

# Polarization from GRB 221009A

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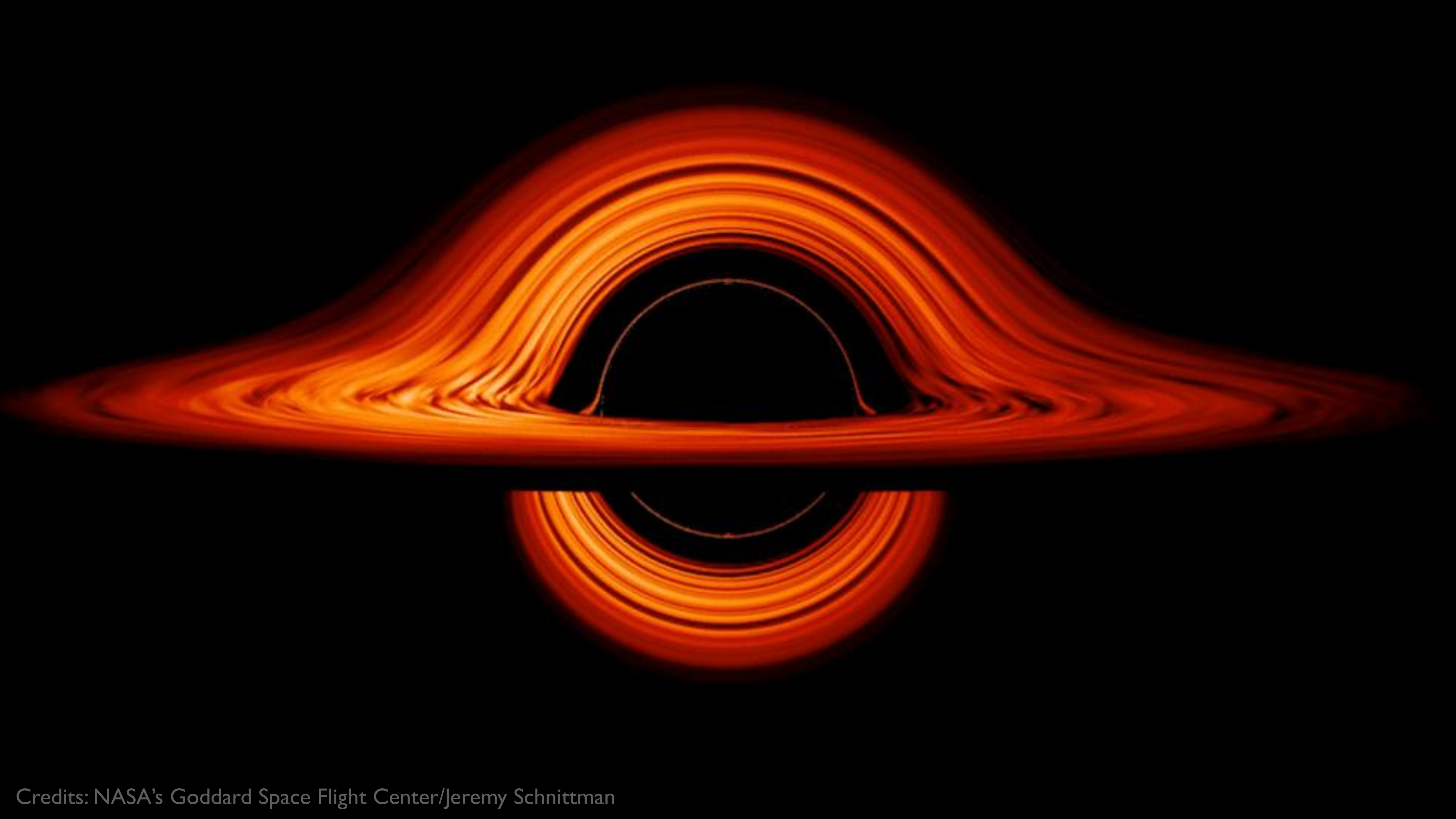


*Goddard*



**CRESST II**

— March 28th 2023, Waikōloa, Hawai'i (USA) —



Credits: NASA's Goddard Space Flight Center/Jeremy Schnittman

Do black holes return power to the universe?

# Do black holes return power to the universe?



- ✓ Extreme energetics
- ✓ Jet powered by magnetic energy, not matter accretion

✓ on these fields



Ehi there,  
did you see any  
neutrinos?

Nope

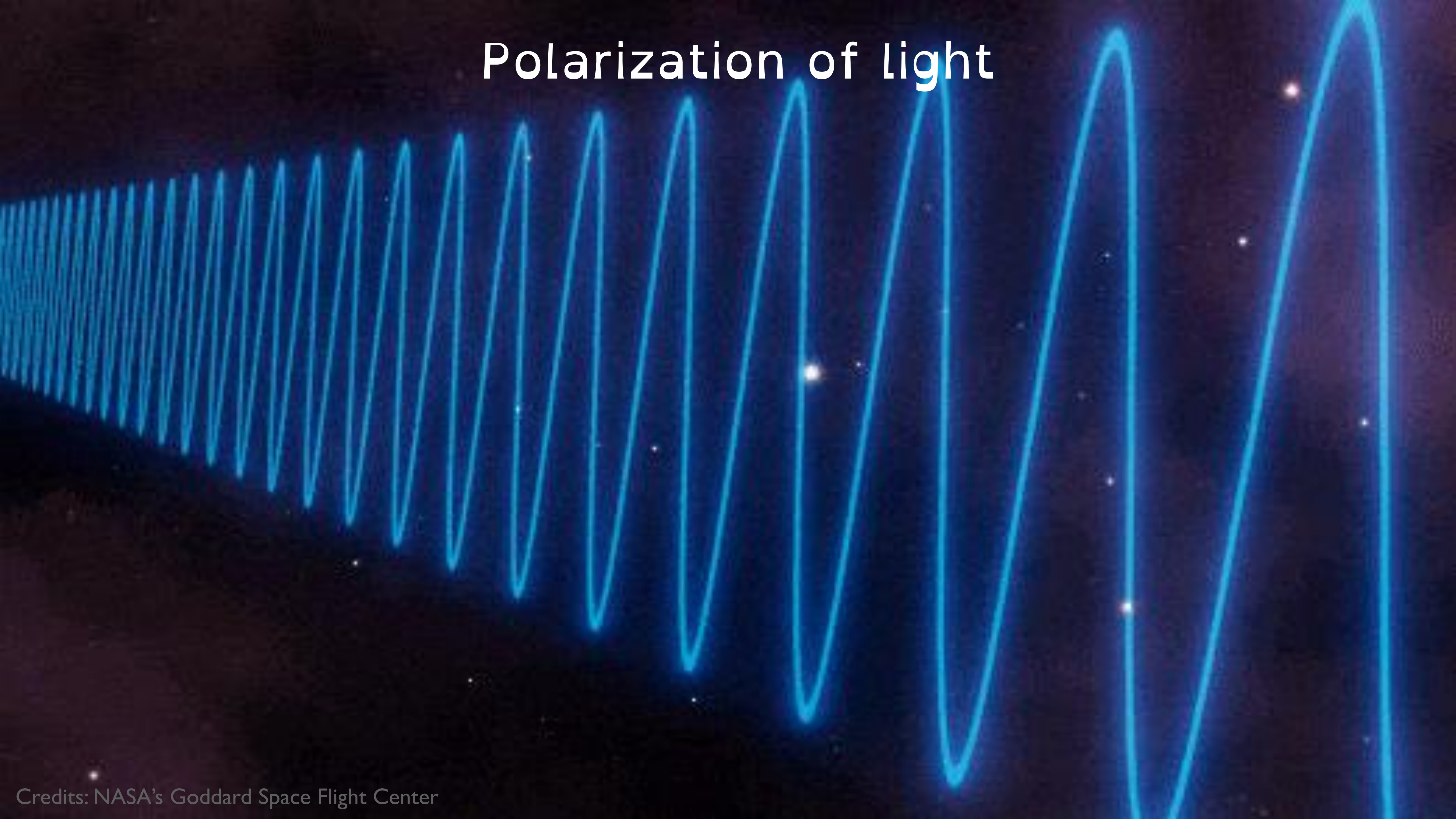
IceCube Collaboration (2023)

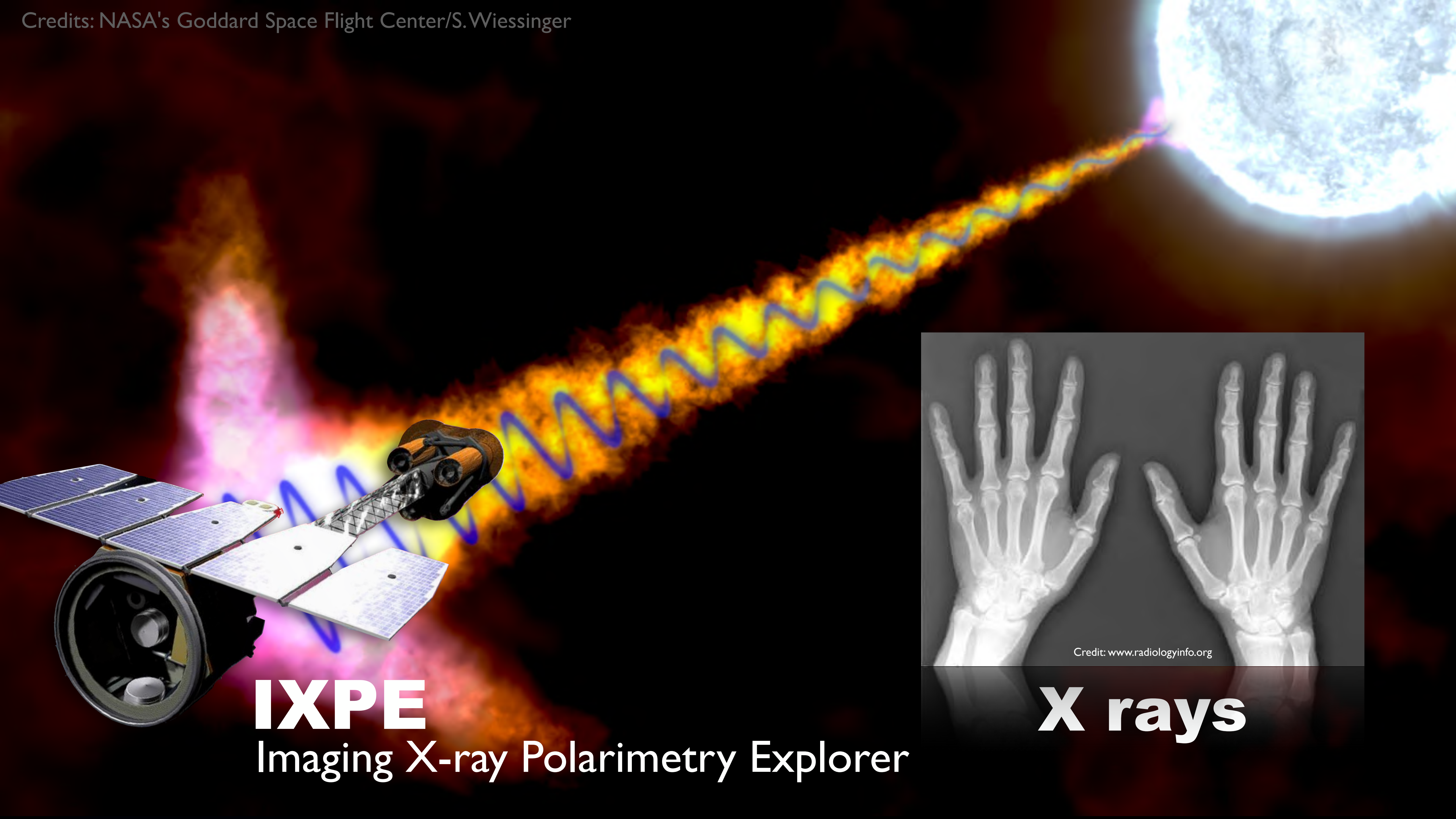
Ah, that's  
cool! 😊

# Polarization of light



# Polarization of light





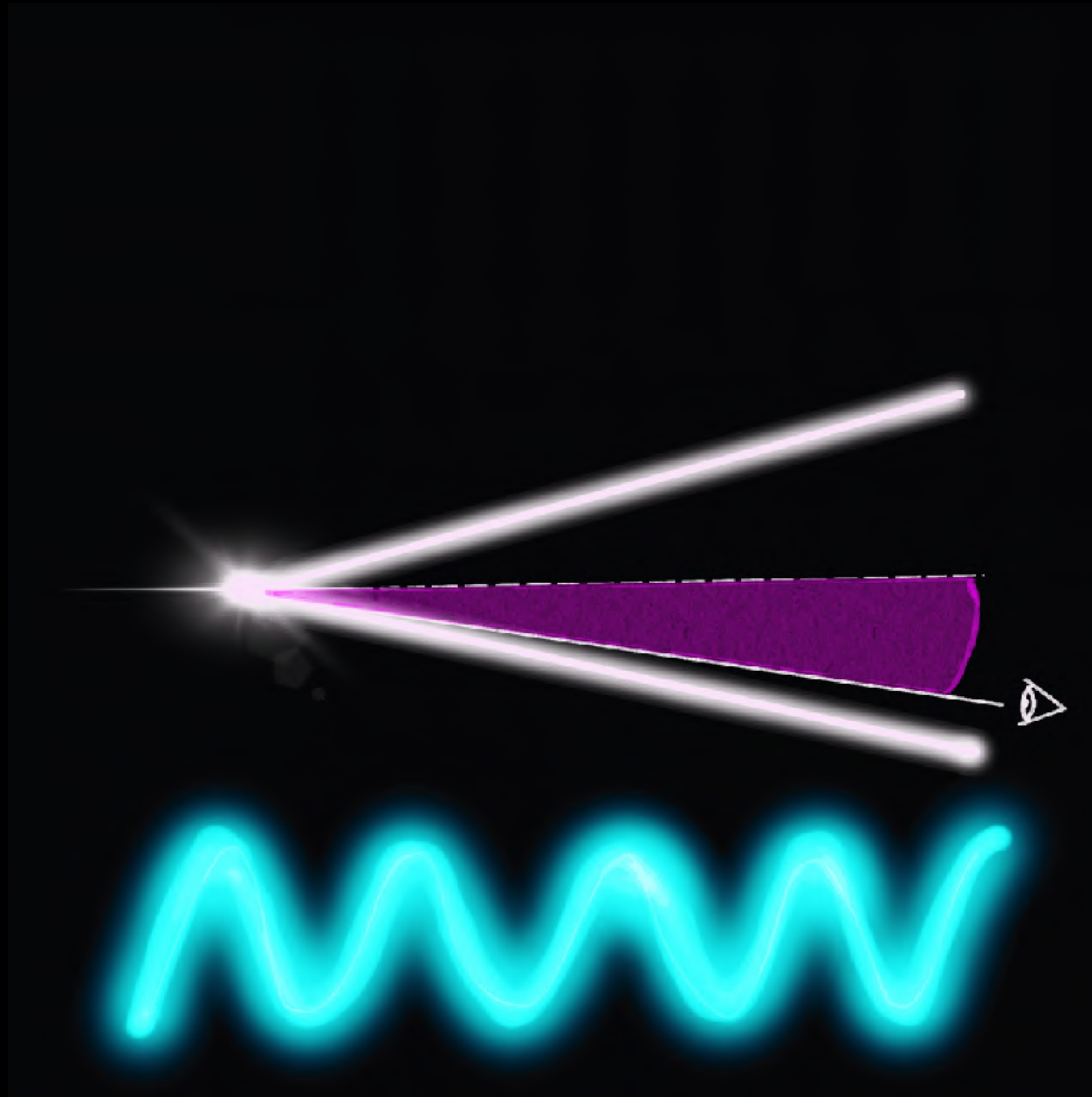
# **IXPE** Imaging X-ray Polarimetry Explorer



Credit: [www.radiologyinfo.org](http://www.radiologyinfo.org)

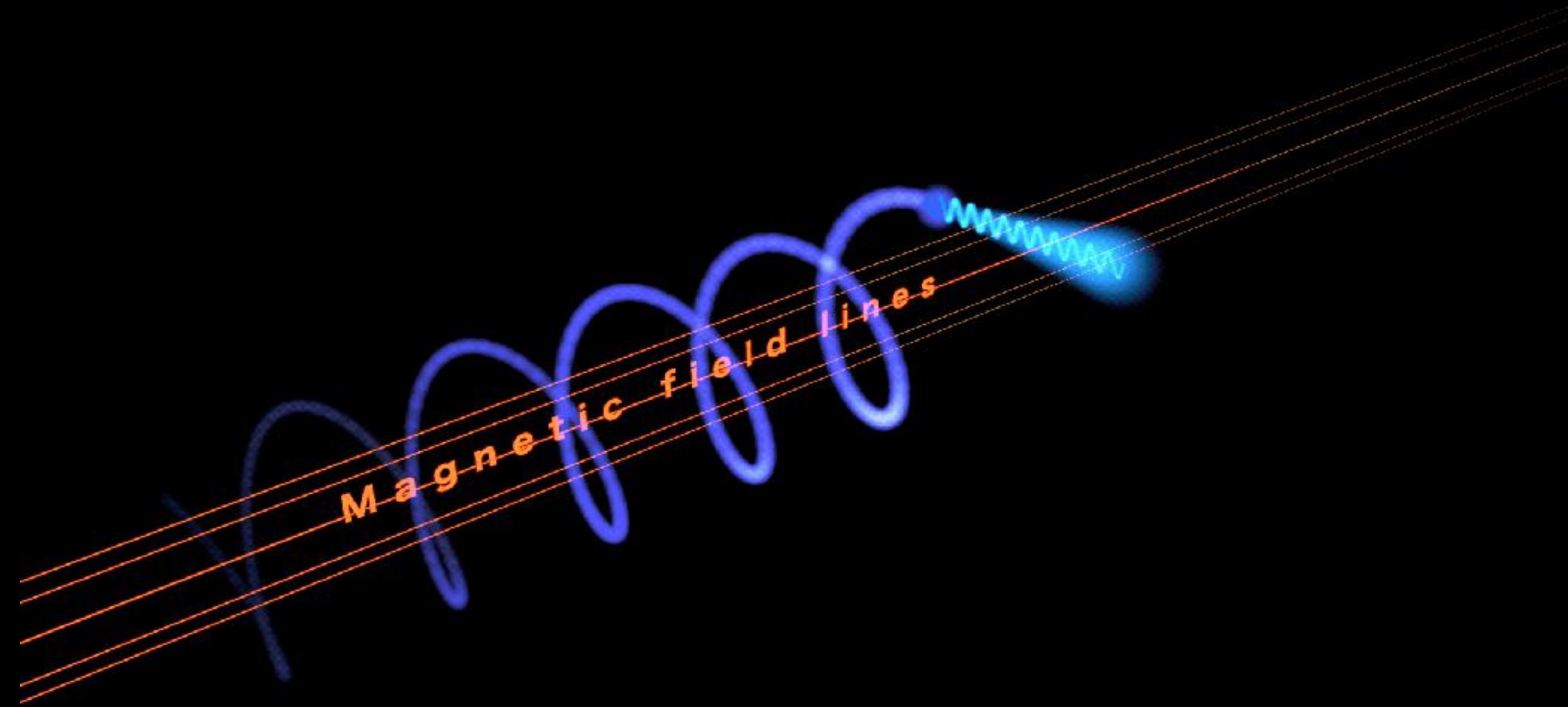
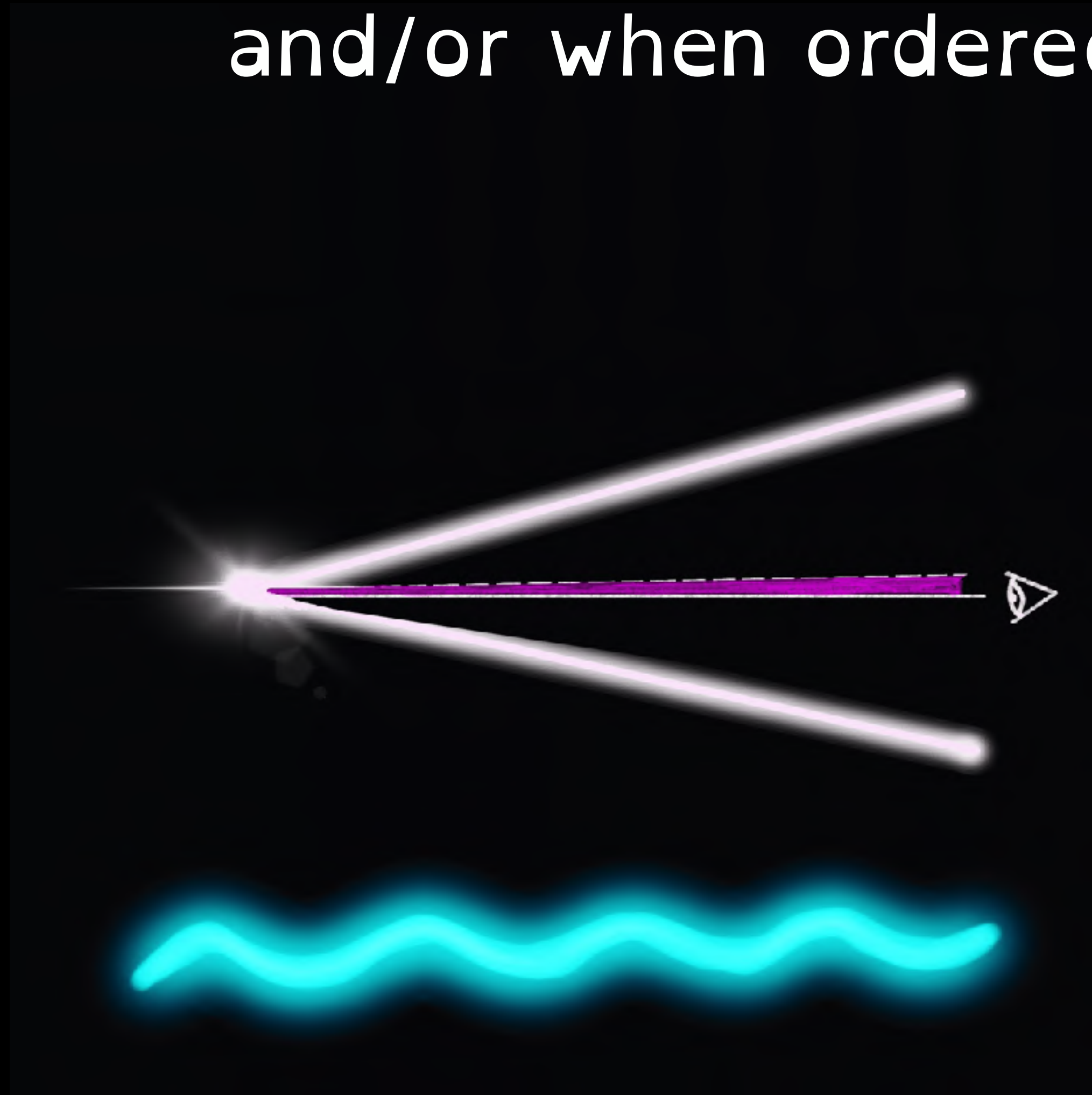
# **X rays**

# Polarization arises in case of geometric asymmetries



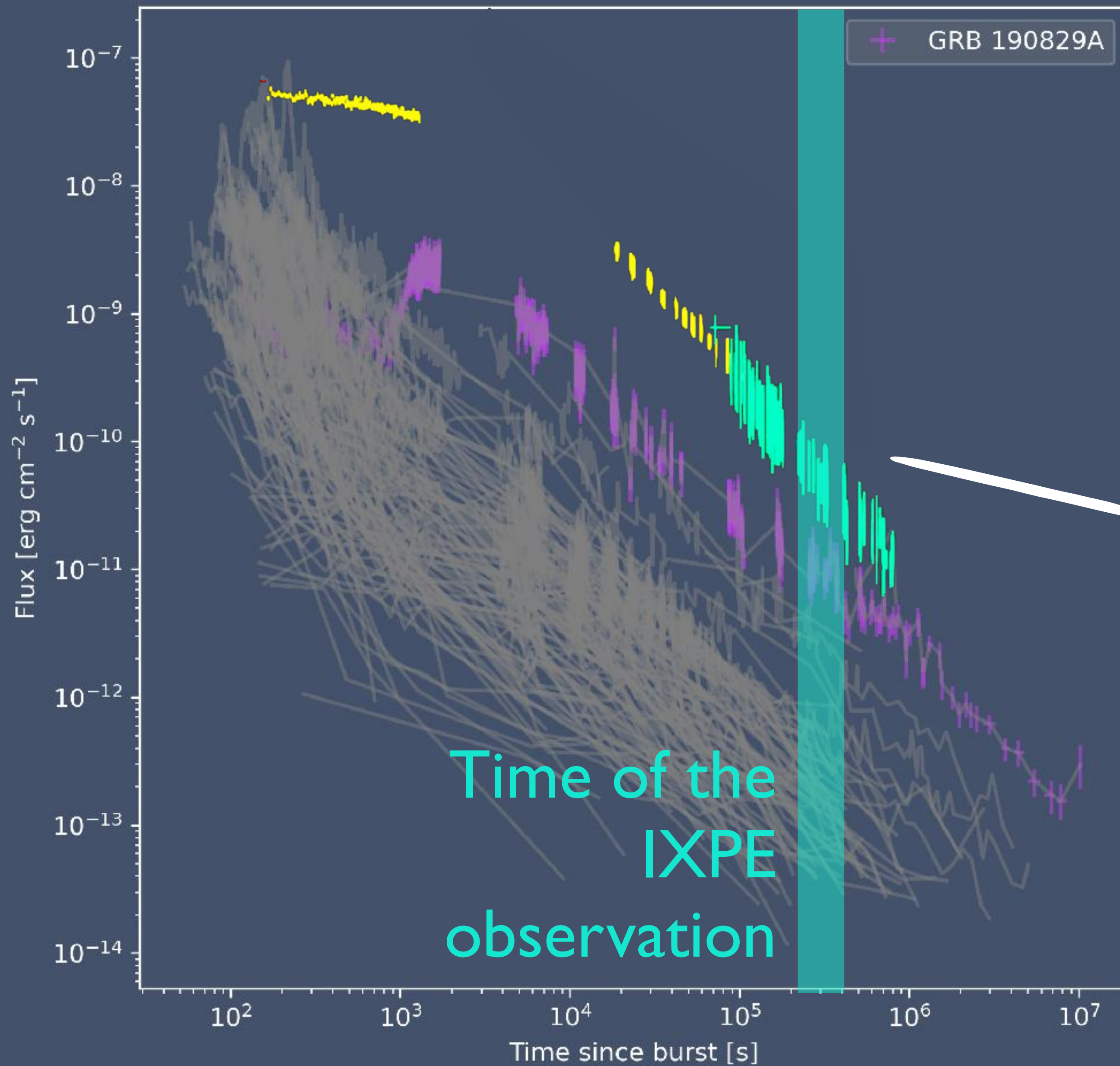


Polarization arises in case of geometric asymmetries  
and/or when ordered magnetic fields are at play





### GRB 221009A

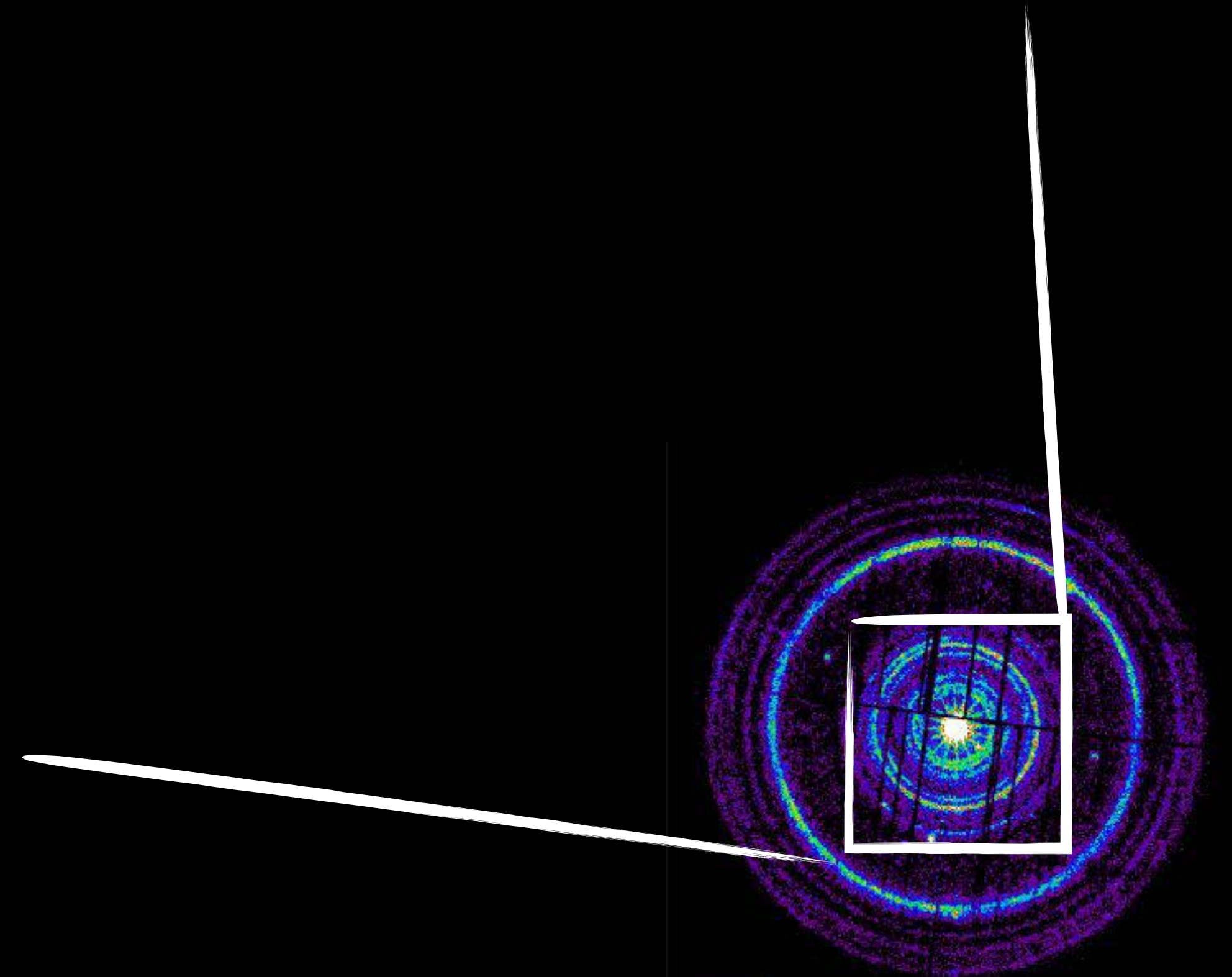
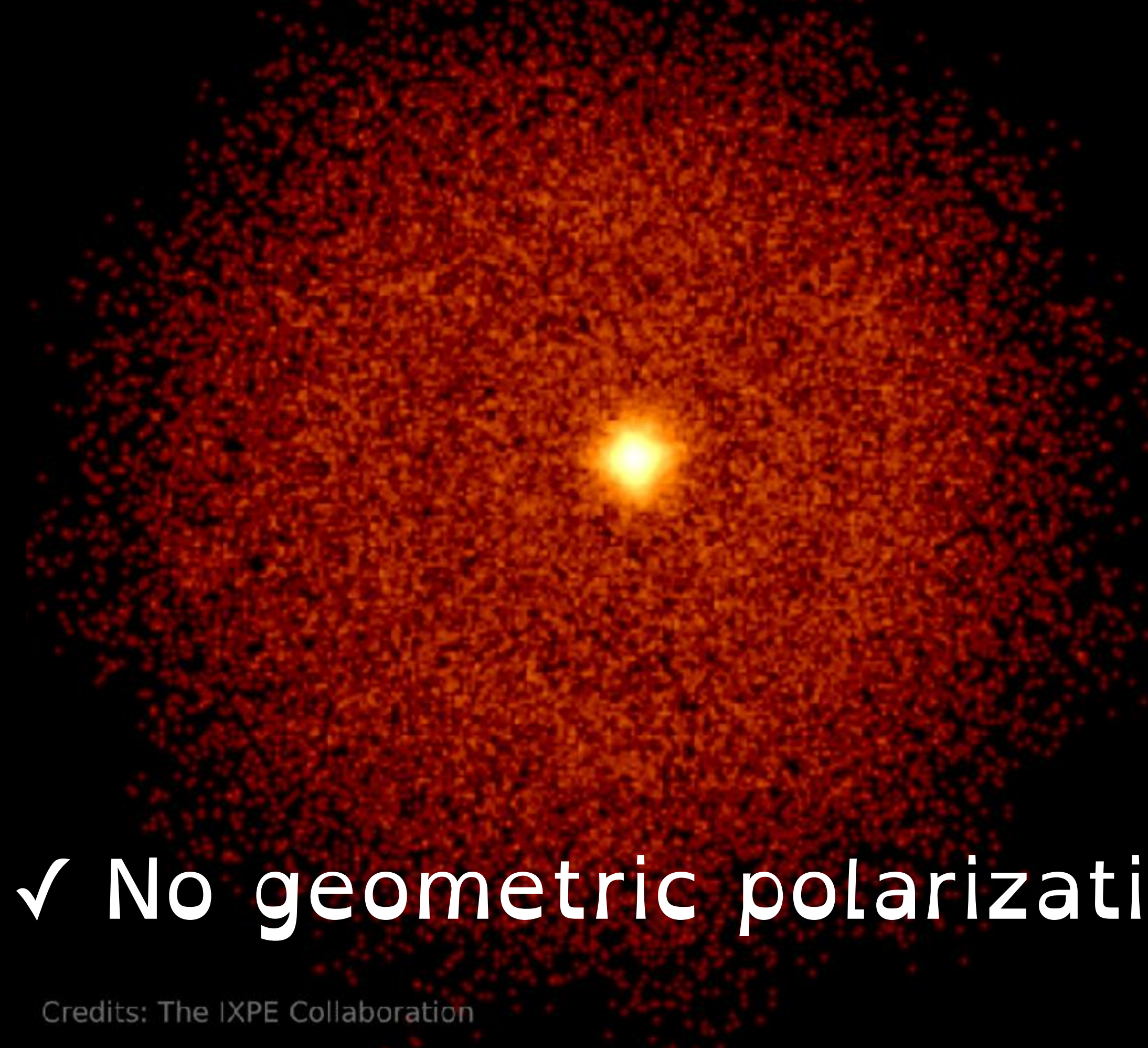


**LATE  
AFTERGLOW**

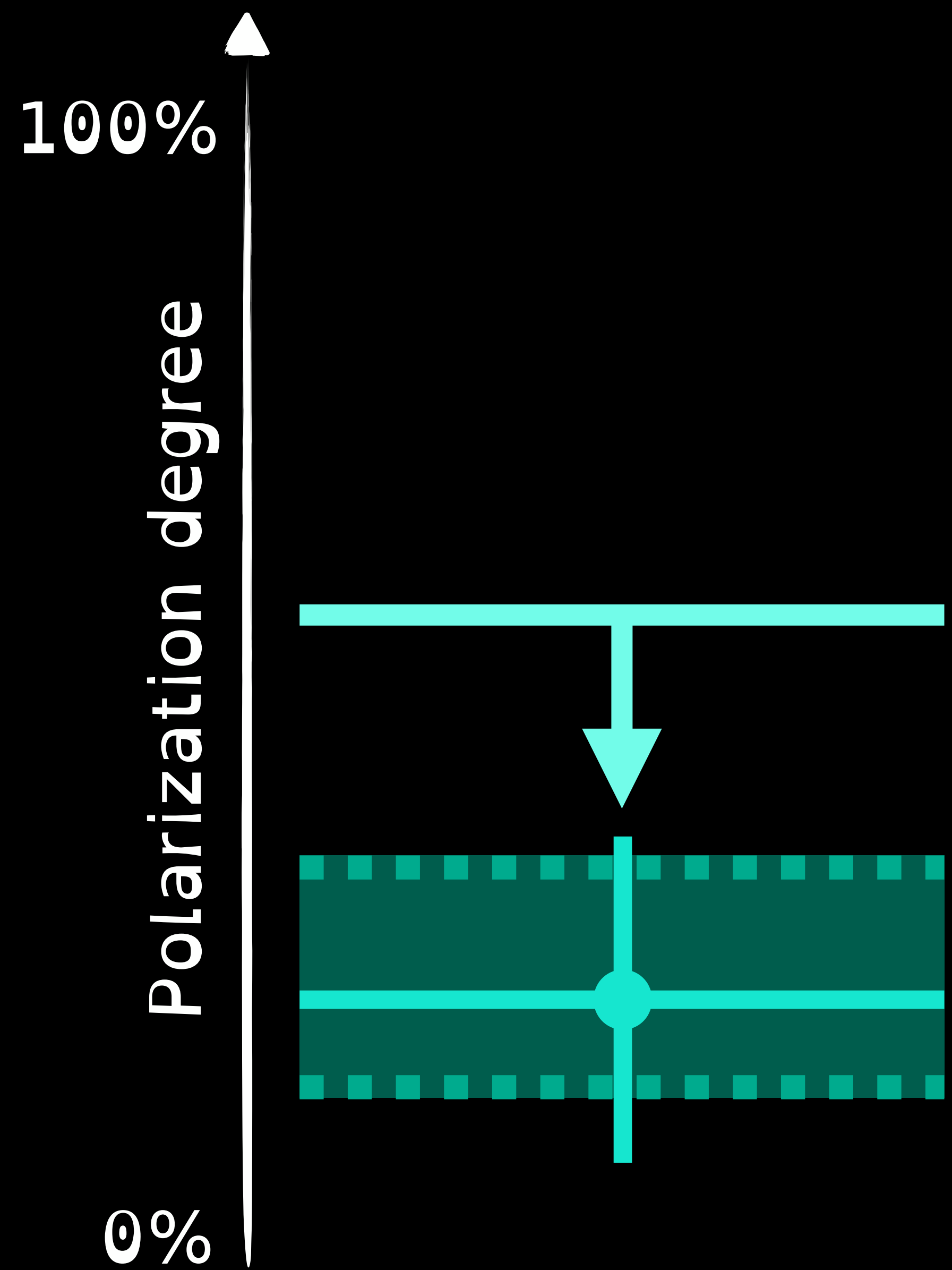
We observed prompt and afterglow... at the same time!

AFTERGLOW

ECHOES OF THE PROMPT



✓ No geometric polarization



Upper limit: 55 %

Measured:  $(22 \pm 13)$  %

Predicted: 16 % — 36 %



Gamma-ray prompt polarization coverage



X-ray polarization coverage of prompt through echoes

Refined energetics estimations

Do black holes return power to the universe?

Inference of the jet structure

Detailed study of the dust-scattering rings



Lack of neutrinos

Thank you for the attention

NASA-GSFC/UMBC



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