

हंसराज कॉलेज



HANS RAJ COLLEGE

UNIVERSITY OF DELHI
Mahatma Hansraj Marg
Malkaganj, Delhi – 110007
Tel.: 011-27667458,
27667747

E-mail: principal_hrc@yahoo.com
Website: www.hansrajcollege.ac.in

दिल्ली विश्वविद्यालय
महात्मा हंसराज मार्ग,
मलकार्ज, दिल्ली- 110007

फ़ोन : 011-27667458, 27667747

ई-मेल : principal_hrc@yahoo.com

वेबसाइट : www.hansrajcollege.ac.in

**NAAC ACCREDITED 'A++' GRADE
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2024-2025

Name of The Event: Throwing Light on Dark Matter (Invited Talk)

Organised By: Lumen: The Physics and Electronics Society

Venue Of The Event: Multipurpose Hall, C-Block, Hansraj College

Speaker: Prof. Amitabha Mukherjee, Retired Prof. from Department of Physics and Astrophysics, University of Delhi

Date Of The Event: 23rd October 2024

Name Of The Convenor: Dr. Davuluri Srikala

LUMEN | The Physics and Electronics Society
of Hansraj College

Speaker Session
on
THROWING LIGHT ON DARK MATTER
by
Professor
AMITABHA MUKHERJEE
Department of Physics and Astrophysics
University of Delhi

Venue: Multipurpose Hall, C-Block
Time: 1:00 P.M.
Date: 23rd October, 2024

For queries:
Ajwa: 7006742403
Shrishti Malik: 9821101107

Lumen Convenor:
Dr. D. Srikala
Dr. Nishant Shankhwar

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Description:

Our esteemed guest was Prof. Amitabha Mukherjee, a retired professor of the Department of Physics and Astrophysics, Delhi University, was invited to grace us with his knowledge on the topic of “Throwing Light on Dark Matter”.

He introduced cosmology to the audience, and talked about black matter, which has been and continues to be a fundamental question in cosmology. What is Bright matter? What objects in this universe emits light and which don't?

He explains the questions of the universe and our solar system, and the worries that come along with these big unknowns of the universe. Our solar system is so small compared to the universe, that there is a vast majority of dark matter out there. After this introduction into the talk, Prof. Mukherjee talks about detecting dark matter. Saturn and Jupiter can be visible to the naked eye by reflected sunlight, but it is impossible to view farther planets like Neptune and Uranus. Even when an object emits no light, it's presence can be inferred from its gravitational effect. Dark matter can be detected from its gravitational effect in a similar way. Going deeper into cosmology, Prof. Mukherjee discusses different galaxies: Spiral galaxies - Our Milky Way galaxy, and Andromeda galaxy (M31), among others - typically look flat, with most stars close to the central plane, and a bulge in the centre. He explained how we obtain synthetic coloured images of the galaxies, and that their colours as seen by us in images are not literal.

Stars exert gravitational forces on one another, while rotating about the centre of the galaxy. It's mass is concentrated in the central bulge. The rotation speed of a star decreases with distance from the centre, as per Newton's law of Gravitation.

But in reality, as we move out towards the edge of the galaxy, the speed of the star remains the same. There are two possible explanations:

I) Newton's law doesn't hold, or

II) The mass in a galaxy is higher and distributed more evenly.

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New Delhi, Delhi, India
1, Hansraj College, New Delhi, Delhi, 110007, India
Lat 28.679001° Long 77.209062°
23/10/24 01:11 PM GMT +05:30



Delhi, Delhi, India
M6h5+rnj7, Hansraj College, Delhi, 110007, India
Lat: 28.67901° Long 77.208994°
23/10/24 01:12 PM GMT +05:30



Delhi, Delhi, India
M6H5+MJ7, Hansraj College, Delhi, 110007, India
Lat 28.67905°
Long 77.209015°
23/10/24 01:25 PM GMT +05:30

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A galaxy is full of dark matter and has the shape of a spherical halo. When we measure speed of stars in an elliptical galaxy, we end up with the same conclusion - most galaxies are full of dark matter. Our 80% to 95% of the total mass of the Milky Way has been estimated to be Dark Matter (DM). What really is DM? And what in its precise nature is galactic halos? These are still open questions in cosmology. There are a few possibilities:

They are planet like objects or stars in the process of formation, or black holes. MACHOs (Massive astrophysical compact halo objects) made of ordinary matter or baryonic matter is a common feature of these halos. But, if MACHOs have baryonic matter, light will reflect from them, so our galaxy full of MACHOs should show up in telescopes. Hence we reach the conclusion that galactic halo DM, unlike DM in our solar system is not made of baryonic matter, but something more exotic, possibly WIMP (weakly interacting massive particles).



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The Standard Model (SM) of particle physics has succeeded greatly after discovery of W bosons. But SM doesn't have place for WIMPs either, WIMPs go beyond the SM. Galactic halos (1,00,000 light years in size) suggest we need to rethink lanes of physics at scales smaller than 1fm. Galaxy clusters with 100-1000 galaxies are held together by their mutual gravitational attraction. The Coma cluster is one such galaxy cluster. We expect average energy of motion of member = Energy of interaction (Virial theorem~ $K.E = -P. E/2$) where a system of gravitating objects interacting through gravitation has been around for a long time. But, we observe that galaxies in most clusters appear to move much faster than expected. An explanation is there is a much greater gravitational force.

Prof. Mukherjee now delves into the history and discovery of dark matter, and it's role in cosmology. "Dark Matter" was a term coined by Swiss astronomer Fritz Zwicky in 1933 while studying the Coma cluster. Cluster mass is 400 times the stellar mass. Dark Matter is likely to play a role in structure and evolution of the universe. Most cosmologists believe it has played a crucial role in the complex formations of the universe. It is believed dark matter dominated the universe, leading to such formations. According to the latest from Planet satellite, the energy content of the universe is: baryonic matter - 4.9%, dark matter - 26.8%, and dark energy - 68.4%. Prof. Mukherjee comes to the conclusion of the talk, while summarising all that has been discussed so far. DM of various kinds are found at various distances. Most dark matter is non- baryonic and its precise nature is unknown. DM connects cosmology to particle physics -connecting the big to the small.

Finally, Prof. Mukherjee took questions from the audience and after answering them gracefully, the speaker session come to an end.

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Orientation Program 2024-25
Date : 30/08/2024
Course: B. Sc(H) PHYSICS
Time : 10:30 AM
Students Attendance

S. No.	Name	Course	Signature
1	Nimish Khondhal	B.Sc Physics (H)	Nimish
2	Rohit	B.Sc Physics (H)	Rohit
3	Nihal Singh	B.Sc Physics (H)	Nihal
4	Anandak Todra	B.Sc Physics (H)	Anandak
5	Nitesh Gupta	B.Sc Physics	Nitesh
6	Ayush Gangwar	B.Sc Physics (H)	Ayush
7	Kush Toppo	B.Sc Physics (H)	Kush Toppo
8	Laksh	B.Sc Physics (H)	Laksh
9	Ditya	B.Sc Physics (H)	Ditya
10	Shri Chand	B.Sc Physics (H)	Shri Chand
11	Anshika	B.Sc Physics (H)	Anshika
12	Aditya Arora, Chanchal	B.Sc Physics (H)	Aditya Arora, Chanchal
13	Sahajit Singh	B.Sc Physics (H)	Sahajit Singh
14	Nikhil Verma	B.Sc Physics (H)	Nikhil Verma
15	Anshika Verma	B.Sc Physics (H)	Anshika Verma
16	Nisha Verma	B.Sc Physics (H)	Nisha Verma
17	Disha Kumar Negam	B.Sc Physics (H)	Disha Kumar Negam
18	Liravith Malhotra	B.Sc Physics (H)	Liravith Malhotra
19	Kapil Kumar	B.Sc Physics (H)	Kapil Kumar
20	Vivek Kumar	B.Sc Physics (H)	Vivek Kumar
21	Akshat Khandelwal	B.Sc Physics (H)	Akshat Khandelwal
22	Anurag Yadav	B.Sc Physics (H)	Anurag Yadav

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Date : 30/08/2024
Course: B. Sc(H) PHYSICS
Time : 10:30 AM
Students Attendance

S. No.	Name	Course	Signature
1	Laksh	B.Sc Phys Hans	Laksh
2	CHANDRAMOULI GUPTA	B.Sc Phys Hans	Chandramouli Gupta
3	Ayush Pandey	B.Sc Phys Hans	Ayush Pandey
4	Karanjit Jhachhney	B.Sc Phys Hans	Karanjit Jhachhney
5	Yash Bhatnagar	B.Sc Phys Hans	Yash Bhatnagar
6	Ravi Ray	B.Sc Phys Hans	Ravi Ray
7	Kanishk Kumar	B.Sc Phys Hans	Kanishk Kumar
8	Karth Sumar	B.Sc Phys Hans	Karth Sumar
9	Kesh	B.Sc Phys Hans	Kesh
10	Shubhan Bor Jagdale	B.Sc Phys Hans	Shubhan Bor Jagdale
11	Juriet	B.Sc Phys Hans	Juriet
12	Siddhant Tiwari	B.Sc Phys Hans	Siddhant Tiwari
13	Rohit Yadav	B.Sc Phys Hans	Rohit Yadav
14	Ravindra Bhatnagar	B.Sc Phys Hans	Ravindra Bhatnagar
15	Pragya Dhanraj	B.Sc Phys Hans	Pragya Dhanraj
16	Indrakishor Kanyal	B.Sc Phys Hans	Indrakishor Kanyal
17	Aditya Sharma	B.Sc Phys Hans	Aditya Sharma
18	Ganesh Yadav	B.Sc Phys Hans	Ganesh Yadav
19	Ashish Dey	B.Sc Phys Hans	Ashish Dey
20	Anvika Verma	B.Sc Phys Hans	Anvika Verma
21	Dhruv Karan Kalita	B.Sc Phys Hans	Dhruv Karan Kalita
22	Kalpit Kumar Meena	B.Sc Phys Hans	Kalpit Kumar Meena
23	Gaurav Sr Bhatia	B.Sc Phys Hans	Gaurav Sr Bhatia
24	Siddhant Pandey	B.Sc Phys Hans	Siddhant Pandey
25	Shruti	B.Sc Phys Hans	Shruti

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Orientation Program 2024-25
Date : 30/08/2024 Time : 10:30 AM

Course: B. Sc(H) ELECTRONICS

Students Attendance

S. No.	Name	Course	Signature
1	Neha Gaudam	Bsc. hons Electronics	Neha
2	Aashi	Bsc(hons) Electronics	Aashi
3	Abhinav Gupta	Bsc. hons Electronics	Abhinav
4	Prithvi	B.Sc. hons. Electronics	Prithvi
5	Mohd Rayyan Ahmad	B.Sc. hons. electronics	Rayyan
6	Suayam Jadhav	BSc hons electronics	Suayam
7	Nisha Kumari	bsc hons. electronics	Nisha
8	Atul Verma	BSc hons Electronics	Atul
9	Vansh Kumar	Bsc (hons) electronics	Vansh
10	Utkarsh Singh	Bsc (Hons) Electronics	Utkarsh
11	Satvik Chaurasia	BSc (Hons) Electronics	Satvik
12	Shashank Senani	BSc (Hons) Electronics	Shashank
13	Satish Chaudhary	BSc (Hons) Electronics	Satish
14	Shubham Kumar (JUBR)	BSC ELECTRONICS (H)	Shubham
15	Raj Chaurasiya	BSc(H) Electronic	Raj
16	Rohan Arora	Bsc(hons) electronics	Rohan
17	Kaushik Purwar	Bsc (h) Electronics	Kaushik

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Orientation Program 2024-25
Date : 30/08/2024 Time : 10:30 AM

Course: B. Sc. PHYSICAL SCIENCES

Students Attendance

S. No.	Name	Course	Signature
1	Rishi Nigam	Physical Sci. (Comp. Sci.)	Rishi
2	Shreyansh	Physical Sci. (Chem.)	Shreyansh
3	Anurag Shukla	Physical Sci. (Chem.)	Anurag
4	Prakul Singh	Physical Sci. (Chem.)	Prakul
5	Vansh Wadhvani	Physical Sci. (Comp. Sci.)	Vansh
6	Atul Derman	Physical Sci. (Comp. Sci.)	Atul
7	ans Arora Kumar	Physical Sci. (Comp. Sci.)	ans
8	Harsh Tomar	Physical Sci. (Comp. Sci.)	Harsh
9	Akshay	Physical Sci. (Chem.)	Akshay
10	Shashank Saini	Physical Sci. (Chem.)	Shashank
11	Harshit Pandey	Physical Sci. (CS)	Harshit
12	Meenakshi	Physical Sci. (CS)	Meenakshi
13	Rishi Lalwani	Physical Sci. (CS)	Rishi
14	Amisha	Physical Sci. (Chem.)	Amisha
15	ETA	Physical Sci. (CS)	ETA
16	Anushka	Physical Sci. (CS)	Anushka
17	Anchita Singhania	Physical Sci. (Chem.)	Anchita
18	Rishabh	Physical Sci. (CS)	Rishabh
19	Vishva	Physical Sci. (Chem.)	Vishva
20	Shubh	Physical Sci. (Chem.)	Shubh
21	Kunal	Physical Sci. (CS)	Kunal
22	Rishabh	Physical Sci. (Chem.)	Rishabh
23	Ananya Ashokan	Physical Sci. (Chem.)	Ananya
24	Rishi Gupta	Physical Sci. (CS)	Rishi
25	Aradhya Malik	Physical Sci. (Chem.)	Aradhya
26	Aradhya Malik	Physical Sci. (Chem.)	Aradhya
27	Aradhya Malik	Physical Sci. (Chem.)	Aradhya
28	Yash Singh	Physical Sci. (CS)	Yash
29	Yash Singh	Physical Sci. (CS)	Yash

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S. No.	Name	Course	Signature
30	Hemant Gupta	Physical Science with Computer	Hemant
31	Mohd. Imran	Physical Science with Computer	Mohd. Imran
32	Hitesh Kumar	Physical Science with Computer	Hitesh
33	Anam	Physical Science with Computer	Anam
34	Nishu	Physical Science with Chemistry	Nishu
35	Vaibhav	Physical Science with Chem	Vaibhav