

Final report: Cooperation agreement BL/35/IN03

Partners:

Royal Belgian Institute for Space Aeronomy, Brussels, BE	Indian Space research Organisation Satellite Center, Bangalore, IN
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Introduction

The Royal Belgian Institute for Space Aeronomy (BIRA-IASB) is the PI institute responsible for the design, manufacturing and timely delivery of the NOMAD experiment to the ExoMars ESA/ROSCOSMOS mission, launched March 14th 2016. BIRA-IASB was also responsible for the SOIR instrument on board Venus Express and is still involved in the scientific investigation of the SOIR results (PlanetADAM project). Both experiments were fully supported by BELSPO through the PRODEX programme.

Planetary science is a growing field in India with the launch of the Chandrayaan-1 and the Mars Orbiter Mission. At this juncture it is very essential for the young generation to get trained in essential skills on data analysis and instrument development to enable them to take a lead role in the many upcoming Indian missions. The researchers of the Space Science Division of the Indian Space Research Organisation (ISRO), under the lead of Dr. Shyama Narendranath, work on instrumental development based on AOTF technology.

The interest of both divisions in planetary missions and their expertise concerning AOTF technology, a key element in SOIR and NOMAD instrumentation, brought naturally the two partners together.

The timing for the first networking contract, CoopInde (BI/35/fwi02) was right and the collaboration started off on the right foot. The BeMind cooperation agreement benefited from this momentum. Even though some difficulties were encountered, the two teams are now actively collaborating and can foresee common activities in a near-future.

In this report, we will present the different visits and their objectives. How the budget was spent and the perspectives of the network are also discussed.

Activities between 15 March 2013 and 16 March 2016:

Visits:

1. 6 - 12 May 2013: "Infrared spectroscopy of planetary atmospheres" workshop and SOIR & ASIMUT Hands-on sessions.

Belgian attendance: Dr. Ir. A.C. Vandaele, Dr. R. Drummond, Dr. L. Neary and Dr. S. Robert

This visit was our second visit to India. It has been thoroughly described in the CoopInde (BI/35/fwi02) final report.

This stay was successful. We had an interesting visit of the ISTE facilities, fruitful exchanges with the Indian planetary community during the “Infrared spectroscopy of planetary atmospheres” workshop and seized the occasion of distributing ASIMUT while introducing young researchers to the Venus’ data available on the Planetary Science Archive of ESA.

2. 2 – 6 June 2014: “Venus workshop” in ISRO Satellite Center, Bangalore, India

Belgian attendance: Dr. Ir. A.C. Vandaele, Dr. L. Neary and Dr. S. Robert



Figure 1: Group picture at the Venus workshop, Bangalore, June 2014

- Overview of the science from Venus and of experiments and instrumentation
- Discussion about past and future missions to Venus
- Brainstorming concerning new mission developments
- Aspects of radiative transfer modelling
- 2 days Hands-on sessions on SOIR data

This workshop was very interesting. Various scientists and engineers presented their research concerning Venus’ study. The potential payload for a future Venus mission in 2023 was discussed during a dedicated session. An up to date workshop about SOIR and ASIMUT was organized in order to encourage the use of the Venus Express data.

3. 16-21 April 2015: Visit of S. Narendranath at BIRA-IASB, Brussels, Belgium

Dr. Shyama Narendranath, official partner of the cooperation agreement, suggested to come and visit BIRA-IASB on her way to the European Geophysics Union’s General Assembly in Vienna. During the 4-days visit, she gave a seminar entitled “Planetary exploration programs in India” at BIRA-IASB and participated to the NOMAD Science Working Team meeting in Liège.

Practical information concerning the calibration of the SOIR instrument were discussed. MATLAB routines and data were selected together as to start developing a calibration tool for the SOIR data. A meeting with the BIRA-IASB SPENVIS team (N. Messios and E. De Donder) was organized as well.

4. 16 – 29 February 2016: Visiting scientist: Dr.Ir. A. Mahieux in ISRO Satellite Center, Bangalore, India

Dr.Ir. A. Mahieux gave talks at the Indian Institute of Astrophysics (IIA), Bangalore and Space Astronomy Group, ISRO on the major discoveries from SOIR during its eight years of observations. The talks were enlightening and spurred interest in Venus.

Two meetings were organized, respectively with the Director of IIA and with the Director of the ISRO Satellite Centre (ISAC). Both directors welcomed the collaboration and supported the joint activities, for instance the possibility of a Venus workshop in mid-2016 at Kodaikanal solar observatory.

Arnaud Mahieux and Shyama Narendranath worked out a plan to implement the calibration of SOIR with the solar spectrum measured on-board in the miniscan mode. The work has begun and is proposed to be completed by August 2016. The major elements of this work include

1. Write codes for each step in IDL ; 2. Run it through all miniscan data available ; 3. Document analysis procedures and any anomalies ; 4. Generate a software manual ; 5. Document results and discuss with the team ; 6. Publication on refined calibration of SOIR.

Publications:

- 1) “Venus – so near yet so far”, Shyama Narendranath K.C., in PLANEX Newsletter - Vol. 5, issue 1 (Jan. 2015)
- 2) Poster at the National Space Science Symposium: “In orbit calibration of the Solar Occultation In Infra-red (SOIR) instrument on-board Venus Express” – S. Narendranath, A. Mahieux, A.C. Vandaele, S. Robert and P. Sreekumar.

Post-Doc fellowship:

A.C. Vandaele submitted an application to the Call 2015 of the Postdoc Fellowships for non-EU researchers, funded by BELSPO, in order to hire P Subramani Athiray as a 1-year Post-Doc at BIRA-IASB. P.S. Athiray attended the 2014 workshop in Bangalore together with the Belgian team. The title of the project was : “Characterizing the IR channels of NOMAD/ExoMars based on laboratory calibration”. Unfortunately, this application was not granted by BELSPO.

Difficulties encountered

It has been very difficult for Indian researchers to come over to Belgium. A visit of three researchers was planned for 2 weeks (15-30 November) in 2014 to take part in the NOMAD

calibration campaign. They had confirmed their visit at the beginning of October. All was ready for their visit. Out of the blue, the trip was cancelled on November 7: "I was told that chairman has written "Regret" on my request for the Belgian trip.", S. Narendranath.

In April 2015, S. Narendranath arranged with her hierarchy to take a leave of absence. This way she could organize a visit to Belgium before going to the European Geophysics Union Assembly, in Vienna. (see above – visit 3)

Budget

23415 euros, including 5% of overhead, were granted to BIRA-IASB in order to develop a research network with the Indian Space Research Organisation (ISRO) and the Indian Institute of Space Sciences and Technology (ISST). The BEMIND funding was used for flights and per diems in Bangalore.

Table 1 indicates the yearly and global budget of the BEMIND agreement. The balance shows that more than half of the allocated budget was not spent. This is explained by two facts: 1. The expenses on 2013 were paid by the CoopInde agreement (BI/35/fwi02), as the two agreements overlapped ; 2. It appeared very complicated to host Indian researchers in Belgium.

Allocated	22300 euros
Overhead (5%)	1115 euros
Expenses	10251,57 euros
2013 expenses	5273,65 euros on CoopInde (BI/35/fwi02)
2014 expenses	4580,12 euros
2015 expenses	2635,85 euros
2016 expenses	3035,60 euros
Balance (Allocated-Expenses)	12048,43 euros

Table 1: Budget Table of the BEMIND agreement

Perspectives of the collaboration:

Thanks to the BEMIND agreement, the collaboration between SAG, ISRO and BIRA-IASB is on the right track to be successful. Although coming to Belgium seems difficult, Dr. S. Narendranath does her best to stay in touch and organize meetings in India once a year. The two partners have exchanged knowledge and paved a new road into this bilateral collaboration. The networking efforts may be more demanding but the results start to pay off with one common publication in preparation and ongoing discussion about new missions to Mars (2020) and Venus (2023).