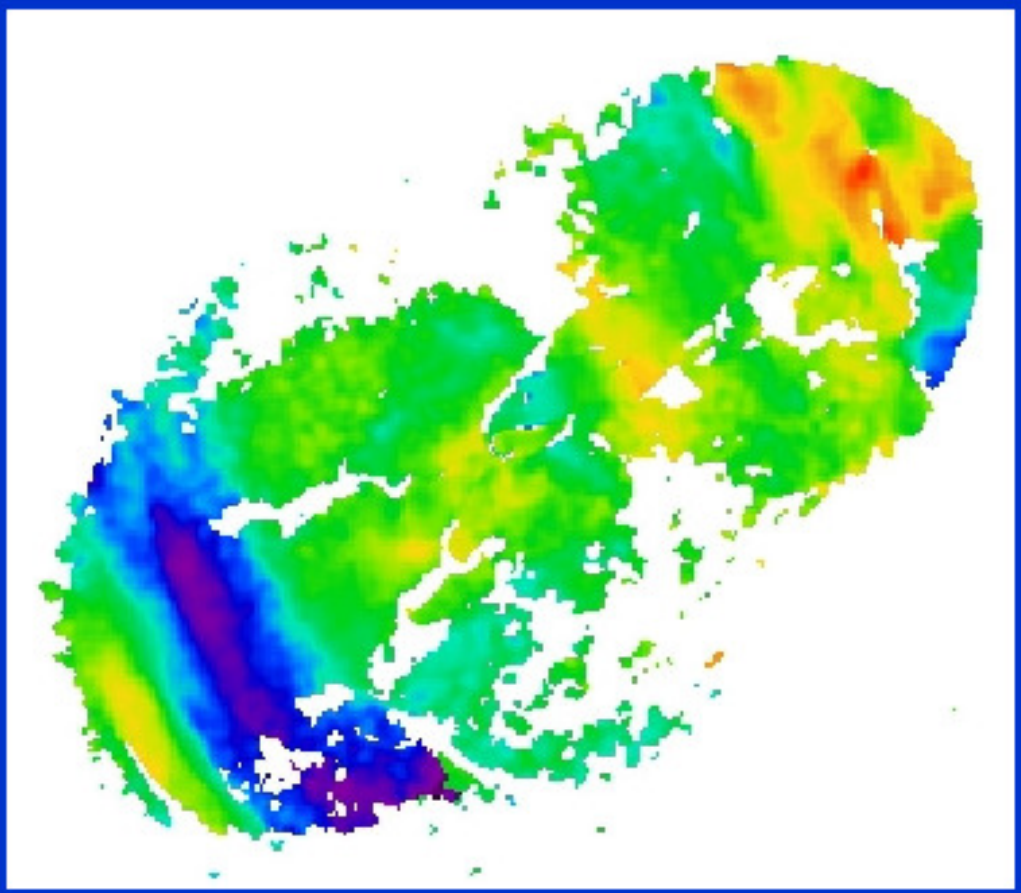
Rotation Measure Analysis of Magnetic Fields in and around Radio Galaxies

Riccione, Italy
10-14 May 2010



Abstract Booklet

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INAF
ISTITUTO NAZIONALE DI ASTROFISICA
NATIONAL INSTITUTE FOR ASTROPHYSICS

RadioNet

Program

Monday, May 10

18:00 – 20:00 Registration
20:00 Welcome dinner at Hotel Lungomare

Tuesday, May 11

CHAIR: LORETTA GREGORINI

08:30 – 09:00 Extended time for registration
09:00 – 09:10 Parma *Welcome and Logistics*
09:10 – 09:30 Laing *Aims of Workshop*

Session 1: RM in Large-scale Structure, Clusters, Groups and Galaxies

Session 1a - *Overview*
09:30 – 10:00 Kronberg *Overview of magnetic probes of the extragalactic Universe*

Session 1b - *Large-scale structure: observations*
10:00 – 10:30 Giovannini *Evidence of magnetic fields in cosmological galaxy filaments*

*** 10:30 – 11:00 ** Coffee Break

Session 1c - *Clusters: observations*
11:00 – 11:30 Brentjens *Wide Field WSRT polarimetry around the Perseus cluster at 350 MHz*
11:30 – 12:00 Murgia *Rotation measure synthesis of radio halos in clusters of galaxies*

*** 12:00 – 14:00 ** Lunch at Hotel Lungomare

CHAIR: GREGORY TAYLOR

14:00 – 14:30 Bonafede *The Coma cluster magnetic field from Faraday RM*
14:30 – 15:00 Vacca *The intra-cluster magnetic field power spectrum in relaxed galaxy clusters from rotation measure studies*

Session 1d - *Clusters: theory*
15:00 – 15:30 Dolag *Simulating Magnetic Fields in Clusters of Galaxies*
15:30 – 16:00 Krause *Synthetic polarisation observations of simulated jets interacting with magnetised intracluster gas*

*** 16:00 – 16:30 ** Tea

Session 1e - *Interpretation*
16:30 – 17:00 Ensslin *Galactic and intergalactic magnetic field inference*
17:00 – 17:30 Junklewitz *Imprints of magnetic power and helicity spectra on radio polarimetry statistics*

Session 1f - *RM in Clusters and Large-scale structure: discussion 1*
17:30 – 18:30 All *Discussion*

Wednesday May 12

CHAIR: MATTEO MURGIA

Session 1g - *RM in Galaxies and groups*

09:00 – 09:30	Laing	*Faraday rotation in and around radio galaxies*
09:30 – 10:00	Macquart	*Faraday Rotation Structure on Kiloparsec scales in the giant lobes of Centaurus A*
10:00 – 10:30	Guidetti	*Anisotropic fluctuations of Faraday rotation across radio galaxies*

*** 10:30 – 11:00 ** Coffee Break

11:00 – 11:30	J. Broderick	*Polarimetric properties of MRC B1221-423: a compact radio source in a merging galaxy*
11:30 – 12:00	Mantovani	*CSSs polarimetry at sub-arcsecond resolution*

Session 1h - *RM in Clusters and Large-scale structure: discussion 2*

12:00 – 12:30	All	*Discussion*

*** 12:30 – 14:00 ** Lunch at Hotel Lungomare

14:00 – 15:30 Free time for poster viewing etc.

*** 15:30 – 16:00 ** Tea

Session 2: Techniques

CHAIR: FRANCO MANTOVANI

Session 2a - *Instrumental*

16:00 – 16:30	Anderson	*Polarization Measurements with LOFAR: Preparing for the Cosmic Magnetism Key Science Project*
16:30 – 17:00	Cotton	*Wide Field Instrumental Polarization and its Correction*

Session 2b - *RM synthesis*

17:00 – 17:30	Rudnick	*Complex polarization behaviour from two simple screens: the case of 3C33*

Session 2c - *Discussion: techniques*

17:30 – 18:00	All	*Discussion*

*** 20:00 ** Workshop Dinner at Locanda 'I Girasoli'

Thursday May 13

CHAIR: TORNSTEN ENSSLIN

Session 3: Magnetic fields in pc-scale jets

Session 3a - *RM Observations on pc scales*

09:00 – 09:30	Gabuzda	*Intriguing Asymmetries in Transverse RM Gradients – Evidence for Helical Fields Generated by a Cosmic Battery*

09:30 – 10:00 Taylor *High Fidelity Rotation Measures Across Parsec-Scale Jets*
10:00 – 10:30 Gomez *Faraday rotation and polarization gradients in the jet of 3C120*

*** 10:30 – 11:00 ** Coffee Break

11.00 – 11:30 Hovatta *Faraday rotation in the MOJAVE blazars*
11:30 – 12:00 Tremblay *Polarization Properties of Active Galaxies on Parsec Scales*
12:00 – 12:30 Kovalev *Extreme Faraday rotation in AGN jets*

*** 12:30 – 14:00 ** Lunch at Hotel Lungomare

CHAIR: ROBERT LAING
14:00 – 14:30 Mahmud *Connecting Magnetic Towers with Faraday Rotation Gradients in the Jets of Active Galactic Nuclei*
14:30 – 15:00 O'Sullivan *The Parsec-Scale Faraday Rotation Measure Distribution of Quasars at z > 3*

Session 3b - *RM on pc scales: interpretation*
15:00 – 15:30 A. Broderick *Measuring the Geometry of AGN Core Magnetic Fields*
15:30 – 16:00 Clausen-Brown *Observational Signatures of Helical Magnetic Fields in Parsec Scale AGN Jets*

*** 16:00 – 16:30 ** Tea

Session 3c - *pc-scale RM's: discussion*
16:30 – 18:00 All *Discussion*

Organized by: INAF Istituto di Radioastronomia

SCIENTIFIC ORGANIZING COMMITTEE
Torsten Ensslin (MPA)
Robert Laing (chair, ESO)
Matteo Murgia (INAF OACa)
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Gregory Taylor (UNM)

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Paola Parma (chair, INAF IRA)
Alessandra Zanichelli (INAF IRA)

Talks

Anderson, James M. – Max Planck Institut für Radioastronomie
Polarization Measurements with LOFAR: Preparing for the Cosmic Magnetism Key Science Project
On behalf of the LOFAR collaboration.

The Cosmic Magnetism Key Science Project (MKSP) of LOFAR is responsible for developing and commissioning calibrators, algorithms, and software tools for the calibration, imaging, and processing of polarization observations with LOFAR. With more than half of the planned stations already operational and the remaining stations expected to be operational by the end of summer 2010, LOFAR has moved into its main instrumental commissioning phase. I will present plans and initial results for polarization commissioning of LOFAR in 2010 by the MKSP. We will observe a combination of point-sources and extended Galactic sources to measure the instrumental behaviour to linearly and circularly polarized emission across the instrumental field of view. A polarization calibrator survey will be included as part of the LOFAR Million Source Shallow Survey commissioning project. Finally, I will discuss the software development for the polarization processing pipeline for LOFAR, including the Rotation Measure Synthesis pipeline.

Bonafede, Annalisa – INAF Istituto di Radioastronomia
The Coma cluster magnetic field from Faraday RM

The aim of the present work is to constrain the Coma cluster magnetic field strength, its radial profile and power spectrum by comparing Faraday Rotation Measure (RM) images with numerical simulations of the magnetic field. We have analyzed polarization data for seven radio sources in the Coma cluster field observed with the Very Large Array at 3.6, 6 and 20 cm, and derived Faraday Rotation Measures with kiloparsec scale resolution. Random three dimensional magnetic field models have been simulated for various values of the central intensity B_0 and radial power-law slope η, where η indicates how the field scales with respect to the gas density profile. We derive the central magnetic field strength, and radial profile values that best reproduce the RM observations.

Broderick, Avery – Canadian Institute for Theoretical Astrophysics
Measuring the Geometry of AGN Core Magnetic Fields

At sufficiently low frequencies the character of Faraday rotation changes, entering what we term the "super-adiabatic regime", in which the rotation measure is proportional to the integrated absolute value of the line-of-sight component of the magnetic field. For AGN cores the critical frequency defining this regime is above the ionospheric cutoff for a number of galactic nuclei, reaching more than 10 GHz in some nearby systems. I will discuss why this occurs, how it may be used to study the magnetic field geometry within, and even location of, AGN Faraday screens. The relevance of this regime for Faraday rotation studies with new and upcoming low-frequency telescopes will also be remarked upon.

Brentjens, Michiel – ASTRON
Wide Field WSRT polarimetry around the Perseus cluster at 350 MHz

A wide field WSRT mosaic was recorded to further investigate fascinating diffuse polarization structures at 350 MHz that were previously tentatively attributed to the Perseus cluster. More specifically: to find out whether the structures are located in (or near) the Perseus cluster, or in the Milky Way. The frequency range was 324 to 378 MHz and the resolution of the polarization maps was 2' x 3'. To counter bandwidth depolarization, the maps were processed using Faraday rotation measure synthesis, covering Faraday depths of -384 to +381 rad m^{-2} in steps of 3 rad m^{-2}. There is emission all over the field at Faraday depths between -50 and +100 rad m^{-2}. All previously observed structures were detected. However, no compelling evidence supporting association of those structures with either the Perseus cluster or large scale structure formation gas flows in the Perseus-Pisces super cluster was found. Instead, one of the structures is clearly associated with a Galactic depolarization canal at 1.41 GHz. Another large structure in polarized intensity at a Faraday depth of +30 rad m^{-2} is linked with a dark object in WHAM Hα maps at a kinematic distance of 0.5 ± 0.5 kpc. I will end my presentation with a simple model of the line of sight, placing all emitting and Faraday rotating areas in the correct order.

Broderick, Jess – University of Southampton
Polarimetric properties of MRC B1221-423: a compact radio source in a merging galaxy

MRC B1221-423 is a nearby (z = 0.17) compact steep-spectrum radio source, lying well within the envelope of a galaxy which is undergoing a tidal interaction with a companion. Previous observations show that there have been several distinct episodes of star formation, connected with the tidal interactions. High-resolution 12 and 7 mm Australia Telescope Compact Array (ATCA) images reveal a striking radio morphology, including a jet with a 180 degree bend. Using ATCA data over the wavelength range 20 cm – 7 mm, we have conducted a polarimetric analysis of B1221-423, including the use of RM synthesis. I will discuss some of the results from our study of this dynamic, interacting system.

Clausen-Brown, Eric – Purdue University
Observational Signatures of Helical Magnetic Fields in Parsec Scale AGN Jets

We show how observed asymmetries in VLBI AGN jets can be reproduced by the presence of axially symmetric large scale helical magnetic fields. These asymmetries are calculated by retaining the synchrotron emission function's dependence on the angle between the line of sight and the magnetic field in the jet comoving frame. We calculate transverse profiles of VLBI intensity, linear polarization, spectral index, and Faraday rotation measure. Our theoretical profiles are able to reproduce qualitative features of observed profiles.

Cotton, William – NRAO
Wide Field Instrumental Polarization and its Correction

Accurate polarimetry requires measuring and removing instrumental contributions to the observed polarization. On-axis instrumental corrections have been applied since the beginning of interferometric polarimetry but the off-axis contributions are seldom considered. With the advent of wide bandwidth deep surveys, off-axis instrumental polarization can limit the accuracy of Faraday rotation measurements. I will discuss recent widefield polarimetric measurements of the EVLA antennas as well as techniques for removing the effects of off-axis instrumental polarization. Results from EVLA tests will be given.

Dolag, Klaus – MPI für Astrophysik
Simulating Magnetic Fields in Clusters of Galaxies

In galaxy clusters, non-thermal components such as magnetic field and high energy particles keep a record of the processes acting since early times till now. These components play key roles by controlling transport processes inside the cluster atmosphere and beyond and therefore have to be understood in detail by means of numerical simulations. I will present results from cosmological, hydrodynamical simulations of structure formation which follow the evolution of magnetic fields. Such numerical experiments are a key tool to understand the build up of large scale magnetic field and allow to predict the expected scaling of the magnetic field among different galaxy clusters. They also allow to study the evolution of the magnetic field structure and its relation to the dynamical state of galaxy clusters.

Ensslin, Torsten – Max Planck Institute for Astrophysics
Galactic and intergalactic magnetic field inference

The strength and geometry of magnetic fields in our own galaxy as well as in clusters of galaxies are crucial for many phenomena, but at the same time are still poorly known. I report on progress and plans how to infer their statistical properties. In particular, new Faraday rotation based measurements of the magnetic power spectrum in the Hydra A cool core regions are presented as well as methods to extract information on magnetic tension force and helicity spectra from radio polarimetry are presented.

Gabuzda, Denise – University College Cork
Intriguing Asymmetries in Transverse RM Gradients – Evidence for Helical Fields Generated by a Cosmic Battery

Theoretical and observational evidence has been building up that many AGN jets are intrinsically associated with helical B fields, which would come about naturally due to the rotation of the central black hole and accretion disk combined with the jet outflow. One form of evidence for helical jet B fields is the observation of transverse Faraday rotation measure (RM) gradients across an increasing number of AGN jets, interpreted as reflecting the systematic variation in the line-of-sight component of a helical field across the jet. However, a new “twist” to this picture has recently arisen - a striking asymmetry in the observed transverse RM gradients, with far more than half oriented clockwise on the sky. This puzzling result can be explained if the direction of the longitudinal jet B field is linked to the direction of the disk rotation, as is the case with the "Cosmic Battery" model of Contopoulos et al. (2009). This model and its current observational status will be discussed.

Giovannini, Gabriele – Dipartimento di Astronomia - Università di Bologna
Evidence of magnetic fields in cosmological galaxy filaments

I will present observational data in total intensity and polarization to discuss the evidence of magnetic fields in large scale structures as galaxy filaments on scale larger than 1 Mpc.

Gomez, Jose L. – Instituto de Astrofisica de Andalucia - CSIC
Faraday rotation and polarization gradients in the jet of 3C120

Helical magnetic fields may play an important role in the formation and collimation of relativistic jets, which may be searched for by looking for Faraday rotation gradients across the jet. Towards this aim we present a thorough study of the jet in the radio galaxy 3C120, consisting of 32 monthly polarimetric 15, 22, and 43 GHz VLBA observations. The motion of superluminal components allows the mapping of the polarization structure along most of the jet and across its width, revealing a coherent in time Faraday screen and RM-corrected polarization angles. Gradients in Faraday rotation and degree of polarization across the jet are observed, together with a localized region of high Faraday rotation measure superposed on this structure. This is explained by the presence of a helical magnetic field in a two-fluid jet model, consisting of an inner emitting jet and a sheath containing nonrelativistic electrons. Interaction of the jet with the external medium would explain the confined region of enhanced Faraday rotation. Preliminary results reveal a possible change in the Faraday rotation screen associated with a strong shock. Implications for this tentative detection of internal Faraday rotation will be discussed.

Guidetti, Daria – ESO
Anisotropic fluctuations of Faraday rotation across radio galaxies
D. Guidetti, R.A. Laing, P. Parma, A. Bridle, L. Gregorini

I will present new and archival detailed images of Faraday rotation measure (RM) showing banded structures observed in radio galaxies in groups or clusters of galaxies. These RM structures are clearly distinguishable from the typical isotropic random variations observed so far and could be the signature of anisotropy in the intra-cluster magnetic field. I will also discuss a physically based model of interaction between radio galaxies and the surrounding medium which could account for the structure and strength of the magnetic field within it.

Hovatta, Talvikki – Department of Physics, Purdue University
Faraday rotation in the MOJAVE blazars
T. Hovatta, M. L. Lister, H. D. Aller, M. F. Aller, D.C. Homan, Y. Kovalev, T. Savolainen

Monitoring of Jets in Active galactic nuclei with VLBA Experiments (MOJAVE) is a long-term program to observe total intensity and polarization variations in jets associated with active galactic nuclei. Most of the sources belong to the extreme class of highly variable blazars. In 2006 we observed 192 AGN jets at 8.1, 8.4, 12.1, and 15.3 GHz with the VLBA as part of the MOJAVE program. We present preliminary results on the polarization and rotation measure gradients in these highly beamed sources, and discuss them in light of current helical field and shock models for parsec-scale magnetic field structures in AGN jets.

Junklewitz, Henrik – Max Planck Institut für Astrophysik
Imprints of magnetic power and helicity spectra on radio polarimetry statistics

Statistical properties of turbulent magnetic fields in radio-synchrotron sources should imprint on the statistics of polarimetric observables. In this work we calculate several correlation functions of such observables. We evaluate correlation functions of the total intensity, the polarized intensity and the rotation measure in all combinations up to fourth order in the magnetic field. We derive these as far as possible analytically and from first principles only using some basic assumptions as given Gaussian statistics of the underlying magnetic field in the observed region and statistical homogeneity as well as some simplifications like a constant electron density. We show that it is in principle possible to gain information about the helical part of the magnetic power spectrum using our statistical approach. For now all calculations are given for the Faraday-free case, but are set up in a way so that Faraday rotational effects could be included later on.

Kovalev, Yuri – Astro Space Center of Lebedev Physical Institute
Extreme Faraday rotation in AGN jets

We discuss a new method to measure extreme values of Faraday rotation which practically has no upper limit. The method is based on a search for a Faraday delay between emission in the right and left circular polarizations. Theoretical ground and computer modelling of its application will be presented. First results of a search for extreme values of Faraday rotation in several bright extragalactic jets with the GBT will be discussed.

Krause, Martin – Max Planck Institut für Extraterrestrische Physik
Synthetic polarisation observations of simulated jets interacting with magnetised intracluster gas

We have run jet simulations into magnetised intracluster gas, where the magnetic field has a Kolmogorov turbulent structure. The jets have some impact on their surroundings. We calculate the Stokes vectors self consistently from the field in the jet cocoon and then consider Faraday rotation from the surrounding cluster gas. Depending on the jet parameters, we find a moderate enhancement of the rotation measure over a comparison simulation without jet.

Kronberg, Phil – Dept Physics, University of Toronto
Overview of magnetic probes of the extragalactic Universe

I describe what we have learned about magnetic fields in intergalactic environments beyond the bounds of individual galaxies and clusters. My talk will range from the local Universe to $z \geq 10$. I will also comment on synergies between theory, next generation radio observations, and observations in other wavebands, emphasizing high energy particle astrophysics.

Laing, Robert – ESO
Faraday rotation in and around radio galaxies

Macquart, Jean-Pierre – ICRAR/Curtin Institute of Radio Astronomy
Faraday Rotation Structure on Kiloparsec scales in the giant lobes of Centaurus A

I will present the results of an Australia Telescope Compact Array 1.4 GHz spectropolarimetric aperture synthesis survey of 34 square degrees centred on Centaurus A - NGC 5128. In the field, we calculated Faraday rotation measures (RMs) and linear polarised intensities for 281 compact radio sources. The ensemble of these background polarised sources was used as line-of-sight probes of the structure of the giant radio lobes of Centaurus A. This is the first time such a method has been applied to radio galaxy lobes. We detected a turbulent RM signal, with rms of 17 rad/m^2 and scale size 0.3 degrees, associated with the southern giant lobe. We cannot verify whether this signal arises from turbulent structure throughout the lobe or only in a thin skin (or sheath) around the edge, although we favour the latter. The RM signal is modelled as possibly arising from a thin skin with a thermal plasma density equivalent to the Centaurus intragroup medium density and a coherent magnetic field that reverses its sign on a spatial scale of 20 kpc.

Mahmud, Mehreen – Joint Institute for VLBI in Europe (JIVE)
Connecting Magnetic Towers with Faraday Rotation Gradients in the Jets of Active Galactic Nuclei

The idea that systematic Faraday Rotation gradients across the parsec-scale jets of Active Galactic Nuclei (AGNs) can reveal the presence of helical magnetic (B) fields has been around since the early 1990s. These gradients are taken to be due to the systematic variation of the line-of-sight B field across the jet. I present here parsec-scale Faraday Rotation distributions for several BL Lac objects, based on polarization data obtained with the Very Long Baseline Array (VLBA). The Rotation Measure (RM) maps for these sources indicate systematic gradients across their jets, as expected if these jets have helical B fields wrapped around their jets. In fact, multi-epoch rotation measure mapping of these sources has indicated that these gradients are dynamic, thus providing new information about their magnetic fields. We also observe an intriguing new feature in these sources, a reversal in the direction of the gradient in the jet as compared to the gradient in the core region. This provides new evidence to support "magnetic-tower" type models in which field lines emerging from the central region of the accretion disk and closing in the outer region of the accretion disk are both "wound up" by the differential rotation of the disk. The net observed RM gradient will essentially be the sum effect of two regions of helical field, one nested inside the other. The direction of the net RM gradient will be determined by whether the inner or outer helix dominates the RM integrated through the jet, and RM gradient reversals will be observed if the inner and outer helical fields dominate in different regions of the jet. This provides new insights about the geometry of the jet B fields, and also evidence for the Poynting-Robertson Battery model of Contopoulos and Kazanas (1998).

Mantovani, Franco – INAF Istituto di Radioastronomia
CSSs polarimetry at sub-arcsecond resolution

The number of CSSs for which detailed radio polarisation information is available is still rather small. Results from a series of observations at mas and sub-arcsec resolution planned to improve the statistics, will be presented. Evidence in favour of the interaction of components of CSSs with dense clouds of gas will be discussed.

Murgia, Matteo – INAF Osservatorio Astronomico di Cagliari
Rotation measure synthesis of radio halos in clusters of galaxies
M. Murgia et al.

We want to investigate magnetic fields in cluster of galaxies through the Rotation Measure synthesis of non-thermal radio halos. For this purpose, we construct virtual observations of radio halos from numerical simulations of turbulent random magnetic fields models and we study the radio halo polarized emission as function of the Faraday depth for different magnetic field power spectra.

O'Sullivan, Shane – University College Cork
The Parsec-Scale Faraday Rotation Measure Distribution of Quasars at z > 3

I will present results from eleven high-redshift (z > 3) quasars that were successfully observed and imaged in full polarization at both 5 and 8.4 GHz using Global VLBI. The observed high core brightness temperatures are consistent with Doppler boosted emission from a relativistic jet orientated close to our line-of-sight; this can also explain the dramatic jet bends observed for some of the sources. The derived jet spectral index distributions support the argument for a steep-spectrum population of the most distant radio quasars, even considering their high emitted frequencies. Furthermore, taking the minimum angle separation between the model-fitted polarization angles at 5 and 8.4 GHz enabled estimation of the minimum RM for each component. Six of the quasars have minimum observed RMs of several hundred rad/m^2 implying very high intrinsic RMs of the order of 10^4 rad/m^2 or greater. This is higher than the intrinsic core RMs found in nearby sources suggesting that high-redshift quasars may reside in significantly denser environments. I will also present results from follow-up polarization observations for one of the sources, at six frequencies from 5-15 GHz with the VLBA, which confirms the high intrinsic RMs and steep jet spectral index distribution.

Rudnick, Lawrence – University of Minnesota
Complex polarization behaviour from two simple screens: the case of 3C33
L. Rudnick, D. Farnsworth, S. Brown

We present an analysis of broadband 350 MHz WSRT polarization observations of 3C33, supplemented by narrow band data from the literature. We use a combination of Rotation Measure Synthesis, along with the wavelength squared dependencies of Q, U, P and Chi and the Argand diagram of Q vs. U to evaluate models of the Faraday structure. The data show a sharp null in polarized intensity at 89 cm wavelength and a nonlinear position angle behaviour with wavelength squared, displaying "pseudo-" local Rotation Measures ranging from less than 1 to over 12 rad/m^2. We show that the data from 21 cm longward are consistent with a simple model of two dominant external screens. Such models give rise to an extremely rich variety of polarization behaviours as a function of wavelength, with a high sensitivity to the amplitude ratio of the two components and the difference in their Rotation Measures. This presents a considerable challenge for Faraday modelling that has been so far ignored.

Taylor, Greg – University of New Mexico
High Fidelity Rotation Measures Across Parsec-Scale Jets
G.B. Taylor and R.T. Zavala

Considerable excitement has greeted the results of Asada et al. (2002) showing RM gradients across the jet in 3C273. These transverse RM gradients have been hailed as the signature of magnetic confinement, the leading model for confinement of jets in AGN. We have carried out new multi-frequency VLBA observations of a sample of strong, resolved jets in order to search for RM gradients or place strong constraints on their absence. In the spirit of this meeting we will also discuss some of the perils and pitfalls of VLBI polarimetry, especially as it applies to the generation of RM distributions on parsec-scales.

Tremblay, Steven – University of New Mexico
Polarization Properties of Active Galaxies on Parsec Scales
S.E. Tremblay, G.B. Taylor, J.F. Helmboldt

The VLBA Imaging and Polarimetry Survey (VIPS; Helmboldt et al. 2007) collected polarization data on a flux limited sample of 1119 sources. Multi-frequency full polarization follow-up observations were performed on a subset of Compact Symmetric Object (CSO) candidates to spectrally and morphologically classify them. CSOs are of interest as they could be an early stage in the evolution of radio galaxies. They also sample the environment close to the central engine, and can be used to test the predictions of unified schemes. While CSOs usually exhibit little or no polarization, our sample is large enough to include some atypical examples. Here we present polarization data on the VIPS CSOs, including rotation measure maps where possible.

Vacca, Valentina – Università degli studi di Cagliari
The intra-cluster magnetic field power spectrum in relaxed galaxy clusters from rotation measure studies
V. Vacca et al.

The goal is to constrain the magnetic field power spectrum in relaxed, cool core, galaxy clusters by comparing Faraday rotation measure images of central radio galaxies with the expectations of 3-dimensional numerical simulations.

Posters

Asada, Keiichi – Institute of Astronomy and Astrophysics, Academia Sinica
Rotation Measure Observations for AGN jets using VLBA

We present results of VLBA multi-frequency polarimetry of AGN jets to reveal a distribution of Faraday rotation Measure. As the results, we detected the gradient of the RM for the jet with enough polarized flux and wide width. The gradient of the RM across the jet has been well interpreted by a helical magnetic field, which is frequently invoked by many MHD models. In addition, we detect the change of the sign of the RM from one side to the other. It strongly suggests the change of direction of the magnetic field, because only magnetic field can change the sign of the RM.

Bruni, Gabriele – INAF Istituto di Radioastronomia
Rotation Measures of Radio-Loud Broad Absorption Line Quasars
About 15% of the quasar population show broad absorption lines in their spectra generated from outflows with velocities up to 0.2 c. We selected a complete sample of Radio Loud Broad Absorption Line Quasars from the Sloan Digital Sky Survey, in order to study their spectral properties and orientation features at radio wavelengths. At the moment two models have been presented to explain these objects: an orientation model (Elvis 2000) and an evolutionary scenario (Becker et al. 2000).
We found that the majority of our sources are compact, ~50% Gigahertz Peaked, with small fractional polarisation and show irrelevant variability. Rotation Measures are distributed in a wide range of values, and one source (1624+37) has the second highest value known. This might suggest a denser environment around the central engine, to be compared with optical column density values. We have embarked on a project to test whether such high Rotation Measures are common in BAL QSOs or whether 1624+37 is a peculiar object.

Drzazga, Robert T. – Astronomical Observatory of the Jagiellonian University
Interactions of radio lobes of NGC4569 with the ICM
R.T. Drzazga, K.T. Chyzy, M. Urbanik, R. Beck, D. Bomans, B. Vollmer, M. Soida

Galaxy NGC4569 is a member of the Virgo Cluster, located in high density medium, near the M87. It is highly deficient in HI gas resulting from strong ISM-ICM interactions. Previously performed radio polarimetric observations with the Effelsberg telescope revealed huge magnetized outflows extending 24 kpc from the galactic disk. Here we report preliminary results of our sensitive VLA polarimetric observations of this object at 21 and 6cm. We investigate the topology and properties of magnetic fields to discuss the origin end evolution of observed radio lobes and their interactions with the cluster medium.

Govoni, Federica – INAF Osservatorio Astronomico di Cagliari
Rotation measures of radio sources in hot galaxy clusters
F. Govoni et al.

We investigate Faraday rotation measure of radio galaxies in hot galaxy clusters in order to establish a possible connection between the magnetic field strength and the gas temperature of the intra-cluster medium.

Reichstein, Andrea – University College Cork
Parsec Scale Investigation of Spine+Sheath Structures in AGN Jets

Baseline Array (VLBA) of selected AGN that seem to have a magnetic (B) field structure with a central "spine" of B-field orthogonal to the jet and a longitudinal B-field near one or both edges of the jet. We found RM gradients transverse to a number of these jets, consistent with the idea that helical jet B-fields are the origin of this polarization structure. One of our sources shows a "slanted" RM gradient, which may be due to the combination of a helical jet B-field and a fall-off in electron density from the core.

List of Participants

Anderson, James M. -- *Max Planck Institut für Radioastronomie*
Asada, Keiichi -- *Institute of Astronomy and Astrophysics, Academia Sinica*
Bonafede, Annalisa -- *INAF Istituto di Radioastronomia*
Brentjens, Michiel -- *ASTRON*
Broderick, Avery -- *Canadian Institute for Theoretical Astrophysics*
Broderick, Jess -- *University of Southampton*
Bruni, Gabriele -- *INAF Istituto di Radioastronomia*
Cenacchi, Elena -- *Max-Planck-Institut f. Radioastronomie*
Clausen-Brown, Eric -- *Purdue University*
Cotton, William -- *NRAO*
Dolag, Klaus -- *MPI für Astrophysik*
Drzazga, Robert T. -- *Astronomical Observatory of the Jagiellonian University*
Ensslin, Torsten -- *Max Planck Institute for Astrophysics*
Feretti, Luigina -- *INAF Istituto di Radioastronomia*
Gabuzda, Denise -- *University College Cork*
Giovannini, Gabriele -- *Dipartimento di Astronomia - Università di Bologna*
Gomez, Jose L. -- *Instituto de Astrofisica de Andalucia - CSIC*
Govoni, Federica -- *INAF - Osservatorio Astronomico di Cagliari*
Gregorini, Loretta -- *Department of Astronomy - University of Bologna*
Guidetti, Daria -- *ESO*
Hovatta, Talvikki -- *Department of Physics, Purdue University*
Iacobelli, Marco -- *Leiden Observatory*
Jiraskova, Sarka -- *Radboud University Nijmegen*
Junklewitz, Henrik -- *Max-Planck-Institut für Astrophysik*
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