INDIAN CENTRE FOR SPACE PHYSICS

Date: 31-8-2022, Wednesday

Personal Details

Candidate's Name : Devendra Bisht
Father's Name : Balwant Singh Bisht
Mother's Name : Janki Devi
Age/Date of Birth : 34 years, 13-11-1987
Gender/Marital Status : Male, Married
Nationality : Indian
Languages Known : Hindi (Mother Tongue), English
E-Mail IDs : devendrabisht297@gmail.com, devendra@csp.res.in

Permanent Address :
H.No-52K, Village-Sitoli, Didihat,
Dist.- Pithoragarh
State-Uttarakhand
India- 262551
Contact Phone No. : +91 9773708357

Research interests:

Star clusters, Infrared and Optical Astronomy, Variability, Exoplanets

Professional service

I am peer reviewer of American Journal of Astronomy and Astrophysics (AJAA)"(ISSN
print:2376-4678; ISSN online: 2376-4686) since July 2020.

Professional Membership:

(1) Junior member of International Astronomical Union (IAU).

(2) Member of Astronomical Society of India, ASI (L 2312)

Career Profile/Honors and Awards

(1) 25th August 2022- Till Date: Scientist-C at Indian Center for Space Physics, Kolkata, India.

(2) 1st June 2022-22 August 2022: Post-doctoral Fellow at the Indian Institute of Astrophysics, Bengaluru

(3) 1st January 2021-May 2022 : Affiliated with the University of Science and Technology of China (USTC) while working from home in India as an independent researcher. I couldn't join, in office, at USTC for that duration due to Covid-19.

(4) 1st January 2018 - 31st December 2020: Post Doctoral Fellow at University of Science and Technology of China.

(5) 4th May 2016 - 3 November 2017: Post Doctoral Fellow at Physical Research Laboratory, Ahmedabad, India.

(6) 17th October 2014 - 18th October 2015: Senior Research Fellow (SRF) at D. S. B campus, Kumaun University, Nainital, India.

(7) 18th October 2012 - 17th October 2014: Junior Research Fellow (JRF) at D. S. B. Campus, Kumaun University, Nainital, India.

(8) Qualied Uttarakhand state eligibility test (U-SET) for the lectureship in university or colleges in 2012.

Academic Profile

(1) 2010 Qualied Pre Ph.D. course work at D. S. B. Campus, Kumaun University, Nainital.

(2) 2009 Post Graduation in Physics (also called Master of Science (M.Sc.)) with specialization in Astrophysics with 68% from D. S. B. campus, Kumaun University, Nainital, India.

(3) 2007 Graduation in science (also called Bachelor of Science (B.Sc.)) with Physics, Chemistry and Mathematics as subjects with 65% from D. S. B. Campus, Kumaun University, Nainital, India.

(4) 2004 Intermediate (Senior Secondary) with 75% from Govt. Inter College, Didihat, Pithoragarh under Board of Secondary Education, Uttarakhand, India.

(5) 2002 Matriculation (or Secondary School Certicate (SSC)) with 60% from Govt. inter college Chaubati, Pithoragarh under Board of Secondary Education, Uttarakhand, India.

Thesis Details

Thesis title: Photometric studies on open star clusters

Supervisor: Dr. Alok Durgapal, Associate Professor, Physics Department, D. S. B. Campus, Kumaun University, Nainital.

Co-Supervisor: Dr. Ramakant S. Yadav, Scientist-E, ARIES, Nainital.

Date of thesis submission: 28th October 2015.

Date of degree awarded: 19th August 2016.

Project Students

(1) Ritika Sethi (IISER Berhampur)
(2) Deepak Bisht (IISER, Berhampur)
(3) Aruna Harikant (IIT Mandi)

Talks Delivered in Conferences

Invited Talks

(1) I delivered a talk on A comprehensive study of open cluster Haner 14 in Gaia Era in the Online Summit on Astrophysics and Space Research-2021 on April 15, 2021.

Contributory Talks

(1) A Deep Investigation of Two Poorly Studied Open Clusters Haffner 22 and Melotte 71 in the Gaia era" in Gaia Symposium: DR3 and Beyond during 11-15 July 2022”

(2) A deep study of an intermediate age open cluster SAI 35 (Juchert 20) using ground-based imaging and Gaia EDR3 astrometry" in the 40th
The Astronomical Society of India meeting held at IIT Roorkee from 25-29 March 2022.

(3) Multi-color photometry and Gaia astrometry of cluster NGC 1746 in the virtual meeting of NEP Conference 2020: Multi-Wavelength Astronomy Collaboration towards the New Era with Deep Survey Data" held at Taiwan during November 25-27, 2020.

(4) The multicolour photometric and Gaia DR2 astrometric study of an intermediate age open cluster NGC 1348 in virtual meeting of The Gaia Symposium: DR2 and Beyond\ held at IIA, India, during 2-6 November 2020.

(5) Mass function and dynamical study of open cluster Haner 11 using ground based imaging and Gaia astrometry" in The Milky Way 2019: LAMOST and other leading surveys held at Yichang, China, during 14-18 October 2019.

(6) Study of II Galactic Quadrant of Milky Way Galaxy using open clusters" in the rst BINA workshop held at Nainital-Uttarakhand, India, during 15-18 November 2016.

(7) 2MASS Analytical study of Galactic star cluster Teutsch 40 in National conference on current issues in Cosmology, Astrophysics and
High energy physics (CICAHEP) held at Department of physics, Dibrugarh University, Dibrugarh 786004, Assam, India, during 2-5 November, 2015.

(8) 2MASS JHK analytical study of open star cluster Teutsch 126 in 9th Uttarakhand State Science & Technology Congress, during 26- 28th February 2015, held at Vigyan Dham, Dehradun.

(9) Photometric study of open star clusters in the National Seminar on Recent Development in Physics & Prosperity in Solar Physics-Space Science on 27-28th December 2014, held at Department of Physics, M. B. Govt. P. G. College, Haldwani, Nainital, Uttarakhand.

Posters Presented

(1) Poster presentation on Study of open cluster NGC 5617 in Gaia era in the meeting of International Astronomical Union held at Shanghai, China during 30 June-5 July, 2019.

(2) Poster presentation on Multi-wavelength study of intermediate age open cluster NGC 5617 in 35th meeting of the Astronomical Society of India held at B. M. Auditorium, Jaipur during March 6-10, 2017.

(3) Poster presentation on Study of II Galactic Quadrant of Milky Way Galaxy using open clusters" in the first BINA workshop at Nainital-Uttarakhand, India during 15-18 November 2016.

(4) Poster presentation on Photometric study of open star cluster Riddle 4 in the 32nd Meeting of the Astronomical Society of India, held at the Indian Institute of Science Education and Research Mohali during, March 20-22, 2014.

(5) Presentation of poster titled Study of open star cluster Teutsch 126 using 2MASS JHK data in the National Seminar on Recent Development in Physics & Prosperity in Solar Physics- Space Science, during 27-28th December 2014, held at Department of Physics, M. B. Govt. P. G. College, Haldwani, Nainital, Uttarakhand.

(6) Poster Presentation on Photometric study of open star cluster Teutsch 1 in 8th Uttarakhand State Science & Technology Congress, during 26-28th December 2013, held at Doon University, Dehradun,Uttarakhand.

(7) Presentation of poster titled Photometric Study of open star clusters Czernik 31 & Haner 11 in the National Seminar on Recent Development in Physics & Prosperity in Solar Physics-Space Science, during 3-4 November 2012, held at Department of Physics, M. B. Govt. P. G. College, Haldwani, Nainital, Uttarakhand.

Observing Experience

Optical photometric observations using the 1.04-m Sampurnanand Telescope (ST), at Manora Peak, ARIES, Nainital, India.

Optical photometric observations using 1.3-m Telescope located at Devasthal, ARIES, Nainital, India.

Optical photometric observations using 1.2-m Telescope located at Mount Abu, PRL, Ahmedabad, India.

Computer Proficiency

Programming, plotting and working experience with Super Mongo (SM) package, GNUPLOT and TOPCAT tool.

Working experience with photometry tools, Astronomical Image Processing software IRAF, DAOPHOT and Python.

Working experience with Linux and Windows Operating Systems.

Science Popularization Activities

(1) Supervised the students attending ATSOA-2015 during 04-13th March 2015 at ARIES, Nainital, India. I taught them techniques of photometric data reduction of open star clusters.

(2) During the National Science Day program in 2017 at Physical Research Laboratory Ahmedabad, I contributed by judging the school student science posters.

List of Publications (Published/Accepted):

(1) A comprehensive study of five intermediate-age Pismis (2, 3, 7, 12, 15) clusters using Photometric and Astrometric data from Gaia EDR3.
Bisht et al. 2022, The Astronomical Journal, Accepted.

(2) Optical linear polarization study towards Czernik 3 open cluster at different spatial scales
Namita Uppal, Shashikiran Ganesh, **D. Bisht**, 2022, The Astronomical Journal, 2022AJ....164...31U

(3) A deep investigation of two poorly studied open clusters Haffner 22

and Melotte 71 in Gaia era. D. Bisht et al. 2022, PASP, 134D, 4201B.

(4). A Gaia based photometric and kinematical analysis of the old open cluster Devesh P. Sariya., Ing-Guey, Jiang, **D. Bisht** et al. 2021, Accepted for the publication in The Astronomical Journal.

(5) Study of an intermediate age open cluster IC 1434 using ground based imaging and Gaia DR2 astrometry
Y. H. M. Hendy and **D. Bisht**, 2021, Accepted for the publication in Revista Mexicana de Astronomía y Astrofísica.

(6). A deep study of an Intermediate-age open cluster SAI 35 (Juchert 20) using ground based imaging and Gaia EDR3 astrometry
D. Bisht., Qingfeng, Zhu., R. K. S. Yadav., Geeta, Rangwal., Alok, Durgapal., Sariya, Devesh P., Ing-Guey, Jiang . 2021, The Astronomical Journal, 161, 182B (DOI: 10.3847/1538-3881/abe383)

(7). Multi-colour photometry and Gaia EDR3 astrometry of two couples of binary clusters (NGC 5617 and Trumpler 22) and (NGC 3293 and NGC 3324)
D. Bisht., Qingfeng, Zhu., R. K. S. Yadav., Shashikiran, Ganesh., Geeta, Rangwal., Alok, Durgapal., Sariya, Devesh P., Ing-Guey, Jiang . 2021, MNRAS, 503, 5929-5947. (DOI: 10.1093/mnras/stab691)

(8). Detalied analysis of the poorly studied northern open cluster NGC 1348 using multi colour photometry and Gaia EDR3 astrometry
D. Bisht, Qingfeng, Zhu., W. H., Elsanhoury., Devesh P., Geeta, Rangwal., R. K. S. Yadav., Alok, Durgapal., Ing-Guey, Jiang . 2021, Published in PASJ (DOI: 10.1093/pasj/psab029)

(9). Astrometric and photometric investigation of three old age open clusters in Gaia era: Berkeley 32, Berkeley 98 and King 23
Devesh P. Sariya., Ing-Guey, Jiang et. al. (including **D. Bisht**), 2021, The Astronomical Journal, 161, 102S (10.3847/1538-3881/abd31f)

(10). A comprehensive analysis of NGC 2158 in Gaia era: photometric parameters, apex and orbit
Devesh P. Sariya., Ing-Guey, Jiang et. al. (including **D. Bisht)**, 2021, The Astronomical Journal, 161, 101S (10.3847/1538-3881/abd31d)

(11). An investigation of the Transit Timing variations in HAT-P-12 planetary System:
Indication of Non-Sinusoidal Variations
Devesh P. Sariya., Ing-Guey, Jiang et. al. (including **D. Bisht**), RAA, 2021, 21,

97. (DOI: 10.1088/1674-4527/21/4/97)

(12). An investigation of poorly studied open cluster NGC 4337 using multi-colour photometric and Gaia DR2 astrometric data
D. Bisht, W. H., Elsanhoury., Qingfeng, Zhu., Devesh P., R. K. S. Yadav., Geeta, Rangwal., Alok, Durgapal., Ing-Guey, Jiang . 2020, The Astronomical Journal, 160, 119 (DOI: 10.3847/1538-3881/ab9ffd)

(13). Study of open cluster King 13 using CCD VI, 2MASS and Gaia DR2 Astrometry
Alok, Durgapal., **D. Bisht**., Geeta, Rangwal., Harmeen, Kaur., R. K. S. Yadav., 2020, NewA, 78, 101364D (10.1016/j.newast.2020.101364)

(14). A search for variable stars in the four open star clusters
Alok, Durgapal., Geeta Rangwal., **D. Bisht.**, Harmeen, Kaur., R. K. S. Yadav., J. C. Pandey., 2020, JApA, 41, 13D (10.1007/s12036-020-09628-9)

(15). A comprehensive study of open clusters Czernik 14, Haner 14, Haner 17 and King
10 using multicolour photometry and Gaia DR2 astrometry
D. Bisht, Qingfeng, Zhu., R. K. S. Yadav., Alok, Durgapal., Geeta Rangwal., 2020, MNRAS, 494, 607B (10.1093/mnras/staa656)

(16). Astrometric and photometric study of NGC 6067, NGC 2506, and IC 4651 open clusters based on wide-eld ground and Gaia DR2 data
Geeta Rangwal, R. K. S. Yadav, Alok Durgapal, **D. Bisht**., Nardiello, D., 2019, MNRAS, 490, 1383R (10.1093/mnras/stz2642)

(17). Mass function and dynamical study of the open clusters Berkeley 24 and Czernik
27 using ground based imaging and Gaia astrometry
D. Bisht, R. K. S. Yadav, Shashikiran Ganesh, A. K. Durgapal, G. Rangwal, J. P. U. Fynbo., 2019, MNRAS, 482, 1471B (10.1093/mnras/sty2781)

(18). Near-infrared study of open clusters Teutsch 10 and Teutsch 25.
D. Bisht, Shashikiran Ganesh, R. K. S. Yadav, A. K. Durgapal, Geeta Rangwal., 2018, Advances in Space Research, 61, 57 (10.1016/j.asr.2017.10.055)

(19). Interstellar extinction in 20 open star clusters
Geeta Rangwal, R. K. S. Yadav, A. K. Durgapal, **D. Bisht**., 2017, PASA, 34, 68R (10.1017/pasa.2017.64)

(20). Mass function study of open star clusters Haner 11 and Czernik 31.
D. Bisht, R. K. S. Yadav, A. K. Durgapal., 2016, New Astronomy, 47, 19 (10.1016/j.newast.2016.01.004)

(21). 2MASS analytical study of four open cluster candidates
D. Bisht, R. K. S. Yadav, A. K. Durgapal., 2017, New Astronomy, 52, 55 (10.1016/j.newast.2016.10.009)

(22). UBVI photometric study of open star cluster Czernik 6 and Ruprecht 25.
D. Bisht, R. K. S. Yadav, A. K. Durgapal., 2016, New Astronomy, 49, 1 (10.1016/j.newast.2016.04.007)

(23). Photometric study of open star clusters in II quadrant: Teutsch 1 and Riddle 4.
D. Bisht, R. K. S. Yadav, A. K. Durgapal., 2016, New Astronomy, 42, 66. (10.1016/j.newast.2015.06.005)

(24). Photometric studies of open star clusters Haner 11 and Czernik 31.
D. Bisht, R. K. S. Yadav, A. K. Durgapal., 2013, New Astronomy, 25, 103. (10.1016/j.newast.2013.04.007)

List of Publications (Under review):

(1). A DEEP STUDY OF AN OPEN CLUSTER NGC 5288 USING PHOTOMETRIC AND ASTROMETRIC DATA FROM GAIA DR3
Reetika Sethi, **D. Bisht**, Geeta Rangwal. 2022, RMxAA

(2). A Gaia based analysis of intermediate age open cluster
Devesh P. Sariya et al. 2022. (**D. Bisht**), New Astronomy.

List of Publications (In Conference Proceedings)

(1). Study of open cluster NGC 5617 in Gaia era.
D. Bisht, Qingfeng Zhu, 2020, IAUS, 353, 22B

(2). Study of II Galactic quadrant of Milky Way Galaxy using open clusters.
D. Bisht, Shashikiran Ganesh, K. S. Baliyan, R. K. S. Yadav, Alok Durgapal., 2018, BSRSL, 87, 229B

(3). Astrophysical parameters of open star clusters using 2MASS JHKs data.
Alok Durgapal, **D. Bisht**, R. K. S. Yadav., 2018, BSRSL, 87, 234D

(4). 2MASS analytical study of galactic star cluster Teutsch 40
D. Bisht, R. K. S. Yadav, A. K. Durgapal.,National Conference on CICAHEP, Dibrugarh (2015), 01, 137

Recent Research Work (Selected/In last 2-3 years)

(1) We present the optical linear polarization observation of stars towards the core of the Czernik 3 cluster in Sloan i-band using the EMPOL instrument on the 1.2 m telescope of the Mount Abu Infrared Observatory. We study the dust distribution towards this cluster by combining the results from our polarization observations with the data from Gaia EDR3, PanSTARRS, 2MASS, WISE and HI, 12 CO surveys. The observed stars show a large range in the degree of polarization indicating that the dust is not uniformly distributed over the plane of the sky even on a small scale. The latest data from the Gaia EDR3 provide astrometric and photometric results which allow to redefine the membership of stars in this cluster. Within 5 arcmin radius of the cluster we find 72 stars with high probability (≥ 90%) of being cluster members. The distance of the cluster is constrained to 3.6±0.8 kpc using the member stars in the core region. The variation of observed degree of polarization and extinction towards the cluster direction reveals the presence of at least two dust layers along the line of sight at distances of ∼ 1 kpc and ∼ 3.4 kpc. The close vicinity of the second layer to the cluster suggests that the cluster could be embedded in the cloud.
(This work has been published in The Astronomical Journal.)

(2) We have done a wide field analysis of three southern open star clusters NGC 6067, NGC 2506 and IC 4651, using WFI@2.2 photometric data combined with Gaia DR2 proper motions, parallax angles and radial velocities data. The optical data are reduced using the standard routines. Using Gaia DR2 parallax data, heliocentric distances of clusters are calculated as 2.284 kpc, 3.482 kpc and 0.942 kpc for the clusters NGC 6067, NGC 2506 and IC 4651 respectively. We determined Galactic orbits of these clusters using Galactic potential models. Fundamental properties of the clusters are derived using radial-density profile and isochrone fitting. Age of the clusters are calculated as 89 ± 10 Myr for NGC 6067, 2090 ± 50 Myr for NGC 2506, 1590 ± 40 Myr for IC 4651. For NGC 6067 slope of mass function is found similar to Salpeter value whereas a flatter mass function slope is observed for NGC 2506 and IC 4651. Mass-segregation is observed for all the three clusters. **(Published in MNRAS)**

(3) We presented a comprehensive analysis (photometric and kinematical) of poorly studied open cluster NGC 4337 using 2MASS, WISE, APASS, and Gaia DR2 database. By determining the membership probabilities of stars, we identified 624 most probable members with membership probability higher than 50% by using proper motion and parallax data taken from Gaia DR2. The mean proper motion of the cluster is obtained as $\mu_x = -8.83 \pm 0.01$ and $\mu_y = 1.49 \pm 0.006$

mas yr −1 . We find the normal interstellar extinction towards the cluster region. The radial distribution of members provides a cluster radius of 7.75 arcmin (5.63 pc). The estimated age of 1600 ± 180 Myr indicates that NGC 4337 is an old open cluster with a bunch of red giant stars. The overall mass function slope for main-sequence stars is found as 1.46 ± 0.18 within the mass range 0.75−2.0 M , which is in fair agreement with Salpeter's value (x=1.35) within uncertainty. The present study demonstrates that NGC 4337 is a dynamically relaxed open cluster. Using the Galactic potential model, Galactic orbits are obtained for NGC 4337. We found that this object follows a circular path around the Galactic center. Under the kinematical analysis, we compute the apex coordinates (A, D) by using two methods: (i) the classical convergent point method and (ii) the AD-diagram method. The obtained coordinates are: (A conv , D conv) = (96.27 ± 0.10, 13.14 ± 0.27) & (A ◦ , D ◦) = (100.282 ±0.10, 9.577 ± 0.323) respectively. We also computed the Velocity Ellipsoid Parameters (VEPs), matrix elements (μ ij), direction cosines (l j , m j , n j) and the Galactic longitude of the vertex (l 2).
(Published in The Astronomical Journal).

(4) Considering the importance of investigating the transit timing variations (TTVs) of transiting exoplanets, we present a follow-up study of HAT-P-12b. We include six new light curves observed between 2011 and 2015 from three different observatories, in association with 25 light curves taken from the published literature. The sample of the data used, thus covers a time span of 10.2 years with a large coverage of epochs (1160) for the transiting events of the exoplanet HAT-P-12b. The light curves are used to determine the orbital parameters and conduct an investigation of possible transit timing variations. The new linear ephemeris shows a large value of reduced χ 2 , i.e. χ 2 (23) = 7.93, and the sinusoidal fitting using red the prominent frequency coming from a periodogram shows a reduced χ 2 around 4. Based on these values and the corresponding O-C diagrams, we suspect the presence of a possible non-sinusoidal TTV in this planetary system. Finally, we find that a scenario with an additional non-transiting exoplanet could explain this TTV with an even smaller reduced χ 2 value of around 2.
(Published in RAA journal)

(5) We have presented a comprehensive analysis of two pairs of binary clusters (NGC 5617 and Trumpler 22) and (NGC 3293 and NGC 3324) located in the fourth quadrant of our Galaxy. For this purpose, we use different data taken from VVV survey, WISE, VPHAS, APASS, and GLIMPSE along with Gaia EDR3 astrometric data. We identified 584, 429, 692, and 273 most probable cluster members with membership probability higher than 80 per cent towards the region of the clusters NGC 5617, Trumpler 22, NGC 3293, and NGC 3324. We found normal extinction law for cluster pair NGC 5617 and Trumpler 22. The values of R ∼ 3.8 and ∼1.9 represent the abnormal extinction law towards the clusters NGC 3293 and NGC 3324. Our kinematical analysis shows that all these clusters have circular orbits. Ages

are found to be 90 ± 10 and 12 ± 3 Myr for the cluster pairs (NGC 5617 and Trumpler 22) and (NGC 3293 and NGC 3324), respectively. The distances of 2.43 ± 0.08, 2.64 ± 0.07, 2.59 ± 0.1, and 2.80 ± 0.2 kpc estimated using parallax are consistent with the values calculated by using the distance modulus. We have also identified 18 and 44 young stellar object candidates present in NGC 5617 and Trumpler 22, respectively. Mass function slopes are found to be in fair agreement with the Salpeter's value. The dynamical study of these objects shows a lack of faint stars in their inner regions, which leads to the mass-segregation effect. Our study indicates that NGC 5617 and Trumpler 22 are dynamically relaxed but the other pair of clusters are not. Orbital along with the physical parameters show that the clusters in both pairs are physically connected. **(Published in MNRAS)**

Future Research Plan at ICSP

(A) Multicolour photometry, astrometry, spectroscopy and Polarimetry of Star clusters

During the post of Scientist-C, I wish to collaborate with the faculty members at ICSP, Kolkata and use the available observing facility of a 24-inch optical Telescope at Sitapur Observatory. I will also use observing facilities in India from different Telescopes. Many open clusters (OCs) are still unstudied or poorly studied. Recently Gaia mission has discovered many new OCs. So, I plan to study such kinds of clusters with the help of space-based and ground-based data sets. Apart from our observed data, I would like to use the publically available multicolor photometric data (VVV, UKIDSS, GLIMPSE, WISE, 2MASS, APASS, PANSTARS, ISOGAL), spectroscopic data (LAMOST, APOGEE, etc.) and astrometric data (Gaia DR3 and upcoming data of Gaia mission) for the deep investigation of clusters. One of our main aims is to study the distribution of OCs in the 6D phase space using our observed data with Gaia DR2 and DR3 kinematical data. This will improve the discovery and membership of distant clusters. Gaia DR3 will also enhance the main physical parameters of clusters. My main objectives are as follows-

(1) Binary members play an important role in the dynamical evolution of Ocs. In the OC, high energy binaries inject kinematical energy into the OC, which leads to a

global expansion of the system and prevents the core collapse. At the same time, binaries in the OC experience dynamical evolution. Low energy binary tends to increase its semi major axis by interactions with other stars in the cluster and broken apart. The high energy binary tends to decrease its semi major axis by interactions with other stars in the cluster. Finally the total binary fraction and the initial semi major axis distribution change. In order to understand such kind of phenomenon in OCs, I am planning to choose a sample of clusters to estimate their membership probability, fundamental parameters and binary fractions using ground based imaging and Gaia astrometry.

(2) The study of variable stars in open clusters are very important. Variable stars are useful tools to improve our understanding of stellar evolution and structure of stars. Star clusters are unique laboratories to study the stellar evolution as star clusters provide a sample of stars having the same age, distance, initial composition and spanning the range of masses. Star clusters have a dierent type of variable stars which show variability at various stages of their evolutionary phases. It would be very important for observational studies of multi periodic pulsating variable stars such as Scuti stars, Gamma Dor stars and SPBS (slow pulsating B stars), etc., because they need accurate time series data to analyze their complicated light curves. By identification of members of pulsating stars and asteroseismology analysis, especially the one in binary systems, one can test the formation and evolution of stars and obtain the stellar parameters independently. We can further study the nature of the clusters itself, such as size, age, mass, metal abundance, formation, dynamical evolution and etc. So, I am aiming to search variable stars in open clusters using a 24 inch-Telescope at Sitapur Observatory and 1.3 meter JCBT at VBO, IIA.

(3) The polarization of starlight through selective extinction byaligned/partially aligned and asymmetric dust grains present inthe general interstellar medium can be considered as a valuable tool to study both the grain properties, such as size and shape,and the small-/large-scale structure of interstellar magnetic fields in the different lines of sight. This kind of research is important because it provides information on the dust itself and it is also useful in establishing custer membership. A comparison between polarization and extinction data in the same lines of sight provides tests for models of extinction and alignment of the grains. As they are thought to align so that their longest axes tend to become orthogonal to the direction of the local magnetic field, the observed polarization vectors map the mean field direction projected on the plane of the sky. My aim is to perform the polarization study of such young Ocs.

(4) One of the essential parameters for our understanding of stellar formation and evolution is the intrinsic metallicity of (proto-)stars of a given mass. Even in the early stages of stellar evolution, metallicity severely influences the cooling and collapsing of ionized gas. To derive metallicity, radial velocity, etc., I aim to do spectroscopic observations for bright stars, giant stars, etc. using the observing facility at Sitapur Observatory and other available spectroscopic data sets (LAMOST, APOGEE,

GALAH, etc.).

(5) How interstellar molecular clouds collapse and form new stars is a key question in astrophysics. The star formation process is not clearly understood. For that purpose, I want to use multiwavelength data of star forming regions. Under this project, I aim to study the star forming young Galactic clusters and investigate their mass function and star formation history. This will be helpful to understand the stellar evolution process as well as to trace the structure of our Milky Way Galaxy. The initial mass function is still a challenging problem at least at a lower mass range (<1 M). I want to study whether initial mass function (IMF) is universal or depends on other astrophysical parameters like metallicity, position and environmental condition of the cluster. To investigate the universality of IMF, we need a larger sample of OCs. So, I would like to take deep observations for a number of clusters.

(6) Interstellar dust is an important component of the interstellar medium. It is the remnant of star formation and stellar evolution process. Interstellar dust grains can transmit, redirect and transmute the starlight. Due to this property of dust grain, the actual distances and magnitude determination of astronomical objects is often very dicult. For this reason, it is very important to have knowledge of interstellar dust in the line of sight of the objects. Young open clusters are ideal objects for this kind of study because they may contain gas and dust around early type (O, B, and A) stars. I am planning to observe a sample of young open clusters to understand the dust properties.

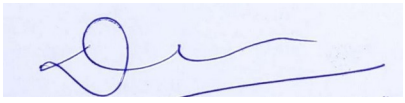
(B) Study of Transiting Exoplanets

I have recently started working on transiting exoplanets. I plan to use various ground-based observing facilities (including a 24-inch Telescope at Sitapur Observatory) to observe transit events. The data will then to be used in combination with already available data to elongate the time baseline for transiting exoplanets. Thus, transit timing variations can be studied. In cases like this, we may detect, hint or discard the presence of additional exoplanets in the exoplanetary systems. Also, with better data quality and a larger amount of data, the orbital parameters will be better dened for these exoplanetary systems. The increasing focus on the science of extrasolar planets (exoplanets) is a prominent feature of astrophysics in the 21st century. The main credit for the discovery of a number of extra-solar planets goes to the techniques of transit surveys and radial velocity measurements. In the recent years, transit method has played a crucial role in nding new planetary systems, while the Doppler-shift based planet detection techniques played a dominant role in the initial phase. The transit discoveries caused an extraordinary jump in the number of well-known exoplanets owing to the satellite observations by CoRoT, Kepler, and the updated version of the Kepler, K2 mission. Despite, the role of ground based observations has been very necessary too. The dierent ground based surveys like SuperWASP, KELT, MASCARA, TrEs, Qatar survey etc. have invented considerable exoplanets.

Ground-based telescopes also provide follow-up observations to conrm the transiting nature of exoplanets discovered from space surveys. The additional contributions from ground-based telescopes are to cover a large eld-of-view and to carry out extensive follow-up observation programs which improve the orbital parameters of a planetary system. These observations can also be used for the analysis of the transit timing variations (TTVs) over a longer time baseline. In essence, a TTV is the transit time deviation from a linear ephemeris which provides clues about the existence of another planet in the system

Declaration

I hereby declare that the information furnished above is true to the best of my knowledge and belief.



Devendra Bisht
Scientist-C
ICSP, Kolkata
Dated: 31 August 2022