Astronomers' Days 2016

Abstract Book

Vapriikki 23.-25.5.2016

Session 1: Cosmology

Nabila Aghanim ***INVITED TALK***

Planck's view of the large scale structures

Planck mission's main achieved objective has been to provide us with the necessary data to establish the cosmological model. Planck has also proved a major source of information on the Large scale structures in the Universe through its mapping of the Sunyaev-Zeldovich effect, the Cosmic Microwave Background and the lensing. The presentation will review the main results on these topics.

Till Sawala

The dwarf galaxies of the Local Universe represent some of the most discriminating tests of structure formation on small scales, and of the Lambda-CDM cosmological model. Based on results from cosmological hydrodynamic simulations of the Local Group, I will show how the impact of baryonic physics affects the relation between the observed galaxies and the underlying dark matter structures. In particular, I will show that a many of the apparent small-scale failures of Lambda-CDM can be resolved when radiation processes including supernova feedback and reionisation are taken into account, resulting in a Local Group dwarf galaxy population that matches the observed one.

Peter Johansson

The formation of the first supermasssive black holes in the Universe

Recent observations have demonstrated the existence of supermassive black holes with masses in excess of 10^9 solar masses at redshifts above z>7 when the Universe was less than 800 million years old. Forming such massive black holes from stellar mass black hole seeds is problematic given the constraints of Eddington limited spherical mass growth and the relatively short available time. Thus an alternative scenario has emerged in which massive gas clouds in the very early Universe with zero metallicity and associated inefficient cooling could instead directly collapse to black hole seeds with masses of the order of ~10^4 solar masses.

In this talk I will discuss our recent simulations of the direct collapse black hole scenario performed using the adaptive-mesh-refinement code Enzo. Our simulations include for the first time an anisotropic radiation field from a realistic first galaxy that irradiates a gas cloud, as opposed to a general isotropic radiation field. We demonstrate that for realistic input spectra and initial separations of 1-2 kpc between the collapsing gas cloud and the radiation source, collapsing cores with masses of 5x10^3-10^4 solar masses can form by redshifts of z~25. These simulations demonstrate the viability of the direct collapse black hole scenario and at the same constrain its prevalence, as it requires the relatively close synchronization of two haloes both in space and time.

Pasi Nurmi

Galaxy structures in our cosmic neighbourhood

Signatures of the processes in the early Universe are imprinted in the cosmic web. Some of them may define shell-like structures characterised by typical scales.
Also the galaxy properties in different large-scale environments are affected by the environment in which they reside. I'll review some of our recent results in these studies.

Pekka Heinämäki

Influence of dark energy on systems of galaxies

According to the current cosmological paradigm the formation and evolution of the cosmic large-scale structure is governed by the gravitational attraction of the dark matter and the repulsion of the dark energy. In this framework we characterize the relative importance of uniform and constant dark energy, as given by the Λ term, in galaxy systems of different scales.

Alexandra Veledina ***WINNER OF THE VÄISÄLÄ PRIZE***

Physical processes operating in black hole vicinity used to be studied through the X-ray vision. However, recent discoveries in the optical wavelengths put under question the whole accretion picture proposed earlier. I will describe advances in black hole multiwavelength astronomy and their implications for models of accretion/ejection.

Session 2: X-ray Binaries

Karri Koljonen

The process of accretion onto black holes and how it leads to the production of relativistic, collimated jets, is still one of the major open questions in astronomy. It has been established that a large fraction of the accretion energy is transported to the jet in active galactic nuclei and X-ray binaries. Thus, the jets are tightly linked to the accretion process, albeit exactly how remains unclear. In this talk I will discuss the observational view of the link between the emission from accretion processes and jets, how they are correlated with each other, and what system parameters affect to these correlations, e.g. whether we can see the effect of the spin or the mass of the black hole.

Juri Poutanen

X-ray bursts as a tool to study equation of state of cold dense matter

I will review how thermonuclear X-ray bursts can be used to determine the masses and radii of neutron stars, which can be then translated to the constraints on the equation of state of cold dense matter.

Sergey Tsygankov

Propeller effect in X-ray pulsars

Propeller effect, i.e. centrifugal inhibition of accretion, is an immediate evidence of the presence of a strong dipole magnetic field in accreting neutron stars. Observation of this effect requires high sensitivity of X-ray telescopes and become possible only recently. From the theoretical point of view many aspects of this effect (spectrum formation, matter leakage through the centrifugal barrier, etc) are still not developed due to the lack of a high quality observational data.
In this talk I will review observational manifestations of the propeller effect in X-ray pulsars with broad range of the magnetic fields from 10^8 to 10^14 G.

Auni Somero

Observational studies of interacting compact binaries - Accretion in very different environments

Interacting compact binaries are stellar systems where a compact object is accreting matter from a companion star. The accreted matter forms an accretion disc around the compact object. This accretion powered disc is the dominating source of electromagnetic emission in the system and thus enables us to study it observationally.

In this talk I will present results of observational studies of three different interacting compact binary systems. The observations cover optical spectroscopy and polarimetry.

Pauli Pihajoki

Geodesics, photon transport and polarization in general spacetimes

I present a new computationally efficient and easily extensible C++ library for propagating geodesics in a curved spacetime, where the metric is arbitrary. The library can be used e.g. to find the path of geodesics, including intersections with arbitrary (non-stationary) surfaces, computing observed dependent emission/absorption angles, solving gravitational and Doppler redshifts and computing the gravitational Faraday rotation of polarization.
I will briefly discuss these various effects and how to compute them numerically. In addition, possible applications to various physical systems are discussed. A specific focus is given on modelling pulse profiles of rotating neutron stars.

Session 3: Galaxy Formation and Evolution

Marianne Vestergaard ***INVITED TALK***

Black holes: from curiosity to everyday reality

Black holes have gone from being a mere curiosity to a household item in every day discussions even among laymen. I wll highlight some of the advances we have achieved in the past decades and especially in recent years. But black holes are also expected to play a significant role for the formation and evolution of galaxies. I will outline some of the research topics of great current interest to astrophysicists.

Antti Rantala

The dynamics of supermassive black holes (SMBHs) is poorly resolved in most modern cosmological / galactic-scale numerical simulation codes. We've developed a regularized Post-Newtonian SMBH dynamics module KETJU for the tree-SPH simulation code GADGET-3 to properly model the formation and evolution of SMBH binaries and the host galaxy - binary interactions. A brief code description as well as the first results concerning the formation of core elliptical galaxies are presented.

Anup Poudel

Effect of large-scale environment on galaxy stellar mass

To understand the role of the large-scale environment in galaxy formation and evolution, it is essential to study the behavior of different galaxy populations under various environmental conditions. By studying the galaxy stellar mass functions for different combinations of the large-scale structure, central and satellite galaxies, and galaxy morphology, we have shown that the large-scale environment plays a significant role in shaping the stellar mass functions of different galaxy populations in groups.

Ronald Läsker

I will present revised scaling relations of masses (MBH) of Supermassive Black Holes (BHs) with galaxy and bulge properties, focusing on bulge masses (Mbul) in low-mass and late-type galaxies where the bulge is only a minor component. Utilizing a campaign of dedicated HST/WFC3 optical and near-infrared data, we analyzed BH host galaxies with MBH precisely known by their nuclear Megamaser emission. Due to the superior image quality and detailed analysis techniques, we were able to decompose these complex systems, to parametrize their (small) classical bulges and, in particular, to isolate them from "pseudobulge" and other small-scale disk-like components. As a result and contrary to common wisdom, we find that (classical) bulges do not necessarily play a distinguished role in a putative BH-galaxy co-evolution scenario, and that the low slope of the revised MBH - Mbul relation constrasts with predictions of standard feedback models. We also note an offset to lower MBH when compared to the MBH-Mbul relation of early-type systems, possibly implying systematic bias in commonplace MBH measurement methods. Our study demonstrates how nuclear Megamasers are able to significantly advance the characterization of BH scaling relations in the undersampled, observationally challenging regime of low MBH and late-type hosts, and highlight the persistent need for a comprehensive, unbiased effort of measuring MBH. The results also indicate the need for an alternate, refined theory of the formation and growth of Supermassive Black Holes.

Kalle Karhunen

The host galaxies and close environments of low redshift quasars in the SDSS Stripe 82.

We present a photometrical multicolour study of low redshift (z < 0.5) quasar host galaxies and their environments on scales < 500 kpc, based on the large and homogeneous dataset of quasars derived from the Sloan Digital Sky Survey (DR7). We studied a sample of ~400 quasars that were imaged in the SDSS Stripe 82 region which is up to 2 magnitudes deeper than the standard Sloan images. Of these ~400 quasars, 52 were selected for a more detailed study of the colour of the host galaxies and their close (< 50 kpc) environments in u, g, r, i and z bands.

Session 4: AGN

Alexis Finoguenov

I will provide a review of what we learned about AGN using their clustering and direct halo occupation studies.

Jari Kotilainen

The host galaxies of AGN with powerful relativistic jets

We present deep near-infrared images of 19 radio-loud active galactic nuclei (AGN) at 0.3 < z < 1.0 with powerful relativistic jets. Together with literature data, we study ~100 radio-loud AGN with host galaxy detections, over a broad range of radio luminosities, divided into high-excitation (quasar-mode; HERG) and low-excitation (radio-mode; LERG) radio galaxies. We find a statistically significant positive correlation between nuclear and host galaxy luminosities for HERGs, but only a weak negative trend for LERGs. This suggests a close coupling between the relativistic jets and their host galaxy. In the most likely scenario, lower luminosity LERGs emit the bulk of their energy in the form of radio jets, producing strong feedback, while the more luminous HERGs are affected by galaxy mergers and interactions, which provide cold gas to feed both nuclear activity and star formation episodes.

Alejandro Olguin

We present near--infrared (NIR) imaging of FBQSJ1644+2619, one of the few gamma-ray emitting Narrow Line Seyfert 1 galaxies detected at high significance level by Fermi-LAT. This study is the first morphological analysis performed to this source and the third performed to this type of objects. Conducting a detailed two--dimensional modeling of its surface brightness distribution and analysing its J-Ks colour gradients, we find that FBQSJ1644+2619 is statistically most likely hosted by a barred lenticular galaxy (SB0). We find suggestive evidence that the bulge in the host galaxy is not classical but pseudo, against the paradigm of powerful relativistic jets exclusively launched by giant ellipticals. Our analysis, also reveal the presence of a ring with a rough diameter equals to the bar length (r = 8.13kpc). Its origin might be a combination of bar-driven gas rearrangement and minor mergers, as revealed by its overall morphology and the apparent merger remnant in the J-band image. In general, our results suggest that secular evolution might be very important in the onset of nuclear activity and the growth of the massive bulge in FBQSJ1644+2619. However, minor mergers seem to play a role as important as secular evolution.

Sebastian Kiehlmann

Blazars are a class of AGN emitting radiation throughout the entire observable spectrum. This radiation is dominated by the non-thermal emission of a relativistic jet which is pointed directly towards the Earth.
One of the main topics regarding the physics of AGN jets is the origin of the Gamma-ray emission. Using light curves of the archetypical blazar 3C 279 at 26 frequencies from radio to Gamma-rays, observed with dozens of instruments, we estimate the variability power spectra and the correlation time lags between different bands. We infer that X-rays are probably produced by synchrotron self-Compton scattering of mm-wavelength synchrotron photons. The correlation between X-rays, gamma-rays, and optical bands exhibits complex behaviour. Time lags between the bands change over time, indicating probably different emission sites and different physical conditions.
Another major topic of ongoing discussion regards the variability of the polarization. Studying an unprecedentedly well sampled polarization curve of 3C 279, we can show that the variability follows two different processes: a stochastic process during the low brightness state and a different - probably deterministic - process during the flaring state.

Rafael Vera Rodriguez

Neural networks: A novel tool for studying young AGN populations.

Compact steep-spectrum sources (CSS), high frequency peakers (HFP), and gigahertz-peaked spectrum sources (GPS) are powerful and compact radio sources. Morphological studies, dense gas analyses, and surveys suggesting the absence of halo diffusion emission, have led to the general agreement that these sources are young AGN (Stanghellini et al. 1996, 1997b; Bicknell et al. 1997; Readhead et al. 1996). We consider that the study of these sources can give insights about the evolutionary scenario of the AGN phenomena. Previously, Torniainen et al. (2008) found that GPS sources do not follow a particular morphological classification. Additionally, they realised that many Blazars with long periods of flaring states are misclassified as GPS, HFP, or CSS. Consequently, we want to carry out a new classification study applying a similar method used by Torniainen et al. (2008). We have explored the use of self organising maps and growing neural gas networks to make a discrete transformation from a multiwavelength data into a discrete 2D manifold of objects called neurons. The neural network forms groups of neurons that only react to a certain combination of inputs, therefore grouping the galaxies in a discrete 2-D space. From that classification, we can obtain information regarding the parent population, the redshift, or the optical counterparts of specific groups of CSS, GPS, and HFP. Currently we are studying the application of both self organising maps and growing neural networks to our sample using pyhton libraries and Matlab classes.

Emilia Järvelä

Multivariable studies of narrow-line Seyfert 1 galaxies

The discovery of gamma-rays, and thus powerful relativistic jets in narrow-line Seyfert 1 galaxies (NLS1) challenge our current knowledge of active galactic nuclei (AGN). NLS1s differ from other gamma-ray emitting AGN; they have lower mass black holes, higher accretion rates, preferably compact radio morphology, and they reside mostly in late-type galaxies. These differences force us to revise AGN unification and evolution schemes, but NLS1s also offer a new perspective on the jet phenomena.

Despite their high importance, NLS1s are a poorly studied class of AGN. A surprisingly large fraction of them are radio-loud and possibly host jets, but some of them seem to be totally radio-silent. This, along with other observational evidence, implies that they do not form a homogeneous class. However, it remains unclear what is triggering the radio loudness in some of them, but, for example, the properties of the host galaxy and the large-scale environment might play a role.

I present the results of an extensive study of a large sample of NLS1s. Using various statistical methods, for example, multivariable correlations and principal component analysis, we examined the interplay between their properties, such as emission properties, black hole masses, large-scale environments, and their effect on radio loudness. I also present the first results of the Metsähovi Radio Observatory NLS1 galaxy observing programme.

Kari Nilsson

The little telescope that could - past and future of the Tuorla blazar monitoring

I will briefly review the latest Tuorla optical blazar monitoring project, which has been running for the past 13 years and the new optical telescope planned on La Palma.

Session 5: Galaxies

Sébastien Comerón

GALACTIC ARCHAEOLOGY OF THE ESO 533-4 THICK DISC WITH VIMOS

The disc of galaxies is made of the superposition of a thin and a thick disc. Thick discs are seen in edge-on galaxies as excesses of light a few thin disc scale-heights above the mid-plane. Star formation occurs in the thin discs whereas thick discs are made of old stars. The formation mechanisms of thick discs are under debate. Thick discs might have formed either at high redshift on a short timescale or might have been built slowly over the cosmic time. They may have an internal or an external origin. To solve the issue of the thick disc origin we studied the kinematics and the stellar populations of the nearby edge-on galaxy ESO 533-4. We present the first Integral Field Unit (IFU) spectroscopy work with enough depth and quality to study the thick disc. This was done with VIMOS@VLT.

We find that the thick disc of ESO 533-4 contains no counter-rotating material. This suggests an internal origin for the thick disc (as opposite to accreted in mergers, which would cause some amount of retrograde stars). The stellar population map indicates that the populations of the thin and the thick discs of ESO 533-4 are separated in the Age-log(Z/Z_Sun) plane. This implies that thin and thick discs are made of two distinct populations. If the thick disc had a secular origin, we would observe a continuity in the Age-log(Z/Z_Sun) plane. Hence, we suggest that the thick disc of ESO~533-4 formed in a relatively short event at high redshift and that the thin disc has formed afterwards within it. We suggest that this formation mechanism is the standard one for massive disc galaxies.

Natalia Lahén

The Antennae galaxies, one of the most studied major mergers, is a pair of interacting galaxies at a distance of a few tens of megaparsecs from the Milky Way. We perform equal mass merger simulations, aiming to reproduce the spatial, kinematical and chemical properties of the Antennae pair. Specifically, the aim is to reproduce the observed metallicity distribution in the Antennae which helps us infer chemical abundancies in the progenitor disks and in the merger remnant.

We follow the evolution of gas, stars and dark matter in a major merger of two observationally motivated disk galaxies using the TreeSPH simulation code GADGET-3. In addition to kinematics, the metallicity in the gaseous and stellar components evolves through stellar feedback including supernovae and AGB-winds, which couple to gas.

Pertti Rautiainen

Multiple patterns in galaxies

Many galaxies have an apparently global pattern, e.g. two spiral arms emerging from the ends of a bar. There have been attempts to model these systems by different methods, e.g. by response models, where the mass distribution has been derived from the light distribution. The pattern speed (=angular velocity of the bar and/or spiral) has then been determined by comparing the response of stellar or gas particles with the observed morphology.

The behaviour of self-gravitating N-body models can be quite different from the response models. There are often several patterns rotating with their own pattern speeds. Sometimes the patterns occupy separate domains, e.g. a small secondary bar near the centre of the disk, with a higher pattern speed than the large scale bar. However, there are also models, where two patterns overlap in radius, and the resulting morphology is a time-dependent superposition. The separate patterns may be easily distinguished at certain moments, but they can also camouflage as a continuous global pattern. Furthermore, some morphological features may be just artefacts of the superposition, i.e. they do not actually exist as dynamical entities.

We will discuss examples of multiple patterns in models and also presentseveral candidates among real galaxies.

Session 6: Solar System

Nicolas Altobelli ***INVITED TALK***

The Rosetta mission: a retrospective on 22 months accompanying a comet...and more to come!

The Rosetta Mission is the third cornerstone mission of the ESA programme Horizon 2000. The aim of the mission is to map the comet 67-P/Churyumov-Gerasimenko by remote sensing, to examine its environment insitu and its evolution in the inner solar system. The lander Philae was the first device to land on a comet and perform in-situ science on the surface. Launched in March 2004 and after a number of gravity assists and various asteroid fly –bys, the spacecraft entered deep space hibernation in June 2011. Nearly 10 years after launch on 20th January 2014 at 10:00 UTC the spacecraft woke up from hibernation, and subsequently successfully entered into orbit around the comet and deployed Philae to the surface. In August last year, the comet passed its closest point to the Sun, with Rosetta observing the spectacular phenomena at the maximum of cometary activity.
This talk will summarise the mission achievements so far and what to expect next.

Juergen Schmidt

Compositional Mapping of Europa's Surface with a Dust Mass Spectrometer

The SUrface Dust Analyser (SUDA) is a new generation dust mass spectrometer developed at the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado. It was selected in May 2015 by NASA for a flyby mission investigating Jupiter's moon Europa. SUDA can measure from orbit the composition of ballistic, micron-sized dust particles populating the thin dust exospheres as they were detected around the Galilean satellites (Krueger et al, Nature, 1999), and recently also around Earth's Moon (Horanyi et al, Nature, 2015). Because these grains are samples from the moon's icy surface, unique information can be obtained about the surface composition, constraining geological activity on and below the surface. The instrument addresses main scientific questions of NASA's Europa Flyby Mission (former provisional name Europa Clipper Mission), in particular about surface composition, habitability, and exchange processes with the deeper interior of Europa. SUDA is a time-of-flight, reflectron-type impact mass spectrometer (<5.6 kg, sensitive area 220 cm2) with mass resolution m/dm of 150-250 in the mass range of interest m=1-300. The ejecta particles recorded by SUDA move on ballistic trajectories. From the location of the detection, the measurement by SUDA of dust velocity components in the moment of detection, and the statistics of particle motion, one can constrain their location of origin on the surface. Thus, from their composition one can conclude, with given probability, on the composition of a certain part of the surface. In this way, recording a large sample of dust grains with an orbiter, it will be possible to resolve compositional variations on the surface and relate them to topological features (Postberg et al, PSS, 2011).**

Olli Wilkman

We present some recent developements in Solar System photometry at the Planetary System Research group at the University of Helsinki. The first concerns a model for the photometry of a particulate surface such as the regoliths of atmosphereless Solar System bodies. Another is the use of an analytical solution for the disk-integrated brightness of an ellipsoid with the Lommel-Seeliger scattering law to produce asteroid spin and shape models for sparsely observed asteroids.

Sissi Enestam

In a small space country, there is a great need to promote space and find ways to bring space enthusiasts together. As the national point of contact for Finland for the Space Generation Advisory Council, and from personal interest, I have organized several space events in the Helsinki area and will discuss the past events with the hope to evoke conversation and suggestions for future events. I will also share some information about international events and space communities.

Session 7: Stars and Stellar Evolution

Mika Saajasto

The Herschel open time key programme Galactic Cold Cores carried out dust continuum emission observations of 116 fields that were selected based on the Planck C3PO catalogue. The fields were mapped with Herschel PACS and SPIRE instruments at wavelengths of 100 - 500 micro meters.

Our current research is concentrated on one of the Herschel fields, G82.62-2.00. The main filament in the field is heavily fragmented and harbours a host of cold clumps, with some faint striations of cold dust seen at the outskirts the filament. However, the field shows a strong gradient between the cold and warm dust components, with the cold dust concentrated in filament and the warm dust seen as a 'background'.

In order to study the kinematics of the field in detail, and to study the state of the cold clumps, we have carried out line emission observations with the 45 meter telescope at the Nobeyama Radio Observatory. The observations covered several different lines, including CO isotopologues.

In this talk I will summarise our observations and present the correlations between the dust and gas components. Secondly I will present the results of spectral study of selected cold clumps.

Anna Parikka

Origin and excitation mechanisms of the warm CO, OH and CH+ in PDRs

Photon Dominated Regions (PDRs), where physics and chemistry are driven by FUV photons, show an extremely rich and warm photochemistry that is closely related to that of protoplanetary disks and starburst galaxies. The rotationally excited lines of CO, OH and CH+ probe the warmest PDR gas layers, providing strong constraints for understanding the physics and chemistry in strongly FUV-irradiated interstellar clouds. The far-IR OH and high-J CO emission lines have been associated with the presence of unresolved dense structures and high pressure gas [e.g., 1, 2, 3] whereas the CH+ excitation is dominated by chemical pumping after reaction of C+ with vibrationally excited H2 [4, 5].

For the first time we present fully sampled PACS maps (110” x 110”) of the CO J=19-18, OH 84 and 119 μm and CH+ J=3-2 lines in the Orion Bar. The spatial distribution of these lines confirms the clumpy structure of the Bar and constrains the origin of high-J CO, CH+ and OH to the dense clumps. Photoelectric effect on small particles is the dominant heating source of the observed high excited molecular gas and the effect of cosmic rays is excluded. It is clear that the vibrationally excited H2 is the key in the formation and excitation of CH+. To a lesser extent, excited H2 is also relevant for OH formation. Interestingly, the peak OH emission corresponds with a bright young object identified as a proplyd, which confirms that this line is tracing dense irradiated structures. Using the spectral and spatial distribution of several CO lines and its isotopes, we present temperature and column density maps as a result of RADEX modeling and we compare the observations with the PDR Meudon code at several positions across the Bar to constrain the pressure in the PDR interface. The origin and evolution of dense structures affected by the intense far-UV radiation will be discussed.

References

[1] Burton et al., ApJ, 365, 620 (1990)
[2] Goicoechea et al., A&A, 530, L16 (2011)
[3] Joblin et al., in prep.
[4] Nagy et al., A&A, 550, A96 (2013)
[5] Godard & Cernicharo, A&A 550, A8 (2013)

Teppo Heikkilä

Progenitor constraints for core-collapse supernovae from Chandra X-ray observations
(Teppo Heikkilä, Sergey Tsygankov, Seppo Mattila, J.J. Eldridge, Morgan Fraser, Juri Poutanen)

The progenitors of hydrogen-poor core-collapse supernovae (SNe) of types Ib, Ic and IIb are believed to have shed their outer hydrogen envelopes either by extremely strong stellar winds, characteristic of classical Wolf-Rayet stars, or by binary interaction with a close companion star. The exact nature of the progenitors and the relative importance of these processes are still open questions. One relatively unexplored method to constrain the progenitors is to search for high-mass X-ray binaries (HMXB) at SN locations in pre-explosion X-ray observations. In a HMXB, one star has already exploded as a core-collapse SN, producing a neutron star or a stellar-mass black hole. It is likely that the second star in the system will also explode as a supernova, which should cause a detectable long-term change in the system's X-ray luminosity. In particular, a pre-explosion detection of a HMXB coincident with a SN could be informative about the progenitor's nature. We analyzed the pre-explosion ACIS observations of 18 nearby type Ib, Ic and IIb supernovae from the Chandra X-ray observatory public archive. Two sources that could potentially be associated with the supernova were identified in the sample. Additionally we made similar post-explosion measurements for 46 SNe. Although our modelling indicates that progenitor systems with compact binary companions are probably quite rare, studies of this type can in the future provide more stringent constraints as the number of discovered nearby SNe and suitable pre-explosion X-ray data are both increasing.

Jussi Harmanen

Interacting supernovae: probes of the late stages of stellar evolution

Supernovae (SNe) are some of the most energetic explosions in the Universe. Nowadays, thousands of SNe are discovered every year thanks to the dedicated wide field search programs for optical transients. A substantial fraction of these transients are classified based on their optical spectra and light curve evolution ranging from ultraviolet to infrared.

Type IIn SNe are one of the rarest subclasses of SNe. Only a few percent of all SNe are classified to this subclass. They are characterised by narrow (hence IIn) Balmer emission lines and often a strongly blue continuum in the early evolution. The spectral features observed are caused by the SN ejecta interacting with dense circumstellar material (CSM). The CSM is thought to originate either from strong stellar winds or strong episodic mass loss preceding the terminal explosion by several months or years. During such outbursts the star can significantly brighten and occasionally subsequent ejections of stellar material may also collide and display a low-energetic transient spectroscopically similar to type IIn SNe. Such transients are known as SN impostors since the progenitor star survives.

I present recent studies of type IIn SNe and SN impostors conducted at Tuorla observatory as a part of international collaboration.

Posters

Joni Tammi

Metsähovi Compact Array – Astronomical radio interferometer for research and education
(Joni Tammi & Juha Kallunki)

Metsähovi Radio Observatory obtained as a donation four 5.5-metre parabolic dish antennas, decommissioned from their use in commercial satellite communication. The antennas are being turned into astronomical radio telescopes capable of single-dish radio astronomy and satellite communication. The main goal, however, is to connect all four telescopes to work together as the only stand-alone radio interferometer in the Nordic countries. This poster outlines the project and invites students and teachers from various fields ranging from astronomy to engineering to get involved.

Participants

Aghanim, Nabila	**(*IAS, Paris*)**
Altobelli, Nicolas	**(*ESA*)**
Comerón, Sébastien	**(*University of Oulu*)**
Enestam, Sissi	**(*Aalto University*)**
Finoguenov, Alexis	**(*University of Helsinki)***
Harmanen, Jussi	**(*Tuorla Observatory)***
Heikkilä, Teppo	**(*Tuorla Observatory*)**
Heinämäki, Pekka	**(*Tuorla Observatory*)**
Hovatta, Talvikki	**(*Metsähovi Radio Observatory*)**
Järvelä, Emilia	**(*Metsähovi Radio Observatory)***
Johansson, Peter	**(*University of Helsinki*)**
Karhunen, Kalle	**(*University of Turku*)**
Kiehlmann, Sebastian	**(*Metsähovi Radio Observatory*)**
Koljonen, Karri	**(*New York University Abu Dhabi*)**
Kotilainen, Jari	**(*FINCA, University of Turku*)**
Lahén, Natalia	**(*University of Helsinki*)**
Lähteenmäki, Anne	**(*Metsähovi Radio Observatory*)**
Läsker, Ronald	**(*FINCA, University of Turku*)**
Nieppola, Elina	**(*Tähdet ja avaruus*)**
Nilsson, Kari	**(*FINCA, University of Turku*)**
Nummila, Sakari	**(*Tähdet ja avaruus*)**
Nurmi, Pasi	**(*Tuorla Observatory, FINCA*)**
Olguin, Alejandro	**(*FINCA*)**
Parikka, Anna	**(*University of Cologne*)**
Pekkola, Marko	**(*Tähdet ja avaruus*)**
Pihajoki, Pauli	**(*University of Helsinki*)**
Poudel, Anup	**(*Tuorla Observatory*)**
Poutanen, Juri	**(*University of Turku*)**
Rantala, Antti	**(*University of Helsinki*)**
Rautiainen, Pertti	**(*University of Oulu*)**
Roos, Matts	**(*University of Helsinki*)**
Saajasto, Mika	**(*University of Helsinki*)**
Sawala, Till	**(*University of Helsinki*)**
Schmidt, Juergen	**(*University of Oulu*)**
Somero, Auni	**(*Tuorla Observatory*)**
Tammi, Joni	**(*Metsähovi Radio Observatory*)**
Tsygankov, Sergey	**(*Tuorla Observatory*)**
Veledina, Alexandra	**(*Nordita*)**
Vera Rodriguez, Rafael	**(*Metsähovi Radio Observatory*)**
Vestergaard, Marianne	**(*DARK, University of Copenhagen*)**
Wilkman, Olli	**(*University of Helsinki*)**