

# Yashika Ghai

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## Work Experience

### R&D Research Associate-

May, 2021-Present

Plasma Theory and Modeling, Fusion Energy Division, FFESD

**Oak Ridge National Lab,**

Oak Ridge, TN, USA

### Postdoctoral Research Associate-

November, 2019-April, 2021

Plasma Theory and Modeling, Fusion Energy Division, FFESD

**Oak Ridge National Lab,**

Oak Ridge, TN, USA

## Research Experience

### R&D Research Associate, ORNL

- Developing surrogate models for energetic particle transport using machine learning tools.
- Analyzed Alfvén eigenmodes instability in W7-X stellarator using FAR3d code.
- Developing theoretical models consistent in the edge-pedestal region of a tokamak
- Adapted and tested tracer particle code KORC to track ion trajectories
- Compared the validity of full orbit vs guiding center plasma models for ions in the edge-plasma region of a tokamak.
- Coupled two in-house codes- AORSA and KORC to study the coupling of whistler waves with runaway electrons (REs) in a tokamak that leads to pitch angle scattering of the REs as a potential solution for the mitigating the harmful effects of Runaways.
- As part of US 2022 Theory Milestone target, studied and compared AE instabilities in the ITER steady state and baseline test cases with matching DIII-D experimental cases.
- Studied nonlinear coupling of energetic particles driven Alfvén eigenmodes and associated fast ion transport in negative-positive triangularity plasmas using FAR3d code.

### Post-Doc, ORNL

- Studied the impact of different plasma shaping on the Alfvén instabilities driven by energetic particles in a fusion device.
- Understood working and application of existing gyrokinetic and fluid codes such as GTC, FAR3D, STELLGAP, STELLOPT, VMEC.
- Developed theoretical models describing energetic particle dynamics in a fusion plasma by adding higher order fluid moment equations.
- Modified existing computational codes to implement new models with higher-order velocity moment equations for the study of energetic particle driven instabilities.

### Ph.D. (Theoretical Plasma Physics), GNDU, India

- Studied nonlinear waves, instabilities and Landau damping of waves in multi-component and dusty plasma environments.

- Employed fluid and kinetic models for plasma along with the non-Maxwellian distribution functions (Kappa-type distribution, Cairns nonthermal distribution) for the charged particle species and derived nonlinear equations describing plasma wave dynamics.
- Analyze time-evolution studies of the nonlinear structures numerically by using MATHEMATICA and MATLAB softwares.
- 11 research publications that highlight significant effects of non-Maxwellian character of the velocity-distribution functions of charged particles, visco-elasticity of the medium, wave-particle interaction, etc. on the propagation of nonlinear structures in different space and astrophysical plasma environments.

#### **Summer Internship** 2013 at Institute of Plasma Physics (IPR), India:

- Selected among 25 students from various institutes all over India during Master's degree to attend a summer school Program (SSP-2013) at "Institute of Plasma Research (IPR), Gandhinagar" from June-July 2013.
- Worked on a research project in ITER-India that has been published in the Journal of Fusion Science and Technology and as a conference paper in the EPJ Web of Conferences.

#### **Project Leadership:**

- **Principal Investigator: Early-Career Lab-directed Research and Development (LDRD)-** "Role of energetic particle transport on burn control in fusion devices", Date(s) of project: 3/1/2024-2/28/2026, Funding amount: \$300 K
- **Co-PI:** FY2022 LDRD proposal- Integrated Plasma Power Exhaust Solutions for a Fusion Pilot Plant, Date(s) of project: 10/1/2021-9/30/2023, Funding amount- \$1257 K

#### **Education**

**Ph.D. (Theoretical Plasma Physics)**  
August, 2014 - July 2019

**Department of Physics, Guru Nanak Dev University,**  
Amritsar, Punjab, India

**M.Sc. (Hons.) Physics**  
2012-2014

**Department of Physics, Guru Nanak Dev University,**  
CGPA 9.46/10  
*Among top three in a class of sixty students.*

**B.Sc. Phys., Math and Comp.Sci.**  
2009-2012

**D.A.V. College, Amritsar, India**  
Marks Percentage: 68.83%.

- Add-on course in Computer Animation and Graphics.
- Awarded a 'prize of merit' for obtaining maximum marks in Physics and English.
- Awarded a memento for representing D.A.V. College in Youth festival at state and interstate level debate competitions.

#### **Accomplishments**

##### **Awards:**

- 2024-EC-LDRD grant
- Won the title of best 2-minute talk in a lab-wide "Your Science in a Nutshell 2020" contest organized at ORNL.
- International Travel Grant from Department of Science and Technology (DST-SERB) for attending "45<sup>th</sup>

*IEEE International Conference on Plasma Science (ICOPS 2018)*”, at Denver (CO), USA.

- Research Travel grant for attending “*Joint 13<sup>th</sup> Asia Pacific Physics Conference and 22<sup>nd</sup> Australian Institute of Physics Congress*” at Brisbane, Australia.
- Department of Science and Technology (DST), India award for participation in “*66<sup>th</sup> Lindau Meeting of Nobel laureates & students*”, 2016 at Lindau, Germany.
- Qualified national level Exam “Graduate Aptitude Test Engineering –GATE 2015”.

### **Professional activities:**

- **Executive Committee member:** US-EU Transport Task Force meeting (TTF) - 2024 onwards.
- **Program committee member-** “Sherwood Fusion Theory Conference 2022” held from April 3-6, 2022 at Santa Rosa, CA.
- **Scientific reviewer for Journals** - *Nuclear Fusion, Physics of Plasmas, Plasma Physics and Controlled Fusion, Waves in Random and Complex Media, Zeitschrift für Naturforschung A- A journal of physical sciences.*
- **Co-organizer** of ITPA-Energetic particles meeting held at Oak Ridge in May, 2023.
- **Mentored** an under-graduate SULI summer internships program 2023 from Xavier University, Louisiana
- **Co-mentored** an under-graduate student from Georgia Tech university under Suli Internships program at ORNL during Summer-2021.
- **Chairperson** of directorate level FFESD education outreach committee at ORNL. Participant of ITPA-energetic particles activity.
- **APS-Career mentoring fellow**
- **Panelist at Princeton Center for Theoretical Sciences (PCTS) workshop on** “Synergistic approaches to magnetized plasma turbulence-from laboratory to astrophysics”.
- **Panelist for “Early Career panel” at the** Pathways to Computing Internship Program (PCIP) workshop at ORNL.
- **Panelist for “DISC-Assessment styles”** at ORNL.
- **Participated in a mock interview panel for MIT graduates** as part of WINGS employee resource group at ORNL.
- **Served at Interview panels for Group leader, Division Director, Post doc recruitment.**

**Scientific Writing:** I voluntarily worked as an editor at a science-blog named "The Secrets of the Universe" (<https://secretsofuniverse.in/>) where I frequently wrote popular science articles and shared my research experiences. I completed a "Month of Equations" series along with the admin where we used to post an article daily on a popular scientific equation and also contributed several articles to the “Basics of Astrophysics” series.

- Published an article titled “Controlling plasma instabilities in a fusion reactor” in GNDU science magazine “INERTIA”, issue- August, 2021.

### **Public Speaking:**

- FIRST in inter college extempore competition.
- Participated in YOUTH FESTIVAL 2011 and bragged 2<sup>nd</sup> position in state level debate competition.
- First in presentation on “Nuclear Energy” on “National Science day-2011” at Guru Nanak Dev University, Amritsar

**Team Work & Discipline:** NCC (Air Wing) C-Certificate holder - A grade

## Technical and soft skills

- Programming in MATLAB, Mathematica, Fortran and Python
- Graphics visualization software-Visit
- MS office, Latex
- Analytical skills
- Public speaking
- Scientific Writing
- Interpersonal and written communication
- Methodology implementation

## Workshops and Presentations

- Invited talk titled “Role of energetic particle physics for burn performance of a reactor-level fusion device”, at Princeton center for theoretical sciences workshop on “Synergistic approaches to particle transport in magnetized turbulence” held from April 15-17, 2024.
- Seminar at PPPL theory department on “Modelling interaction of Runaway electrons with Whistler waves using KORC-AORSA model” on April 19, 2024.
- Contributed talk titled “Modelling interaction of Runaway electrons with Whistler waves using KORC-AORSA model”, at US-EU Transport Task Force meeting, held from April 9-12, 2024.
- Poster presentation titled “Application of FAR3d gyro-Landau fluid model for analyzing AE instability in stellarators”, at APS-DPP meeting 2023, held from Oct 30<sup>th</sup>-Nov. 3<sup>rd</sup>, 2023.
- Presented a poster titled “Alfvén instabilities driven by fast ions in DIII-D plasmas with a negative triangularity” at MIT-PSFC summer school held at MIT-Boston, 2023 from August 21-26, 2023.
- Contributed talk titled “Modelling interaction of Runaway electrons with Whistler waves using KORC-AORSA model” at US Transport Task Force meeting held from May 3-5, 2023.
- Poster presentation titled “Modelling interactions between runaway electrons and whistler waves”, at Sherwood Fusion Theory conference held from May 8-10, 2023.
- Contributed talk titled “ Modelling interaction of runaway electrons with whistler waves using KORC-AORSA model” at APS-Division of Plasma Physics conference held from Oct 16-Oct 20, 2022.
- Contributed talk titled “Modelling energetic particle instabilities using FAR3D for ITER simulations” at 27<sup>th</sup> Meeting of ITPA topical group on Energetic Particle Physics held from May 2-6, 2022.
- Contributed talk titled “Modelling energetic particle instabilities using FAR3D for ITER simulations” at 2022 Transport Task Force Meeting held from April 3-6, 2022.
- Contributed talk titled “Instabilities driven by fast ions in DIII-D plasma with a negative triangularity”, at 26<sup>th</sup> Meeting of ITPA topical group on Energetic Particle Physics held from Nov 2-5, 2021.
- Contributed oral talk titled “Negative triangularity shaping effects on Alfvén eigenmodes in DIII-D plasma”, at 17th IAEA Technical Meeting on Energetic Particles, held Dec 6-9, 2021.
- Contributed talk titled “Effect of negative triangularity shaping on Alfvén eigenmodes and fast ion transport in DIII-D” at 64<sup>th</sup> Annual Meeting of APS division of Plasma Physics held from October 17-21, 2021.
- Contributed talk on “ Suppression of Alfvén eigenmodes with negative triangularity plasma shaping”, at 2021 Sherwood Conference held from August 16-18, 2021
- Presentation titled “Effects of plasma shaping on energetic particle driven Alfvén eigenmodes in DIII-D” at ITPA-EP 2021 meeting held from May 17-21, 2021.

- Oral presentation titled “Instabilities driven by fast ions in DIII-D plasmas with a negative triangularity” at US-EU Transport Task Force 2021 meeting held on April 19-23, 2021.
- Presentation titled “Controlling energetic particle driven Alfvén instabilities in Fusion Plasmas” at a youtube channel named ‘Fusion EP talks’ held on Dec 14, 2020.
- Presented invited talk titled “Science- For and With the Society” to undergraduate students of Khalsa College of Engineering and Technology, Amritsar on the occasion of World science Day 2020.
- Presented a poster titled “An improved gyrofluid model to study energetic particle instabilities” at the virtual APS 2020 conference held on Nov 9-13, 2020.
- Oral presentation titled “A 3+1 moments gyrofluid model to study energetic particle driven instabilities in fusion plasma” at the “International conference on Plasma Theory and Simulations (PTS-2020)” held virtually on Sept 14-15, 2020.
- Participated in PPPL Simons Summer School 2020 on 'Stellarator Optimization' held on Aug 17-21, 2020.

### Scientific Publications

- J Varela, D A Spong, L Garcia, **Y Ghai**, D Zarzoso et al, Effect of the neutral beam injector operational regime on the Alfvén eigenmode saturation phase in DIII-D plasma, Plasma Physics and Controlled Fusion, 65, 125004 (2023).
- J. Ortiz, J. Varela, D. A. Spong, L. Garcia, **Y. Ghai**, Study of Alfvén eigenmode stability in Quasi-Poloidal Stellarator (QPS) plasma using a Landau closure model, Nuclear Fusion 63 (5), 056010 (2023).
- Jacobo Varela, J Huang, Donald Spong, J B Chen, V Chan, Luis Garcia, Andreas Wingen, **Yashika Ghai**, Y Zou, “Theoretical study of the Alfvén eigenmode stability in CFETR steady state discharges”, Nuclear Fusion, 62 (2022).
- **Yashika Ghai**, Donald A Spong, Jacobo Varela, Luis Garcia, MA Van Zeeland, ME Austin, “Effects of negative triangularity shaping on energetic particle driven Alfvén eigenmodes in DIII-D, Nuclear Fusion, 61,126020, 2021.
- Jacobo Varela, Donald A Spong, Luis Garcia, Satoshi Ohdachi, KY Watanabe, Ryosuke Seki, **Yashika Ghai**, “Theoretical analysis of the saturation phase of the 1/1 energetic-ion-driven resistive interchange mode, Nuclear Fusion, 61, 126016, 2021.
- D. A Spong, MA Van Zeeland, WW Heidbrink, X Du, J Varela, L Garcia, **Yashika Ghai**, “Nonlinear dynamics and transport driven by energetic particle instabilities using a gyro-Landau closure model”, Nuclear Fusion, 61 (2021).
- Jacobo Varela Rodríguez, Akihiro Shimizu, Donald A Spong, Luis Garcia and **Yashika Ghai**, “Study of the Alfvén Eigenmodes stability in CFQS plasma using a Landau closure model”, Nuclear Fusion, **61**, 026023 (2021).
- **Yashika Ghai**, N. S. Saini and B. Eliasson, “Neutrino-driven instability of ion acoustic waves in an ultrarelativistic degenerate plasma”, The Astrophysical J., 884 (2019).
- **Yashika Ghai**, Nimardeep Kaur, Kuldeep Singh and N. S. Saini, “Dust acoustic shock waves in magnetized dusty plasma”, Plasma Sci. and Tech. , 20, 074005 (2018).
- **Yashika Ghai**, N. S. Saini, B. Eliasson, “Landau damping of dust acoustic solitary waves in nonthermal plasmas”, Phys. Plasmas, 25, 013704 (2018).
- Kuldeep Singh, **Yashika Ghai**, Nimardeep Kaur and N. S. Saini, “Effect of polarization force on dust acoustic Cnoidal waves in dusty plasma”, The European Physical Journal D”, 72, 160 (2018).

- Nimardeep Kaur, Kuldeep Singh, **Yashika Ghai** and N. S. Saini, “Non-planar dust acoustic solitary and rogue waves in an ion beam plasma with superthermal electrons and ions”, *Plasma Sci. Technol.*, 20, 074009 (2018).
- **Yashika Ghai**, Manpreet Singh, N. S. Saini, “Effect of Nonthermal Electrons and Ions on Longitudinal Dust Acoustic Solitary Waves in a Strongly Coupled Dusty Plasma”, *IEEE Trans. Plasma Sci.*, 99 (2017)
- B. S. Chahal, **Yashika Ghai**, N. S. Saini, “Low-frequency shock waves in a magnetized superthermal dusty plasma”, *J. Theor. Appl. Phys.*, 11:181–189 (2017).
- **Yashika Ghai**, N. S. Saini, “Shock waves in dusty plasmas with two temperature superthermal ions”, *Astrophys. and Space Sci.*, 362:58 (2017).
- N.S. Saini, **Yashika Ghai**, Ripin Kohli, “Dust acoustic dromions in a magnetized dusty plasma with superthermal electrons and ions”, *J. Geophys. Res.*, 121 (2016).
- P.V. Subhash, **Yashika Ghai**, Hitesh K Pandya, Amit K Singh, A.M. Begum, P.Vasu, “Computational studies on ECE spectrum for ITER, in the presence of a small fraction of non-thermals and radial resolution evolution for oblique view”, *EPJ Web of Conferences* 87,03004, (2015).”
- P.V. Subhash, **Yashika Ghai**, S.K.Amit, A.M. Begum, P. Vasu, “Radial Resolution Evaluation for Oblique-View Electron Cyclotron Emission for ITER”, *Fusion Science and Technology*, 67 (4), (2015).