Ravinder Goyal

Field of research:

- Study of nonlinear electromagnetic waves, turbulent spectra and scaling in magnetized plasmas.
- Study of linear waves and frequency spectra in inhomogeneous magnetized laboratory plasma.
- Mathematical modeling, numerical simulations and results similarity with the observational and experimental results.

Name of institute:

Indian Institute of Technology, Delhi

Pursuing degree:

Ph.D

Completed degree (in descending order):

M.Sc (Physics)

Trainings Taken (in descending order):

Write Here

Publications (in descending order):

Published-

1. **R. Goyal**, R. P. Sharma, M. L. Goldstein and Navin Kumar Dwivedi, "Nonlinear interaction of proton whistler with kinetic Alfven waves to study solar wind turbulence", **Physics of Plasmas**, Vol. 20, 122308 (2013); DOI: 10.1063/1.4849457.
2. R. P. Sharma, **R. Goyal**, Earl E. Scime and Navin Kumar Dwivedi, "Localization of linear kinetic Alfven wave in an

inhomogeneous plasma and generation of turbulence", **Physics of Plasmas**, Vol. 21, 042113 (2014); DOI: 10.1063/1.4871497.

3. **R. Goyal**, R. P. Sharma and Earl E. Scime, "Time dependent evolution of linear kinetic Alfvén waves in inhomogeneous plasma", **Physics of Plasmas,** Vol. 22, 022101 (2015); DOI: 10.1063/1.4906882.

Accepted-

R. P. Sharma, **R. Goyal**, Nidhi Gaur and Earl E. Scime, Linear kinetic Alfvén waves in inhomogeneous plasma: effects of Landau damping. **Euro Physics Letters.**

To be communicated soon-

1. Nonlinear interaction of high amplitude whistler waves with kinetic Alfvén waves in radiation belts.
2. Evolution of linear kinetic Alfvén waves in collisional plasma.

Oral presentation (in descending order):

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Poster presentations (in descending order):

1) **'Temporal evolution of linear kinetic Alfvén waves in inhomogeneous plasmas and turbulence generation'** in **Science for Space Weather** conference held in **Goa (India)** during January 24-29, 2016.
2) **'Nonlinear interaction of proton whistler with kinetic Alfvén waves to study solar wind turbulence'** in International conference on **Coupling and Dynamics of the Solar Atmosphere** held at **IUCAA, Pune (India)** during November 10-14, 2014.

Schools/Workshops Attended (in descending order):

1) **Introduction to Space Weather Concepts and Tools** School at **Community Coordinated Modeling Center (CCMC)** in conjunction with **Science for Space Weather conference** on January 28, 2016.

Purpose of study in the research field (in 1000 words):

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Inhomogeneous laboratory plasma

The coronal ion heating in the Sun is primarily considered due to Alfvén wave dissipation. The *Hinode* data which has provided strong evidence for the presence of Alfvén waves in the corona and in coronal loops, has lead laboratory investigations and numerical simulations of Alfvén wave propagation and damping. The inhomogeneous plasmas with steep density gradients can be employed to study such phenomenon in relatively shorter systems. Previously i have studied and derived a model for the propagation of Kinetic Alfvén waves (KAWs) in inhomogeneous plasma when the inhomogeneity is in transverse and parallel directions relative to the background magnetic field. The semi-analytical technique and numerical simulations have been performed to study the KAW dynamics when plasma inhomogeneity is incorporated in the dynamics. The model equations are solved in order to study the localization of KAW and their magnetic power spectrum which indicates the direct transfer of energy from lower to higher wave numbers as well as frequencies. The inhomogeneity scale lengths in both directions may control the nature of fluctuations and localization of the waves and play a very important role in the turbulence generation and its level. A theoretical study of the localization of KAWs has been composed, variations in magnetic field amplitude in time, and variation in the frequency spectra arising from inhomogeneities have been plotted. The relevance of the model to space and laboratory observations is discussed.

Radiation belts

I have just proposed a model to study the dynamics of high amplitude whistler waves at resonance cone angle in Earth's radiation belts. The dispersion relation that has been derived translates into a model equation to give the high amplitude wave packet as observed by STEREO instrument. The wave dynamics and output wave electric field profile clearly indicate

the whistlers to be of electrostatic nature at resonance cone angle. A numerical simulation technique has been employed to study the nonlinear interaction of these high amplitude electrostatic whistlers with low frequency KAWs and to observe the localization of whistler waves as well as KAWs.

Other details:

Awards & Honour (i.e.NET/SLAT/JEST/GATE/Any equivalent):

- Qualified Joint Entrance Screening Test (JEST) organized by various research institutes in India in 2011 securing 94.4 percentile.
- Qualified Graduate Aptitude Test in Engineering (GATE) jointly organized by IISc and IITs in 2011.
- Qualified Graduate Aptitude Test in Engineering (GATE) jointly organized by IISc and IITs in 2012 securing 93.95 percentile.

Any other examinations (i.e. IELTS/TOFEL/ any equivalent)

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Computer Operating and/or Programming Skill:

- Programming languages: FORTRAN
- Operating Systems: Windows, UNIX, Linux
- Software tools: Matlab R2013a, Mathematica

Language Skill

English, Hindi, Punjabi

Permanent communication address:

H. No- 7435/10777, Kartar Basti, Backside Govt. Rajindra college, Bhatinda-151001, Punjab, India.

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Secondary contact number:

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Write here as mentioned on ccmc.gsfc.nasa.gov/staff/krishnarao.php

Ravinder is a Senior Research Fellow at Indian Institute of Technology, Delhi and is about to submit his doctoral thesis.

As a research scholar he has been working on numerical simulations of MHD and plasma waves viz. kinetic Alfven waves and whistler waves in both space as well as laboratory plasma systems.

He has been experienced in analyzing and solving differential equations leading to formation of governing equations of the waves considering nonlinearities and inhomogeneities into consideration.

Apart from his recent work related to simulations of the waves in laboratory plasmas Ravinder just started working on the dynamics of radiation belts. He has just proposed a model to study the propagation of high amplitude whistler waves in radiation belts. This model will be very much useful to understand the formation of high amplitude whistler wave burst near resonance cone. The model proposed by Ravinder narrates the nature of whistler to be electrostatic.