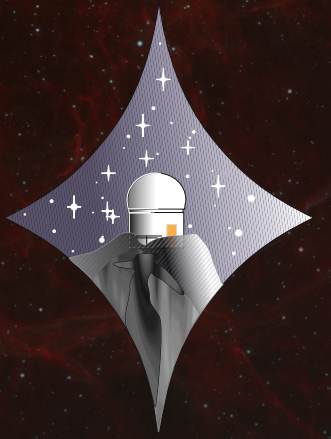
The Fifth Gravi-Gamma-Nu workshop

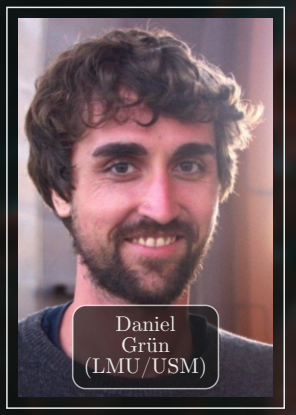
Theoretical Modeling of Binary Black Hole Merger Light Curves and Follow-Up Observations

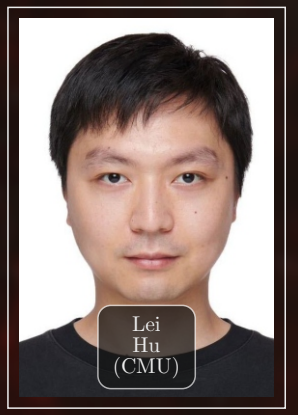
JULIAN SOMMER

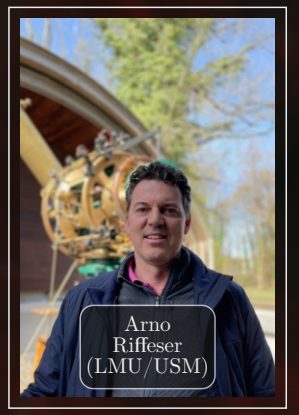
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

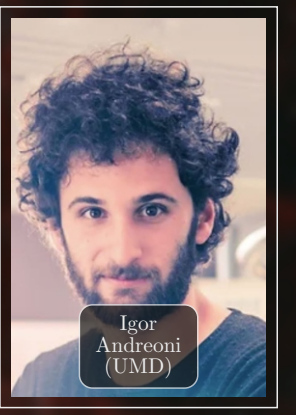


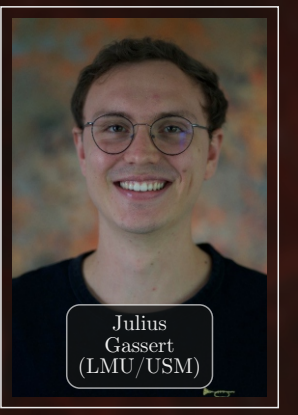
The Team











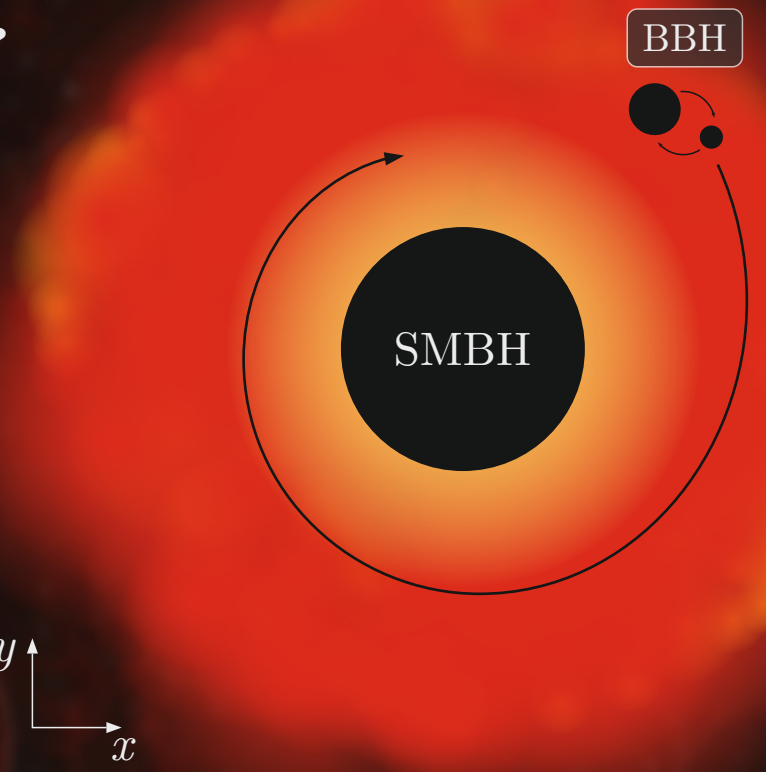
... and Lena Schnappinger (LMU),
Franziska Krause (LMU),
Elia Engelhard (LMU)

Why do we expect flares of BBH mergers?

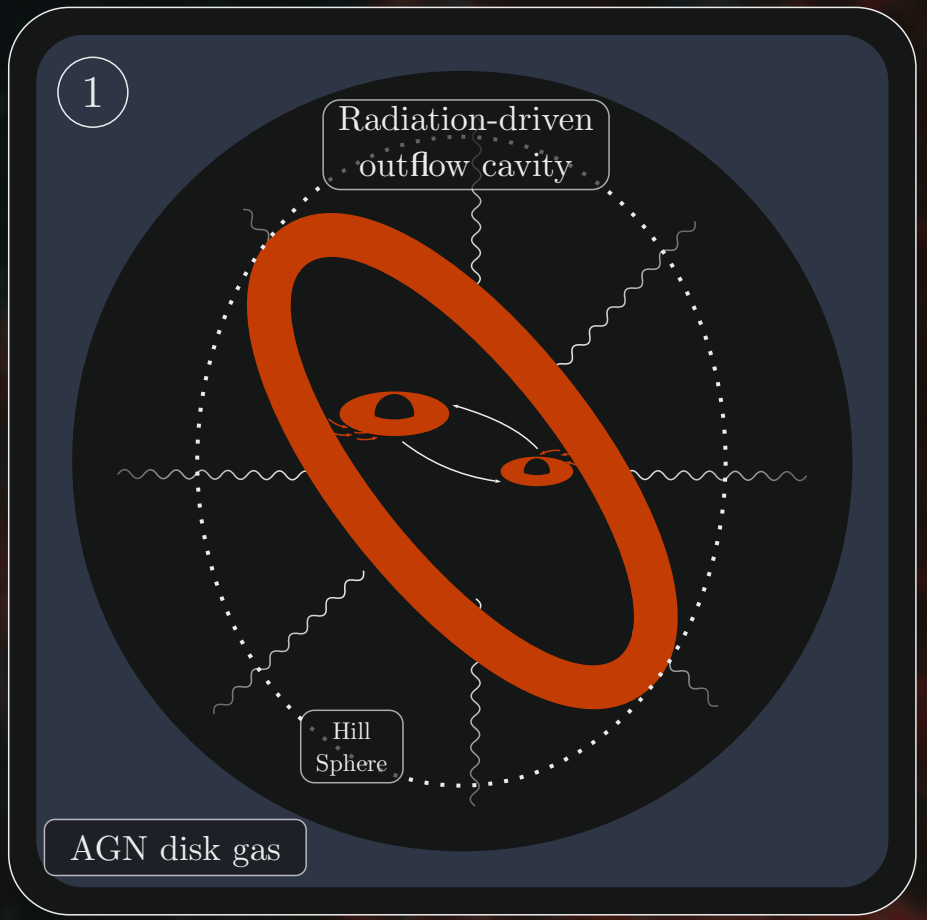
- Many GW detections of massive stellar mass black holes
- Explanation: AGN disks as formation channels for such black holes

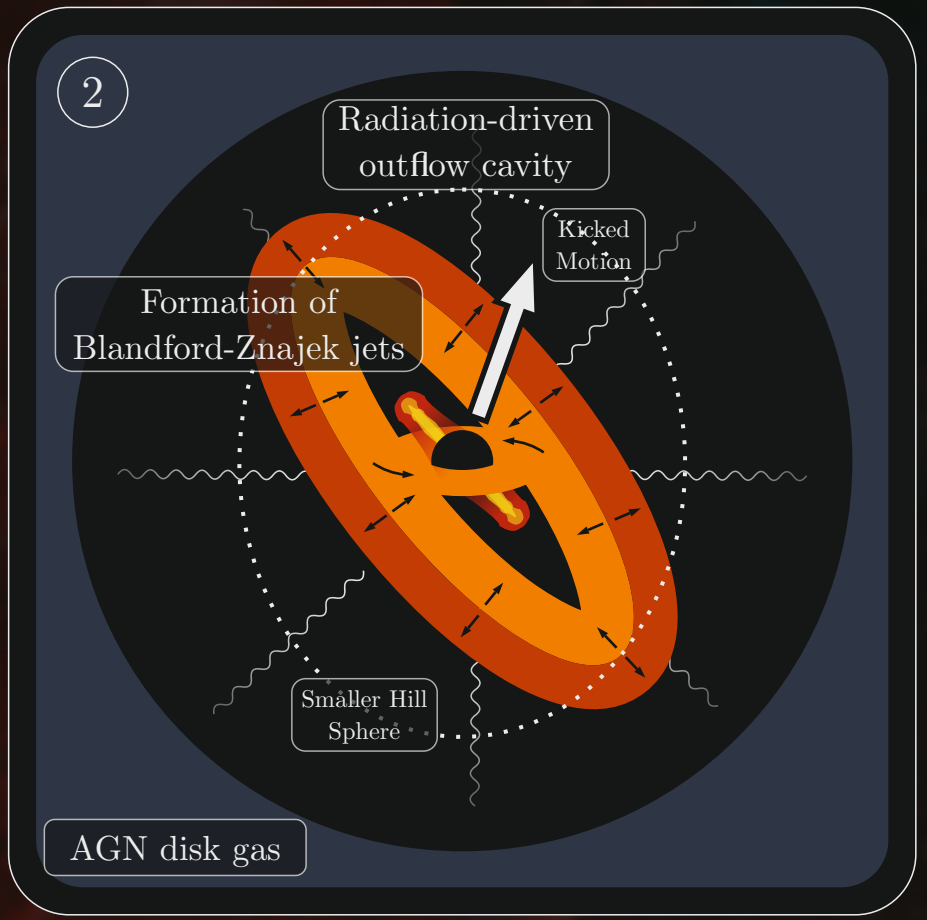
Cosmological Implication

- Distances and Hubble Tension
- Goal to cross-identify spectroscopic host redshift with GW detection luminosity distance by LVK (standard sirens)



Binary Black Hole Merger in Accretion Disks of SMBHs





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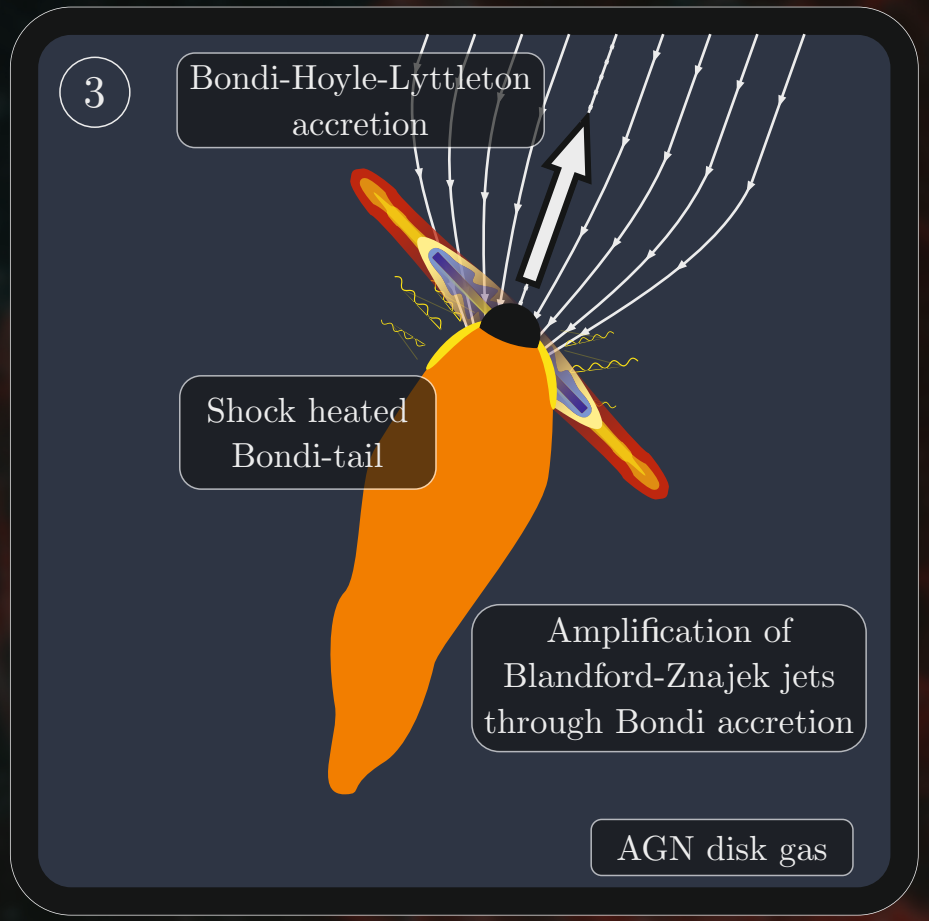
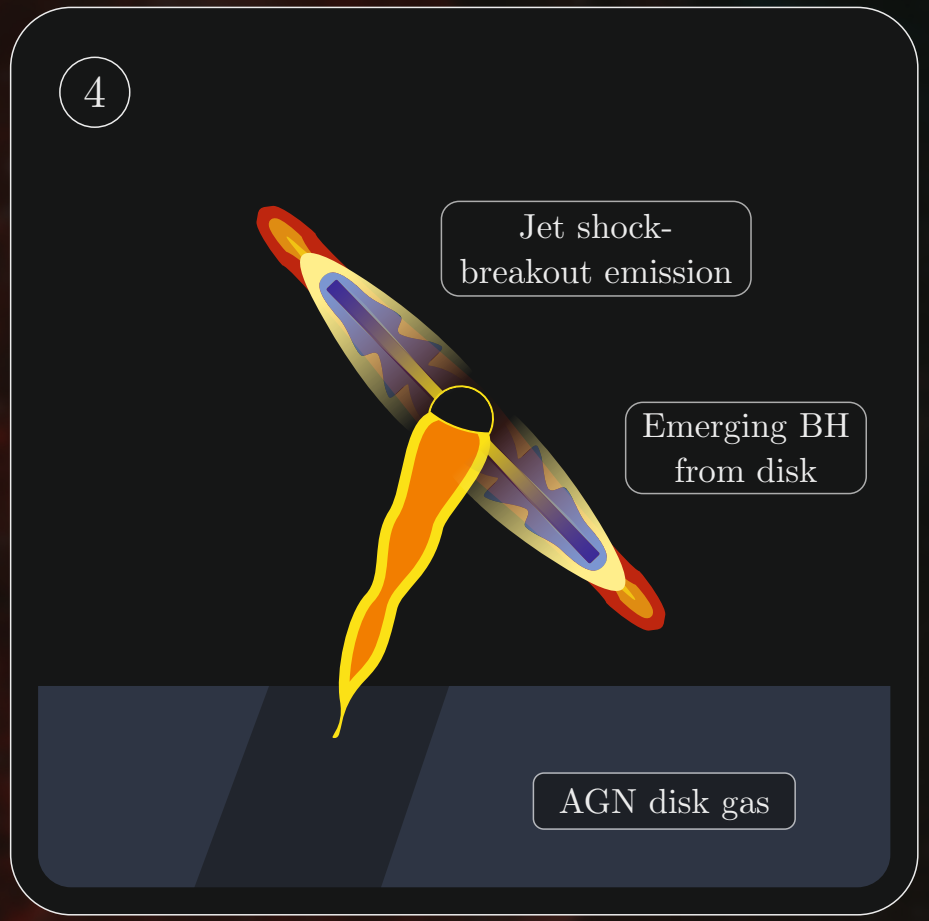
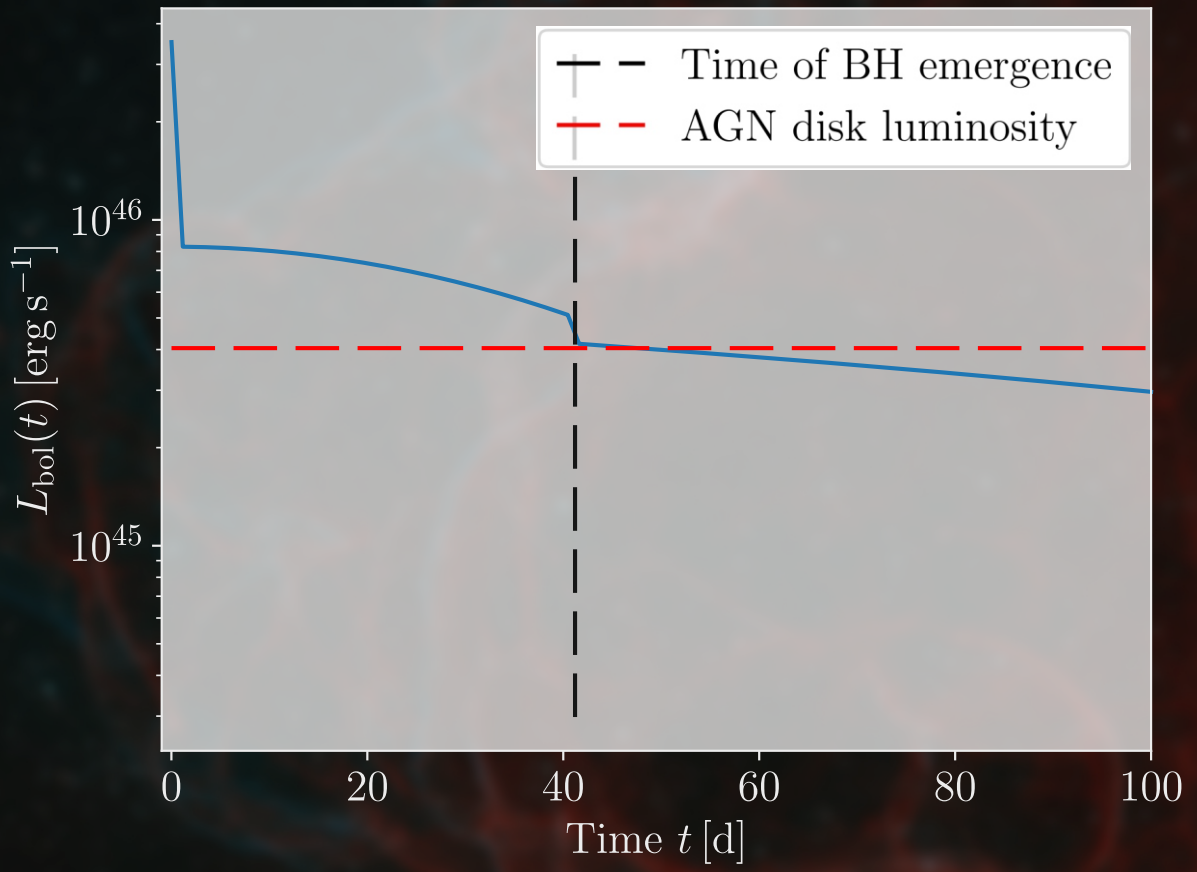


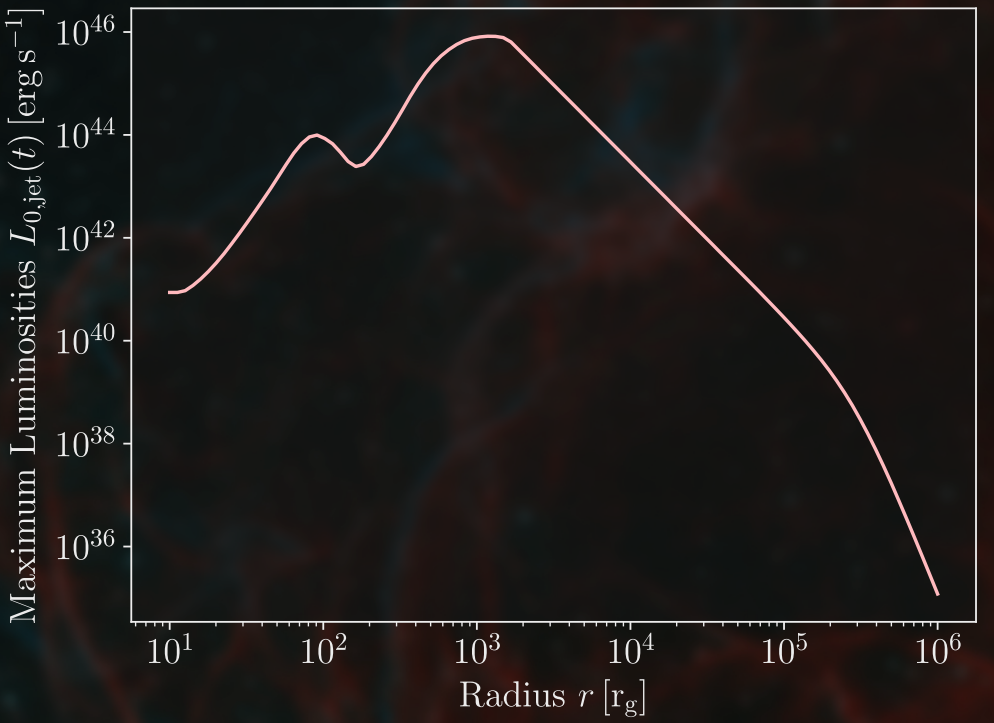


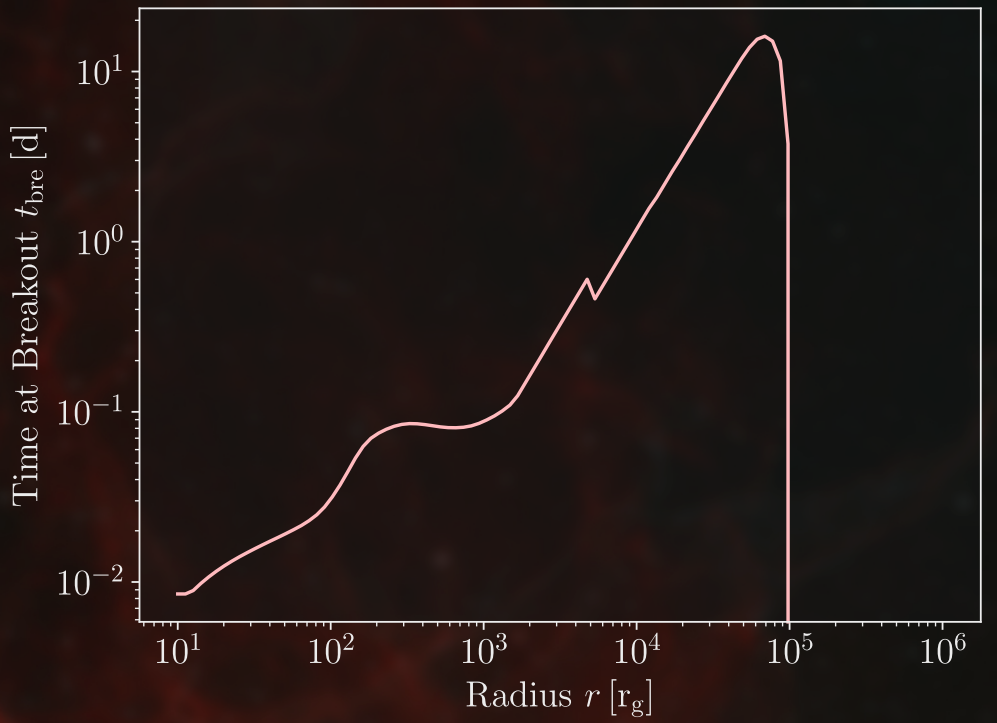
Example Light Curve



$M_{\mathrm{SMBH}} = 10^8 M_\odot$	Mass of the central SMBH
$M_{\mathrm{BH}} = 100\, M_\odot$	BH mass after merger
$r \sim 10^3 r_g$	Radial distance from the SMBH
$v_{\mathrm{kick}} = 400\,\mathrm{km\,s^{-1}}$	Black hole kick velocity

Finding the Right Parameters



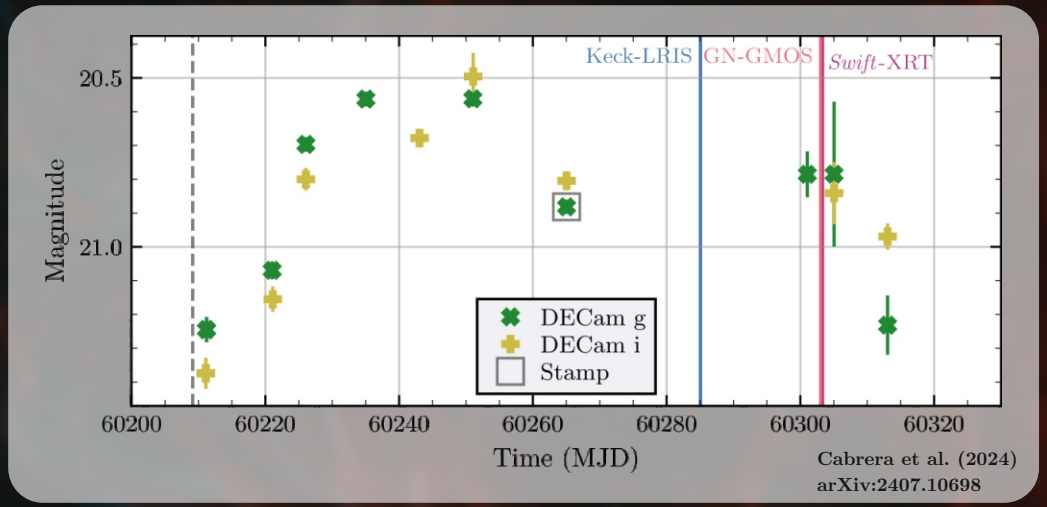


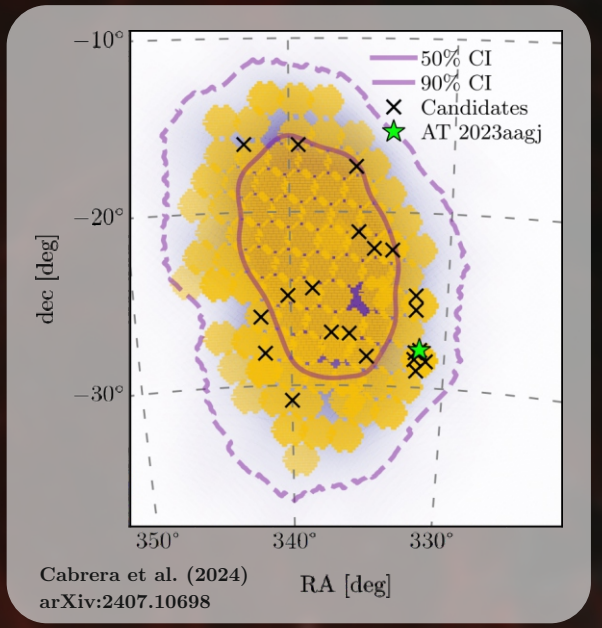
Luminosity and time of emission depend on radial distance and physical properties of the disk!

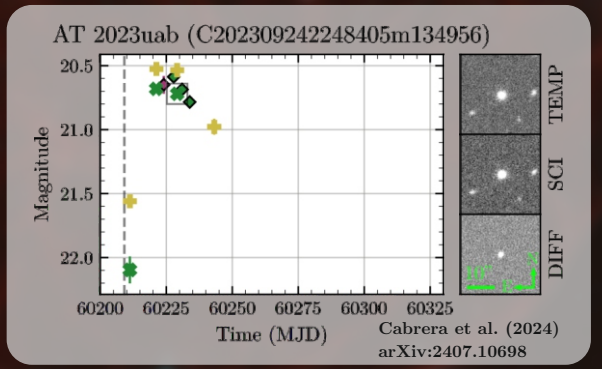
Follow-up Campaign: S230922g

Instruments

- Wendelstein 2.1 m telescope:
  Wide field imager + 3-channel optical-NIR camera
- Coordination with DECam Survey GW-MMADS
- Spectroscopic redshifts by DESI







← Wendelstein observations in diamonds

Take-Home

Summary

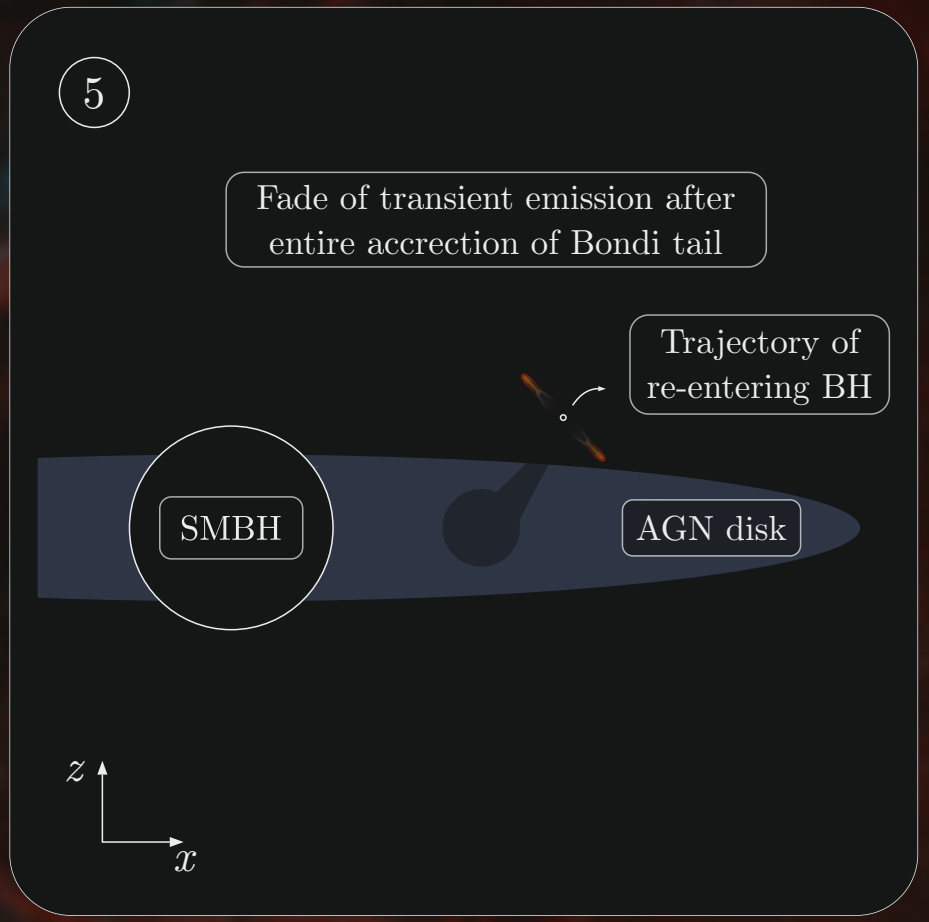
- Possibility to predict a light curve depending on a combination of parameters
- Possibility to detect flares of BBH mergers

Future Work

- Refining the light curve model
- Implementing the light curve model into a light curve fitting routine (MCMC)

Goals

- Fit observed light curves and provide parameter estimates for the merger scenario
- Solve cosmological problems...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Fade of transient emission after entire accretion of Bondi tail
Trajectory of re-entering BH
SMBH
AGN disk
z
x