

UNIVERSITY OF MILAN

Public selection for recruiting No. 1 tenure track researcher(s) (RTT) for competition sector 02/C1 - Astronomy, Astrophysics, Earth and Planetary Physics, (scientific-disciplinary sector FIS/05 - Astronomy and Astrophysics) at the Department of PHYSICS "ALDO PONTREMOLI", (announcement published in Official Gazette No. 4011/2024_of 12/06/2024) - Competition code _5579

HESHOU ZHANG

CURRICULUM VITAE

(N.B. CV MUST BE OF UP TO 30 PAGES AND INCLUDE THE DETAILS CANDIDATES CONSIDER USEFUL FOR THE ASSESSMENT.

ALL THE TITLES INSERTED BELOW ARE JUST EXAMPLES THAT CAN BE REPLACED, CHANGED OR COMPLETED)

PERSONAL DATA (DO NOT INCLUDE YOUR PERSONAL ADDRESS AND LANDLINE OR MOBILE PHONE NUMBER)

SURNAME	ZHANG
NAME	HESHOU

QUALIFICATIONS

DEGREE

(Specify full degree name and related score, University, date, thesis title, etc.)

Degree name: Doctor rerum naturalium (Dr. rer. nat.),
Major: Astrophysics
Final grade: magna cum laude
From: The University of Potsdam,
Graduation Date: 08/Oct./2021,
Thesis title: "Magnetic fields in the universe: Diagnostics, turbulent properties, and their implications"

Degree name: Bachelor of Science (B.Sc.),
Major: Physics
From: Peking University,
Graduation Date: 01/Jul./2014
Thesis title: "Tracing Magnetic Fields in Extended Radiation Fields"
Thesis grade: 85/100 (A-)

DOCTORAL DEGREE OR EQUIVALENT QUALIFICATION EARNED IN ITALY OR ABROAD / MEDICAL SPECIALISATION DIPLOMA OR EQUIVALENT QUALIFICATION, FOR THE RELEVANT SECTORS, EARNED IN ITALY OR ABROAD

(Specify qualification full name and related score, institution, date, thesis title, etc.)

Equipollenza issued by Università degli Studi di Padova (issue in Dec. 2023, equipollenza for the doctoral degree on Astronomy, the equipollenza document attached in the application file) for the following Doctoral Degree :
Degree name: Doctor rerum naturalium (Dr. rer. nat.),
Final grade: magna cum laude
From: The University of Potsdam,
Graduation Date: 08/Oct./2021,

Thesis title: "Magnetic fields in the universe: Diagnostics, turbulent properties, and their implications"

RESEARCH CONTRACTS, RESEARCH FELLOWSHIP CONTRACTS, POSTDOCTORAL SCHOLARSHIPS OR SIMILAR CONTRACTS

(Specify, for each contract, university/institution, starting and termination date, duration in years, etc.)

Non-tenure fixed-term Lv. III researcher : 12/2022 - 12/2024, INAF-OAB, Italy (present position)
Postdoc Fellowship : 09/2022 - 12/2022, INAF-OAB, Italy
Research assistant : 09/2015 - 12/2021, DESY & Uni. Potsdam, Germany
Research assistant : 09/2014 - 07/2015, KIAA, Peking University, China

TEACHING ACTIVITIES AT ITALIAN OR FOREIGN UNIVERSITIES

(Specify academic year, university, degree course, number of hours/CFU, indicate type of activity, start and end date - day, month, year, etc.)

Teaching assistant: 2017-2018, graduate course "Physical processes in astrophysics", the University of Potsdam, Germany
Teaching assistant: 2016-2017, graduate course "Physical processes in astrophysics", the University of Potsdam, Germany

ATTESTED TRAINING OR RESEARCH ACTIVITIES AT QUALIFIED ITALIAN OR FOREIGN INSTITUTIONS

(Specify academic year, institution, course, period, commitment in terms of hours, indicate type of activity, etc.)

I performed research on astrophysics:
1) in KIAA-PKU, China (2014-2015). I was a full-time research assistant, and my main research target is measuring the magnetic field in diffuse interstellar medium.
2) in Desy and Uni. Potsdam, Germany (2015-2021). I was a research assistant and doctoral candidate, and my research includes measuring different plasma modes in interstellar turbulence, understand the role that different plasma modes play in cosmic ray transport, observe the magnetic field with polarized atomic lines from the ground state.
3) in INAF, Italy (2022-now). I was first a postdoctoral fellow. Then from Dec. 2022, I became a Lv. III fixed term researcher (non-tenure). My research target is to understand the non-thermal emission in the Galactic outflows, and study the cosmic ray transport in the magnetized Galactic halo.

ATTESTED ACTIVITY IN THE CLINICAL FIELD

(Specify date, duration, role, institution where the aid activity was carried out, etc.)

None.

IMPLEMENTATION OF PROJECTS

(Specify date, project name, indicate type of activity, any organization in favor of which the activity was carried out etc.)

1) Funding management project (time: from Dec. 2022 to present, name: X-ray in Studying the Multiphase Astrophysics "X-riStMas", institution: INAF-OAB, Italy).

I am the PI of 150k Euro grant under Italian Ministry of University and Research funded by European Union - NextGenerationEU. The current project is executed following the planned timeline. I already have 1 first-author publication (Zhang et al. 2024, accepted by Nature Astronomy).

2) Super-computing projects (time and organization: 2019-2021, HLRN Germany; 2023-2024, Pleaidi, INAF, Italy).

I have been the PI and Project admin for supercomputing projects. Our proposals have been granted for more than 20 million CPU hours. I have used parallel computing methods including MPI and OpenMP to perform 3D-MHD simulations. I have also used bash scripts and python to run multi-core data analyses. We have produced important results published in high impact journals (see publication list).

- 3) Observational proposal project (PI for ALMA observational proposal (Project Code: 2018.1.01687.S. Around 32 hours data delivered for ALMA band 8). Additionally, I was Co-I for accepted proposals in XMM, LBT, SOFIA (DDT), SALT)

4) Research projects that I lead:

I have led several groundbreaking projects and published in top astronomy journals (see publication list). My past research spans a broad range of projects from theory, simulation, to observations. I established a good and efficient work record. My previous research focuses on cutting-edge questions arising from new observations and I have developed innovative techniques to tackle them. I am especially good at analysis based on multi-wavelength observations and finding interesting physics underneath.

- a. multi-wavelength galactic outflows of the Milky Way (time: from 2022 to present, institution: INAF-OAB, Italy).

My first-author work (Zhang, Ponti+ 2024, No. 1 publication in my publication list) is accepted for Nature Astronomy, entitled “A magnetised Galactic halo from inner Galaxy outflows”. We perform the most comprehensive comparison between the new-discovered Milky Way outflows with multi-wavelength observational data from more than 10 all-sky surveys from radio-InfraRed-X-Gamma-ray, involving physical processes including synchrotron radiation, polarized dust emission, galactic outflows from active-star-forming regions, emission and absorption of hot plasma in X-ray, Inverse Compton scattering. Additionally, our work (Locatelli+2024 A&A) discusses the radio and X-ray extended features discovered around the LMC.

- b. Plasma MHD turbulence and its observation in ISM (time: from 2017-2020, institution: Desy & Uni. Potsdam, Germany).

Our work established the novel method, “Signature from Polarization Analysis” (SPA), which leads to the first detection of magneto-sonic modes in the interstellar medium (Zhang, Chepurnov+2020, with me as the first author published in Nature Astronomy, No. 2 publication in my publication list). The work used 3D-MHD simulations to distinguish different plasma because they show different anisotropy and axis-symmetry in the observed emissivity of synchrotron polarization signals. This work bridged the turbulence observation in radio band with gamma-ray observation from Fermi-LAT about the famous “Cygnus Cocoon”.

- c. High energy Cosmic Rays transportation (Multiple projects carried out in Desy and Uni. Potsdam, Germany during 2018 -2021; in INAF-OAB, Italy from 2022 - present).

I have worked on both theoretical and observational perspectives for cosmic ray transport. The two projects mentioned in point 4a and 4b have an important part on gamma-ray observation for diffuse emission in Galactic halo and ISM. Additionally, our work (Fornieri, Zhang 2022, PRD, with me as co-corresponding author) interpreted the gamma-ray observation in Cygnus X region through cosmic ray propagation modelling in different plasma modes. I have co-supervised the test particle simulation for high energy cosmic ray transport in different MHD modes (Maiti, Makwana, Zhang+ 2021 ApJ). Our research (Liu, Yan &Zhang 2019, PRL) has provided an explanation for observation of the Geminga’s TeV halo based on turbulence anisotropy. See more details about my contribution to those projects in the Scientific Publications’ part of this form (last part).

- d. Magnetic field measurements in the Universe (Multiple projects carried out in KIAA-PKU, China during 2014-2015; in Desy and Uni. Potsdam, Germany during 2015 -2021; in INAF-OAB, Italy from 2022 - present).

Magnetic field is ubiquitous in the Universe, but it is extremely challenging to measure it, especially in the diffuse medium. I have been working on magnetic field diagnostics for 10 years and am familiar with all the magnetic tracers for diffuse medium at different scales in the Universe (including circumstellar medium, interstellar medium, and galactic outflows etc). Magnetic field and turbulence play an important role in all the aforementioned projects in 4a-4c, including synchrotron polarization, polarized dust emission, Faraday Rotation, and spectral fitting from multi-wavelength spectral energy distribution. On top of these classic methodologies, I have more than 6 years of working experience on the novel magnetic tracer: Ground State atomic Alignment (GSA) and led its first observational discovery (Zhang, Gangi et al. 2020, ApJL, me as first author), which was 14 years after the theoretical proposal (since Yan & Lazarian 2006, ApJ). This work observed the 3D magnetic field in the stellar atmosphere of the post-AGB 89Herclius by mining 10 years of archive observational data of CFHT. My projects also cover other aspects of magnetic field measurements in the Universe: theory (Zhang et al. 2015, ApJ, Zhang&Yan, 2018, MNRAS), numerical simulation (Zhang et al. 2018, MNRAS). See more details about my contribution to those projects in the Scientific Publications' part of this form (last part).

ORGANISATION, SUPERVISION AND COORDINATION OF NATIONAL AND INTERNATIONAL RESEARCH GROUPS, OR PARTICIPATION IN THEM

(For each entry, specify year, role, research group, any financing institutions and amount of financing, indicate type of project, etc.)

Currently, I have established an international cooperation team to study the science about galactic outflows and feedback, including leading experts in multi-wavelength: G. Ponti (INAF, Italy, PI for the "hotmilk" Italian-German team studying the diffuse X-ray emission of the Galactic center and circumgalactic medium) for X-ray, E. Carretti (INAF, Italy, PI for S-PASS in 2.3GHz) for radio band, R.Y. Liu (Nanjing University, China, leading PWN study in LHAASO collaboration) and F. Aharonian (MPIK, Germany, scientific advisor for LHAASO) for gamma-ray, M.R. Morris (UCLA, USA, senior scientific advisor for the Galactic center group in UCLA). Our collaboration has established for 2 years since 2022, and our first result: HESHOU ZHANG, G. Ponti, E. Carretti, et al. "A magnetised Galactic halo from inner Galaxy outflows", (2024) has just been accepted in principle by Nature Astronomy.

Before I obtained my Ph.D. degree, I have worked in the plasma astrophysics group in Desy and Uni. Potsdam, Germany. I have also worked for the institutional supervision program for pre-doctoral students: I supervised summer students in Desy summer school program in Jul.-Sep. 2017 and Jul.-Sept. 2019 summer for total 3 students (Sarah Appleby, Jen Kantapon, Bolu Feng) in Desy, Germany. Co-organization for the international conference "The Midwest Magnetic Fields Meeting 2022" (MMF2022, online) and chairing one of the discussion sessions.

HOLDING PATENTS

(For each patent, specify authors' names, title, classification (national or international), patent number, etc.)

None.

SPEAKING AT NATIONAL AND INTERNATIONAL CONFERENCES AND CONVENTIONS

(Specify conference/convention title, date, duration in days/hours, organizing institution, etc.)

Presentations are listed in time sequence (conference talks first, and the institutional talks):

- 1) "Atomic alignment- probing magnetic field in diffuse media and beyond", KIAA-SHAO bi-lateral workshop2015, Beijing, China, May 2015
- 2) "Fine-structure lines and Magnetic Field", SOFIA2017 Ringberg Workshop, Ringberg, Germany, Mar. 2017

- 3) "Probing Magnetic field with submillimeter spectropolarimetry", Magnetic Fields in the Universe VI (MFUVI), Natal, Brazil, Oct. 2017
- 4) "Tracing magnetic fields with the polarization of submillimeter lines", Submm/mm/cm Q&U (and V) European Southern Observatory Workshop (QUESO2017), ESO, Germany, Oct. 2017
- 5) "Identification of magnetosonic modes in Galactic turbulence with synchrotron polarization", First TagKASI International Conference: Cosmic Dust and Magnetism (TagKASI2018), KASI, Daejeon, South Korea, Oct. 2018
- 6) "Cosmic compass - First tomography of an outer 3D sub-Gauss field via atomic alignment", The 2019 Midwest Magnetic Field Meeting (MMF2019, Invited), Madison, Wisconsin, USA, May 2019
- 7) "Cosmic compass - First tomography of an outer 3D sub-Gauss field via atomic alignment", Workshop on Polarization in Protoplanetary disks and jets, Sant Cugat, Spain, May 2019
- 8) "Measurement of 3D magnetic field with atomic alignment", Virtual Annual Meeting of the German Astronomical Society, Germany, Sept. 2020
- 9) "The observation of 3D magnetic field with atomic alignment", The 2021 Midwest Magnetic Field Meeting (MMF2021, Invited), Madison, Wisconsin, USA, June 2021
- 10) "First identification of plasma modes in Galactic turbulence with synchrotron polarization", The Past, Present, and Future of the VLA: Celebrating 40 Years, USA, Aug. 2021
- 11) "The observation of 3D magnetic field with atomic alignment", Astrophysical Magnetic Field Colloquium Series (AMF2021, Invited), Madison, Wisconsin, USA, Nov. 2021
- 12) "The observation of 3D magnetic field with atomic alignment", The Midwest Magnetic Fields Meeting 2022 (MMF2022, Invited), Madison, Wisconsin, USA, May. 2022
- 13) "Observation of MHD modes and its implications on cosmic ray transport", 6th Asia Pacific Conference on Plasma Physics - Division of Plasma Physics (AAPPS-DPP2022, Invited), online conference of Association of Asia-Pacific Physical Societies, Oct. 2022
- 14) "A multi-wavelength view of the eROSITA Bubbles", EAS2024, Padova, Italy, Jul. 2024
- 15) "Non-thermal radiation due to CR transport in the magnetic halo of the Milky Way", High energy astrophysics session, The 17th Marcel Grossmann Meeting, Pescara, Italy, Jul. 2024
- 16) "Multi-wavelength view of the Galactic Center outflows", (Invited) for the session "Latest results from Galactic center observations", The 17th Marcel Grossmann Meeting, Pescara, Italy, Jul. 2024
- 17) Talks in different institutions:

CfA (Harvard-Smithsonian Observatory, SMA seminar); Institute for Advanced Study (Bahcall Lunch); Princeton University; Caltech; INAF-OAB (Italy); MPE (Germany); Univ. Free State (South Africa); KIAA (Peking Uni.); Beijing Normal University (Beijing); Nanjing University (Nanjing)

NATIONAL AND INTERNATIONAL AWARDS AND ACCOLADES FOR RESEARCH ACTIVITY

(Specify award and motivation for the award, date, issuing organisation, etc.)

- 1) PI of 150k Euro grant for the “X-riStMAs” project (2022.12 - present, Seal of Excellence n. [0000153]. The acronym stands for “X-ray in Studying the Multiphase Astrophysics”) under the PNRR of Italian Ministry of University and Research funded by the European Union - NextGenerationEU
- 2) “Seal of Excellence” Awards from the European Commission under the Horizon Europe Marie Skłodowska-Curie Actions call MSCA Postdoctoral Fellowships 2021 and 2022
- 3) 2020 Chinese Government Award for Outstanding Self-financed Students Abroad (Top 500 among all Chinese Ph.D. graduate students of the year for all majors across the world) under China Scholarship Council
- 4) PI for ALMA observational proposal (Project Code: 2018.1.01687.S. Around 32 hours data delivered for ALMA band 8). Co-I for accepted proposals in LBT, SOFIA (DDT), SALT, XMM.
- 5) PI and Project Admin for HLRN (Germany) and PLEIADI (INAF, Italy) computing program with more than 20 million CPU hours granted.
- 6) Summa Cum Laude for Ph.D. defence; Magna Cum Laude for Ph.D. thesis in Uni. Potsdam, Germany

HOLDING A EUROPEAN SPECIALISATION DIPLOMA RECOGNISED BY INTERNATIONAL BOARDS

(For those competition sectors for which it is requested)

(Specify diploma and indicate the area, date, institution that awarded the diploma, etc.)

None.

QUALIFICATIONS UNDER ART. 24, PARAGRAPH 3.a AND 3.b, OF LAW No. 240/2010 OF 30 DECEMBER 2010

(Specify whether it is a type A or type B contract, University, contract effective date and end date, etc.)

- 1) I hold a Ph.D. degree in astrophysics, obtained from the University of Potsdam in Germany.
- 2) My Ph.D. degree has been examined and issued the Equipollenza recognition by Università degli Studi di Padova, as equivalent to the doctoral degree in astronomy in Italy.
- 3) I have a good publication record, including 2 first-author Nature Astronomy paper.
- 4) I have funding management experience by PI 150k Euro from the NextGenerationEU program.
- 5) I have teaching experience and supervision experience.
- 6) I can speak fluent English as my working and communicating language. I have gained some knowledge of Italian, and I am willing to take more Italian course to improve my language skills if needed.
- 7) My research is very relevant to the call because I study cosmic ray transportation in interstellar turbulent magnetic field, and multi-wavelength galactic outflows. These studies play a very important role in the galactic feedback related to cosmology, as well as relativistic particle acceleration and scattering in the Universe.
- 8) I am not working on tenured or tenure-track contracts.
- 9) I am not a relative to the people in the University.
- 10) I have no criminal record and enjoy civic and political rights in my home country.
- 11) I have not been removed from an employment before.
- 12) I possess a valid residence permit in European Union.

SCIENTIFIC PRODUCTION

SCIENTIFIC PUBLICATIONS

(For each publication, specify the following: authors' names, full title, publisher, date and place of publication, ISBN/ISSN/DOI or equivalent code)

Below I list 12 of my publications. Among them, I have

2 first-author papers in *Nature Astronomy*,
1 first-author paper in *Astrophysical Journal Letter*,
2 first-author papers in *Montly Notice of Royal Astronomical Society*,
1 first-author paper in *Astrophysical Journal*,
1 paper in *Physical Review D* as the second and corresponding author,
another three papers as contributing authors,
my Ph.D thesis in 2021,
as well as one first-author research result on ArXiv.

In total, there are 8 first-author publications. Below I list all my publications based on my author order and the year of publication. I will provide a brief introduction to each of the publications and my contributions inside the works below each work.

a) First-author publications in Nature Astronomy:

1. **HESHOU ZHANG**, G. Ponti, E. Carretti, et al. "A magnetised Galactic halo from inner Galaxy outflows", (2024) *Nature Astronomy*, accepted in principle by the journal (Manuscript No. NATASTRON-24020176), invited to be highlighted in the Research Briefing of Nature Astronomy (proof emails scanned in the attachment, Research Briefing journal reference No. NATASTRON-24070608).

This work reveals a magnetic halo featuring coherent magnetized ridges several kilo-parsecs above and below the Galactic disc and its gamma-ray counterpart. They are likely due to outflows driven by star-forming regions in the Galactic disc, 3-5 kpc from the Galactic center. I am the first and corresponding author of the paper, leading the whole project. Because the paper is under the embargo from the journal, I submit the accepted version of the paper for this application as well as the emails proof for its acceptance.

2. **HESHOU ZHANG**, A. Chepurnov, H. Yan et al, "Identification of magnetosonic modes in Galactic turbulence with synchrotron polarization", (2020) *Nature Astronomy*, Volume 4, p. 1001-1008, DOI: 10.1038/s41550-020-1093-4

This work proposes a novel method to identify the magnetosonic modes with the statistics of synchrotron polarization. We made progress in theory, simulation and observation: the theoretical development yields the method, the numerical simulation to test the new method with supercomputing, the observational analysis on finding magneto-sonic modes for the first time in galactic medium, and the multiple waveband comparison with Fermi, CO survey, rotation survey, dust survey to solve the "Cygnus Cocoon" mystery. I am the first author and lead the whole project.

b) Other first-author or corresponding-author publications

3. **HESHOU ZHANG**, M. Gangi, F. Leone et al, "Discovery of Ground-state Absorption Line Polarization and Sub-Gauss Magnetic Field in the Post-AGB Binary System 89 Her", (2020) *Astrophysical Journal Letter*, Volume 902, id.L7, 7 pp., DOI: 10.3847/2041-8213/abb8e1

This work goes through 10 years of archive observational data from CFHT and finds the first direct 3D measurement of sub-Gauss magnetic field from the stellar environment of the post-AGB 89 Herculis with the novel method, Ground State Alignment (GSA). It is the first observational proof of GSA 14 years after its theoretical proposal (Yan & Lazarian 2006). PI is the first author and lead the whole project.

4. **HESHOU ZHANG**, H. Yan, "Polarisation of submillimetre lines from interstellar medium", (2018) *MNRAS*, Volume 475, Issue 2, p.2415-2420, DOI: 10.1093/mnras/stx3164

This work composed of two parts: first, a comprehensive analysis on the potential of GSA as a magnetic tracer with different submillimeter fine-structure lines (some common lines showing more than 20% potential), useful with current telescopes with ALMA and SOFIA. Secondly, the work used MHD simulation to justify that GSA works for multiple scales, up until trans-Alfvenic magnetic turbulence. I am the first author and lead the whole project.

5. **HESHOU ZHANG**, H. Yan, P. Richter, “The influence of atomic alignment on absorption and emission spectroscopy”, (2018) *MNRAS*, Volume 479, Issue 3, p.3923-3935, DOI: 10.1093/mnras/sty1594

Utilizing analytical calculation and MHD simulation, this work reveals that the spectroscopic analysis is not appropriately calibrated without accounting for GSA, with a more than 50% difference within multiplets. It is crucial to account for this after GSA's first observation (see [3] in the publication list). I am the first author and lead the whole project.

6. **HESHOU ZHANG**, H. Yan, L. Dong, “Tracing Magnetic Fields by Atomic Alignment in Extended Radiation Fields”, (2015) *Astrophysical Journal*, Volume 804, Issue 2, article id. 142, 15 pp., DOI: 10.1088/0004-637X/804/2/142

This work analyzed theoretically GSA in general radiation field. It shows that the radiation in typical diffuse gas will provide enough anisotropy for atomic alignment. Combining with other theoretical expectation for the more than 20% polarization expected from different waveband (e.g., Yan & Lazarian2006, [4]), it reveals GSA is a strong magnetic tracer. I am the first author and lead the whole project.

7. **HESHOU ZHANG**, “Magnetic fields in the universe: diagnostics, turbulent properties, and their implications”, (2021) Ph.D. thesis, Book PPN: 1786849674. in the library system of the University of Potsdam.

This is my Ph.D thesis for astrophysics in Uni. Potsdam. The thesis is awarded “magna cum laude”.

8. **HESHOU ZHANG**, H. Yan, “Polarization of fluorescence lines: tracing magnetic field from circumstellar medium to early universe “, (2021) *ArXiv*: 2111.09184, DOI: 10.48550/arXiv.2111.09184

This work studies the polarization in atomic emission lines related to the Ground State Alignment effect. Our results found that these polarization signals can be used to trace magnetic field in different cosmic time. I am the first author and lead the whole project.

9. O. Fornieri, **HESHOU ZHANG**, (as co-corresponding author), “MHD decomposition explains diffuse γ -ray emission in Cygnus X”, (2022) *Physical Review D*, Volume 106, Issue 10, article id.103015, DOI: 10.1103/PhysRevD.106.103015

This work studies the CR propagation in different plasma modes as observed in Cygnus X region. It finds that the difference between the diffusions of CRs in magneto-sonic/Alfvenic modes could explain the observed diffuse gamma-ray enhancement in the Cygnus Cocoon as observed by Fermi-LAT and HAWC. I am the corresponding author and performed the MHD simulation, studied the CR propagation environment and lead multi-wavelength comparison between theory results and observation.

c) Other contributing-author publications

10. R.-Y. Liu, H. Yan, **HESHOU ZHANG**, “Understanding the multiwavelength observation of Geminga's TeV halo: the role of anisotropic diffusion of particles”, (2019) *Physical Review Letter*, Volume 123, Issue 22, id.221103, DOI: 10.1103/PhysRevLett.123.221103

This work proposes a novel perspective to explain Geminga TeV halo: the anisotropy of turbulence. I am the third author and performed the MHD simulation and calculated the degree of anisotropy and the change of CR scattering angle in different turbulence environments.

11. S. Maiti, K. Makwana, **HESHOU ZHANG**, H. Yan, "Cosmic ray Transport in Magnetohydrodynamic turbulence", (2022) *Astrophysical Journal*, Volume 926, Issue 1, id.94, 8 pp., DOI: 10.3847/1538-4357/ac46c8

This work performs test particle simulations in different MHD turbulence as well as decomposed MHD modes to study the CR transport properties in magnetic turbulence. It shows that fast modes indeed govern the CR scattering. The perpendicular transport is strongly dependent on the Alfvénic-Mach number. The super diffusion is observed. I performed the MHD simulations, co-supervise the test particle simulation and lead the manuscript preparation.

12. S.Q. Zhao, C.J. Xiao, T.Z. Liu, H. Chen, H. Zhang, M.J. Shi, S. Teng, **HESHOU ZHANG**, et al., "Observations of the Beam-Driven Whistler Mode Waves in the Magnetic Reconnection Region at the Dayside Magnetopause", (2020), *Journal of Geophysical Research: Space Physics*, Volume 126, Issue 2, article id. e28525, DOI: 10.1029/2020JA028525

This work studies the beam-driven whistler mode waves in the magnetic reconnection region observed in the dayside magnetopause using magnetospheric multiscale mission. I contributed to the discussion of wave-particle interactions.

Date

18/Jul./2024

Place

Merate, Italy