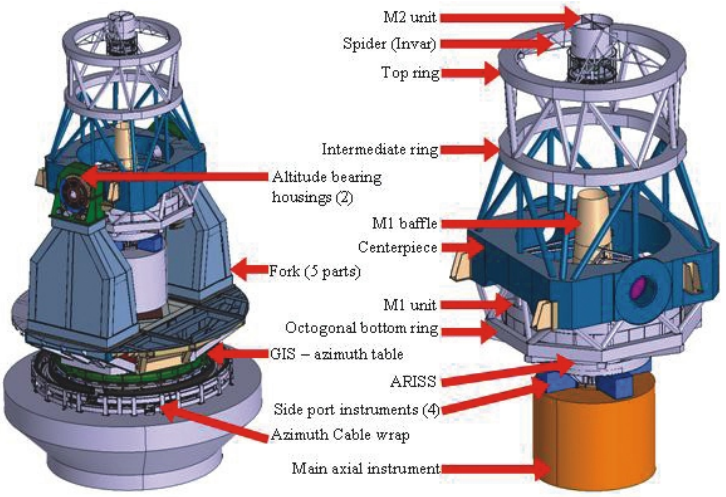
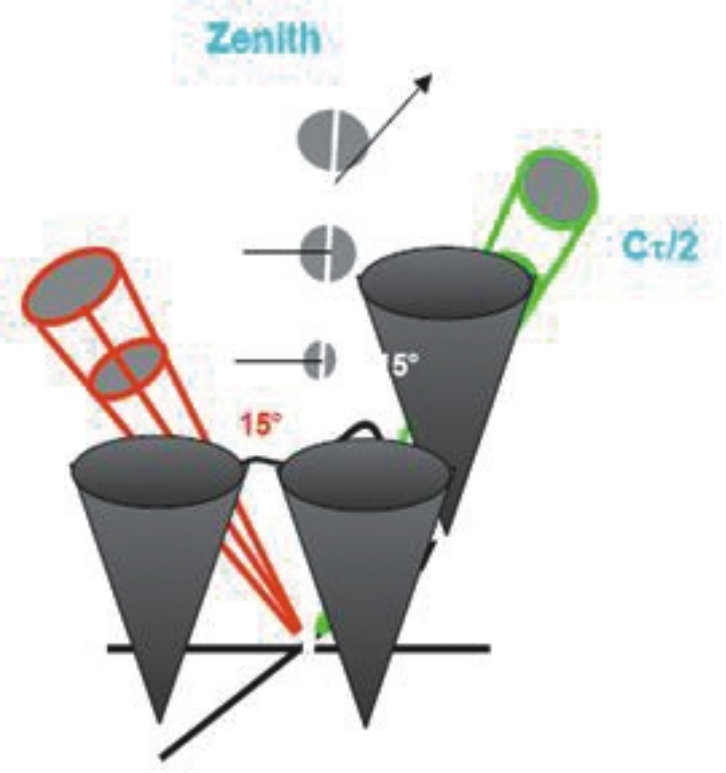
Aryabhatta Research Institute of Observational Sciences (ARIES)

Academic Activities



New optical telescope to be installed by ARIES at Devasthal. The size of telescope will be 3.6-m. Once completed, this will become the largest optical telescope facility in India. The project is expected to get completed by 2012.



ST-RADAR facility to be installed at Manora Peak, Nainital.

Preamble

Aryabhatta **R**esearch **I**nstitute of Observational Scienc**ES** (ARIES) is an autonomous institute devoted to research and development in Astronomy & Astrophysics and Atmospheric Sciences. The Institute is funded by the Department of Science and Technology (DST), Government of India. Nearly 36 scientists and engineers are actively engaged in the scientific activities of the institute.

Research activities at ARIES

Astronomy & Astrophysics

Research activities at ARIES cover topics related to sun, stars and galaxies. ARIES has significant contributions particularly to the field of star clusters and Gamma-Ray Bursts (GRBs). The longitude of ARIES (79º East) locates it in the middle of about 180-degree wide longitude band having modern astronomical facilities between Canary Islands (20º West) and Eastern Australia (157º East). The observations, which are not possible in Canary Islands or Australia due to daylight, can be obtained by ARIES. Because of its geographical location and existence of good astronomical sites, ARIES has made unique contributions to many areas of astronomical research, particularly those involving time critical phenomena (e.g., the first successful attempt in the country to observe optical afterglow of GRBs was carried out from ARIES). A large number of eclipsing binaries, variable stars, star clusters, nearby galaxies, GRBs, and supernova have been observed from ARIES. The other research fields of the institute include solar astronomy, stellar astronomy, star clusters, stellar variability and pulsation, photometric studies of nearby galaxies, Quasars, and transient events like supernovae and

highly energetic Gamma-Ray Bursts (GRBs). A total solar eclipse lasting about 4 minutes was successfully observed from Manavgat, Antalya in Turkey on March 29, 2006 by a team of scientists from the Institute. In past, new ring systems around Saturn, Uranus, and Neptune were discovered from the observatory. Recently, for the first time a direct correlation between the intra-night optical variability and the degree of polarization of the radio jets in Quasars was established based on the observations from ARIES. For the first time periodic oscillations are detected in optical intra day variability data of blazers which is extremely useful to get the blackhole mass of blazers and also strong support to accretion disk based models of AGN.

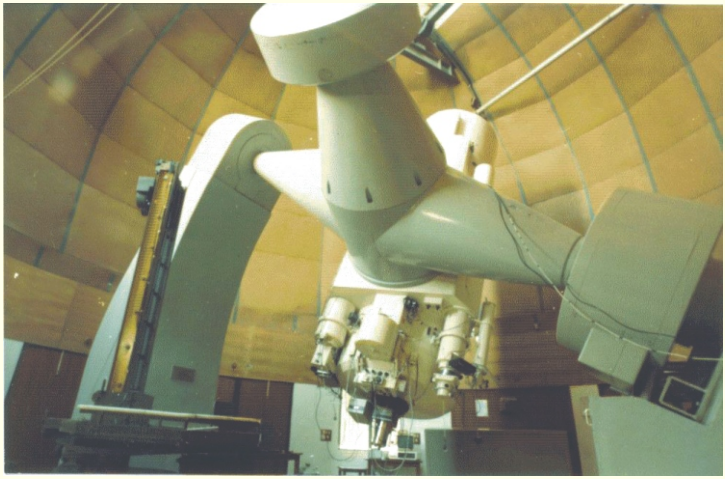
Atmospheric Sciences

Nainital (29.4^{o}N; 79.5^{o}E, 1958 m amsl) is located at higher altitude in the Central Himalayas and away from urban cities or any major pollution source. This factor makes it best suited for carrying out observations in background condition and to study the regional environment, particularly interactions between natural and anthropogenic trace species and climate change. Additionally, this site can also provide information on long range transport of pollutants. Studies on lower atmospheric dynamics are also very important in this region, which is severely lacking over northern India.

Facilities

Astronomy & Astrophysics

The 104-cm telescope, known as the Sampurnanand telescope, has been the mainstay of the photometric, spectrophotometric and polarimetric observations. It is equipped with modern instruments like cooled CCD camera, spectrophotometer, and filters etc. Other instruments available are Cassegrain plate holder, Meinel Camera, near infrared and photoelectric photometer, a spectrum scanner, and optical multi-channel analyser. For the study of solar flares, prominences, etc. we have 15-cm Solar Tower Telescope equipped with Bernhard Halle H filter and fast CCD Camera.



104-cm Sampurnanand Optical Telescope located at Manora Peak, Nainital.

Upcoming 130-cm optical telescope at Devasthal.

15-cm Coude Solar Tower Telescope equipped with Bernhard Halle H filter & fast CCD Camera for solar activity observations.

ARIES is setting up two new telescopes, a 130-cm and a 360-cm, at Devasthal. Both 130-cm and 360-cm telescopes will be operational by 2009 and 2012, respectively. ARIES promotes research using observations taken at other wavelengths like X-ray, ultra-violet, and radio. It is proposed that ARIES will help in building up of a user community for the upcoming observing facilities like ASTROSAT, the first multi-wavelength Indian astronomical Satellite to be launched in coming years, and the existing facilities such as Giant Meter-wave Radio Telescope (GMRT) of the Tata Institute of Fundamental Research (TIFR) near Pune and the new 2-meter Optical Himalayan Chandra Telescope (HCT) of the Indian Institute of Astrophysics (IIA) at Hanle in Leh.

Atmospheric Sciences

Aerosols optical depth observations are being carried out using a Multi-wavelength Solar Radiometer. An optical particle counter and an Aethalometer are being used for observations of number concentration of composite aerosols in 15 size ranges and black carbon, respectively. Observations of trace gases (O_3, CO, CH_4, NMHCs, CO_2, N_2O, and SF_6) have also been initiated using in-situ instruments and air-samplings. A portable lidar system is operational for aerosols and clouds studies. A Rayleigh and Mie Lidar is also being setup to study up to about 80 km altitude. Installation of a

Stratosphere-Troposphere (ST) Radar is also finalized. This radar would be operated up to about 20 km altitude. Phased Array Yagi Antenna will be used and physical area of the array is about 800 m^2. This system will be very useful for meteorological study, turbulence and up to some extend stratosphere-troposphere exchange (STE) studies.

Housing where LIDAR is placed.

The LIDAR instrument.

Infrastructure

The Institute has in-house workshops to meet the requirements of electronic, mechanical, and optical maintenance of the instruments. ARIES has a modern computer centre with internet facility and a well maintained library with more than 10,000 volumes of research journals and an excellent collection of books on Astronomy & Astrophysics and Atmospheric Sciences.

Doctoral Programme

ARIES offers fellowships to pursue Ph. D. in Astronomy & Astrophysics and Atmospheric Sciences. ARIES selects students as research scholars via the JEST and NET exams. The minimum qualification is M.Sc. degree in Physics. The details of these exams are usually announced via., advertisements in national newspapers and posters at most of the educational institutes/universities in the country. The selection is based on an interview, which is usually held in June.

Course work, Tenure, Scholarship & other allowances

All selected research scholars are required to undergo a course work, which lasts for about nine months. The course work comprises

of class teaching, assignments, quizzes, seminars, and project works. At the end of course work, research scholars are required to select either Astronomy & Astrophysics or Atmospheric Sciences as the field of their interest for Ph. D. degree. Research scholars are expected to submit their thesis within five years from the start of their programme. Research scholars admitted for the Ph. D. programme are initially offered a Junior Research Fellowship (JRF) with a stipend of Rs. 12000/-. On completion of two years as JRF, a student is promoted to a Senior Research Fellow (SRF), with an enhanced stipend of Rs. 14000/-, after a review before ARIES academic committee. Research scholars are also eligible for a book grant on yearly basis, accommodation in the campus and catering facilities at nominal cost. ARIES promotes research scholars to participate in national and international meetings and conferences.

ARIES library with more than 10,000 volumes of research journals and an excellent collection of books on Astronomy & Astrophysics and Atmospheric Sciences.

Postdoctoral Programme

ARIES offers postdoctoral fellowships and visiting positions to work in any branch of Astronomy & Astrophysics, Atmospheric Sciences, Engineering and Instrumentation, or Software development. Exceptionally bright and highly motivated candidates can be considered for regular staff positions.

Visiting Students Programme

Apart from regular Ph. D. programme, ARIES also has two more training programmes mainly for students (graduates & postgraduates from other institutes/universities) involved in various projects supervised by ARIES faculty members.

(a) The summer project students programme

This programme aims at spotting young talented students and attract and encourage them to do research in Astronomy & Astrophysics and Atmospheric Sciences. Under this programme, students entering in their final year of M.Sc./B.E. can work on short term projects with any of the faculty at ARIES during the summer for a period of about two months. The programme is widely publicized in January every year by sending posters to a large number of educational institutions. Selected students are fully supported. The number of students participate are normally around 10. The programme starts by the last week of April every year. The projects can be on instrumentation, observations or theory and are carried out at the Nainital campus or at Devasthal campus.

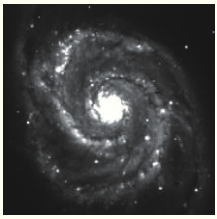
(b) Visiting Research Scholars Programme

Research scholars working for their Ph. D. in other institutes or universities can visit ARIES to work in collaboration with any of the institute faculty. Such visits are generally expected to be financially supported by home institute.

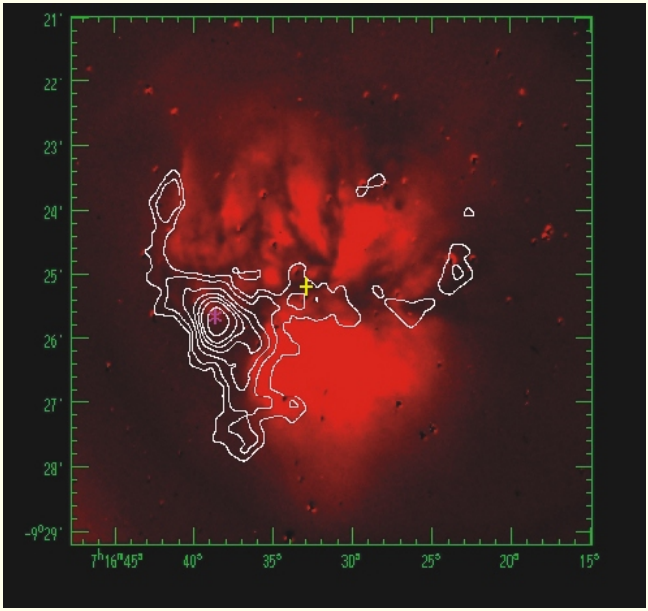
Important dates

Summer Projects	**: last week of April**
Interview for Ph.D. programme	**: last week of June**
Notification of results	**: first week of July**
Commence of Ph.D. course work	**: 1st of August**

A planetary nebulae imaged with the 104-cm telescope at ARIES. The nebulae of gas is created by explosion of a runaway Sunlike star.



The Whirlpool (M 51) galaxy imaged with the 104-cm telescope. The spiral arms are the sites, where new stars are being born.



A Galactic H II region (Sh 2294) imaged with 104-cm telescope at ARIES, along with MSX A-band intensity contours.

Areas of Research

Sun and Solar System	Observations and modeling of solar activity, waves, transient events in the solar atmosphere. Comets, asteroids and planets.
Stellar Astronomy	Young stars, evolved stars, novae, supernovae, stellar variability and asteroseismology, chemically peculiar stars, binary stars, circumstellar matter and chromospherically active stars.
Star Clusters and Star Formation	Initial mass function and star formation, stellar evolution and stellar dynamics.
Interstellar Medium	Study of galactic HII regions, extinction and reddening properties, galactic structure and molecular clouds.
X-ray Astronomy	X-ray emitting binary stars.
Extragalactic Astronomy	Kinematics of star clusters in external galaxies, multi-wavelength variability of active galactic nuclei, quasars absorption line systems, microlensing, study of gamma ray burst afterglows, massive star formation in external galaxies, dark matter and galaxy formation.
Atmospheric Sciences	Trace gases, aerosols physical and chemical properties, studies on lower dynamics and lower atmospheric studies using satellite data.

Mailing Address:

The Director

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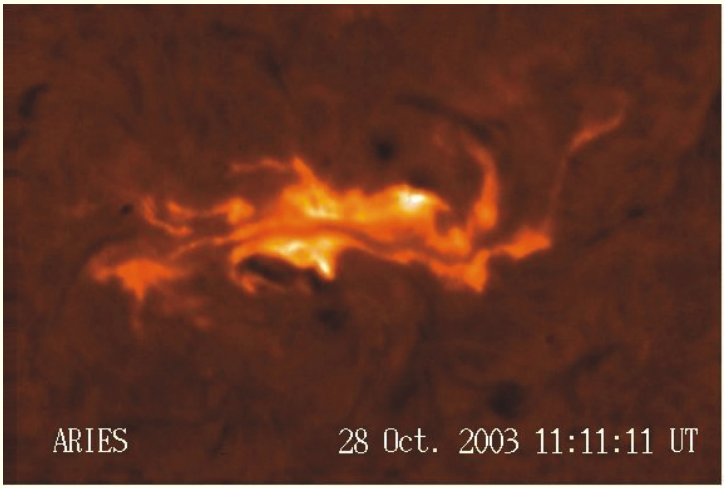
How to reach : Connected from Kathgodam (broadgauge) and Lal Kuan (meter-guage) railway stations. ARIES is about 9-km from Nainital bus stand.



4B/X17.2 class historical flare observed at ARIES on 28 October 2003 from superactive region NOAA 10486 with 15-cm Coude Solar Tower Telescope.

Comet Hale-Bopp

Red sprite with bluetendrils seen above thunderclouds

Total solar eclipse
Taken on 29th March 2006 by ARIES
from Antalya, Turkey