The Power of Faraday Tomography
~towards 3D Mapping of Cosmic Magnetic Fields~

May 28 (Mon.) - June 2 (Sat.), 2018
Cottage Himuka, Miyazaki, Japan
http://ska-jp.org/ws/SKAJP_MAGWS2018/index.html

Topics

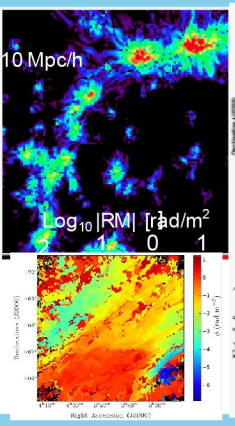
Session 1: Faraday Tomography
Session 2: Cosmology, Large-scale Structure and Galaxy Clusters
Session 3: Galaxies and AGN
Session 4: High Energy Magnetism Messengers from Space
Session 5: Magnetic Fields in The Milky Way
Session 6: Amazing Magnetism Projects
Session 7: Tutorial of AIPS and Tomography
Special Session: POSSUM users meeting

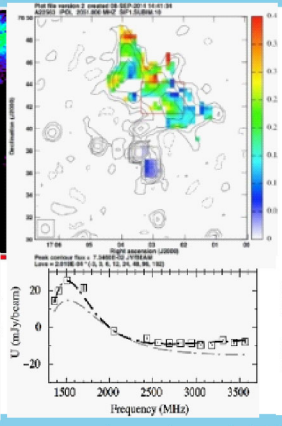
Invited Speakers

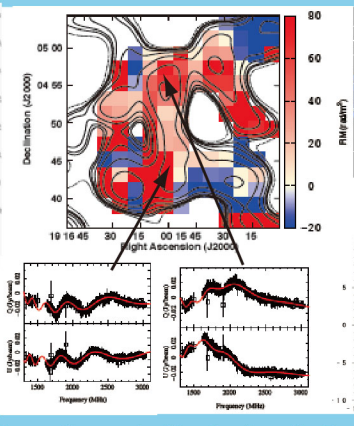
Ideguchi Shinsuke (NAOJ)
Ryu Dongsu (UNIST)
Vacca Valentina (INAF)
O'Sullivan Shane (Hamburg)
Ravi Vikram (Caltech)
Van Eck Cameron (Radboud Univ.)
Vernstrom Tessa (Univ. of Toronto)
Heald George (CSIRO)
Gaensler Bryan (Univ. of Toronto)

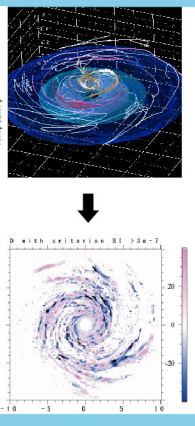
Tutorial

Ideguchi Shinsuke (NAOJ)
Heald George (CSIRO)
Farnes Jamie (Oxford Univ.)
Nakanishi Hiroyuki (Kagoshima Univ.)
Takahashi Keitaro (Kumamoto Univ.)
Haverkorn Marijke (Radboud Univ.)





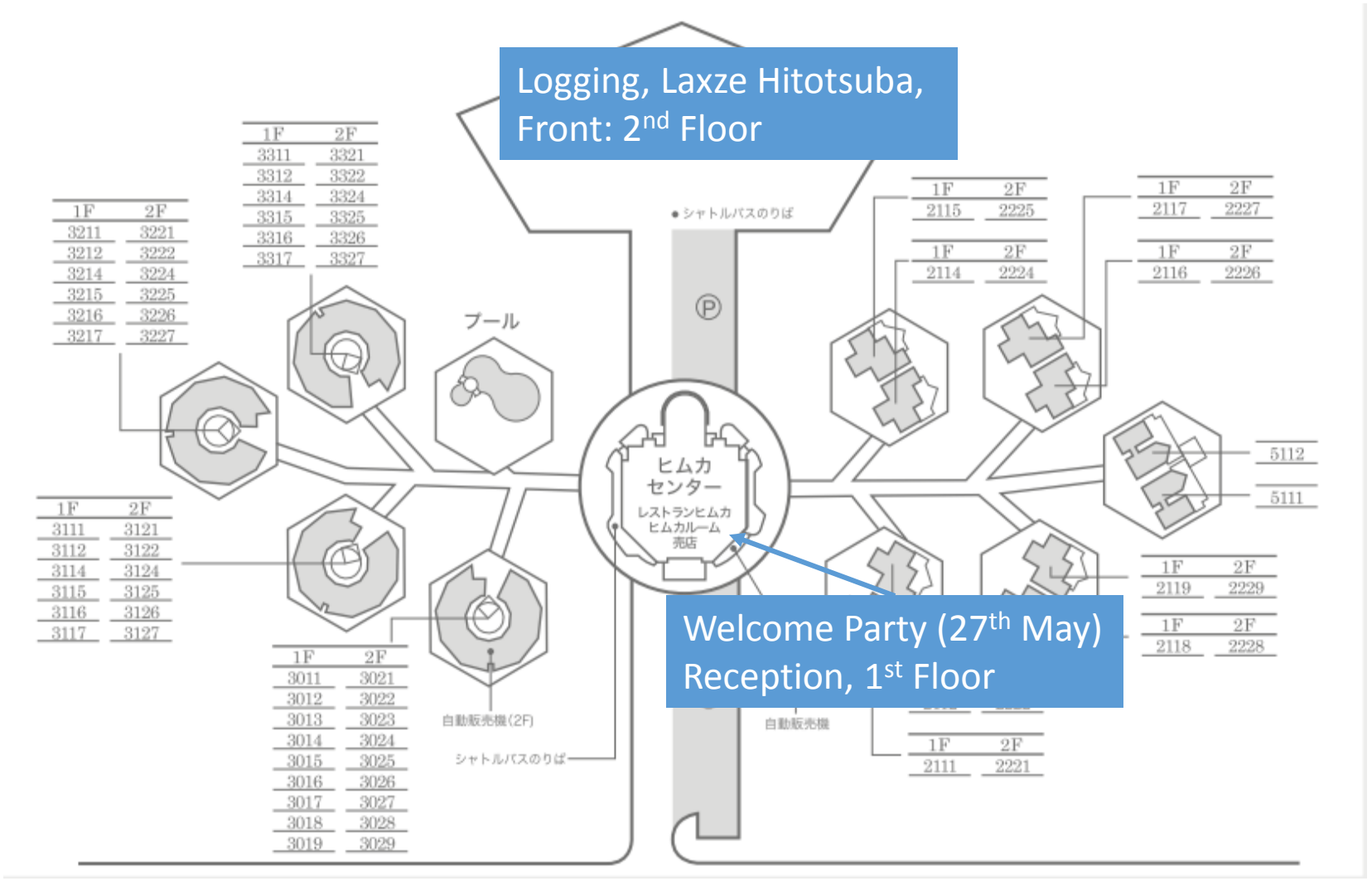




SOC

Akahori Takuya (NAOJ)
Akamatsu Hiroki (SRON)
Ideguchi Shinsuke (Kumamoto Univ.)
Farnes Jamie (Oxford Univ.)
Haverkorn Marijke (Radboud Univ.)**
Machida Mami (Kyushu Univ.)*
Nakanishi Hiroyuki (Kagoshima Univ.)
Takahashi Keitaro (Kumamoto Univ.)
Takizawa Motokazu (Yamagata Univ.)
*Chair, ** Co-Chair

Supported by Miyazaki Convention & Visitors Bureau
This event has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730562 [RadioNet]
This work is achived using the grant of Research Assenbly supported by NAOJ


Logging, Laxze Hitotsuba, Front: 2nd Floor
Welcome Party (27th May) Reception, 1st Floor
プール
ヒムカ センター
レストランヒムカ
ヒムカルーム
売店
シャトルバスのりば
自動販売機(2F)
自動販売機
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2111 2221

FLOOR GUIDE MAP

1F

2F

- Himuka Room
- Restaurant Himuka

※宿泊受付はラグゼ一ッ葉、2階カウンターまでお来しください。

For Cottage Himuka and Luxze Hitotsuba Stay Guests:
Please note that the Check-in Counter is on the 2nd floor of Luxze Hitotsuba.

THE POWER OF FARADAY TOMOGRAPHY
~TOWARDS 3D MAPPING OF COSMIC MAGNETIC FIELDS~

May 28 (Mon) - June 2 (Sat), 2018, Cottage Himuka, Miyazaki, Japan
http://ska-jp.org/ws/SKAJP_MAGWS2018/

#SKA_JAPAN_MAG2018 PROGRAM

Talks

Invited talks are 30 min + 10 min for questions. Contributed talks are 15 min + 5 min. Please check the connection to the projector before your talk.

Posters

Posters should be a maximum of A0 size format, in portrait orientation. There is an opportunity to advertise your poster within 1 minute. Please check the connection to the projector before your talk.

Twitter

If you post on Twitter about the conference, please use the hashtag #SKA_JAPAN_MAG2018

Time Table

Time	28 Mon	29 Tue	30 Wed	31 Thu	1 Fri	2 Sat
09:00-09:20	Opening	V. Vacca	T. Kawashima	B. Gaensler	POSSUM	AIPS CASA Tutorial
09:20-09:40	S. Ideguchi		H. Takahashi			
09:40-10:00		H. Akamatsu	Discussion 4	T. Vernstrom		
10:00-10:20	C. Purcell	M. Takizawa	C. Van Eck			
10:20-10:40	W. Raja	M Hoeft		Coffee/Tea (40 min)		
10:40-11:00	Coffee/Tea (40 min)	Coffee/Tea (40 min)	Coffee/Tea (40 min)			
11:00-11:20				G. Heald		
11:20-11:40	Y. Miyashita	V. Ravi	A. Hills			
11:40-12:00	P. Arras		T. Zenko	J. Farnes		
12:00-12:20	T. Akahori	J. Bray	J. West	Summary & Discussion		
12:20-12:40	Discussion 1	Discussion 2+3	M. Alves			
12:40-13:40	Lunch (60 min)					
13:40-14:00	D. Ryu	S. O'Sullivan	J. Green	POSSUM	Tomography Tutorial	
14:00-14:20			O. Kameya			
14:20-14:40	M. Langer	C. Anderson	A. Thomson			
14:40-15:00	T. Minoda	Y. K. Ma	J.-B. Durrive			
15:00-15:20	Poster	A. Pasetto	Coffee/Tea (40 min)			
15:20-15:40	Coffee/Tea (40 min)	Coffee/Tea (40 min)				
15:40-16:00			S. Katsuda			
16:00-16:20	J. Schober	Y. Kudo	J. Shimoda			
16:20-16:40	K. Kunze	M. Machida	H. Sakemi			
16:40-17:00	J. Donnert	M. Krause	T. Omura			
17:00-17:20	S. Roh	H. Nakanishi	M. Nomura			
17:20-17:40	F. Loi	S. S. Sridhar	Discussion 5			
17:40-18:00	D. Sokoroff	M. Kierdorf				
18:30~	Dinner	Banquet	Dinner	Dinner	Dinner	

Session ID: 1=Tomography 2=LSS/GC 3=Messenger 4=Galaxies/AGN 5=Milky Way 6=Project

Monday 28th May			
Start	**End**	**Talk Title**	**Speaker**
09:00	09:20	Opening Remarks	SOC & LOC
Session 1: Faraday Tomography 1 (Chair: Keitaro Takahashi)			
09:20	10:00	The Power of Faraday Tomography: Basics and Applications to Cosmic Magnetism study	Shinsuke Ideguchi
10:00	10:20	Modelling Faraday Active Spectra for POSSUM Early Science	Cormac Purcell
10:20	10:40	new Generation Radio Telescopes: Challenges in Instrumental Calibration	Wasim Raja
10:40	11:20	Coffee/Tea	
11:20	11:40	Performance test of QU-fit in cosmic magnetism study	Yoshimitsu Miyashita
11:40	12:00	RESOLVE -- Latest Developments	Philipp Arras
12:00	12:20	Optimum Frequency for Studying the IGMF with Faraday Tomography	Takuya Akahori
12:20	12:40	Discussion on Session 1	
12:40	13:40	Lunch	
Session 2: Cosmology, Large-scale Structure, and Galaxy clusters (Chair: Motokazu Takizawa)			
13:40	14:20	Cosmic Magnetic Fields: A Theorist View of the Nature and Origin	Dongsu Ryu
14:20	14:40	Magnetizing the Cosmic Web during Reionization	Mathieu Langer
14:40	15:00	thermal Sunyaev-Zel'dovich effect in the IGM due to the primordial magnetic fields	Teppei Minoda
15:00	15:20	Poster Presentations	Marijke Haverkorn Chikaedo Ogbodo Keinji Nakamura Kohei Kurahara Cathy Horellou
15:20	16:00	Coffee/Tea	
16:00	16:20	EPFL Chiral dynamos and the origin of cosmic magnetic fields	Jennifer Schober
16:20	16:40	Tracing primordial magnetic fields with 21 cm line observations	Kerstin Kunze
16:40	17:00	Towards Exascale simulations of the ICM dynamo with Wombat	Julius Donnert
17:00	17:20	Magnetic fields in clusters of galaxies: a simulation study	Soonyoung Roh
17:20	17:40	Simulations of the polarized sky of the SKA: how to constrain intracluster magnetic fields	Francesca Loi
17:40	18:00	Wavelet RM synthesis versus fitting parametric models for reconstruction magnetic field structure	Dmitry Sokoloff
18:30	---	Dinner	

Memo

Tuesday 29th May			
Start	**End**	**Talk Title**	**Speaker**
Session 2: Continue (Chair: Hiroyuki Nakanishi)			
09:00	09:40	Magnetic fields in Galaxy Clusters and in the Large-Scale Structure of the Universe	Valentina Vacca
09:40	10:00	Synergy between X-ray and low-frequency radio telescopes on particle accelerations in galaxy clusters	Hiroki Akamatsu
10:00	10:20	X-ray and radio observations of the radio relic galaxy clusters 1RXS J0603.3+4214 and RXC J1053.7+5453	Motokazu Takizawa
10:20	10:40	The Toothbrush Radio Relic: Filaments and Polarization	Matthias Hoeft
10:40	11:20	Coffee/Tea	
Session 3: High Energy Magnetism Messengers from Space (Chair: Hiroki Akamatsu)			
11:40	12:00	Fast Radio Burst tomography of the circum- and inter-galactic medium	Vikram Ravi
12:00	12:20	Limits on cosmic magnetic fields from cosmic-ray results	Justin Bray
12:20	12:40	Discussion on Sessions 2 and 3	
12:40	13:40	Lunch	
Session 4: Galaxies and AGN (Chair: Jamie Farnes)			
13:40	14:20	Untangling cosmic magnetic fields: Applications of broadband radio spectro-polarimetry	Shane O'Sullivan
14:20	14:40	The structure of magnetized thermal plasma in the lobes of Fornax A an Centaurus A	Craig Anderson
14:40	15:00	Broadband Investigation of NVSS High Rotation Measure Extragalactic Radio Sources	Yik Ki Ma
15:00	15:20	Broad-band spectropolarimetric observation of high-RM AGN	Alice Pasetto
15:20	16:00	Coffee/Tea	
16:00	16:20	3D Magnetohydrodynamic Simulations of AGN Torus	Yuki Kudo
16:20	16:40	Faraday depolarization effects of the spiral galaxies	Mami Machida
16:40	17:00	Magnetic fields in the halo of spiral galaxies seen edge-on – as deduced from CHANG-ES	Marita Krause
17:00	17:20	Magnetic field vector maps of nearby spiral galaxies	Hiroyuki Nakanishi
17:20	17:40	Revealing the nature of anomalous arms in NGC4258 using Faraday Tomography	Sarrvesh Seethapuram Sridhar
17:40	18:00	Probing the Magnetized Disk-Halo Interaction in M51 via Wideband Polarimetry	Maja Kierdorf
18:30	---	Dinner	

Memo

Wednesday 30th May			
Start	**End**	**Talk Title**	**Speaker**
Session 4: Continue (Chair: Mami Machida)			
09:00	09:20	On a spin signature in black hole shadow of M87	Tomohisa Kawashima
09:20	09:40	Numerical Study of Supercritical Accretion onto Black Holes and Neutron Stars	Hiroyuki Takahashi
09:40	10:00	Discussion on Session 4	
Session 5: Magnetic Fields in the Milky Way (Chair: Mami Machida)			
10:00	10:40	The Power of Low-Frequencies: Faraday Tomography with LOFAR	Cameron Van Eck
10:40	11:20	Coffee/Tea	
11:20	11:40	Faraday tomography of the Milky Way ISM with GMIMS	Alex Hills
11:40	12:00	Magnetic field of Milky Way by near-infrared polarimetry of Cepheids	Tetsuya Zenko
12:00	12:20	Searching for helical magnetic fields in the Milky Way	Jennifer West
12:20	12:40	The Local Bubble: a magnetic veil to our Galaxy	Marta Alves
12:40	13:40	Lunch	
Session 5: Magnetic Fields in the Milky Way (Chair: Marijke Haverkorn)			
13:40	14:00	The Power of Zeeman: Mapping Magnetic fields in our Galaxy through masers	Jimi Green
14:00	14:20	Structure of electron density and magnetic field in the Milky Way Galaxy	Osamu Kameya
14:20	14:40	Uniform fields in Hii Regions revealed by GMIMS	Alec Thomson
14:40	15:00	Analytic growth rate of gravitational instability in self-gravitating planar polytropes	Jean-Baptiste Durrive
15:00	15:20	Coffee/Tea	
15:20	16:00	H-alpha Polarization Measurements of Tycho's Eastern Limb with the Subaru FOCAS	Satoru Katsuda
16:00	16:20	On Measuring the Turbulent Magnetic Energy Spectrum in Supernova remnant by Correlation Analysis of Radio Synchrotron Intensity	Jiro Shimoda
16:20	16:40	Propagation and Structure of Astrophysical Jets by Two-temperature Magnetohydrodynamics	Takumi Omura
16:40	17:00	Faraday Tomography of the SS544 Jet Terminal Region	Haruka Sakemi
17:00	17:20	Magnetohydrodynamic Simulations of a Plunging Black Hole into a Molecular Cloud	Mariko Nomura
17:20	17:40	Discussion on Session 5	
17:40	18:00	Free time	
18:30	---	Dinner	

Memo

Thursday 31th May			
Start	**End**	**Talk Title**	**Speaker**
Session 6: Amazing Magnetism Projects (Chair: Takuya Akahori)			
09:00	09:40	POSSUM: First Results from Wide Field Polarization Surveys	Bryan Gaensler
09:40	10:20	MWA	Tessa Vernstrom
10:20	11:00	Coffee/Tea	
11:00	11:40	LOFAR MSSS	George Heald
11:40	12:00	The Square Kilometre Array (SKA) Science Data Processor Integration Prototype	Jamie Farnes
12:00	12:40	Summary and Discussion	
12:40	14:00	Lunch	
POSSUM Meeting			
14:00	18:00	POSSUM	
18:30	---	Dinner	

Friday 1st May			
Start	**End**	**Talk Title**	**Speaker**
POSSUM Meeting			
09:00	12:40	POSSUM	
12:40	14:00	Lunch	
Tutorial of Faraday Tomography			
14:00	18:00	Tutorial	
18:30	---	Dinner	

Saturday 2st May			
Start	**End**	**Talk Title**	**Speaker**
Tutorial of AIPS/CASA			
09:00	12:40	Tutorial	
12:40		Conference Close	

CODE OF CONDUCT

Our conference aims to provide a wide range of opportunities for our scientific presentation, productive discussion, and enjoyable conversation among all of the participants. We should behave professionally and be kind to others. To insult or to put down other attendees is strictly prohibited. All communication should be appropriate for both young and senior audiences including people of many different backgrounds.

We do not allow harassment of participants in any form. Harassment includes sustained disruption of talks or other events, inappropriate physical contact, sexual attention and innuendo, deliberate intimidation, stalking, photography or recording of an individual without consent, and and offensive comments, especially related to gender, sexual orientation, disability, physical appearance, body size, race or religion.

The participants who are asked to stop any inappropriate behavior must comply immediately. The organizers can ask the attendees, who are violating this code of conduct, to leave the conference without a refund of any charge.

Any participant who wishes to report a violation of this code of conduct is asked to speak or mail, in confidence, to the conference organizers .

行動規範

私達の会議は参加者すべての間での科学的な発表、創造的な議論、そして楽しい対話のための様々な機会を提供することを目的としています。私たちはプロフェッショナルに振る舞うべきであり、他人に対して親切であるべきです。他の参加者を侮辱することや貶めることは厳禁です。すべての意思疎通は様々な異なる背景をもつ若手と年長者両方の観衆いずれにも適切であるべきです。

私達は参加者のハラスメント行為を一切許しません。ハラスメント行為には、講演やイベントを繰り返し中断させること、不適切な身体接触、性的な注目や風刺、意図的な威力行為、つきまとい、許可なく個人の写真撮影や録音をする行為、そして性的位置付け、障碍の有無、外見、身体の大きさ、人種、宗教に関する攻撃的なコメントを含みます。

参加者は、これらのハラスメント行為を止めるように求められた場合すぐに従わなければなりません。 会議世話人は行動規範を侵害した参加者に参加費を返還することなく会議からの退席を求めることができます。

行動規範の侵害を報告したい参加者は、内緒で、会議世話人に話すあるいはメールをしていただくようお願いします。

The Power of Faraday Tomography: Basics and Applications to Cosmic Magnetism Study

Author: Ideguchi Shinsuke (Kumamoto University)

Abstract:

The synchrotron radiations from various astronomical objects and their Faraday rotation allow us to obtain the information about magnetic fields of the objects and of the media between them and us. The low-frequency, wide-band polarization observations made with the next-generation telescopes represented by Square Kilometer Array (SKA) and its precursor/pathfinder such as Australian SKA pathfinder (ASKAP), Low Frequency Array (LOFAR) and Murchison Widefield Array (MWA) make it possible to use Faraday rotation to create a tomographic reconstruction of magnetized structures along the line of sight, a technique known as Faraday tomography. In this talk, I will introduce the basics of the technique and overview the previous studies. I will also carry a message that the interpretation of the results of the technique (Faraday dispersion function or Faraday spectrum) is also important to maximize the potential of the technique.

Cosmic Magnetic Fields: A Theorist View of the Nature and Origin

Author: Dongsu Ryu (UNIST)

Abstract:

Magnetic fields appear to be ubiquitous in astrophysical environments. The existence of magnetic fields in the large-scale structure of the universe, especially in clusters of galaxies, has been established through various observations, such as Faraday rotation and synchrotron observations. Yet, the nature and origin of the cosmic magnetic fields remains controversial and largely unknown. In this talk, I briefly summarize recent progresses in theoretical studies. I describe a plausible scenario for the origin of cosmic magnetic fields; seed fields were created in the early universe and subsequently amplified during the formation of the large-scale structure of the universe. I then discuss the prospect of studies of cosmic magnetic fields with upcoming facilities including the SKA.

Magnetic fields in Galaxy Clusters and in the Large-Scale Structure of the Universe

Author: Valentina Vacca (INAF - Osservatorio Astronomico Cagliari)

Abstract:

Magnetic fields in galaxy clusters are poorly known and, to date, no firm observational evidence is available of their presence beyond galaxy clusters periphery, along the filaments and voids of the cosmic web. A detailed knowledge of the properties of magnetic fields in these environments is crucial to shed light on the history (origin and evolution) of cosmological magnetic fields and their relation with the dynamical state and the thermal properties of the system. Radio observations in total intensity and polarization of diffuse synchrotron sources and of the Faraday effect on background radio galaxies are a powerful tool to investigate magnetic field strength and structure. During this talk, I will give an overview of the current knowledge in this area and I will describe the advanced techniques developed in the last years to study magnetic fields in galaxy clusters and in the large-scale structure of the Universe in the SKA era.

Fast Radio Burst tomography of the circum- and inter-galactic medium

Author: Vikram Ravi (Caltech)

Abstract:

The discovery of the extragalactic Fast Radio Burst (FRB) phenomenon has opened a promising new discovery space in our understanding of the diffuse plasma of the Universe. Much like radio-pulsar observations have done for the Milky Way, FRBs can be used to measure the free-electron column densities, density fluctuations, and aligned magnetic-field strengths along cosmological sightlines. As part of the motivation for such studies, I will review the crucial roles that structured magnetic fields may play in determining the physical conditions in circum-galactic halos, and in the intergalactic medium. I will then describe how FRB analyses are constraining the presence of, and will eventually reveal, these magnetic fields.

Untangling cosmic magnetic fields: Applications of broadband radio spectro-polarimetry

Author: Shane O'Sullivan (Hamburg Observatory)

Abstract:

A new window into the magnetic universe has been opened by radio-telescope facilities that allow broadband, continuum-polarisation observations at high spectral resolution. The bright radio sky accessible to current facilities is dominated by active galactic nuclei (AGN) that produce powerful jets of relativistic plasma emitting non-thermal synchrotron radiation. Accurately characterising the Faraday rotation properties of these radio AGN is important for studying the magnetised structures intrinsic to the AGN and also for using them as reliable statistical probes of foreground magnetic fields (e.g. the intergalactic medium, intervening galaxies and the Galactic ISM). In this talk I will present recent results from millimetre, centimetre and metre wavelength spectro-polarimetric observations that highlight the different magnetoionic regions that are probed, and the challenges related to the interpretations of these results.

The Power of Low-Frequencies: Faraday Tomography with LOFAR

Author: Cameron Van Eck (University of Calgary/University of Toronto)

Abstract:

Faraday tomography in the low-frequency (100 MHz) regime has some distinct differences from the higher (GHz+) regime. Specifically, with low-frequency data we have fantastic power to resolve Faraday depth structure (resolution of a few rad/m/m) at the cost of filtering out broad structures in Faraday depth (broader than a few rad/m/m). These properties open up exciting new opportunities to study the small-scale structure of magnetic fields within our Galaxy. In my talk, I will discuss some of the consequences of these properties, show some examples of polarized features we can observe using Faraday tomography with LOFAR data, and demonstrate how we can combine these to produce a physical interpretation of these features.

First Results from Wide Field Polarisation Surveys

Author: Bryan Gaensler (University of Toronto)

Abstract:

Over the last decade, we have extracted substantial amount of information on Faraday rotation and magnetic fields from the NVSS, CGPS, SGPS and other surveys. However, these data sets have had limited sensitivity, sky coverage and/or bandwidth. To move past these limitations, the community has been working toward a suite of new wide-field polarisation surveys, based around high sensitivity, high angular resolution and broad bandwidths. These surveys, which aim to provide more than a million polarisation measurements over the sky, are now finally getting underway. In this presentation, I will present early polarisation results from POSSUM, VLASS and other wide-field surveys, which showcase the transformational potential of these new programs.

The LOFAR MSSS Survey

Author: George Heald (CSIRO Astronomy and Space Science)

Abstract:

The Multifrequency Snapshot Sky Survey (MSSS) is LOFAR's first all-sky imaging survey. The MSSS effort has been responsible for establishing fundamental common practices for LOFAR imaging work, and training a new generation of low-frequency radio astronomers, but it has also presented a number of challenges and taught us many lessons. In this talk I will provide an overview of the primary MSSS goals, and give an update for the planned 45" total intensity data release. I will also introduce a complementary effort (MAPS: MSSS All-sky Polarization Survey) to generate full polarization data products to support a range of science aims in the magnetism domain. I will conclude with an update on a similar effort in the southern sky: the POGS (Polarization with the GLEAM Survey) project, which is to the MWA GLEAM survey as MAPS is to MSSS. POGS and MAPS together will provide a unique view of the entire low-frequency polarized sky.

The Murchison Widefield Array: Overview and Recent Results

Author: Tessa Vernstrom (University of Toronto)

Abstract:

The Murchison Widefield Array (MWA), precursor to the SKA Low, with its low frequency observing bands, large fractional bandwidth, and very large field of view has already begun putting out exciting new science covering transients, EoR, and Galactic and Extragalactic fields. This talk will give an overview of what the MWA is and what it can do (both previously and now with the Phase II upgrade). This will also include a description of the GLEAM and GLEAM-X surveys and highlights of recent results, as well as discussion of polarimetry with the MWA.

Modelling Faraday Active Spectra for POSSUM Early Science

Author: Cormac Purcell (Macquarie University)

Abstract:

Early science observations on the Australian Square Kilometre Array Pathfinder (ASKAP) have begun and are starting to deliver high-quality polarisation data. Characterising Faraday complexity in the wide-band ASKAP Early Science data is essential for later creating a grid of rotation measures using narrow-band POSSUM data. Here we present a new QU-fitting code that uses nested sampling to perform robust Bayesian model comparison. We test this code on simulated ASKAP data and recent broad-band ATCA data, mapping parameter space where we can confidently distinguish between proposed models in the presence of realistic noise. The code is offered as a resource to the community as part of the prototype POSSUM Early Science Pipeline.

new Generation Radio Telescopes: Challenges in Instrumental Calibration

Author: Wasim Raja (CSIRO)

Abstract:

In this talk we present a brief overview of various kinds of instrumental non-idealities and how these are addressed in current calibration schemes. We highlight the specific challenges posed by new-generation radio telescopes like the ASKAP. Results from a few novel techniques addressing some of these challenges are presented.

Performance test of QU-fit in cosmic magnetism study

Author: Yoshimitsu Miyashita (Kumamoto University)

Abstract:

Rotation measure (RM) synthesis is an important tool to study galactic and extragalactic magnetic fields. This technique introduces the Faraday dispersion function (Faraday spectrum), the distribution of polarized sources along a line of sight (LOS), from a Fourier transformation of the polarized emission (Brentjens and de Bruyn 2005). Faraday spectrum is expected to provide us the three-dimensional information of magnetic field as well as that of thermal and cosmic-ray electron density. However this method has an ill-posed conditioned deconvolution problem because the polarimetric measurements are restricted to limited wavelength. In this presentation, I will introduce QU-fitt, which is a standard model-fitting method, for the recovery technique of the Faraday spectrum and show the performance of QU-fit by simulating observations of two polarized sources located along the same LOS, varying the widths of the sources and the gap between them in RM space, systematically.

RESOLVE – Latest Developments

Author: Philipp Arras (Max-Planck Institute for Astrophysics)
Abstract:

RESOLVE is a Bayesian imaging algorithm based on information field theory. Solely by algorithmic advances the inference could be sped up significantly and behaves noticably more stable now. This is one more step towards a fully user-friendly version of RESOLVE which van be applied routinely by astronomers.

In this talk the new incarnation of RESOLVE which is based on a global Newton scheme will be presented. Additionally, first results on unifying calibration and imaging in one single Bayesian inference step will be discussed. Finally, it will be described how RESOLVE will incorporate imaging of spectral cubes and polarisation data which ultimately will be used to do Bayesian Faraday tomography.

Optimum Frequency for Studying the IGMF with Faraday Tomography

Author: Takuya Akahori (NAOJ)
Abstract:

It has been suggested that Faraday tomography is one of the promising tools to explore the intergalactic magnetic field (IGMF) in filaments of galaxies. In order to improve the quality of the detection, ultra-wide bandwidth of radio polarimetric data is essential. But it is often difficult to obtain because of instrumental specification and radio interference. In this paper, we investigate which coverage in frequency is effective to study Faraday rotation measure (RM) due to the IGMF by means of Faraday tomography. We make a simple model for Faraday tomography and perform Fisher analysis to derive error ranges of the model parameters. Overall, polarimetric data in ultra high frequency (UHF) is essential for exploring the IGMF RM predicted theoretically. Seamless broadband data in UHF is not necessarily required, and meaningful constraints for the parameters could be achievable with multi-band data in UHF. We demonstrate that, with data at 1.4 GHz and 1.6 GHz as core frequencies, optimum multi-band frequency and bandwidth depends on the magnitude of the IGMF RM, and is typically 600 MHz with a 20 MHz bandwidth.

Magnetizing the Cosmic Web during Reionization

Author: Mathieu Langer (Institut d'Astrophysique Spatiale, Universite Paris-Sud)
Abstract:

An increasing amount of evidence suggests that cosmological sheets, filaments and voids may be substantially magnetised. The origin of magnetic fields in the the Intergalactic Medium is currently uncertain. It seems now well known that non-standard extensions to the physics of the Standard Model are capable of providing mechanisms susceptible of magnetising the Universe at large. Much less well known is the fact that standard, classical physics of matter-radiation interactions possesses actually the same potential. After reviewing briefly our current knowledge about magnetic fields on the largest scales, I will discuss a magnetogenesis mechanism based on the exchange of momentum between hard photons and electrons in an inhomogeneous Intergalactic Medium. Operating in the neighbourhood of ionising sources during the Epoch of Reionization, this mechanism is capable of generating magnetic seeds of relevant strengths on scales comparable to the distance between ionising sources. In addition, summing up the contributions of all ionising sources and taking into account the distribution of gas inhomogeneities, I will show that this mechanism leaves the IGM, at the end of Reionization, with a level of magnetization that might account for the current magnetic fields strengths in the cosmic web.

thermal Sunyaev-Zel'dovich effect in the IGM due to the primordial magnetic fields

Author: Teppei Minoda (Nagoya University)

Abstract:

In the present universe, there are magnetic fields with various strength on various scales. One possible origin of these cosmic magnetic fields is the magnetogenesis in the primordial universe. B-fields created from such mechanisms are called primordial magnetic fields (PMFs), and are considered to affect the evolution of matter density fluctuations due to the Lorentz force and the thermal history of the IGM gas due to the so-called ambipolar diffusion. Hence the information of PMFs is expected to be imprinted on the anisotropies of the cosmic microwave background through the thermal Sunyaev-Zel'dovich (tSZ) effect in the IGM. In this talk, given an initial power spectrum of PMFs, we show dynamical and thermal evolutions of the IGM with PMFs, and compute the resultant tSZ angular power spectrum. As a result, we find that the tSZ angular power spectrum induced by the PMFs becomes more remarkable on small scales than that by galaxy clusters even with PMFs below the current cosmological constraint (Minoda et al., 2017, Phys. Rev. D 96, 123525). Therefore, we conclude that the measurement of the tSZ angular power spectrum on small scales will provide the stringent constraint on PMFs.

Chiral dynamos and the origin of cosmic magnetic fields

Author: Jennifer Schober (LASTRO, EPFL)

Abstract:

The origin and evolution of magnetic fields in the Universe is one of the great mysteries of modern cosmology. A hint towards field generation shortly after the Big Bang comes from observations of blazar emission which suggest that the intergalactic medium is permeated by large-scale magnetic fields. In this talk, I will present a modified theory of magnetohydrodynamics, which adequately describes a relativistic plasma like the one in the early Universe. Therefore, we include additional terms and equations in order to follow the dynamics of the chiral chemical potential, i.e. the asymmetry between left- and right-handed fermions. This asymmetry can give rise to a new electric current along the magnetic field, an effect known as chiral anomaly. Using high-resolution numerical simulations we study the amplification of weak magnetic seed fields shortly after the Big Bang. I will present different new dynamos which can operate in a relativistic plasma for both laminar and turbulent flows. These results, which are constrained by present-day observations of the intergalactic medium, can help us to better understand the role of magnetic fields in the early Universe.

Tracing primordial magnetic fields with 21 cm line observations

Author: Kerstin Kunze (University of Salamanca)

Abstract:

There are several effects of large scale, cosmological magnetic fields which potentially could influence the 21 cm line signal. On the one hand primordial magnetic fields present since before decoupling influence not only the CMB temperature anisotropies and polarization but also the linear matter power spectrum. On the other hand due to the interaction with the cosmic plasma magnetic fields dissipate in the post recombination universe due to decaying MHD turbulence and ambipolar diffusion (or plasma drift). This changes the thermal and ionisation history and thus affects the 21 cm line signal. In my talk I will address the implications of these effects on the 21 cm line signal and estimate its detectability with experiments such as the Square Kilometre Array (SKA).

Towards Exascale simulations of the ICM dynamo with Wombat

Author: Julius Donnert (INAF - IRA)

Abstract:

The current revolution in radio astronomy is unraveling an increasingly complex picture of non-thermal extragalactic radio sources. A rough understanding of the mechanisms leading to diffuse sources like radio haloes and radio relics is now established. We require numerical simulations to connect the underlying physics with upcoming radio surveys. However, the performance of new radio telescopes represents a serious challenge for current cosmological codes, as the underlying physics is notoriously difficult to simulate. In my talk, I will sketch out the problem of magnetic field amplification in the ICM from a simulators point of view and propose requirements that should go into the design of next-generation simulation codes. I will then introduce our new code "WOMBAT" that aims at the first resolved simulation of the magnetic dynamo in the intra-cluster-medium. We are developing WOMBAT in collaboration with performance engineers at Cray Inc. in the USA. I will present its novel parallelization strategy alongside early results regarding scalability to largest processor numbers and the fidelity of the underlying CT-MHD algorithm. I will end with an outlook of next development steps and connect the techniques used in WOMBAT to upcoming big data challenges in observational surveys.

Magnetic fields in clusters of galaxies: a simulation study

Author: Soonyoung Roh (Ulsan National Institute of Science and Technology)

Abstract:

Magnetic fields in clusters of galaxies play a critical role in shaping up the intracluster medium. Their existence has been established through observations of synchrotron emission, especially from radio relics and halos, as well as observations of rotation measure. In the so-called Sausage relic, which is one of Mpc-size giant radio relics detected in the outskirts of merging clusters, for instance, the magnetic fields are believed to have a few microG strength and a Mpc scale. The observed magnetic fields are conjectured to be produced by the process of small-scale turbulence dynamo. To investigate the dynamo origin, we simulate the development of turbulence and the follow-up amplification of magnetic fields in galaxy clusters using a three-dimensional magnetohydrodynamical code. Turbulence is induced in highly stratified backgrounds expected in clusters, and driven sporadically mimicking major mergers. We here present preliminary results, aiming to answer whether the turbulence dynamo scenario can explain observed magnetic fields in clusters of galaxies.

Simulations of the polarized sky of the SKA: how to constrain intracluster magnetic fields

Author: Francesca Loi (INAF-OAC & Cagliari University)

Abstract:

The advent of the Square Kilometre Array (SKA) will have an unprecedented impact on the study of the cosmic magnetism. An all-sky survey at 1.4 GHz will be proposed for the SKA with the aim to produce an accurate map of the Rotation Measure (RM) based on a enormous number of radio sources spread over cosmological distances. The spatial density of these radio sources will be such that we will obtain a RM grid with several hundreds of sources per squared degree. In order to be prepared to use this RM grid, we need to understand if and how we will be able to invert the information encoded in the grid to reconstruct the strength and the structure of large scale magnetic fields. In this talk, I will present an original numerical approach that is able to produce full-Stokes realistic images of the radio sky that we would observe with the SKA. Among the several uses of this tool, I will show the results concerning the study of magnetic fields in galaxy clusters based on the application of the Faraday RM Synthesis on simulated data.

Wavelet RM synthesis versus fitting parametric models for reconstruction magnetic field structure

Author: Dmitry Sokoloff (Moscow State University and IZMIRAN)

Abstract:

Two ways are visible for reconstruction of 3D magnetic field structures from the data of observations of polarized radioemission. There are fitting of finite parametric models and solving of inverse problems. In the latter case, we have to deal with the infinite parameter problem. Wavelets looks a possible approach to the second way. We consider and compare perspectives for developing in both ways.

Synergy between X-ray and low-frequency radio telescopes on particle accelerations in galaxy clusters

Author: Hiroki Akamatsu (SRON the Netherlands Institute for Space Research)

Abstract:

Radio relic is diffuse elongated radio emission locate at outskirts of galaxy clusters, which is believed to be formed via shock accelerations induced by cluster merging activity. To understand their role in the cluster evolution, it is crucial to understand detailed shock properties (Mach number, shock velocity, shock acceleration efficiency, etc.). In particular, the acceleration efficiency of low-Mach number shocks seen in galaxy clusters is thought to be too low to reproduce the observed radio brightness. Even previous studies provided a basic view of formation scenario of radio relics, some unclear issues are still unclear.

In this contribution, we will summarize understandings and limitations from current X-ray observatories and present new science cases and further insights on the nature of radio relics with Athena and future low-frequency radio observatories.

X-ray and radio observations of the radio relic galaxy clusters 1RXS J0603.3+4214 and RXC J1053.7+5453

Author: Motokazu Takizawa (Yamagata University)

Abstract:

We study galaxy clusters with radio relics, 1RXS J0603.3+4214 and RXC J1053.7+5453, with X-ray and radio observations. Radio relics are diffuse non-thermal radio sources found in outskirts of galaxy clusters. Because of their shape and location, they are thought to be related with cluster merger shocks. The galaxy cluster 1RXS J0603.3+4214 and RXC J1053.7+5453 have a well-known linear-shape ”toothbrush” radio relic and standard arc-like relic, respectively. We investigate the temperature structures across the relics, constrained the Mach numbers of possible shocks, and compare them with radio results. In addition, we obtained upper-limits of non-thermal inverse Compton X-rays in the relic regions and calculate lower-limits of the magnetic field strength, which are utilized to constrain the physical properties of the relic regions.

The Toothbrush Radio Relic: Filaments and Polarisation

Author: Matthias Hoeft (Thüringer Landessternwarte Tautenburg)

Abstract:

We precent recent deep observations of Toothbrush radio relic with the Karl Jansky Very Large Array (VLA). Using all four VLA configurations we obtained an unprecedented detailed view of the relic (Rajpurohit et al. 2018). The images revealed that the emission is rather filamentary. We conclude that wider filaments are caused by projection. In contrast, narrow filaments may reflect the magnetic field distribution. The relic is significantly polarised above a few GHz and quickly depolarises towards lower frequencies. We present a detailed analysis of the polarisation of the Toothbrush including a discussion of the Rotation Measure spectra. We show that Toothbrush radio relic is a unique target to study the magnetisation of the intra-cluster medium.

Limits on cosmic magnetic fields from recent cosmic-ray results

Author: Justin Bray (University of Manchester)

Abstract:

Charged cosmic rays are deflected by magnetic fields as they pass through extragalactic space. Their arrival directions therefore retain an imprint of magnetic fields in voids in the large-scale structure of the Universe, the most pristine remnant of the cosmic seed field. Recent results from the Pierre Auger Observatory, linking ultra-high-energy cosmic rays with several classes of extragalactic sources, allow a constraining upper limit to be placed on the strength of the extragalactic magnetic field. The future detection of cosmogenic photons will provide a similar but more sensitive probe, free of confusion from the Galactic magnetic field.

Faraday depolarization effects of the spiral galaxies

Author: Mami Machida (Kyushu university)

Abstract:

Magnetic fields play important roles in formation of the structures of spiral galaxies and propagation of cosmic-rays in spiral galaxies. The information of magnetic fields can be obtained from the radio observation such as the Stokes parameters and Faraday rotation measure. However, these observables are integrated along the line of sight. Due to resolve the three dimensional structures of magnetic fields, we investigate 100ZMHz to 10 GHz radio synchrotron emission from spiral galaxies, using the data of global three-dimensional MHD simulations and comparison with the observational data. We model internal and external depolarization at small scales and frequency independent depolarization. It is found that the internal and external depolarization becomes comparable inside the disk, although that becomes ineffective in the halo. When the observed frequency is in the MHD band, polarized intensity vanishes in the disk, while that from the halo may be observed whose polarization degree is about a few %.

Magnetic fields in the halo of spiral galaxies seen edge-on – as deduced from CHANG-ES

Author: Marita Krause (Max-Planck-Institut fur Radioastronomie)
Abstract:

Spiral galaxies are known to host a large-scale axisymmetric magnetic field structure along its disk. According to the mean-field α-ω dynamo theory, this plane-parallel field is accompanied by a weak large-scale dipolar or quadrupolar halo field. This halo field component, however, is by an order of magnitude too small to explain the X-shaped field structure that is observed by polarization observations in the halos of edge-on galaxies. Without Faraday depth or RM information of the halo, we cannot even say whether the observed X-shaped pattern is due to a regular (coherent) or an anisotropic (e.g. elongated loops) magnetic field. We performed a survey of 35 edge-on galaxies in radio continuum and polarization with the EVLA in C- and L-band, called CHANG-ES, in order to better understand the halos and their magnetic fields. The polarization data were analyzed with RM synthesis. We detected for the first time a large-scale Faraday depth pattern with different signs, indicating the existence of a regular (coherent) magnetic field in the halo of spiral galaxies. The results for the well-known galaxy NGC 4631 are presented and discussed in more detail.

Numerical Study of Supercritical Accretion onto Black Holes and Neutron Stars

Author: Hiroyuki Takahashi (NAOJ)
Abstract:

Black hole and neutron star accretion disks are known to be one of the most energetic systems in high-energy astrophysical phenomena. In particular, the super critical accretion disk is of interest in the sense that the large amount of gravitational energy is liberated, and the relativistic outflows and hard X-rays are observed. In this system, not only the gas motion, but also the magnetic field, strong gravity, and radiation field play important role. The numerical simulation is the most powerful tool to understand the energetics and dynamics of this system. In this talk, we will introduce our study using general relativistic radiation magnetohydrodynamic simulations. We will show that the structures of accretion disks and outflows, and also discuss the difference between the black hole accretion disks and neutron star accretion disks.

On a spin signature in black hole shadow of M87

Author: Tomohisa Kawashima (NAOJ)
Abstract:

M87 is known as one of the best targets for imaging the black hole shadow and it is recently proposed to be partially optically thick against synchrotron self-absorption (SSA). Little is known, however, about the feature of shadow images of black holes surrounded by partially SSA-thick plasmas. We calculate black hole shadow images of M87 at 230 GHz taking into account the partially SSA-thick plasmas. We have found that, when the black hole spin is high, the black hole shadow image shows the positional offset between the center of the photon-ring and that of the SSA-thick ring at the innermost stable circular orbit (ISCO) due to the frame-dragging effect in the Kerr spacetime. As a result, a dark-crescent structure appears between the photon-ring and the SSA-thick ISCO-ring in the black hole shadow image. The dark-crescent will be marginally detectable by Event Horizon Telescope, and will be a new signature of a rapidly spinning black hole.

Revealing the nature of anomalous arms in NGC 4258 using Faraday Tomography

Author: Sarrvesh Seethapuram Sridhar (ASTRON)

Abstract:

NGC 4258 (also known as M106) is a nearby spiral galaxy that is well-known for its anomalous radio arms. Despite numerous studies in the literature, the nature of the anomalous radio arms in NGC 4258 remains unknown even after 40 years since their discovery. In this talk, I will present results based on our recent observation campaign using the LOFAR and the Westerbork radio telescopes. In my talk, I will also discuss how Faraday tomography can be used finally to discern the nature and morphology of the anomalous arms.

3D Magnetohydorodynamic Simulations of AGN Torus

Author: Yuki KUDOH (Kagoshima university)

Abstract:

Formation of the obscuring torus and the mass accretion through the torus are important issues of active galactic nuclei(AGN). In order to explain the AGN luminosity, it is necessary to supply gas from the torus to the accretion disk. Magnetic fields of the AGN obscuring torus could contribute to inflate the obscuring gas and to affect the accretion rate through the magnetohydrodynamic(MHD) turbulence driven by the magneto rotational instability(MRI). We carried out three-dimensional global MHD simulations including X-ray heating and the radiative cooling. We used the HLLD method, with which fifth-order accuracy in space and third-order accuracy in time are achieved. Without the radiative heating and cooling, we confirmed that the azimuthal magnetic fields reverse their direction quasi-periodically on the time scale of 10 rotation period at each radius. On the other hand, with the heating/cooling terms, the reversal time scale of the azimuthal magnetic fields is extended. A cold(100K) and warm(10000K) disk is formed. The surface of warm disk is composed of filament-like clouds due to the thermodynamic instability driven by MRI turbulence.

Probing the Magnetized Disk-Halo Interaction in M51 via Wideband Polarimetry

Author: Maja Kierdorf (Max-Planck-Institute for Radio Astronomy)

Abstract:

An excellent laboratory for studying well ordered magnetic fields is the grand design face-on spiral galaxy M51. Due to wavelength-dependent Faraday depolarization, polarized emission at different radio frequencies gives a picture of the galaxy at different depths: previous observations at L-band (1-2GHz) probes the halo region while at C-band (4-8GHz) the polarized emission comes from the disk region of M51. I will present new observations of M51 with the Very Large Array at S-band (2-4GHz), where currently no polarization data exists, to shed new light on the interaction region between disk and halo. The wide frequency coverage and high spatial resolution (7 arcsec) allow us to probe the disk-halo interaction region to get information on the magnetic field structure in the plane of the sky and on the vertical component in this unknown layer. I will show our observational results of the transition layer, which is critical for our understanding on how large-scale halo fields are connected to the underlying galactic disk. For the 3D picture of the magnetic field, I will show preliminary results of Faraday rotation synthesis and QU-fitting, a tool to study wavelength-dependent depolarization effects.

Broadband Investigation of NVSS High Rotation Measure Extragalactic Radio Sources

Author: Yik Ki Ma (Max Planck Institute for Radio Astronomy)
Abstract:

The NVSS RM Catalogue is a powerful dataset for cosmic magnetism studies. With RM values through 37,543 sightlines north of declination of -40 degrees at a density of about one per square degree, it is the largest RM catalogue to date. The RM values were determined with polarisation measurements at two frequency bands around 1400 MHz, and could be susceptible to npi-ambiguity. The authors tackled this with (1) measured bandwidth depolarisation, and (2) RM values of neighbouring sources. To test this algorithm, we performed the first broadband spectro-polarimetric observations of 23 npi-ambiguity candidates in the NVSS RM Catalogue with JVLA at L-band, analysed with RM-Synthesis. We found that 2 of our targets have polarisation below our detection limit (¡ 0.07

Magnetic field vector maps of nearby spiral galaxies

Author: Hiroyuki Nakanishi (Kagoshima University)
Abstract:

Magnetic fields of spiral galaxies are thought to be classified into asymmetric spiral (ASS), bisymmetric spiral (BSS), and quadrisymmetric spiral (BSS). Azimuthal plot of Rotation Measure (RM) has been used for classifying magnetic field morphology. However, this method cannot work for a part of galaxies since the azimuthal RM change can be different from the ideal model. In order to overcome this issue, we propose a method for obtaining magnetic field vector maps of nearby galaxies based on the Rotation Measure and geometry of galactic disks. We discuss the patterns of magnetic fields based on the obtained vector maps.

Broad-band spectropolarimetric observation of high-RM AGN

Author: Alice Pasetto (Instituto de Radioastronomía y Astrofísica (IRyA-UNAM))
Abstract:

We present broadband polarimetric observations of a sample of high-Faraday-rotation-measure (high-RM) AGN using the JVLA telescope at C and X bands. The sample consists of very compact sources (linear resolution smaller than $\approx$ 5 kpc) that are unpolarized at 1.4 GHz in the NVSS. Total intensity data have been modeled using a combination of synchrotron components. Depolarization modeling, through the so-called qu-fitting, has been performed on the polarized data. Understanding which depolarization mechanisms better represent the data, would help the qualitative understanding of the AGN jet environment and whether it is embedded in a dense external magneto-ionic medium or if it is the jet-wind that causes the high RM and strong depolarization. This new high-sensitivity data shows a complicated behavior in both total intensity and polarized spectra with the presence of several synchrotron components and Faraday components with a turbulent magnetic field local to the sources. The new qu-fitting technique can be used to probe the magnetised environment and to spectrally resolve the polarized components of unresolved radio sources. Moreover, some VLBI-EVN preliminary result of some of the targets will be shown, confirming the extreme conditions of these AGN.

The structure of magnetised thermal plasma in the lobes of Fornax A and Centaurus A

Author: Craig Anderson (CSIRO)

Abstract:

The search for magnetised thermal plasma in radio lobes has a long and storied history, but conclusive detections of this material have remained elusive. Over the past few years, work at radio and X-ray/gamma ray wavelengths has resulted in claimed detections of 10^{10} solar masses of thermal plasma in the lobes of two of our nearest and most iconic radio galaxies — Fornax A and Centaurus A — though with poor constraints on its origin and structure. In this talk I will introduce our recent broadband polarisation study of Fornax A, wherein we claim to directly detect and map the detailed magneto-ionic structure of thermal plasma in the lobes, and reveal its likely origin. I will also present new results in the same vein for the radio galaxy Centaurus A, which make use of broadband polarisation data from the new ASKAP telescope.

Faraday tomography of the Milky Way ISM with GMIMS

Author: Alex Hill (DRAO/UBC/SSI)

Abstract:

The Global Magnetoionic Medium Survey (GMIMS) is a project to measure diffuse radio polarization of the entire sky from approximately 400 to 1800 MHz with 40 arcmin angular resolution. These observations will enable Faraday tomography over much of the sky. I will present observations from the GMIMS High Band North survey, a 1250-1750 MHz component of GMIMS obtained with the 26 m John A. Galt Telescope at the Dominion Radio Astrophysical Observatory in Canada. We have combined the GMIMS data with other radio and optical observations to derive information about the global structure of the Milky Way magnetic field toward the Fan Region and the North Polar Spur. I will also discuss the use of Canadian Hydrogen Intensity Mapping Experiment (CHIME) data to provide the northern sky 400-800 MHz component of GMIMS.

Magnetic field of Milky Way by near-infrared polarimetry of Cepheids

Author: Tetsuya Zenko (Department of astronomy, Kyoto University)

Abstract:

We present the measurement of the interstellar polarization for 69 Cepheid variables observed by IRSF 1.4m telescope. 69 Cepheid variables are the area between -10° $\leq l \leq$ 30∘ and b$\leq$ 0.5∘. Using the polarization as the function of distance, we analyze the magnetic structure in the galactic plane. Approximately 70% Cepheids have the polarization parallel to the galactic plane within 20 degree, so the large-scale magnetic field is nearly parallel to the galactic plane. We find the region which the galactic arm and the long bar are in contact with has the large dispersion of the polarization. This tendency suggests the magnetic structure isn't aligned well.

Searching for helical magnetic fields in the Milky Way

Author: Jennifer West (University of Toronto)
Abstract:

The origin and 3D structure of magnetic fields on galactic scales remains a mystery. We simulate observations for models of spirally symmetric classical galactic dynamos viewed from within, as is the case of the Milky Way Galaxy. These models include reversals and a vertical, X-shaped component, which are motivated by previous models and observations of the Milky Way and other external galaxies. The models also include a large scale helicity that extends into the halo. We search for possible observational signatures in these models and compare to data from the Global Magnetoionic Medium Survey (GMIMS).

The Local Bubble: a magnetic veil to our Galaxy

Author: Marta Alves (Radboud University Nijmegen)
Abstract:

The magnetic field in the local interstellar medium does not follow the large-scale Galactic magnetic field. The local magnetic field has probably been distorted by the Local Bubble, a cavity of hot ionized gas extending all around the Sun and surrounded by a shell of cold neutral gas and dust. However, so far no conclusive association between the local magnetic field and the Local Bubble has been established. We develop an analytical model for the magnetic field in the shell of the Local Bubble, which we represent as an inclined spheroid, off-centred from the Sun. We fit the model to Planck dust polarized emission observations within 30deg of the Galactic poles. We find a solution that is consistent with a highly deformed magnetic field, with significantly different directions towards the north and south Galactic poles. This work is a stepping stone towards modelling the three-dimensional (3D) structure of the magnetic field in the local interstellar medium, which is a most awaited input for large-scale Galactic magnetic field models. For the 3D modelling, Faraday tomography and stellar polarisation observations will be key.

The Power of Zeeman: Mapping Magnetic fields in our Galaxy through masers

Author: Jimi Green (CSIRO Astronomy and Space Science)
Abstract:

I will outline recent work on Zeeman splitting of Galactic hydroxyl masers, both ground and excited-state transitions, discussing the expectations and conventions of magnetic fields determined from the spectral line splitting. I will discuss a current large-scale survey for ground-state hydroxyl towards regions of high-mass star formation and a smaller-scale survey of excited-state hydroxyl exploring the propensity of linearly polarised pi components (previously believed to be elusive) and how these studies can be extended to projects utilising the Square Kilometre Array. These projects aim to explore the transition between weak large-scale magnetic fields and those encountered in regions of high density associated with high-mass star formation. I will discuss the detections, polarimetric properties and the implications for the role of magnetic fields in high-mass star formation.

Structure of electron density and magnetic fied in the Milkyway Galaxy

Author: Osamu Kameya (National Astronomical Observatory of Japan)
Abstract:

The distribution of the electron density and the magnetic field in the Milky way Galaxy was investigated based on the Pulsar parallax, dispersion measure and rotation measure. Pulsar parallaxes were mainly measured by VLBI and Pulsar timing measurements. The results indicate relationship between spiral arms and HI distribution. Mizusaawa VLBI Observatory,, NAOJ has telescopes which are available for VLBI or single dish observations of Pulsars, The future plans of using them are described.

Uniform fields in Hii regions revealed by GMIMS

Author: Alec Thomson (The Australian National University)
Abstract:

Magnetic fields, by intertwining with the various phases of the interstellar medium, significantly influence the formation of structure in the Milky Way. These structures are often diffuse in nature and cover large angular scales. To this end the Global Magneto-Ionic Medium Survey (GMIMS) has observed the diffuse radio polarisation in the entire Southern Sky from 300 to 480 MHz. From these observations the rotation measure spectrum has been produced by rotation measure synthesis. I will give a brief overview of GMIMS, as well as an update on the project's current status. The results from GMIMS have provided a number of surprising insights into the magneto-ionic medium in the nearby Galaxy. I will discuss our finding of coherent magnetic fields in large Hii regions. These include two well-known objects, Sh2-27 and Barnard's Loop, as well as two previously unknown objects. These first results from the Southern, low-frequency GMIMS demonstrate the unique power that diffuse polarisation observations have for probing the magneto-ionic medium of the Galaxy.

Analytic growth rate of gravitational instability in self-gravitating planar polytropes

Author: Jean-Baptiste Durrive (Nagoya University)
Abstract:

Gravitational instability is a key process that may lead to fragmentation of gaseous structures (sheets, filaments, haloes) in astrophysics and cosmology. We introduce here a method to derive analytic expressions for the growth rate of gravitational instability in a plane stratified medium. We consider a pressure-confined, static, self-gravitating fluid of arbitrary polytropic exponent, with both free and rigid boundary conditions. The method we detail can naturally be generalized to analyze the stability of more complex systems, notably including magnetic fields. Our analytical results are in excellent agreement with numerical resolutions.

H-alpha Polarization Measurements of Tycho's Eastern Limb with the Subaru FOCAS

Author: Satoru Katsuda (Saitama University)

Abstract:

We performed spectrally-resolved polarimetry of Tycho's eastern limb with the Subaru FOCAS. Our observation is similar to the pioneering work by Sparks et al., 2015, ApJL, 815, L9 who measured 2

On Measuring the Turbulent Magnetic Energy Spectrum in Supernova Remnant by Correlation Analysis of Radio Synchrotron Intensity

Author: Jiro Shimoda (Tohoku University)

Abstract:

The energy spectral index of magnetic-field disturbance quantifies energy dependence of diffusion coefficients of cosmic-rays, and eventually cosmic-ray acceleration. Previous theoretical studies have shown that the index of turbulence in the interstellar medium (ISM) can be studied with the correlation function of synchrotron radiation from the ISM. However, this correlation analysis is practical only if the three-dimensional geometry of the emission region is simple and known. In this study, we develop a method to apply the correlation analysis to a target with spherical-shell-like structure. We test our method using a radio continuum image of Tycho's supernova remnant (SNR), and find that the energy spectrum of field disturbance follows the Kolmogorov-like scaling. It is explained by some theoretical predictions. The origin of magnetic-field structure in Tycho's SNR can be determined if we have a sub arcsecond resolution and high sensitivity. We emphasize that our method would be available for not only other SNRs but also radio relics in galaxy clusters, where its structure can be well-approximated by a spherical shell.

Propagation and Structure of Astrophysical Jets by Two-temperature Magnetohydrodynamics

Author: Takumi Omura (Kyushu university)

Abstract:

We investigate the structure and dynamics for astrophysical jets with two-temperature magnetohydrodynamics (MHD) simulations. The calculations are perfomed assuming axisymmetric geometry and follow jet propagation over a long distance. The jet plasma are sufficiently low density that the electron-proton Coulomb collision times is much longer than the dynamical times, thus the ions and electrons have different temperature. We assume that the energy equation of the ion and that of the electron are solved separately, although the bulk motion of the electron is considered same as the ion. Electrons receive the energy by the Coulomb interaction with the ion and emit the energy by the radiation such as thermal bremthstlhlung, synchrotron radiation and inverse Compton scattering.
We find that ions-temperature is similar profile of one-temperature MHD calculations. The ions gas heat up by jet's terminal shock and forming cocoon with back flow. On the other hand electrons-temperature do not heat up by terminal shock. Therefore the jet's axis electrons-temperature higher than hot spot and cocoon. Synchrotron radiation estimated from one-temperature simulations dominant at jet shot spot and cocoon, but two-temperature's one is dominant at the hot spot, contact discontinuity and axis.

Faraday Tomography of the SS433 Jet Terminal Region

Author: Haruka Sakemi (Kyushu University)

Abstract:

W50 is a large radio nebula located near the Galactic plane. At the center, micro quasar SS433 exists ejecting the precessing jets. As W50 has an elongated structure in the propagating direction of the jets, it is suggested that W50 should interact with the jets. At the eastern-edge of W50, there is a filamentary structure which regarded as a terminal shock of the jet. However, the filament seems too large to suppose it to be the terminal shock whose length is about 20 pc when we assume a distance to SS433 of 5.5 kpc. Also, the north and south parts of the filament show different characters with each other. Therefore, we suggest that a part of the filamentary structure is not the terminal shock.

In order to verify it, we carried out Faraday tomography using the dataset observed with the Australia Telescope Compact Array at 1.4–3.0 GHz (Farnes et al. 2017). We also analyzed some helical structures, which coil around the eastern part of W50 (Dubner et al. 1998). As a result, we revealed that the south part of the filament has the same structure with the helical structures. It suggests that a section of the filamentary structure which is supposed the terminal shock is a part of the helical structures.

Magnetohydrodynamic Simulations of a Plunging Black Hole into a Molecular Cloud

Author: Mariko Nomura (Tohoku university)

Abstract:

An isolated, inactive black hole would pull up ambient material, leaving a trace in the interstellar medium as a spatially compact, broad-velocity-width feature. The ”Bullet” in the W44 molecular cloud is a candidate for such a black hole trace (Sashida et al. 2013, Yamada et al. 2017). Using two-dimensional magnetohydrodynamic simulations, we investigated the gas dynamics around a black hole plunging into a molecular cloud. In these calculations, we assumed a parallel-magnetic-field layer in the cloud. We found that the magnetic tension force has an important role in reproducing the Bullet feature. The size of the accelerated region around the black hole is far larger than the Bondi-Hoyle-Lyttleton radius, being approximately inversely proportional to the Alfven Mach number for the plunging black hole. Our results successfully reproduce the Bullet in the W44 molecular cloud. The size of the Bullet is also reproduced within an order of magnitude using a reasonable parameter set. This consistency suggests that the plunging black hole is the plausible origin of the Bullet.

The Square Kilometre Array (SKA) Science Data Processor Integration Prototype

Author: Jamie Farnes (University of Oxford)

Abstract:

The SKA will be both the largest radio telescope ever constructed and the largest Big Data project in the known Universe. The first phase of the project will generate up to 1 terabyte per second of data that needs to be continuously ingested by the SKA Science Data Processor (SDP). Within the SDP Consortium, we are building a lightweight end-to-end prototype of the major components of the SDP system - a project we call the SDP Integration Prototype (SIP). The aim is to build a mini, fully-operational SDP. We have been testing SIP together with polarization data from the LOFAR Multifrequency Snapshot Sky Survey (MSSS), for which we have been developing a realistic SKA-like science pipeline that can handle the large data volumes generated by LOFAR at 150 MHz. The pipeline images, detects sources, and performs Faraday Tomography across the entire LOFAR sky, with the goal of providing the first-ever detection of magnetic fields in the “cosmic web” of galaxy filaments and voids. In this talk, I shall provide an update on SIP progress and on our efforts to place the tightest ever constraints on the magnetised large-scale structure of the Universe.

IMAGINE: the Interstellar Magnetic Field Inference Engine

Author: Marijke Haverkorn (Radboud University)

Abstract:

In recent years, a number of investigations have captured the large-scale structure of the Galactic magnetic field in a variety of parametrized models. These models can help understand the origin and evolution of galactic magnetism, cosmic-ray propagation, galactic gas flows and other processes. The existing models are increasingly complex, incorporating e.g. out-of-plane components and (an)isotropic turbulent fields. Yet they are very heterogeneous in structure, parameters used and data used to fit. The international IMAGINE collaboration is building a Bayesian framework for models of the Galactic magnetic field, with the possibility to utilize various available data sets and to input prior kowledge on the magnetic field. This poster will explain the background and science goals of the project, and the IMAGINE consortium and software.

Polarimetry of 1720 MHz OH masers

Author: Chikaedu Ogbodo (Macquarie University)

Abstract:

Astrophysical masers can be associated with high-mass star forming regions, chief of which are methanol masers. Although this species of maser is ideal for identifying high mass star formation, it is difficult to utilise as a magnetic field tracer. Hydroxyl masers which can also be found in such regions, can crucially provide the polarimetric information, and we are currently looking at the 1720 MHz transition of hydroxyl masers coincident with positions of methanol masers from the Methanol Multibeam (MMB) survey. Primarily, we are studying the magnetic field properties of these compact sources from inherent polarization information caused by the spectral splitting of the emission lines-the Zeeman effect. This information provides us with the direction, magnetic field strength, flux of the four Stokes parameters (I,Q,U,V), position, velocity (and derived kinematic distances) with which we might be able to describe both local and large scale effects of magnetic field on the evolution of young high-mass stars within our Galaxy. We present initial results of the polarimetric properties , and derived magnetic fields, of 1720 MHz OH masers of sources (both new and previously re- ported sources) from the MAGMO project, observed with the Australian Com- pact Array (ATCA) .

2D MHD simulations for the state tranition of the X-ray binaries with the thermal conductivity

Author: Kenji Nakamura (Kyushu Sangyo University)

Abstract:

Two-dimensional axisymmetric MHD simulation on the state transition of X-ray stars from the hard state to the hard intermediate state was carried out. This time, an anisotropic heat conduction calculation was incorporated. Radiative cooling was included after 10 rotational time at 10 Schwarzschild radius, and time evolution of the disk structure was investigated. Here, we consider only bremsstrahlung as radiative cooling. Without considering heat conduction, the high-temperature lean accretion flow, which is considered to be in the hard state, rapidly undergoes temperature decrease and density rise upon cooling by radiation, and an accretion disk of low plasma β was formed on the equatorial plane. On the other hand, when considering heat conduction, a low temperature and high density accretion disc is formed in the same way, but a warm accretion flow enclosing this accretion disc is formed. When the initial density was lowered, the time scale of radiation cooling became longer than the time scale of heat conduction, and no low temperature high density accretion disk was formed.

Magnetic line structure of the nearby galaxy

Author: Kohei Kurahara (Kagoshima university)

Abstract:

Motion of gas in the galactic plane is circular motion. Since the ionized gas move along a magnetic line by Lorentz force, If Motion of gas in the galactic plane is circular motion, The magnetic field in the galactic plane should also have circular structure. We decided magnetic field vector about the nearby galaxy, And inspected whether a magnetic line of the nearby galaxy was closed in a circle by comparing with the result of Dobbs et al. (2016). As a result, We found that the azimuthal variation of the nearby galaxy's magnetic pitch angle was continuous between the material arm. However, the azimuthal variation of the nearby galaxy's magnetic vector angle was not continuous. On the other hand, in the case of a magnetic field vector explained in Dobbs et al.(2016), The azimuthal variation of the magnetic pitch angle and vector angle were continuous between the material arm. From these results, We understood that the nearby galaxy did not have the magnetic line structure that could explain in Dobbs et al.(2016). Therefore, we suggested that the magnetic line of the nearby galaxy was not closed in a circle.

Reliable detection and characterization of low-frequency polarized sources in the LOFAR M51 field.

Author: Cathy Horellou (Chalmers University of Technology, Onsala Space Observatory)

Abstract:

The new generation of broad-band radio continuum surveys will provide large data sets with polarization information. New algorithms need to be developed to extract reliable catalogs of linearly polarized sources that can be used to characterize those sources and produce a dense rotation measure (RM) grid to probe magneto-ionized structures along the line of sight via Faraday rotation. We have developed a computationally efficient and rigorously defined source-finding algorithm for linearly polarized sources. We used the calibrated data set from the LOw Frequency ARray (LOFAR) at 150 MHz centered on the nearby galaxy M51 and published by Mulcahy et al. (2014) to search for polarized background sources. With a new imaging software, we re-imaged the field at a resolution of 18"×15" and cataloged a total of about 3000 continuum sources within 2.5 degrees of the center of M51. We made small Stokes Q and U images centred on each source brighter than 100 mJy in total intensity (201 sources) and used RM synthesis to create corresponding Faraday cubes that were analyzed individually. For each source, the noise distribution function was determined from a subset of the measurements at high Faraday depths where no polarization is expected; the peaks in polarized intensity in the Faraday spectrum were identified and the p-value of each source was calculated. Finally, the False Discovery Rate method was applied to the list of p-values to produce a list of polarized sources and quantify the reliability of the detections. We also analyzed sources fainter than 100 mJy but that were reported as polarized in the literature at at least another radio frequency. Of the 201 sources that were searched for polarization, six polarized sources were detected confidently (with a false discovery rate of 5 percent). This corresponds to a number density of one polarized source per 3.3 square degrees, or 0.3 source per square degree. Increasing the false discovery rate to 50 percent yields 19 sources. A majority of the sources have a morphology that is indicative of them being double-lobed radio galaxies, and the ones with literature redshift measurements have $0.5< z <1.0$. We find that this method is effective in identifying polarized sources, and is well suited for LOFAR observations. In the future, we intend to develop it further and apply it to larger data sets such as the LOFAR Two-meter Survey of the whole northern sky, LOTSS, and the ongoing deep LOFAR observations of the GOODS-North field.

Tomography Tutorial

Abstract:

The aim of the Faraday tomography tutorial is that the participants become able to understand the basic behaviors of the Faraday tomography technique and to apply the technique to the real data by their own hands. The tutorial consists of the lecture of basics of the technique and the practice using Python (plus Fortran90) codes that we provide.

AIPS & CASA Tutorial

Abstract:

The aim of the CASA/AIPS tutorial session is to introduce young beginners to the reduction of radio polarization data. The session begins with a short introduction that includes the basic concepts of polarization observations and data reduction with AIPS, followed by the CASA tutorial, which has three stages: (i) An overview of CASA and its capabilities. (ii) Work through a tutorial to become familiar with the manual use of running tasks in CASA. (iii) Work through the running of a basic automated Python script in CASA, on a small polarised dataset from the VLA archive. Participants are requested to bring their own laptop PC and to install CASA onto it by the beginning of the tutorial session. Please also see Hiroyuki Nakanishi or Jamie Farnes during the week of the conference, in order to obtain a copy of the VLA data.

PROCEEDINGS

galaxies

Invitation to submit

The Power of Faraday Tomography

Guest Editors
Dr. Mami Machida, Dr. Marijke Haverkorn, Dr. Takuya Akahori, Dr. Jamie Farnes

Deadline
30 September 2018

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