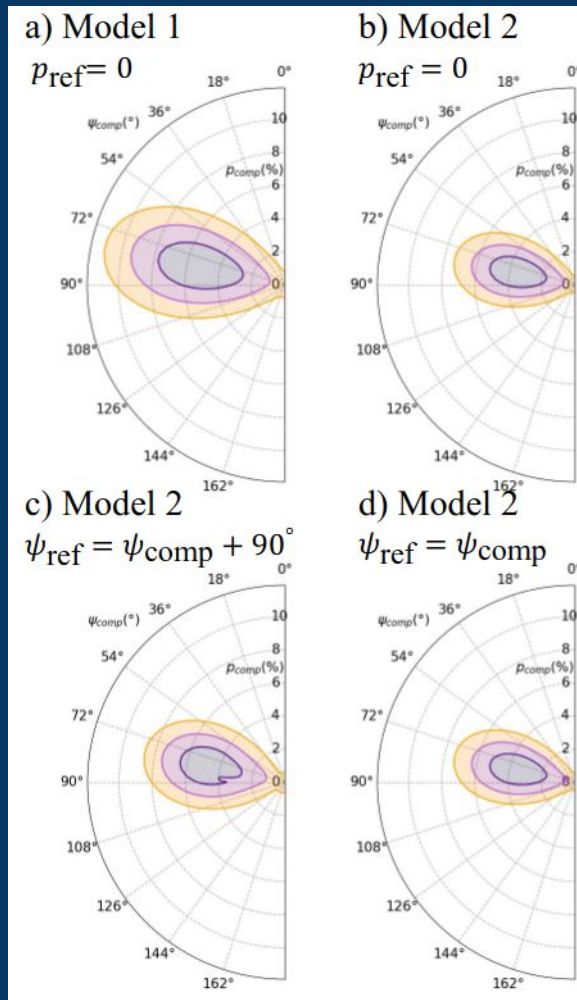
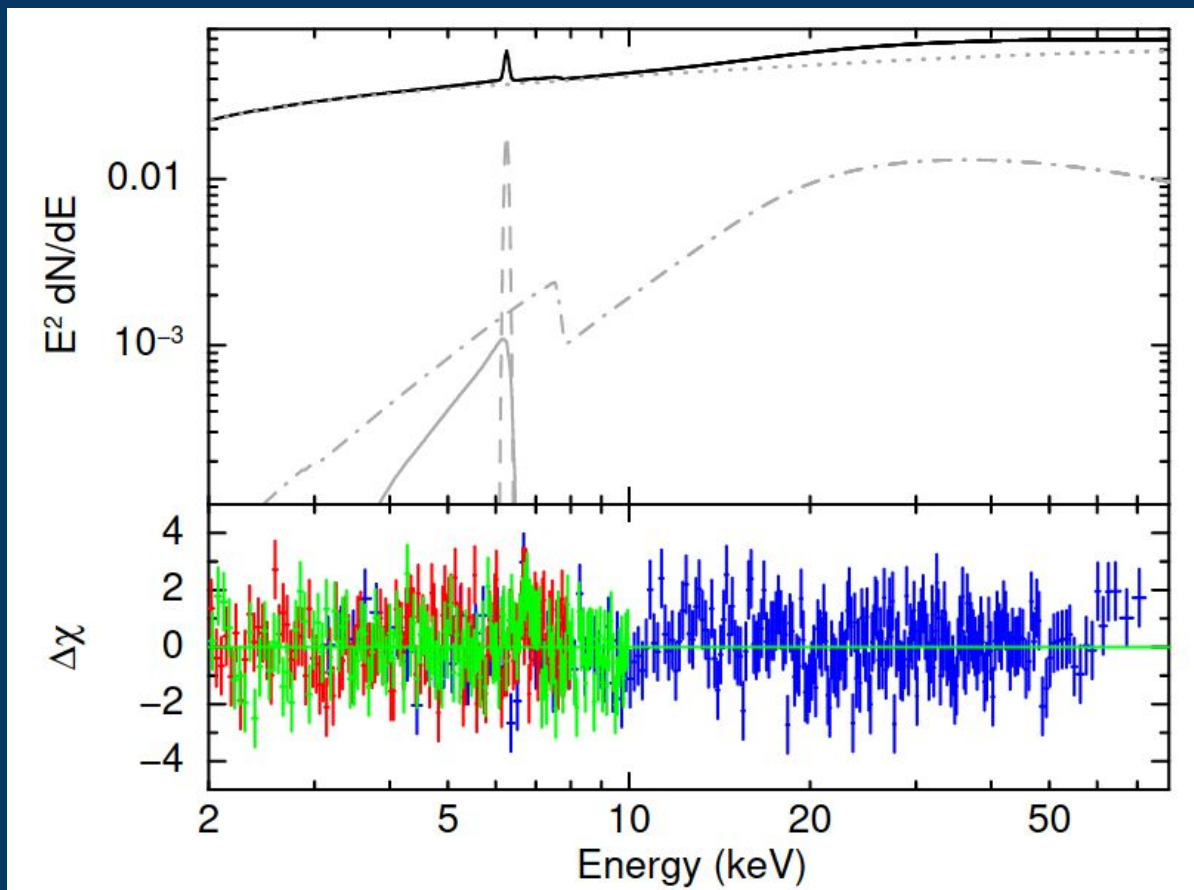
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MCG-5-23-16 polarization simulations (Tagliacozzo+23)



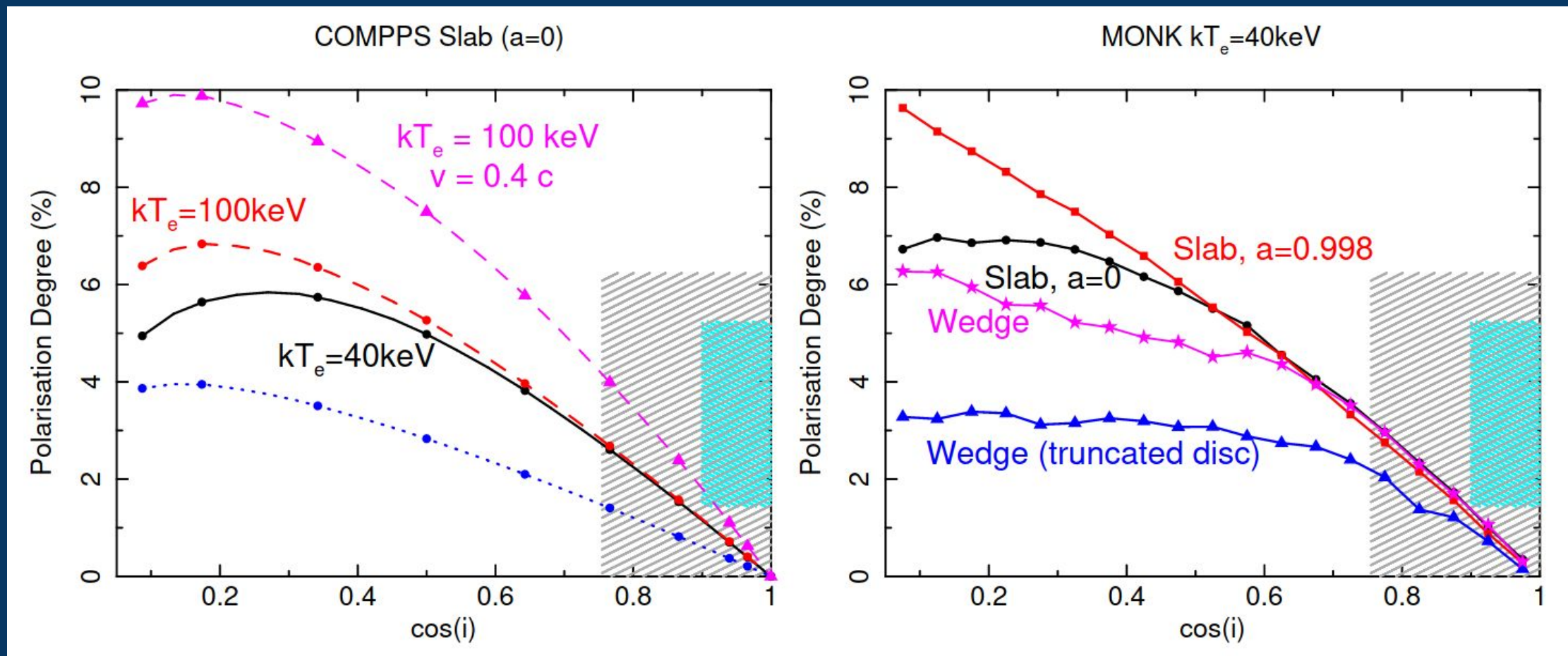
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IC 4329A spectral fit (Ingram+23)

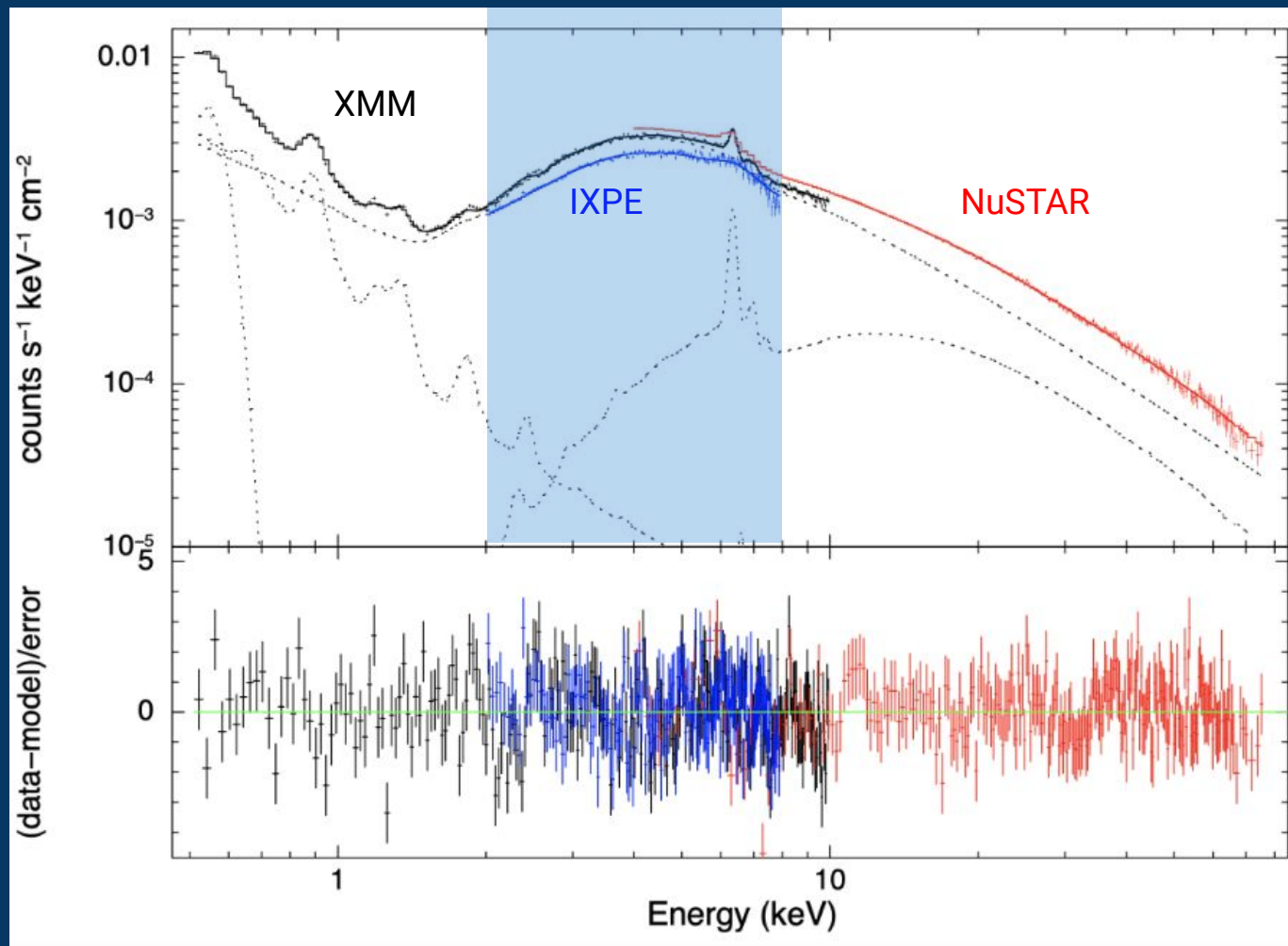


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IC 4329A polarization simulations (Ingram+23)

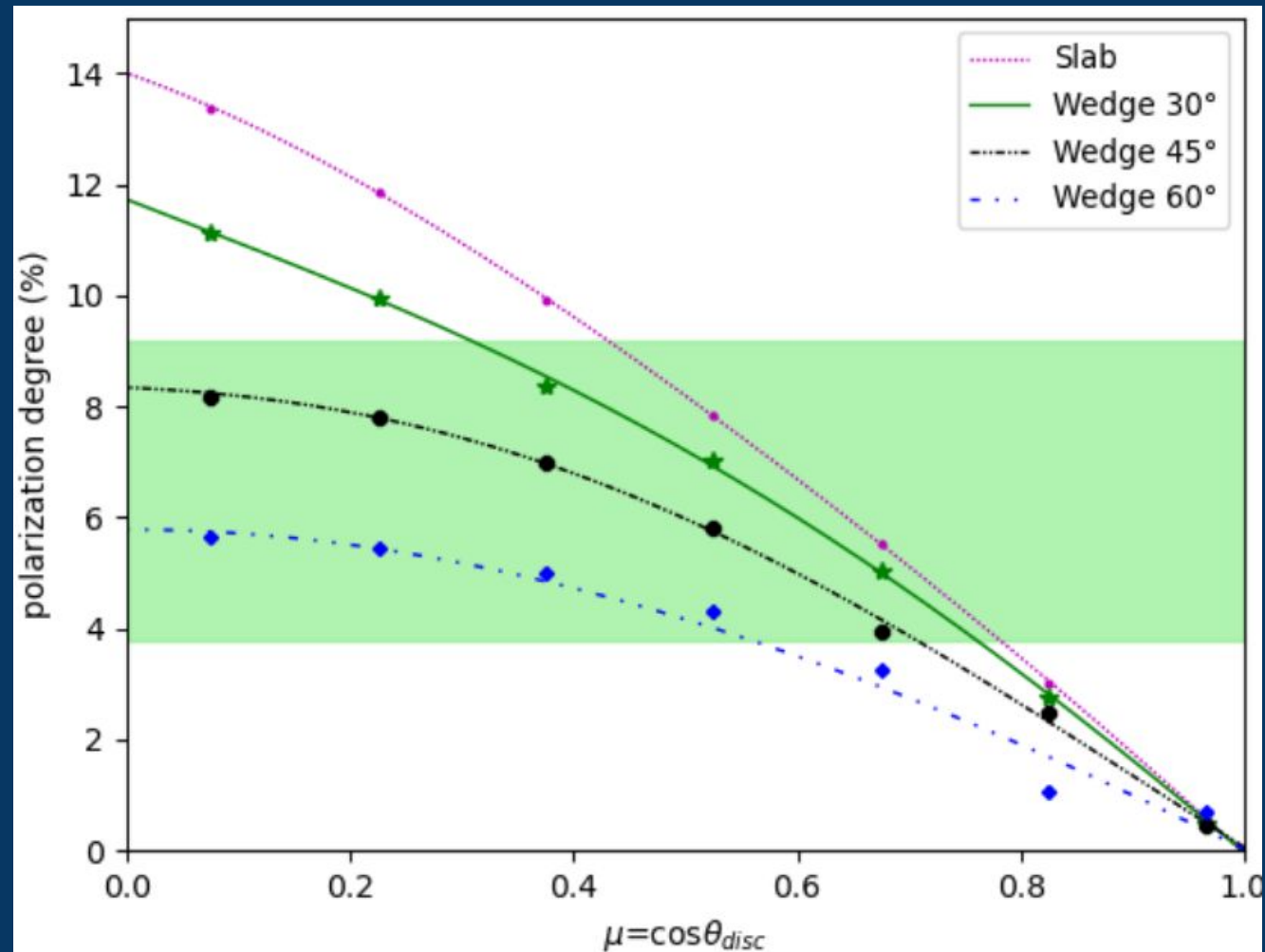


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NGC 4151 spectral fit (Gianolli+23)

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NGC 4151 polarization simulations (Gianolli+23)