

Astronomy Research in Nepal

Binil Aryal
Central Department of Physics
Tribhuvan University



120 M.Sc. Student/Year

Major:

Astro, Solid State, Plasma

20 Faculties

25 Ph.D. Students

Central Department of physics, Tribhuvan University



120 M.Sc. Student/Year

Major:

Astro, Solid State, Plasma

**About 50-60% students
study Astrophysics**

Central Department of physics, Tribhuvan University

Astrophysics Education in Nepal

2008: Tribhuvan University has offered Astrophysics course at M.Sc. (Physics) Level: 6 CH course

>> contains stellar astrophysics, origin of elements, galactic dynamics & computational stuff

>> recently introduced a ELECTIVE course (Space Science) for BSC III year

>>No separate department/institute for A&A till date

Government of Nepal established a high level committee to study the R&D activities in Astronomy

>> 16 inch Schmidt telescope (Nagarkot)

Course Contents: M.Sc. III Semester (3 CH)

General Astronomy: 1.1 Brief history & developments of Astronomy 1.2 Stellar magnitude: apparent and absolute 1.3 Opacity: distance-magnitude-extinction relation 1.4 colour index, colour excess 1.5. Mass-luminosity relation 1.6 Astronomical time scales: nuclear, thermal and dynamical 1.7 Analytical and numerical problems [10 hours]

Stellar Interior: 2.1 Pressure exerted by the gas in the star: non-degenerate, degenerate (both relativistic and non-relativistic) 2.2 Pressure exerted by the photons in the star: radiation pressure 2.3 Internal equilibrium conditions: hydrostatic equilibrium, mass-continuity relation 2.4 Linear stellar model: applications 2.5 Polytropic model: modeling electron degenerate star 2.6 Polytropic model: modeling neutron degenerate star 2.7 Convective energy transport 2.7 Theory of random walk: photon 2.10 Local thermodynamic equilibrium 2.8 problems [20 hours]

Stellar Energy Sources: 3.1 proton-proton chain 3.2 CNO cycle 3.3 Triple alpha process, oxygen, carbon and silicon burning, photo-dissociation, 3.4 Solar neutrino problem 3.5 Nuclear coulomb energy 3.6 Nuclear reaction cross-section [7 hours]

Stellar Atmosphere: 4.1 Stellar spectra: classification 4.2 Harvard & Yerkes classification 4.3 H-R diagram: evolutionary track of the star [4 hours]

Open Database: 6.1 NED, SIMBAD, SKYVIEW 6.2 IRAS maps: ALADIN

[4

Course Contents: M.Sc. IV Semester (3 CH)

Interstellar Medium: 1.1 Components: gas, dust, magnetic field and cosmic rays 1.2 Classification of gas 1.3 Detection techniques for molecular, neutral and ionized Hydrogen 1.4 ISM cycle 1.5 Heating and cooling mechanism in ISM **[6 hours]**

Star Formation: 2.1 Molecular cloud 2.2 Jeans instability 2.3 Virial theorem 2.4 Jeans mass and length 2.5 Stages of star formation **[5 hours]**

Stellar Evolution: 3.1 Less massive star: red giant, He-flash, horizontal branch, instability, asymptotic giant branch, planetary nebula, white dwarf 3.2 Massive star: multiple burning, super giants, neutron drip, photodissociation, shock wave, supernova explosion, neutron star, black hole 3.2 Radiative energy transport **[8 hours]**

Big Bang Nucleosynthesis: 4.1 Planck scale, 4.2 GUT epoch, 4.3 Inflation 4.4 Electro-weak epoch 4.5 Quark epoch, 4.6 Hadron epoch, 4.7 Lepton epoch, 4.8 Photon epoch, 4.8 Dark epoch 4.9 Supporting facts 4.10 Unsolved issues: Horizon problem, flatness problem, monopole problem, Baryon asymmetry, Dark matter and dark energy problem 4.11 Contemporary rival models: de Sitter model, Einstein's static model, Oscillating Universe, Steady state theory **[9 hours]**

Large Scale Structure Formation: 5.1 Einstein field equation, 5.2 Structure of the space-time: Robertson-Walker metric, 5.3 Co-moving coordinate system 5.4 Eddington equation, 5.5 Density parameter, 5.6 Hubble Parameter **[6 hours]**

Galaxy: 6.1 Milky-Way: structure and formation 6.2 Classification of galaxies, 6.3 Galaxy rotation curve: dark matter, 6.4 Hubble law and age of the Universe 6.5 LCDM model 6.6 Cosmic microwave background radiation 6.7 COBE and WMAP results **[7 hours]**

Computational Astrophysics: Use of software 7.1 ALADIN, 7.2 IDL and others **[4 hours]**

A&A Research at CDP

2006: supervision M.Sc. Dissertation in Astrophysics

>> **Spatial orientation of Galaxies in the cluster** (2006-till date)

Spatial orientation of angular momentum vectors of galaxies in six rotating clusters

B. Aryal,^{1,2}★  C. Rajbahak² and W. Saurer¹

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B. Aryal¹ · A. K. Jha¹, · R. Weinberger²

Two Dust Cavities in the Far Infrared IRAS and AKARI Maps at -64° and -66°

Spatial orientation of spin vector of galaxies in six clusters having high velocity dispersion

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Innsbruck, Austria

Ph.D. (2002)



Asiago, Italy



La Palma, Spain





Innsbruck, Austria

Ph.D. (2002)



Asiago, Italy



UW, Seattle, USA



La Palma, Spain



A&A Research at CDP

2006: begun M.Sc. Dissertation in Astrophysics

>> Spatial orientation of Galaxies in the cluster (2006-till date)

2007: later expanded area of research

>> ISM interactions (2007-till date)

>> Chiral Symmetry in LSS (2007-till date)

>> Cosmological Constant (2008-till date)

>> Photodissociation region (2010-till date)

>> Search of AGN in X-ray clusters (2013-till date)

Till date:

>> 112 students have completed their masters thesis in A&A

>> One Ph.D. project is complete

>> Three Ph.D. projects are running

>> 18 M.Sc. Students are doing masters dissertation

Collaborations:

>> 7 collaborations

Collaborators

Innsbruck University, Austria

Prof. Ronald Weinberger, Prof. Walter Saurer
University of Washington, Seattle, USA

Prof. Noam Soaker, Prof. Bruce Ballik
KISO Observatory, Japan

Prof. J. Okamura, Prof. Y. Kashikawa
Napoli University, Italy

Prof. A. Lattanzi
Krakow Observatory, Poland

Prof. W. Godlowski
Koeln University, Germany

Prof. J. Stutzki
SN Bose, Calcutta, India

Prof. S. N. Chakraborty

<http://astronepal.webs.com>

DATABASE

POSSII, ESO, SDSS, 2dFGRS (Optical)

IRAS, AKARI, SPITZER (Infrared)

KOSMA >> TIBET, NONTEN2 (submm)

BAT, XMM NEWTON, CHANDRA (X-ray)

WMAP, CPBE (CMB anisotropies)

SIMBAD, ADS, NED, Sky View, ATNF, etc

PUBLICATIONS (Peer Reviewed International Journal)

- B. Aryal, H. Bhattarai, S. Dhakal, C. Rajbahak & W. Saurer, Spatial orientation of galaxies in 6 rotating clusters, MNRAS,, (2013)**
- 1.B. Aryal, S.N. Yadav & W. Saurer, Spatial orientation of galaxies in the Zone of Avoidance, Bulletin of Astron. Soc. Ind. (BASI), 40, 65 (2012)**
- 2.B. Aryal, R. R. Paudel, W. Saurer, Spatial orientation of angular momentum vector of galaxies in three merging binary clusters, Astrophysics & Space Science Journ. (Springer), 337, 313 (2012)**
- 3.B. Aryal, Winding Sense of Galaxies Around the Local Supercluster, Research in Astronomy & Astrophysics Journ., 11, 293 (2011)**
- 4.B. Aryal, R. K. Bachchan & Saurer W., Optical Search Limit and Preferred Position Angle Distribution of Galaxies in 35 Clusters, Bulletin of Astron. Soc. Ind. (BASI), 38, 165 (2010)**
- 5.B. Aryal, C. Rajbahak & R. Weinberger, A giant dusty bipolar structure around the planetary nebula NGC 1514, Monthly Notice of Royal Astronomical Society (MNRAS), 402, 2, 1307 (2010)**
- 6.B. Aryal, C. Rajbahak & R. Weinberger, Planetary Nebula NGC 6826 and NGC 2988: early aspherical mass loss?, Astrophysics & Space Science Journ. (Springer), 323, 323 (2009)**
- 7.B. Aryal, P. Kafle & W. Saurer, Radial velocity dependence in the spatial orientations of galaxies in and around the local supercluster, Monthly Notice of Royal Astronomical Society (MNRAS), 389, 741 (2008)**
- 8.B. Aryal, D. Nupane & W. Saurer, Morphological dependence in the spatial orientations of galaxies around the Local Supercluster, Astrophysics & Space Science Journ. (Springer), 314, 177 (2008)**
- 9.B. Aryal, S. Paudel & W. Saurer, Coexistence of chiral symmetry restoration and random orientation of galaxies, Astrophysics & Astronomy Journ. (A&A), 479, 397 (2008)**
- 10.B. Aryal, S. Paudel & W. Saurer, Spatial Orientation of galaxies in 7 clusters of BM type II, Monthly Notice of Royal Astronomical Society (MNRAS), 379, 1011 (2007)**
- 11.B. Aryal, S. R. Acharya & W. Saurer, Chirality of spiral galaxies in the Local Supercluster, Astrophysics & Space Science Journ. (Springer), 307, 369 (2007)**
- 12.B. Aryal, S. M. Kandel & W. Saurer, Spatial orientation of galaxies in the core of the Shapley Concentration: The cluster Abell 3558, Astrophysics & Astronomy Journ. (A&A), 458, 377 (2006)**
- 13.B. Aryal & R. Weinberger, A new high latitude cone like far-IR nebula, Astrophysics & Astronomy Journ. (A&A), 446, 213 (2006)**
- 14.B. Aryal & W. Saurer, Spin vector orientation of galaxies in ten clusters of BM type II-III, Monthly Notice of Royal Astronomical Society (MNRAS), 366, 438 (2006)**
- 15.B. Aryal & W. Saurer, Spin vector orientation of galaxies in the region $19^{\text{h}}26^{\text{m}}00^{\text{s}} < RA(2000) < 20^{\text{h}}19^{\text{m}}00^{\text{s}}$, $-68^{\circ} < Dec.(2000) < -65^{\circ}$, Monthly Notice of Royal Astronomical Society (MNRAS), 360, 125 (2005)**
- 16.B. Aryal & W. Saurer, Spin vector orientation of galaxies in seven Abell clusters of BM type III, Astrophysics & Astronomy Journ. (A&A), 432, 841 (2005)**
- 17.B. Aryal & W. Saurer, Morphological dependence in the spatial orientation of Local Supercluster galaxies, Astrophysics & Astronomy Journ. (A&A), 432, 431 (2005)**
- 18.R. Weinberger & B. Aryal, Huge Dust Structures and Cavities Around PNe: NGC 6826 and NGC 2899, Edited by Margaret Meixner, Joel H. Kastner, Bruce Balick and Noam Soker, ASP Conf. Proc., Vol. 313. San Francisco: Astronomical Society of the Pacific, 2004., p.112-115 (2004)**
- 19.R. Weinberger & B. Aryal, Asymmetric mass-loss on the AGB: examples from IRAS data, Edited by Y. Nakada, M. Honma and M. Seki. Astrophysics and Space Science Library, Vol. 283, Dordrecht: Kluwer Academic Publishers, ISBN 1-4020-1162-8, p. 103-106 (2003)**
- 20.B. Aryal & W. Saurer, Spin vector orientation of galaxies in seven Abell clusters of BM type I, A&A, 425, 871 (2004)**
- 21.B. Aryal & R. Weinberger: "Structure of Interstellar Bubbles: A Numerical Time-Dependent Calculation", Supplementary Issue 2, Vol. 324, Short Contributions of the Annual Scientific Meeting of the Astronomische Gesellschaft in Berlin, September 23-28, 7 (2002)**
- 22.B. Aryal & W. Saurer, The influence of selection effects on the isotropic distribution curve in galaxy orientation studies, Edited by José G. Funes, S. J. and Enrico Maria Corsini. San Francisco: Astronomical Society of the Pacific. ISBN: 1-58381-063-3, ASP Conf. Ser., Vol. 230, p. 145-156 (2001)**
- 23.B. Aryal & W. Saurer, Comments on the expected isotropic distribution curve in galaxy orientation study, A&AL, 364, L97-L100 (2000)**

Note: These papers can be found in the url: <http://adsabs.harvard.edu/> (go to the abstract service)

Every year we work hard to upgrade student's skill, make them *capable* to work in the international community.....



4 paged article
as
News/Feature

20 Nov 2014 (Vol. 515)



20 Nov 2014 (Vol. 515)

FAR-FLUNG PHYSICS

The International Centre for Theoretical Physics was set up to seed science in the developing world; 100,000 researchers later, it is still growing.

BY KATIA MOSKVITCH

The dust in Kathmandu cloaks everything. It carpets the streets with a dingy layer. Women cutting waist-high grass are wearing face masks to keep it out. And it settles on the dilapidated buildings of Tribhuvan University (TU) — the biggest scientific establishment in Nepal.

Adhikari's accomplishments are rooted in more than his own determination and wit; they also draw on support from the International Centre for Theoretical Physics (ICTP), an organization based a world away in the picturesque Italian seaside town of Trieste. Set up in 1964 by Pakistani physics Nobel laureate Abdus Salam and Italian physicist Paolo

in a pair of Nobels. Most physicists credit the institute with stemming the brain drain and bolstering academia in the developing world. The institute is “widely admired”, says Martin Rees, an astrophysicist at the University of Cambridge, UK, and former head of the Royal Society in London, who hopes that it will “inspire the creation of similar institutions

One of the reputed theoretical Physics Learning Centre in this area of the world!



NEWS FEATURE

FAR-FLUNG PHYSICS

The International Centre for Theoretical Physics was set up to seed science in the developing world; 100,000 researchers later, it is still growing.

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20 Nov 2014 (Vol. 515)

Theoretical Physics Department

About 910 graduates of this Dept are in various US Universities (faculty, researcher, post docs, Ph.D. students) and a few (~50) in EU nations.



Narayan Adhikari (centre, in pale blue shirt and black trousers) with students from the physics department at Tribhuvan University.

Theoretical physics still could be done anywhere on the planet. I remember reading that young Lew Landau was sent to the provincial city of Harkov in the USSR and created an international center that attracted students from Europe and other continents.

Michael Lerman • 2014-11-20 06:46 PM

Past thesis students (2007-2014)

1. Dr. Sunil Mani Kandel (2007 / USA)
2. Dr. Ajya Mishra (2007 / USA)
3. Dr. P. Lammichhane (2008 / USA)
4. Dr. Nirmal J. Ghimire (2008 / USA)
5. Dr. Sanjaya Paudel (2008 / Germany)
6. Mr. K. Simkhada (2008 / USA)
7. Mr. Ashok Devkota (2009 / USA)
8. Dr. Tulsi Gyawali (2009 / USA)
9. Dr. Barun K. Gupta (2009 / USA)
10. Dr. Tara Nidhi Acharya (2009 / USA)
11. Dr. Prajwal Kafle (2010 / Australia)
12. Mr. Prakash Thapa (2010 / USA)
13. Mr. Nauraj Pokhrel (2010 / USA)
14. Dr. Binod Rai (2010 / USA)
15. Mr. Lekhnath Paudel (2010 / USA)
16. Mr. Disoj Nupane (2010 / USA)
17. Mr. Hari Sharma (2010 / Italy)
18. Dr. Udhav Chamlagain (2010 / France)
19. Mr. Sunil Karn (2010 / USA)
20. Mr. Bhim Chamlagain (2011 / USA)
21. Mr. Rajesh Panthi (2011 / USA)
22. Mr. Rajesh K Bachchan (2011 / Sweden)
23. Mr. Chinta Mani Aryal (2011 / USA)
24. Mr. Raj Kiran Koju (2012 / USA)
25. Mr. Amrit Ladauri (2012 / USA)

26. Mr. Riway Pokhrel (2012 / USA)
27. Mr. Utsab Shrestha (2012 / USA)
28. Dr. Binod Adhikari (2012 / Brazil)
29. Mr. Tak Pd. Adhikari (2012 / Poland)
30. Mr. Rishi Ram Paudel (2012 / USA)
31. Mr. Ramesh Mainali (2013 / USA)
32. Mr. Suman K. Paudel (2013 / USA)
33. Mr. Sudeep Neupane (2013 / Chile)
34. Mr. Taiendra Neupane (2013 / USA)
35. Mr. Anil Aryal (2013 / USA)
36. Mr. Amrit Kafle (2013 / USA)
37. Mr. Balram Kaderiya (2013 / USA)
1. Mr. Sagar Paudel (2013 / USA)
2. Mr. Saroj Dhakal (2013 / USA)
3. Mr. Thir Prasad Gautam (2013 / USA)
4. Mr. Popular Pandey (2013 / USA)
5. Mr. Ramesh Pandey (2013 / USA)
6. Mr. Hemanta Bhattarai (2013 / USA)
7. Mr. Krishna C. Pokhrel (2013 / USA)
8. Mr. Amit Nidhi Adhikari (2014 / USA)
9. Mr. Dilli Prasad Paudel (2014 / USA)
10. Mr. Utsav Shrestha (2014 / USA)
11. Mr. Sunil Laudari (2014 / USA)
12. Mr. Padam Ghimire (2014 / Germany)
13. Mr. Rabin Mahat (2014 / USA)

List of Our Graduates Leaving for USA during July-August 2016

Dedicated to Amalie Emmy Noether, a female physicist who formulated Symmetry Principle

Symmetry
Volume X, 2016
An annual publication of Central Department of Physics, TU

100 Years of Noether Theorem
Einstein Writes about Emmy
Physics Curriculum at TU
Computational Physics
Experimental Setup for Seeded-Arc Plasma at CDP
Higher studies in Physics
An Encounter with Prof. M. M. Aryal
Dr. Elite Prastid
ICTP Post Doc Fellow at CDP
Cosmic Rulers
How Physics works in Biology?
Geometry of Gauge Theories and Symmetry Breaking
Physics in War and Heisenberg Controversy

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9	Binod Subedi	Tulane University	stardustbinod@gmail.com
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34	Saroj Pokharel	University of Akron	cu2saroj@gmail.com
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36	Shashi Pandey	University of Tennessee- Knoxville	shashi.universe@gmail.com
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38	Shiva Pd Poudel	University of Arkansas	shivapoudel29@gmail.com
39	Sijal Dangol	Univ. of Maryland-College Park	sijal_das-1@hotmail.com
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A good research work in Astrophysics can be conducted at the Central Department of Physics, TU, Kirtipur. For this, we need intelligent students, experts and fast computers with softwares.

Our aim is to publish at least 3 papers/year in the International Peer Reviewed Journal (IF > 3).

Thanks for your kind attention