

Priority Area:

5. Astronomy and Astrophysics

Coordinators:

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India-Japan Cooperative Science Programme

Activity Report in the Area: Astronomy and Astrophysics

Overview and Future Plan

1.FY2001-2002 Overview

In this research field, a single comprehensive collaboration was organized and executed successfully with the same title, "Astronomical Observations with Advanced Instrumentation", succeeding to the last period. Both countries have been intimately collaborating with each other for the development of advanced astronomical instruments and the application to actual observational research at good sites and by good facilities.

In particular, i) development of submillimeter wave astronomy in Himalayas, ii) far-infrared balloon observation at Hyderabad, iii) super-mirror technology development for X-ray observation from space, iv) solar physics, v) gravitational wave detector technique, vi) planetary system are major activities producing noticeable results during this period.

2.FY2003-2004 Future Plan

In next two years, the collaboration in this field is extended more widely not only in Astronomy/Astrophysics but also Solar/Planetary Science. A new 2m telescope at Hanle, Himalayas will be operated as a steady-state operation phase, and produce fruitful observational results. This Hanle site is the best site in the submillimeter wave observation, too. Collaborative work for developing instruments for the Hanle site is expected to start.

Balloon-borne observation in the infrared and X-ray wavelengths is expected to be extensively continued. The balloon flight facility of TIFR at Hyderabad is a well-maintained facility in the world, and locates at the most southern part of the earth except for the Antarctic continent.

By frequent exchanges in solar physics, planetary science, and gravitational wave detection more close collaborating program will be started for ASTRO-SAT of India and for ASTRO-F, E2, Solar-B satellites of Japan. Exchanges in high-energy cosmic-ray physics is to be started soon.

3.Summary

In the field of Astronomy and Astrophysics, frequent exchanges and tight collaborations have actually been executed in this program. The program was a single, unified one including all topics of this research field. As observational studies in this field is expected to make advances continuously in both countries (large ground-based telescopes, satellites, balloon-borne telescopes), this research theme should be continued at least in next two years.

Modes of Cooperation:

1. Joint Research Projects

Report

1. Joint Research Projects

FY2001-2002

Project No.1

Title: Astronomical Observations with Advanced Technologies

Objectives:

This research is aimed to advance collaborative activities in astronomical observations with advanced technologies. The following sub-themes are set for the period FY2001-2002. Among them, Development of Gravitational Detector and Optical Observation of Open Clusters are new sub-themes, and other five sub-themes are continuation from the previous period.

- a) Ground-Based Astronomy from Hanle
- b) X-ray Astronomy
- c) Balloon Observations of Infrared Objects
- d) Observation of Interplanetary Dust Particles
- e) Observational Study of Solar Physics
- f) Development of Gravitational Wave Detector (new)
- g) Optical Observation of Open Clusters (new)

Project Coordinators:

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(Indian)

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Professor

Indian Institute of Astrophysics

Date of Commencement: 1 April 2001

Date of Completion: 31 March 2005

Accomplishment Status:

X-ray, optical, infrared, and optical astronomical observations with advanced technologies have been extensively executed as collaborative projects of both countries. In the ground-based observation, the 2-m telescope at Hanle, Himalayas is in its commission phase. Balloon infrared observations were executed every year, given the benefit that instruments can be recovered in the wide country of India without serious damages. X-ray observations by balloon was planned and discussed for future

collaborative observation at Hyderabad. Gravitational wave detection and high-energy gamma ray detection were started as collaborative researches. The followings are the status reports of individual sub-themes.

a) Ground-Based Astronomy from Hanle

The 2-m telescope at Hanle, Himalayas was successfully constructed and opened to the astronomical community not only of India but of foreign countries. The site was demonstrated to be one of the best astronomical site in the world, especially in the optical, near-infrared, and submillimetric wave regions, being comparable to the ATACAMA site in Chile. By exchanging astronomers between both countries, possibilities in mutual collaborations of using the Hanle site for submillimetric observations and high-energy gamma-ray detection.

b) X-ray Astronomy

By the collaborative researches, the hard X-ray polarimetric detector (CdZnTe) technology, the hard-X-ray super mirror technology, and the gas proportional counter technology were significantly advanced. TIFR and Nagoya University made a collaborative observation plan in the hard X-ray balloon-borne telescope project, that will be launched at Hyderabad in the near future. The Indian X-ray astronomy group are developing the instruments for the Indian satellite project, ASTROSAT. The Japanese X-ray astronomers joined the discussion on these instruments in the technical point of view.

c) Balloon Observations of Infrared Objects

Balloon infrared observation by using the TIFR 1-m telescope with a Japanese spectrometer was successfully executed in 2001. In addition to this, a Japanese 50cm telescope with a far-infrared array sensor was launched three times in 2001 and 2002. The flights were remarkably successful. The observational data were far-infrared continuum emission from interstellar solid particles and far-infrared spectral line emission from the ionized carbon gas, and the results are quite important and unique, and presented in journal papers as well as in international conferences.

d) Study of Interplanetary Dust Particles

The zodiacal light is the light scattered by irregular-shaped interplanetary dust particles of sub-micron size. The distribution and the spectra of the dust particles are important information on the origin of the solar and planetary system. Kobe University and IUCAA investigated the possibility of the observation of the zodiacal light from the Hanle site as collaboration. In addition to this, simulation work for scattering by irregular-shaped solid particles was executed.

e) Observational Study of Solar Physics

A collaborative research of the solar activity was executed by comparison between the data from the

Japanese satellite, YOHKOH, and the data taken by a ground solar telescope in India. For several flare events, cooperative analysis has been executed. As for the solar X-ray spectrometer onboard the Indian satellite, technology exchanges were made.

f) Development of Gravitational Wave Detector

Japanese scientists are developing a gravitational wave detector, TAMA 300, achieving the highest sensitivity so far. The discussion was made on participation of Indian scientists to this project as a role of data analysis.

g) Optical Observation of Open Clusters (new)

By a visit of an Indian astronomer to Japan, nine open clusters were successfully observed by the Schmidt Telescope of Kiso Observatory. The analysis were made by astronomers of both countries.

Future Plan:

In the latter half of the current four-year period, the collaboration in this field will enter in a new phase.

Himalayan Chandra Telescope entered into its steady-state operation phase. It will produce fruitful observational results. Japanese astronomers are interested in using this telescope for their own research. Additionally, the follow-up observation of the Japanese ASTRO-F survey will be planned by constructing a new near-infrared instrument by a collaboration.

Balloon-borne observation in the far-infrared wavelength will enter into the harvest. As the telescope and the balloon flight became stable and reliable, the wide-area survey in the far-infrared will be executed effectively. The energy budget/flows between various phases in the interstellar space will be resolved by this collaboration.

An X-ray balloon-borne observation is expected to start soon. The super mirror technology in the hard X-ray region is notably powerful to detect the dark matter through observations of the hot gas in the cluster of galaxies. Japanese and Indian X-ray astronomers will make a new X-ray telescope with the super mirror telescope.

By frequent exchanges in solar physics and planetary science, much more close collaborating program will be able to be established. Exchange programs other than those existing sub-themes are also effective for extend this Japanese-Indian close collaboration in this field. They should be kept at the same level in the latter half of the current period.

Exchange Visits Undertaken

FY2001

Japan to India

Name and Affiliation	Research Subject	Main Host	Period
Kojun Yamashita Professor Nagoya University	Development of X-ray Telescopes with Multilayer Supermirrors	P.C. Agrawal Professor Tata Institute of Fundamental Research	9 Sep.2001- 16 Sep.2001 (8 days)
Kiyoshi Hayashida Associate Professor Osaka University	1) Discuss on the Future Plan for X-ray Polarimetry 2) Inspect and Gather Informations about Calibration Facility	P.C. Agrawal Professor Tata Institute of Fundamental Research	24 Mar.2002- 28 Mar.2002 (5 days)
Hiroshi Shibai Professor Nagoya University	Study of Galactic and Extragalactic Far-Infrared Dust Emission by Balloon-Borne Observations	R.P. Verma Professor Tata Institute of Fundamental Research	10 Mar.2002- 15 Mar.2002 (6 days)
Takao Nakagawa Professor The Institute of Space and Astronautical Science	To make Indian-Japanese Collaborative Balloon Experiments for Far Infrared Spectroscopic Observations of Galactic and Extragalactic Star-Forming Regions	R.P. Verma Professor Tata Institute of Fundamental Research	15 Nov.2001- 25 Nov.2001 (11 days)
Satoshi Masuda Assistant Nagoya University	Energy-Release Mechanism of Solar Flares	Rajmal Jain Professor Physical Research Laboratory	7 Oct.2001- 22 Oct.2001 (16 days)
Tadashi Mukai Professor Kobe University	Polarization Properties of Star Forming Clouds	Ranjan Gupta Professor Inter-University Centre for Astronomy and Astrophysics	26 Mar.2002- 29 Mar.2002 (4 days)
Masakatsu Fujimoto Professor National Astronomical Observatory	Gravitational Data Analysis	Sanjeev Dhurandhar Professor Inter-University Centre for Astronomy and Astrophysics	24 Feb.2002- 1 Mar.2002 (6 days)

India to Japan

Name and Affiliation	Research Subject	Main Host	Period
T.P.Prabhu Professor Indian Institute of Astrophysics	Utilization of the Himalayan Ghandra Telescope in the Infrared Band	Munetaka Ueno Professor University of Tokyo	19 Mar.2002- 31 Mar.2002 (13 days)
P.C. Agrawal Professor Tata Institute of Fundamental Research	Discussion on Cooperation and Collaboration in Research in X-Ray Astronomy	Kojun Yamashita Professor Nagoya University	9 Mar.2002- 24 Mar.2002 (16 days)
Biswajit Paul Fellow-E Tata Institute of Fundamental Research	Joint Experiment for X-ray Polarimetry	Kiyoshi Hayashida Associate Professor Osaka University	3 Mar.2002- 18 Mar.2002 (16 days)
R.P. Verma Professor Tata Institute of Fundamental Research	Infrared Astronomy	Hiroshi Shibai Professor Nagoya University	17 Mar.2002- 30 Mar.2002 (14 days)
Rajmal Jain Professor Physical Research Laboratory	Study of Solarflares Using the YOHKOH Satellite, and Ground-Based Observations in India	Takeo Kosugi Professor Institute of Space and Astronautical Science	4 Mar.2002- 17 Mar.2002 (14 days)
R.P.Singh Professor Indian Institute of Technology	Light Scattering and Its Use in Monitoring Aerosol and Terrestrial Remote Sensing	Tadashi Mukai Professor Kobe University	16 Dec.2001- 29 Dec.2001 (14 days)
Sanjeev Dhurandhar Professor Inter-University Centre for Astronomy and Astrophysics	Gravitational Wave Data Analysis:Searching for Coalescing Binaries and Continuous Wave Sources	Nobuyuki Kanda Associate Professor Miyagi University of Education	16 Jan.2002- 30 Jan.2002 (15 days)
Anil Kumar Pandey Doctor State Obserbatory, Naintal	CCD Photometry in a Wide Field around Open Clusters	Kasuo Ogura Professor Kokugakuin University	14 Nov.2001- 28 Nov.2001 (15 days)

FY2002

Japan to India

<u>Name and Affiliation</u>	<u>Research Subject</u>	<u>Main Host</u>	<u>Period</u>
Saburo Kawakami Professor Osaka City University	To Work Out the Possibility of International Collaboration in High Energy Gamma Ray Physics	T.P.Prabhu Professor Indian Institute of Astrophysics	22 Dec.2002- 27 Dec.2002 (6 days)
Masahiro Teshima Associate Professor University of Tokyo	To Work Out the Possibility of International Collaboration in High Energy Gamma Ray Physics	T.P.Prabhu Professor Indian Institute of Astrophysics	22 Dec.2002- 27 Dec.2002 (6 days)
Yasushi Ogasaka Assistant Professor Nagoya University	To learn and discuss about scientific balloon observations in India	P.C. Agrawal Professor Tata Institute of Fundamental Research	20 Feb.2003- 28 Feb.2003 (9 days)
Kojun Yamashita Professor Nagoya University	Development of Multilayer X-ray Optical Systems for X-ray Astronomy	P.C. Agrawal Professor Tata Institute of Fundamental Research	21 Mar.2003- 31 Mar.2003 (11 days)
Hiroshi Shibai Professor Nagoya University	Study of Galactic and Extragalactic Far-Infrared Dust Emission by Balloon Borne Observations	R.P. Verma Professor Tata Institute of Fundamental Research	28 Jan.2003- 8 Feb.2003 (12 days)
Yasuo Doi Research Associate University of Tokyo	Study of Galactic and Extragalactic Far-Infrared Dust Emission by Balloon Borne Observations	R.P. Verma Professor Tata Institute of Fundamental Research	9 Feb.2003- 4 Mar.2003 (24 days)
Hidehiro Kaneda Research Associate The Institute of Space and Astronautical Science	To make Indian-Japanese Collaborative Balloon Experiments for Far-Infrared Spectroscopic Observations of Galactic Star-Forming Regions	R.P. Verma Professor Tata Institute of Fundamental Research	11 Feb.2003- 28 Feb.2003 (18 days)
Takeo Kosugi Professor Institute of Space and Astronautical Science	Collaborative Study of Solar Flares based upon Japanese Yohkoh X-ray Observations and Indian Optical Observations	Rajmal Jain Professor Physical Research Laboratory	23 Feb.2003- 1 Mar.2003 (7 days)
Katsuo Ogura Professor Kokugakuin University	Wide-Field Photometry of Young Open Clusters	Anil Kumar Pandey Doctor State Observatory, Naintal	27 Oct.2002- 4 Nov.2002 (9 days)

India to Japan

<u>Name and Affiliation</u>	<u>Research Subject</u>	<u>Main Host</u>	<u>Period</u>
B.S.Acharya Professor Tata Institute of Fundamental Research	Feasibility Study on High Energy Gamma Rays Measurement with Large Telescope at Hanle	Saburo Kawakami Professor Osaka City University	16 Mar.2003- 30 Mar.2003 (15 days)
R.Manchanda Professor Tata Institute of Fundamental Research	Development of X-ray Instrumentations for X-ray Astronomy	Kojun Yamashita Professor Nagoya University	18 Feb.2003- 2 Mar.2003 (13 days)
Hemant Dave Professor Physical Research Laboratory	Sub-Millimeter Wave Facility	Hiroshi Shibai Professor Nagoya University	15 Mar.2003- 29 Mar.2003 (15 days)
D.K. Ojha Doctor Tata Institute of Fundamental Research	Activities Related to Far-and Near-Infrared Astronomy	Hiroshi Shibai Professor Nagoya University	6 Jan.2003- 20 Jan.2003 (15 days)
Uddin Wahab Astronomer Department of Science and Technology State Observatory	Study of Solar Flares	Takeo Kosugi Professor Institute of Space and Astronautical Science	5 Jan.2003- 19 Jan.2003 (15 days)
Asoke Kumar Sen Reader Department of Physics Assam University	Investigation of the Light Scattering by Irregular Shaped Particles	Tadashi Mukai Professor Kobe University	22 Jan.2003- 29 Jan.2003 (8 days)
Sanjeev Dhurandhar Professor Inter-University Centre for Astronomy and Astrophysics	Astronomical Observations with Advanced Technologies	Nobuyuki Kanda Associate Professor Miyagi University of Education	15 Dec.2002- 22 Dec.2002 (8 days)
Ranjan Gupta Professor Inter-University Centre for Astronomy and Astrophysics	Present/Discuss the T-Matrix Calculations Recently Carried Out by Indian PI in Context of Understanding the Interstellar Extinction Observed Curves from Out Milky-Way, LMC and SMC etc.	Tadashi Mukai Professor Kobe University	12 Mar.2003- 20 Mar.2003 (9 days)

FY2003

List of Members of Research Team

Japanese Members

Name (LAST, First M.)	OGAWA, Hideo	
Affiliation & Position	Position	Professor
	Department	Graduate School of Science
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