

Belgo-Indian Network for Astronomy & Astrophysics (BINA)

Santosh Joshi

ARIES, Nainital

(on behalf of BINA Members)



Indian Partners Institutions

- ARIES (Aryabhata Research Institute of Observational Sciences; Nainital): **Santosh Joshi** (PI) et al.
- SNBNCBS (S.N. Bose National Center for Basic Science Kolkata): S. Mondal et al.
- IIA (Indian Institute of Astrophysics; Bangalore): A. Goswami et al.

- ISRO (Indian Space Research Organization Bangalore, India): V. Girish et al.
- IIST (Indian Institute of Space Science & Technology; Trivandrum): R. Lekshmi et al.
- PRL (Physical Research Laboratory; Ahmadabad): S. Naik et al.

- TIFR (Tata Institute of Fundamental Research; Mumbai): A. Mazumdar et al.
- NCRA (National Center for Radio Astrophysics, Pune, India) : I. Chandra et al.

- IUCAA (Inter-University Centre for Astronomy and Astrophysics; Pune): A.N. Ramaprakash et al.
- DU (Delhi University, North Campus Delhi) : H. P. Singh et al.
- KU (Kumaun University, Nainital) : A. K. Durgapal et al.
- RSU (Pt. Ravi Shankar University, Raipur Chhatishgadh) : N. K. Chakradhari et al.

Indian Investigators



Belgian Partners Institutions and Investigators

- **ROB (Royal Observatory of Belgium): P. De Cat (PI) et al.**
- **ULg (Université de Liège): J. Surdej et al.**
- **KUL (Katholieke Universiteit Leuven): H. Van Winckel et al.**
- **UGent (Universiteit Gent): M. Baes et al.**
- **UAntwerp (Universiteit of Antwerp) : K. Kolenberg et al.**
- **ULB (Université Libre de Bruxelles) : Alian Jorissen et al.**



Objective of BINA Network

➤ Efficient scientific exploitation of observations of solar system, galactic and extragalactic celestial objects

➤ Optimal development and commissioning of new instruments

➤ Shared approach for:

1. Preparation of observing proposals

2. Procedures for data acquisition, reduction and back-up

3. Scientific goals of common interest (e.g. asteroseismology, binaries, massive stars, abundance studies, galaxies, active galactic nuclei, quasars, ground-based follow-up observations for missions like Astrosat)

Major Observational facilities available at Devasthal for BINA Network

➤ 3.6-m Devasthal Observatory Telescope (DOT)



- ✓ 7% guaranteed time for Belgium
- ✓ 33 % for ARIES, 60% for other Indian Institutions

Instruments currently offered

- ✓ Imager (optical; Johnson-Cousins + SDSS filters)
- ✓ ADFOSC (350-900 nm; $R \sim 2000$, U,B,V and narrow band filters)
- ✓ TIRCAM2 (1 to 5 μm ; 7 filters + ~ 1.5 arcmin FoV)

Upcoming instruments

- ✓ TANSPEC (imaging and spectroscopy in J, H, K bands) ($R \sim 2750$, FoV $1' \times 1'$, will be operational from 2019)
- ✓ Integrated Field Unit Camera (IFU)
- ✓ high-resolution spectrograph (cf. HERMES) ($R \sim 80k, 40k$, $RV \sim 2\text{-m/sec}$, expected to available by 2022)

➤ 4.0-m International Liquid Mirror Telescope (ILMT)



- ✓ rotating container with mercury
- ✓ strip of 0.5 deg around dec = 29.4 deg

Other BINA Observing Facilities

Indian Telescopes

- ✓ 2.01-m HCT (Optical)
- ✓ 1.2-m Mount Abu
- ✓ 1.3-m Devasthal
- ✓ 1.04-m ARIES

- ✓ GMRT (radio)

- ✓ Astrosat (UV, X-ray)

- ✓ 2.0-m IGO
- ✓ 2.5-m Mount Abu
- ✓ 1-m class telescope SNBNCBS

Belgian and Other Telescopes

- ✓ 1.2-m Meracator

- ✓ 6.0-m SAO, Russia

- ✓ 10.01-m, 1.9-m SAAO

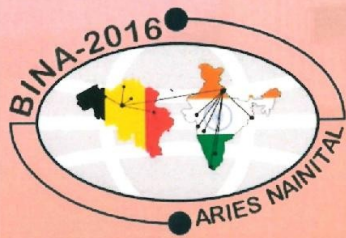
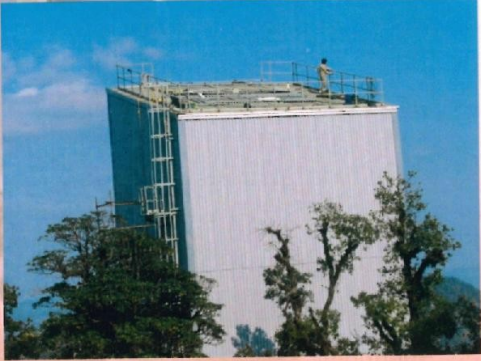
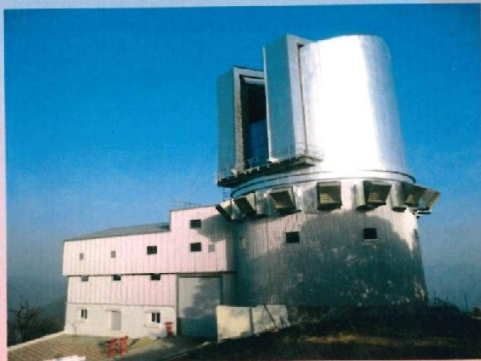
- ✓ ESO telescopes

Network Activities: Organization of the Workshops and Work Visits

- Practically, the BINA project was started about two years ago.
(05 May 2016)
- 4-days Workshops : Instrumentation & Science with 3.6-m DOT at Nainital
(15-18 November 2016)
- 2-weeks work visits by 3 Indian scientists to Belgium
(08-23 October 2017)
- 1-day Workshop at ROB : The ongoing activities of BINA Network
(12 October 2017)
- 2 weeks work visits for installation activities of ILMT
(07 - 21 January 2018)
- 4-days Workshop : BINA as an expanding international collaboration
(09 to 12 October 2018)

Network Activities : The First BINA Workshop (15-18 November)

Belgo-Indian Network for Astronomy and Astrophysics (BINA)



Proceedings
of
First BINA Workshop
ARIES, Manora Peak, Nainital, India
15 -18 November 2016



Network Activities : ILMT and Related Project (Surdej et al.)

- Prof. Jean Surdej et al. are working hard to commission the ILMT project at Devasthal.
- Exchange visit : 2-3 time per year visited India for the ILMT activities.
- First light of ILMT expected : Spring 2019
- Visit of two Indian students to Université de Liège for couple of months.
- Observing Proposals to monitor Multiply Images Quasars Candidates
- Exchange visit to IIA, IIST, IUCAA for collaborative and teaching activities.
- Two ILMT related papers are published in the Proceedings of First BINA workshop.

Network Activities : Erasmus Mobility Grant (Michael de Becker et al.)

➤ 3 Students from ARIES, IIA, IUCAA visited Universite de Lige from May- December 2018 to foster exchanges between Liede and Indian BINA partner Institutions under the Erasmus+ International Credit Mobility grant.

1. Bharti Arora (ARIES:JCP) worked with Michel de Becker on Investigation of X-ray emission from Massive Stars for a stay of period of 3 months.
2. During 3 month (Feb-May2018) stay, Sabyachi Chatopadhyay (IUCAA : ANR) and Oliver Absil worked together on direct detection on exo-planets using cross Correlation technique and apply the technique on exoplanet HD142527 B.
3. Amit Kumar Mandal (IIA: AS,RS,BM) is presently visiting Belgium to work on multi-wavelength AGN variability and investigating Black holes properties.

Network Activities : Optical characterization and Radial velocity monitoring with Belgian and Indian Telescopes (ORBIT) (Y. C. Joshi et al.

Under the Indo-Belgian network, ORBIT project has been started in the year 2018 between the Indian and Belgian astronomers with the following aims :

- Search for exo-planets around cool stars.
- Detection of eclipsing binaries
 - Plan to monitor some bright candidates, which are extracted from Kepler archival data, using the telescopes having high-precision photometric and high-resolution spectroscopic instruments.
 - Characterize large number of poorly classified eclipsing binaries through medium-precision multi-band observations and low-resolution spectroscopy, which is relatively easily available, to know their precise nature and determine fundamental parameters

Network Activities : Variable Stars and Nucleosynthesis (Aruna Goswami et al.)

1. Prof. Marcel Arnould, Prof Alain Jorissen and Dr. Sophie van Eck of Institute of Astronomy and Astrophysics, ULB,

Stellar Evolution and Neutron-capture Nucleosynthesis

(D. Karinkuzhi & A. Jorissen et al. 2018, A&A, (in press), arXiv : 1807.06332)

2. Successful Observing Proposal to HESP on HCT and HERMES on MERACATOR entitled

Orbital Solution for New Spectroscopic Systems Discovered among A-F type Candidate hybrid Stars from the Kepler Mission” (PL, AG, SJ, PDC).

The spectral data analysis is in progress.

Network Activities : Stellar Variability in A-F Stars (S. Joshi et al.)

1. Successful observing proposals on “Investigating the Pulsational Variability in Am Stars HD73045 and HD118660 on Meracator HERMES, SAO, TNO (SJ, PDC, PL, ES, DM)

Results are being presented in detail by Eugene Semenko in this workshop (CT21)

2. Stellar Variability in Kepler Stars (SC, SJ, PL, PDC, YCJ, CE, KTP)
2018, paper under review

Observing Proposal on “Investigating the atmospheric, chemical and rotational properties of A and Am stars” for the period Oct. 18- March 19 on Meracator (PDC, SJ, PL, TO)

Network Activities : Reverberation Mapping of AGN (Amit Kumar et al.)

1. Measuring Black hole mass as well as dusty torus in AGN (AK, RS, CSS)

2. Spectroscopic and Photometric Monitoring of Black hole candidates.

Interferometry to resolve central engine in few AGN using VLT via BINA

Monitoring of quasars using ILMT telescope for

Multiwavelength Variability,

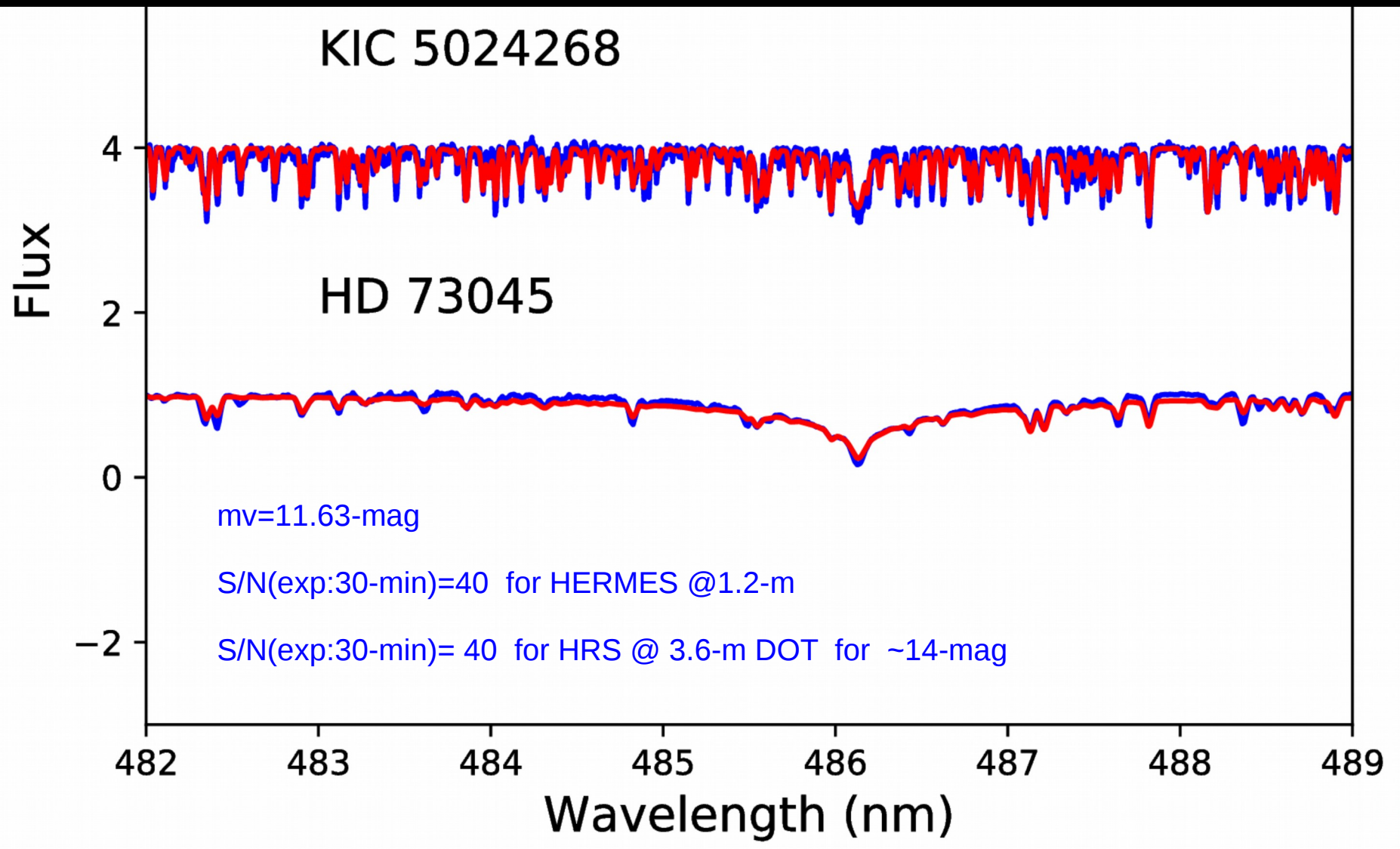
Discovery and study for new quasars,

Measurement of Hubble constant using lensed quasars.

Network Activities : Instrumentations

- Designing the High-resolution spectrograph (HRS) : Prof. Gert Ruskin
- Specification for HRS : National Committee+JCP, YCJ, David Mktrichian+ Peter De Cat+..
- The proposal has now been approved by DST, Govt of India where about 2 Millio Euro has been sanctioned.
- Project duration : 2019-2022
- Up-gradation of the current instruments : ADFOCS and other instruments.
- Proposals for the new Instruments from both the countries.

Observations from HERMES and Importance of HESP on 3.6-m DOT



KIC 5024268 : Teff:5065+67K, log g: 2.74+-0.36 dex, [M/H]: 0.10+-0.06 dex, Vsini: 6.29+-0.68 km/s

HD73045 : Teff:6991+-150K, log g: 4.77+-0.2 dex, [M/H]: 0.04+-0.02 dex, Vsini: 16.66+-0.14 km/s

Thank You

