Astronomical Institute of the Czech Academy of Sciences

6th December
13:00 CET

- ***Do massive black holes in nearby galaxies come in pairs? – An observer's tale***
- Presenter: **Dr. Sabine Thater**
  University of Vienna, Austria
- ufind.univie.ac.at/en/person.html?id=109657
- Recording link:
- ***Abstract:***

The formation of supermassive black holes (MBH) is thought to be tightly linked to the formation and growth of their host galaxies. While it is difficult to infer information about MBHs, galaxy evolution often leaves an imprint on the host galaxy properties. One of those properties is that the most massive galaxies often show 'cores' in their central surface brightness profiles. Instead of a continuously steep power-law surface brightness cusp, core galaxies show a shallow central light profile, depleted in stars with respect to the extrapolation of the outer surface brightness distribution. Depleted cores mainly occur in very luminous, slow rotator galaxies and are thought to result from 'dry merger' events of galaxies hosting black holes. During the galaxy collision the MBHs migrate to the centre of the merger remnant through dynamical friction and form a MBH binary. Stars in the vicinity of the MBH binary are ejected from the nuclear region of the galaxy and depleted galaxy cores form. A kinematical prediction of the MBH binary core scouring scenario is that the orbital distribution in the vicinity of the remnant MBH will be dynamically 'tangentially anisotropic', which was observationally confirmed for a number of galaxies.

I will present here our kinematical and dynamical study of 20 nearby galaxies (half "cores", half 'coreless') in which we have tested the scenario above. For our measurements we made wide use of IFU data, such as SINFONI, NIFS, MUSE and more, as well as testing different dynamical measurement methods to derive the MBH masses and the orbital distributions in the vicinity of the central black holes. Among other findings, we do not find more tangential orbits within the sphere of influence of the black holes for cored than for coreless galaxies. I will discuss the implications of this finding and what additional observational data is needed to dynamically detect MBH binaries. I will conclude with a discussion on how we can use the detailed orbital information of dynamical models to get additional information of the build-up of galaxy centers.

15th November
13:00 CET

- ***Extreme physics in AGN: jets, shocks, flickering and the highest energy particles in nature***
- Presenter: **Dr. James Matthews**
  University of Cambridge, UK
- jhmatthews.github.io
- Recording link:
- ***Abstract:***
Both cosmic rays and AGN jets were discovered over a century ago, and, despite spectacular progress in that period, we are still far from a complete understanding of either of these extreme phenomena. In this talk, I will explore the links between the two, focusing particularly on particle acceleration in astrophysical jets and the origin of ultrahigh energy cosmic rays (UHECRs); UHECRs are protons and nuclei striking our atmosphere with energies extending beyond 1e20 eV. I will discuss ways in which particles can be accelerated to such extreme energies, focusing particularly on diffusive shock acceleration and the self-regulated cosmic ray acceleration process. Aided by hydrodynamic simulations, I will show that shocks can be formed in backflows in radio galaxies and that these shocks can accelerate particles to ultrahigh energy. I will then discuss a model in which 'dormant' radio galaxies such as Centaurus A and Fornax A act as slowly-leaking UHECR reservoirs. These sources may also be able to explain the observed UHECR arrival directions, particularly if we allow for time-dependence in their jet power and scattering off nearby magnetic structures; in fact, the UHECR signal we observe may merely be an "echo" of past AGN jet activity within $\sim$20 Mpc. Finally, I will describe a new work in which we study how a flickering jet power affects the particles accelerated by the jet and the morphology of the kpc-scale radio lobe. I will also discuss observational applications, highlighting the importance of flickering for jet power inference, the radio-loud/radio-quiet dichotomy and our understanding of radio emission in optically bright quasars.

10th November
16:00 CET

- ***Unveiling the Rate and Nature of Dual AGN***
- Presenter: **Dr. Adi Foord**
  KIPAC/Stanford University, USA
- www.adifoord.com
- Recording link:
- ***Abstract:***

Supermassive black hole pairs at kiloparsec scales are expected as a result of massive galaxy mergers – and if sufficient levels of gas are efficiently funneled into the central active regions, one may expect a large fraction of AGN pairs. The ongoing search for AGN pairs has spanned over 25 years, via a wide range of multi-wavelength techniques. X-ray, optical, and radio analyses have been carried out, using both indirect and direct detection techniques, for various sources. However, to date, the number of confirmed AGN pairs remains relatively small; AGN pairs that are widely separated relative to the instrument PSF and have near unity flux ratios are easy to identify, but those with small separations and/or flux ratios are more difficult to detect. The small number of confirmed pairs, the majority of which have large (> 1 kpc) separations, has limited our understanding of the role galaxy mergers play in AGN activation and the dependence of AGN activity on the surrounding environment. In the following talk I'll review recent progress to detect AGN pairs in X-ray observations, where statistical analyses with BAYMAX (Bayesian AnalYsis of Multiple AGN in X-rays) allows for identification of closely separated and/or faint AGN pairs across a large range of redshift. Additionally, combining X-ray results with available optical and IR observations allows for better insight on preferential environments of AGN pairs. Most importantly, finding more AGN pairs across a range of separations in the local universe will lead to a constraint on the gravitational wave rate, as expected to be detected by Pulsar Timing Arrays and LISA.

1st November
13:00 CET

- ***Dirty Dancing: piercing the dusty environment of merging supermassive black holes***
- Presenter: **Dr. Matteo Guainazzi**
  ESA/ESTEC, Netherlands
- www.cosmos.esa.int/web/personal-profiles/matteo-guainazzi
- Recording link:
- ***Abstract:***

It is a posit of modern astrophysics that most galaxies host a super-massive black hole (millions to billions of times more massive than the Sun). These black holes affect the evolution of galaxies well beyond their gravitational sphere of influence (which does not extend wider than 1/1000th of a typical galaxy linear size). In turn, the evolution of galaxies affects the growth of black holes through, e.g., galaxy merging. Interacting galaxies, or galaxies with a multiple (active) nuclei are key laboratories to investigate these processes.
While the extragalactic astrophysical community share a broad consensus on each of the above statements taken individually, how these feed-back loops work in the Universe, and the relative importance of various feed-back channels remain largely not understood. Furthermore, the existing samples of dual/binary/multiple active galaxies are remarkably scarce and incomplete. My talk will offer a glimpse of the recent efforts that a group of scientists in the MAGNA ("Multiple AGN Activity"; "Eat" in Roman dialect) collaboration have been undertaking to acquire large observational samples of dual/binary AGN, and to use them to inform the cosmological and "local" simulations aiming at predicting the concurrent galaxy/black hole evolution. This talk will allow you to pierce your (X-ray) view through the dusty environment of these systems.

Parental guidance not needed.

18th October
15:00 CEST

- ***Obscured AGN Growth in Mid-IR Dual AGNs and Beyond***
- Presenter: **Ryan Pfeifle**
  George Mason University, USA
- bgc.physics.gmu.edu/black-hole-experts/
- ***Abstract:***

Galaxy collisions, a ubiquitous phenomenon in the Universe, are predicted to be a critical avenue for galaxy and black hole growth and evolution. During a merger event, gravitational torques drive reservoirs of gas and dust toward the galactic cores, and these inflows are consequently accreted by the central supermassive black holes, which then manifest as active galactic nuclei (AGNs). Dual AGNs are expected to occur in late-stage mergers, where the black holes are predicted to experience their most rapid period of growth. In our *Chandra* investigation of 15 late-stage mergers preselected with *WISE*, we found dual AGNs or candidate duals in 8 out of 15 mergers, many of which show no evidence for AGNs in the optical. Our multiwavelength observations suggest that the AGNs in these mergers are highly absorbed, with intrinsic column densities in excess of $N_{\mathrm{H}} > 10^{23} - 10^{24}$ cm^{-2}, consistent with hydrodynamic simulations. One of these mergers, SDSS J0849+1114, was in fact a triple galaxy merger, and exhibited three nuclear X-ray sources detected by *Chandra*. Through a multiwavelength follow-up program, we demonstrated that SDSS J0849+1114 represents the most compelling case for a triple AGN in the literature and has since been confirmed by two further studies. We will also discuss more recent work related to obscured AGN growth more generally, highlighting a new X-ray/mid-IR diagnostic for AGN obscuration identified in our study of Swift/BAT AGNs. This diagnostic relies upon the well-known $\mathrm{L}_{\mathrm{X,Obs.}}/\mathrm{L}_{12\,\mu\mathrm{m}}$ luminosity ratio as well as mid-IR colors to select heavily obscured Swift/BAT AGNs ($\log[N_{\mathrm{H}}] > 23.5$) with high completeness and reliability. Our new obscuration diagnostic could be used to differentiate between unobscured and heavily obscured AGNs in future, large samples of AGNs, such as those now being detected by the eROSITA all-sky survey.