Blackholistic Early Career Scientist Workshop, Nijmegen 2026

Report of Contributions

https://indico.global/e/16246

Contribution ID: **3** Type: **not specified**

Structure & logistics of today

Presenter: FRAGA ENCINAS, Raquel (Radboud University)

Session Classification: Introduction

Contribution ID: **4** Type: **Presentation**

How can M87 flare so brightly at TeV energies?

Tuesday, 27 January 2026 16:42 (19 minutes)

The super-fast (˜day), very-high-energy (VHE; >0.1 TeV) photon flares from the nearby active galactic nucleus M87 provide a unique, exciting opportunity to fast-forward our understanding of particle acceleration in jets. Despite 5 detected VHE flares in the last 20 years and extensive multiwavelength (MWL) campaigns, the process and location of these VHE flares in the jet are still not fully understood. I will present a physically motivated model to further unravel this question, with a component of persistent emission from an MHD driven multizone jet (BHJet) in combination with a time-dependent flaring component (AM³). Furthermore, I will give an overview of my plans to tackle this problem from a different perspective, using high-resolution H-AMR GRMHD simulations enhanced with test-particles. Looking ahead, this work is also particularly relevant as a preparation for the confirmed 2-month EHT/MWL/VHE movie campaign in Spring 2026.

Author: KLINGER-PLAISIER, Marc (Anton Pannekoek Institute - University of Amsterdam)

Presenter: KLINGER-PLAISIER, Marc (Anton Pannekoek Institute - University of Amsterdam)

Session Classification: Session 1

Contribution ID: **5** Type: **Presentation**

Resolving VLBI data

Wednesday, 28 January 2026 13:30 (17 minutes)

In this presentation I will explain how we use the open-source package “Resolve” to image VLBI data. Specifically we can use Resolve to dynamically image the sparse radio data observed by the EHT to image SMBH’s like Sgr A*and M87*. I will introduce some changes that we have made to Resolve in order to improve the imaging of dynamical features and to open the path to multi-epoch reconstructions.

Author: VAN DEN BERG, Bram (Radboud University)

Presenter: VAN DEN BERG, Bram (Radboud University)

Session Classification: Session 2

Contribution ID: **6** Type: **Presentation**

Recovering the Fundamental Plane of Black Hole activity using GRMHD simulations

Wednesday, 28 January 2026 13:48 (17 minutes)

Accreting black holes span a wide range of regimes, from stellar-mass X-ray binaries to supermassive AGN, and they operate across very different accretion states. These systems are often modeled separately, and a key goal of our work is to test whether a single physical framework can describe these systems across both mass and accretion scales.
The fundamental plane of black hole activity—a correlation between radio and X-ray luminosities in sub-Eddington systems—implies that similar physical processes may operate in XRBs and AGN. To investigate this, we use scale-free GRMHD simulations together with the GRRT code RAPTOR (Bronzwaer et al. 2020) to compute synthetic radio and X-ray luminosities and derive the corresponding correlations.
Early results are promising: the simulations reproduce the expected fundamental-plane trend and show indications of additional dependencies, such as inclination angle. This approach also provides a natural framework to explore potential spin-related effects in future work.

Author: OOSTERHUIS, renze (Radboud University Nijmegen)

Co-authors: Dr KÖRDING, Elmar (Radboud University Nijmegen); FALCKE, Heino (Radboud University); Dr VOS, Jesse (KU Leuven)

Presenter: OOSTERHUIS, renze (Radboud University Nijmegen)

Session Classification: Session 2

Contribution ID: **7** Type: **Presentation**

Black hole jet Lorentz factors across the mass range

Wednesday, 28 January 2026 11:15 (17 minutes)

Jets from stellar mass black holes in X-ray binaries (XRBs) and supermassive black holes in active galactic nuclei (AGN) provide distinct opportunities to study the jets of black holes across two different mass regimes with very different selection effects. Historically, the apparent speeds of XRB jets have been observed to be lower than those of AGN, leading to the assumption that stellar mass BHs produce slower jets. We employ novel modelling techniques such as nested sampling and simulation-based inference to obtain credible posteriors for the Lorentz factor parent populations of both samples. Both are best described by a power law distribution $N(\Gamma) \propto N^b$. Comparing these samples can give insights into fundamental scaling relations across eight orders of magnitude in black hole mass and further our understanding of jet physics.

Author: LILJE, Clara (University of Oxford)

Co-authors: Dr MATTHEWS, James H. (University of Oxford); Prof. FENDER, Rob (University of Oxford)

Presenter: LILJE, Clara (University of Oxford)

Session Classification: Session 2

Contribution ID: **8** Type: **Presentation**

The Homogeneous MeerKAT & Swift XRT Radio:X-ray Plane

Wednesday, 28 January 2026 09:30 (17 minutes)

The radio:X-ray plane is a valuable tool for probing the connection between core accretion and jet production in X-ray binaries during their hard spectral states. Although this correlation was once thought to be universal –and was extended to active galactic nuclei via a mass term –its universality is now questioned due to numerous 'outliers'that deviate from the 'standard'relation. To date, large studies of the plane have combined data from multiple telescopes, introducing uncertainties when converting fluxes to a common frequency and accounting for differing telescope systematics. ThunderKAT was a five-year programme monitoring outbursting X-ray binaries with the MeerKAT radio telescope, and ran alongside SwiftKAT, which obtained quasi-simultaneous Swift/XRT observations. Using these data, we have compiled the largest homogeneous radio:X-ray plane for X-ray binaries to date. I will present the results of this study, and discuss what the refined correlation reveals about accretion and jet physics.

Author: CROOK-MANSOUR, Justine (University of Oxford)

Presenter: CROOK-MANSOUR, Justine (University of Oxford)

Session Classification: Session 2

Contribution ID: **9** Type: **Presentation**

Calibrating the power of stellar mass black hole jets

Wednesday, 28 January 2026 09:49 (17 minutes)

Binary systems with a stellar mass black hole accreting from a companion star show bright synchrotron flaring in radio through to the infrared, linked to changes in the accretion properties of the black hole and the launch of powerful transient large scale jets. Despite observations of flaring in ˜50 X-ray binary systems over 50+ years, many questions remain about the nature of this behaviour. We present the first comprehensive population analysis of synchrotron flaring from stellar mass black holes. We use an updated analysis framework allowing us in a model independent way to constrain the energy, emitting region size and magnetic field strength of the plasma. Correlations over the population of X-ray binaries with varying black hole mass, spin and accretion rate are investigated. We attempt to constrain the typical bulk velocity of the emitting plasma demonstrating whether or not the flaring from X-ray binaries is from a relativistic jet.

Author: COWIE, Fraser (University of Oxford)

Presenter: COWIE, Fraser (University of Oxford)

Session Classification: Session 2

Contribution ID: **10** Type: **Presentation**

Determining the black hole spin of EHT sources

Wednesday, 28 January 2026 14:42 (17 minutes)

The Event Horizon Telescope (EHT) has enabled horizon-scale imaging of supermassive black holes. However, constraining black hole spin remains a challenge, despite its importance for testing accretion physics, jet launching, and gravity. Therefore, it is worthwhile to investigate new methods for determining spin, particularly those that make minimal assumptions about the complex astrophysics surrounding the black hole. In this talk, I will present a novel method for constraining spin by utilizing hot spots —localized regions around the black hole that flare up and can appear multiple times in images when the hot spot is bright enough. I will also show some initial work on possible new spin dependencies found in MAD disks using GRMHD simulations.

Author: DE KLEUVER, Joost (Radboud University)

Presenter: DE KLEUVER, Joost (Radboud University)

Session Classification: Session 2

Contribution ID: **11** Type: **Presentation**

Studying jet properties in nearby active galactic nuclei with multi-wavelength, multi-zone modeling

Tuesday, 27 January 2026 16:00 (19 minutes)

My work involves developing and applying a physically motivated multi-zone jet model to a variety of low luminosity active galactic nuclei, fitting their radio to X-ray spectral energy distributions to constrain and better understand micro/macro jet physics and particle acceleration, and how it might vary between sources. Building on this, a new analysis pipeline is being developed that couples the jet model directly to X-ray and gamma-ray instrument responses, enabling simultaneous fits to high energy counts spectra and broadband flux measurements, and further implementing bayesian analysis into MWL fitting. This model and pipeline will be utilized to study the VHE emission observed from jetted AGN in conjunction with other wavelengths, to better understand the radiative properties & conditions of jets themselves.

Author: DUNCAN, Ruby (University of Amsterdam)

Presenter: DUNCAN, Ruby (University of Amsterdam)

Session Classification: Session 1

Contribution ID: **12** Type: **Presentation**

Lighting up a black hole: phenomenological reconstruction of particle microphysics around a black hole

Tuesday, 27 January 2026 16:21 (19 minutes)

A key open question in astrophysics is how particles are heated and accelerated in accretion flows and how this shapes observed emission. We present a new method for reconstructing the connection between plasma dynamics and particle acceleration in the accretion flow of the LLAGN M87*, using the 2017 Event Horizon Telescope multi-wavelength campaign as a prototype. Our Bayesian framework constrains a multi-dimensional, parameterized lepton distribution in the accretion disk, capturing a range of heating and acceleration mechanisms without relying on specific sub-grid models. By jointly fitting horizon-scale imaging, polarimetric data, and multi-frequency observations, we obtain quantitative constraints on thermal and non-thermal lepton populations, including energetics, spectral indices, and high-energy cutoffs. These results offer new insights into near-horizon acceleration processes and show that multi-wavelength and polarimetric data are essential for breaking degeneracies between microphysical models. The inferred lepton distributions provide data-driven inputs for PIC simulations and can extend to other LLAGN.

Author: ROY, RITTICK (UNIVERSITY OF AMSTERDAM)

Presenter: ROY, RITTICK (UNIVERSITY OF AMSTERDAM)

Session Classification: Session 1

Contribution ID: **13** Type: **Presentation**

Painting by Numbers with Picasso: validating a new polarized GRRT code using RAPTOR and IPOLE

Wednesday, 28 January 2026 14:06 (17 minutes)

General relativistic ray-tracing (GRRT) codes are used to track accretion disk photons back to the observer in order to create a simulated image. For polarized observations, such as those of M87*, the GRRT must also track the evolution of the full Stokes parameters. We have developed a new polarized GRRT code, Picasso, building on the previous unpolarized version. To validate the use of this code, we compare it to the other GRRT codes RAPTOR and IPOLE. Using pre-existing snapshots from ten general relativistic magnetohydrodynamics simulations, we have also created a library of images for M87* and derived the resulting image statistics. These include the total flux density, linear polarization fraction, average polarization, and the electric vector position angle. Here, we present the results of this validation, as well as discuss the advantages of this new framework as a tool for fitting and recreating EHT data and observations.

Author: LATTIMER, Aylecia (Anton Pannekoek Institute, University of Amsterdam)

Presenter: LATTIMER, Aylecia (Anton Pannekoek Institute, University of Amsterdam)

Session Classification: Session 2

Contribution ID: **14** Type: **Presentation**

Universality of Energy Extraction from Black Holes

Tuesday, 27 January 2026 17:24 (19 minutes)

I will review several energy extraction mechanisms (classical and quantum) to facilitate discussions on approaching the Blandford-Znajek process in the future.

Author: WONDRAK, Michael Florian

Presenter: WONDRAK, Michael Florian

Session Classification: Session 1

Contribution ID: **15** Type: **Presentation**

What we know about very-high-energy particle acceleration in x-ray binary jets

Wednesday, 28 January 2026 10:08 (17 minutes)

X-ray binaries have recently emerged as a promising candidate to explain the highest energy cosmic rays. I will present an overview of the existing observational constrains provided by gamma ray telescopes, and introduce ongoing efforts to estimate the cosmic rays luminosity of these systems.

Author: OLIVERA-NIETO, Laura (Anton Pannekoek Institute for Astronomy, University of Amsterdam)

Presenter: OLIVERA-NIETO, Laura (Anton Pannekoek Institute for Astronomy, University of Amsterdam)

Session Classification: Session 2

Contribution ID: **16** Type: **Presentation**

Imaging black holes and jets from space

Wednesday, 28 January 2026 12:12 (17 minutes)

The images of the shadows of M87 and Sgr A*, taken by the Event Horizon Telescope using the technique of very long baseline interferometry (VLBI) at 230 GHz, have opened up a new window into horizon-scale black hole and accretion science. However, ground-based VLBI is hitting fundamental resolution limits due to the limited size of the Earth and atmospheric corruptions at high frequencies. Space-based VLBI is the inevitable next step towards order-of-magnitude resolution improvements in black hole imaging. SHARP is a space-to-space VLBI array that will consist of three satellites in Medium Earth Orbits, attaining a resolution of ˜3 micro-arcseconds with a fully filled uv-plane at 690 GHz. SHARP images will provide precision measurements of the black hole spacetime, and test of theories of jet launching. The SHARP Experiment (SHARPEx) will demonstrate the space-to-space VLBI technique and provide images of AGN jets at cm wavelengths with unprecedented resolution and fidelity.

Author: ROELOFS, Freek

Presenter: ROELOFS, Freek

Session Classification: Session 2

Contribution ID: **17** Type: **Presentation**

A close correspondence between the low X-ray variability and jet ejections

Wednesday, 28 January 2026 10:27 (17 minutes)

Accretion states and their relationship with the formation of relativistic jets have long been studied to understand the dynamics of jet-launching events. One focus of such studies has been attempting to confirm the causal connection between changes in the accretion flow and the launching of transient ejecta. While suggestions have been made that particular timing signatures (i.e. Type-B QPOs) correspond to the moment of jet launching, we still do not have definitive evidence for this connection. Our sample study indicates that the drop in X-ray variability can be a more reliable signature of jet launching.

Author: ZHANG, Zuobin

Co-author: Prof. FENDER, Rob (University of Oxford)

Presenter: ZHANG, Zuobin

Session Classification: Session 2

Contribution ID: **18** Type: **Presentation**

Single-Dish Calibration Pipelines and VLBI Simulation Studies for Millimetre Astronomy with the Africa Millimetre Telescope

Wednesday, 28 January 2026 14:24 (17 minutes)

This PhD research develops practical tools for millimetre astronomy, supporting blazar monitoring and evaluating the Africa Millimetre Telescope's (AMT) role in global VLBI. A core component is a single-dish calibration and analysis pipeline for continuum blazar observations. Using IRAM 30-m test data, key calibration steps (pointing, opacity, elevation-dependent gain, and polarization) are first applied in GILDAS/MIRA and then independently implemented in Python from the underlying calibration equations. The two reductions are compared to validate the pipeline and deliver a transparent, flexible workflow, with new IRAM observations planned for further testing.

In parallel, two VLBI studies assess AMT's contribution to the EHT. SYMBA imaging simulations test how adding AMT affects array performance and image quality for targets such as M87*and Sgr A*. Separately, Monte-Carlo fringe-detectability analyses at 230 GHz combine realistic atmospheric conditions, baseline sensitivity, and measured coherence times to estimate how often AMT baselines achieve reliable high-SNR detections.

Author: KATJAITA, Hiiko (University of Namibia)

Presenter: KATJAITA, Hiiko (University of Namibia)

Session Classification: Session 2

Contribution ID: **19** Type: **Presentation**

A view into the AGN jets with ALMA polarimetry

Wednesday, 28 January 2026 11:53 (17 minutes)

The ALMA observatory is unprecedented in terms of high quality polarimetric observations at mm and sub-mm wavelengths. With its ˜ 1 arcsecond resolution, ALMA can help us study the large scale (kpc) jets of AGN and possibly even untangle their magnetic field structure. I present brightness and polarization maps of M87 and characterize the key observational aspects of the jet, while at the same time exploring what the predictions of different models can tell us about the underlying physics.

Author: FERREIRA CARLOS, Douglas (Universidade de São Paulo)

Presenter: FERREIRA CARLOS, Douglas (Universidade de São Paulo)

Session Classification: Session 2

Contribution ID: **20** Type: **Presentation**

Simulating Synchrotron Light: Bridging RMHD Jets and Polarimetric Data

Relativistic jets from black holes—spanning X-ray binaries to AGN—are natural laboratories for studying high-energy particle acceleration. Yet, how these systems convert bulk kinetic energy into nonthermal particle populations remains a central open question.
My work combines 3D RMHD simulations with polarized radiative transfer to model synchrotron and inverse Compton emission across the electromagnetic spectrum. Using PLUTO with a Lagrangian particle module and post-processing tools like RADMC-3D and 3DPol, I generate synthetic Stokes maps and SEDs for direct comparison with VLBI, IXPE, and Fermi data.
In AGN such as 3C 84 and BL Lac, I explore how magnetic topology and shock dynamics shape polarization and γ-ray flares. I also model SS 433's eastern lobe, recently identified as a TeV acceleration site, probing X-ray synchrotron emission from recollimation shocks.
This multi-scale approach connects microquasars to blazars, supporting a unified framework for jet-driven particle acceleration in the multi-messenger era.

Author: Dr KRAMER, Joana (University of Amsterdam)

Presenter: Dr KRAMER, Joana (University of Amsterdam)

Contribution ID: **21** Type: **Presentation**

Mapping Plasma Flow in Black Hole Jets with Tracers and Adaptive GRMHD

Tuesday, 27 January 2026 17:03 (19 minutes)

We investigate the composition and dynamics of black hole accretion jets using novel high-res GRMHD simulations. By deploying Lagrangian composition tracers and adaptive mesh refinement (AMR), we achieve two goals: 1) We precisely track how disk material mixes into the jet and how jet plasma entrains into the surrounding sheath, and 2) We maintain high resolution dynamically within the jet and key disk regions. Our results provide a clear picture of plasma transport and the turbulent structure of the jet-disk boundary. This global model is specifically designed to supply physically realistic initial conditions for future, finer-scale hybrid simulations that will study test particle acceleration in the turbulent jet sheath, bridging global observable dynamics to local plasma physics.

Presenter: PRAHARAJ, Subhrat (University of Amsterdam)

Session Classification: Session 1

Contribution ID: **23** Type: **not specified**

Simulating synchrotron light: bridging RMHD jets and polarimetric data

Wednesday, 28 January 2026 11:34 (17 minutes)

Presenter: KRAMER, Joana

Session Classification: Session 2

Contribution ID: **24** Type: **not specified**

Session wrap up & Questions

Tuesday, 27 January 2026 17:45 (15 minutes)

Session Classification: Session 1

Contribution ID: **25** Type: **not specified**

Tutorial: Estimating internal energies from radio synchrotron measurements

Thursday, 29 January 2026 09:30 (30 minutes)

Presenter: COWIE, Fraser (University of Oxford)

Session Classification: Session 4

Contribution ID: **26** Type: **not specified**

Tutorial: How to use BHJet to study the MWL spectrum of any jetted system in Python

Thursday, 29 January 2026 11:15 (30 minutes)

Presenter: DUNCAN, Ruby (University of Amsterdam)

Session Classification: Session 4

Contribution ID: **27** Type: **not specified**

Tutorial: How to make a conda-forge package out of your code

Thursday, 29 January 2026 13:30 (30 minutes)

Presenter: KLINGER-PLAISIER, Marc (Anton Pannekoek Institute - University of Amsterdam)

Session Classification: Session 4

Contribution ID: **28** Type: **not specified**

Tutorial: Simulating VLBI observations with SYMBA

Thursday, 29 January 2026 15:30 (30 minutes)

Presenter: FERREIRA CARLOS, Douglas (Universidade de São Paulo)

Session Classification: Session 4

Contribution ID: **29** Type: **not specified**

Discussion

Thursday, 29 January 2026 10:00 (44 minutes)

Session Classification: Session 4

Contribution ID: **30** Type: **not specified**

Discussions

Thursday, 29 January 2026 11:45 (44 minutes)

Session Classification: Session 4

Contribution ID: **31** Type: **not specified**

Group discussion about the use of RAPTOR and PICASSO

Thursday, 29 January 2026 14:00 (30 minutes)

Presenter: OOSTERHUIS, renze (Radboud University Nijmegen)

Session Classification: Session 4

Contribution ID: **32** Type: **not specified**

Discussion

Thursday, 29 January 2026 14:30 (30 minutes)

Session Classification: Session 4

Contribution ID: **33** Type: **not specified**

Discussion

Thursday, 29 January 2026 16:00 (30 minutes)

Session Classification: Session 4