

# **List of Czech Republic activities approved by ESA Committees and Programme Boards**

## **1. Science Programme Committee**

### **CLUSTER II . Data processing and simulation facility, numerical modeling and interpretation of wave and particle data**

Continuation of PRODEX activities.

This project is aiming at research work on the global, meso and micro scales of the solar wind-magnetosphere interaction using kinetic codes (Vlasov/PIC/hybrid) and in situ data analysis (PRASSADCO, IDFS/ISDAT data interface) in collaboration with UCLA, Los Angeles (NSF grant: Analysis of Waves and Turbulence in Space Plasma), LESIA Meudon (PICS) University of Iowa (NSF grant: Study of Propagation and Non-Linear Properties of Plasma Waves Using Advanced Techniques). Furthermore this project is a preparation for the forthcoming BepiColombo mission. It also aims at using existing know-how in the preparation of space experiments to initiate development of search-coil sensors and miniaturized low/middle frequency pre-amplifiers.

### **Czech participation in INTEGRAL**

Continuation of PRODEX activities.

The Czech participation in INTEGRAL consists of the project co-ordination and local management (including the Czech INTEGRAL science team and Ondrejov INTEGRAL Data Centre) within the Czech Republic, international collaboration and links, and focuses on direct participation in ISDC and OMC activities. The project leader is Co-I of INTEGRAL OMC experiment and Co-I and consortium member of INTEGRAL Science Data Centre (ISDC).

### **SOHO observations and data analysis**

So far, several SOHO instruments have been used to study the solar atmosphere, prominences, filaments and CMEs. The observations were analyzed using sophisticated numerical simulations of the non-LTE radiative transfer and MHD, and several papers containing important results have been published. The PI of this proposal is the Associate Scientist of the SOHO-SUMER project and has been observing and analyzing the SOHO data in collaboration with the SUMER team at MPAE Lindau and MEDOC team at IAS Orsay. Further collaboration includes the Observatoire de Paris, Meudon and MPA Garching. Results of this work were awarded in 2003 by the prize of the Czech Academy of Sciences.

SOHO has been obtaining unique data since its launch and new observations can be scheduled. This project is aiming at:

1. using an extensive SOHO archive and analyzing spectra and spectral images of the selected solar structures;
2. organizing and performing new observations, namely with CDS and SUMER;
3. continuing the development of modern analysis tools based on theoretical approaches to non-equilibrium plasma spectroscopy and solar MHD;
4. using the results for definition of future ESA solar missions like Solar Orbiter.

It is planned to continue the studies of the chromospheric UV and EUV line formation, of the oscillations in hydrogen Lyman lines and the mechanisms of the chromospheric heating. The goal is also to better understand the physics of solar prominences and filaments, namely their fine structure, interaction of the plasma with the magnetic field and the dynamics. The attention will be also devoted to eruptive processes related to the filament activation and CME.s, with the output for Space Weather Programme (in the framework of ILWS).

### **Waves and turbulence in space plasmas**

This project aims at application of state-of-the-art analysis techniques to wave measurements in space plasmas. It is planned to use data from two ESA missions that already are in the operational phase, Cluster and Double Star. The research activities will be concentrated on important wave phenomena occurring in the Earth's magnetosphere at the magnetospheric boundaries, and in the solar wind. In the framework of the preparation of the ESA mission Solar Orbiter, it is foreseen to analyze data from the Stereo spacecraft, and, for the Solar Orbiter mission it is also planned to do a preparatory study of a special onboard spectral analyzer. As an integral part of this data analysis effort, the antenna theory will be developed and numerical simulations performed. The experience gained in previous successful international projects will be used: NSF grants .Study of Propagation and Non-Linear Properties of Plasma Waves Using Advanced Techniques. in collaboration with the University of Iowa, .Analysis of Waves and Turbulence in Space Plasma. with the University of California (LA), French-Czech international program of scientific cooperation (PICS) No. 469, and the PRODEX project .Cluster II: data processing and simulation facility, numerical modeling and interpretation of wave observation..

## **2. Industrial Policy Committee**

### **Advanced monitoring for a modern generic Mission Control System**

Traditionally Mission Control is done at a central, entirely closed Mission Operations Centre with no direct or indirect connection to the world outside. New communication and Internet technologies are enabling the capability of remote monitoring, using technologies such as Internet/Web applications or GSM/Personal Digital Assistants (PDA). The availability of these technologies and new features in non-space related monitoring systems (e.g. SCADA Systems) ignited a growing demand to open also the MCS to external and remote users. However, this implies higher performance requirements (more clients are connected to the server), therefore performance is becoming an important issue, especially for high data rate missions. Also, this requires

communication and middleware technologies supporting these new remote monitoring facilities, such as PDA. For both issues, new IP communication and middleware technologies are the key point.

The main objective of this activity is to provide a design, which is already verified by prototypes and which constitutes the baseline for an implementation into a full operational system. In addition the output shall meet the demanding needs of commercial satellite operators, thereby improving the international competitiveness of the generic European Mission Control System. The envisaged activity shall therefore achieve the following:

- Analyse how new IP communication technologies can be exploited to achieve an optimal trade-off between performance and reliability for satellite monitoring systems.
- In a second step, the results of this analysis shall be applied to define a new design for the Monitoring subsystem of the ESA Mission Control SCOS-2000.
- Analyse how new communication and middleware technologies can be used to facilitate the interface between the central mission control system server and remote users based on GSM/PDA technology. Adjust the design of the SCOS-2000 Monitoring subsystem accordingly.
- Since the used middleware technology is a crucial point, it shall be analysed how TCP/IP connections can be replaced by CORBA. In a second step the MCS shall be redesigned and modified accordingly.
- Design a suitable Man Machine Interface for a Monitoring client, which is suitable to run on a PDA.
- All activities will be supported by prototypes on various levels of operational maturity.

For this activity Siemens Austria will count with the participation of two subcontractors: ANF-DATA (Czech Republic), who will be in charge of the Homogenous CORBA based Telemetry Monitoring Subsystem (459 k.), and Siemens PSE (Hungary), who will be developing the Mobile Duty Extension for Mission Control (128.671 ). The total cost of these two subcontracts shall be funded by the PECS programme. The participation of Siemens Austria will be funded by GSTP.

### **3. Earth Observation Programme Board**

#### **Spectral-spatial scaling from leaf to canopy level using spectro-directional**

##### **approaches in support of the SPECTRA mission**

Norway spruce belongs to the most important tree species of the boreal forests, which are representing one of the largest biome on the Earth. Consequently, investigation and research of the carbon cycle dynamic (carbon transformation, sinks and sources) within Norway spruce ecosystem, considering a scenario of the global climate change, is currently under high scientific and social attention. Present spectro-directional remote sensing systems (e.g. CHRIS on PROBA, MISR) are capable to provide useful tools for research and modelling of the carbon cycle at different scale levels.

In 2003, the Czech national project CzechCarbo, aiming at studying mechanisms and main environmental factors controlling deposition capacity of the atmospheric carbon by

the European terrestrial ecosystems from local to regional extent was released. This project is based on a dual-constraint method including both bottom-up and top-down modelling approach. The bottom-up approach directly simulates the processes of the carbon exchange between the ecosystem and atmosphere, using models of several vegetation physiological and biophysical processes, e.g. photosynthesis, respiration, transpiration, etc. Imaging spectroscopy can be used to parametrize these models through retrieval of the biophysical and biochemical variables from hyperspectral data of airborne (e.g. AVIRIS, HyMAP, CASI) or spaceborne systems (MERIS, MODIS, Hyperion), exploiting appropriate radiative transfer (RT) models.

### **New model for knowledge management in forestry based on integration of principles of ambient mobile intelligence, new methods of navigation and integration of space imaging**

This project intends to establish a new concept of Ambient Mobile Intelligence (AMI) for forest management integrated mobile communication, new methods of navigation (GPS, EGNOS, GALILEO) and integration of spatial information including satellite imaging (SPOT, IKONOS, EROS) The project will be focused on three specific objectives, which will be solved:

- . Integration Spatial data infrastructure (integrated satellite imagery) as a part of forestry knowledge system on the base of standards and recommendation of OGC with principles of Semantic Web.
- . The design and implement of communication and navigation system in heterogeneous network (terrestrial Internet, GPRS, WiFi, satellite) in combination with current and future navigation systems (GPS, EGNOS, GALILEO).
- . New methods of data mining, modelling and analysis will be used for improving forestry knowledge management. The new technologies will support the building of the forestry knowledge system (forest management, forest fire protection).

The system will offer to the forest owners and to the forest planning offices new methods of data collection and data analysis providing an optimal combination of field work, new sources of information and analysis for to they are able to prepare forest management plans more effectively, faster and cheaper.

### **Assessment of the porting of different EO processors to GRID Technology**

GRID computing is a new and active field that is focused on large scale sharing of resources (computing power, storage and/or bandwidth).

ESA has been involved in the development of a GRID portal for EO services, including data processors and efficient interface to the MUIS Multimission Gateway. Following in this line of activities, it is proposed to assess the porting of different EO processors to the GRID technology. The potential applications for the proposed study are the following:

DINSAR, SAR Differential Interferometry. The main objective of DINSAR is the detection of small surface movements during time periods extending from months to few years. It involves the processing of huge amount of EO data.

SMOS re-processing scenario. SMOS, (Soil Moisture and Ocean Salinity) is the first opportunity mission in the Earth Explorer series.

Generation of Value Adding EO products for urban management. This application has clearly a commercial orientation. The idea is the generation of change maps in urban areas based on SAR images and derived products. These products could be used to generate European wide statistics, with refresh period of one year. The potential scope is the top 500 urban areas in EU.

### **Soil Moisture and Ocean Salinity (SMOS) simulator**

ESA contracted EADS CASA for the SMOS (Soil Moisture and Ocean salinity), to be primarily involved in the payload and cosponsored by CNES (via Alcatel for the Proteus bus) and CDTI (Spain) for the ground segment. It is currently in C/D phase.

Science Systems (SciSys) are responsible to EADS CASA for the On Board Software for the payload SMOS, and suggested ideas to enhance this task. One of these ideas was to have a more sophisticated Instrument Software Validation Facility/instrument simulator, than the test harness that they are currently contracted to develop. The reason being that the team would like more flexibility to de-risk hardware/software integration and test.

This simulator would be made by Iguassu Software Systems (CZ) in parallel to the project and used when available. I.e. it would not be a risk to the project but would add considerable benefit if available in time. It would be much closer to what Astrium/SSF have produced for the platform system on missions such as CryoSat/Proba than the usual test harness used for instruments. SciSys would have a small element of work to specify the task and support the development. The main task for Iguassu Software Systems would then be:

1. specify and produce a design , that would have to be based around TSIM, the target processor simulator used by SciSys
  2. simulate the Payload module external hardware to the processor
3. provide a GUI to drive it (this could be done using SCOS or the ESA SVF building blocks)
4. the simulation should be script driven with automatic checking to allow automation (could be based around SCOS or the test tool Cantata)
5. move SciSys system level tests from SciSys test harness to run on the new SVF as a validation exercise and to allow seamless integration into the current project .

## **4. Programme Board on Satellite Navigation**

### **Development of SISNeT-Related Software and Applications**

EGNOS is becoming operational through 2004 and additional services are being implemented to broadcast EGNOS messages that will constitute the core of the European navigation services in near future. In particular, ESA has developed SISNET, which allows transmission of EGNOS messages through Internet (and GPRS) thus providing substantial added value for non-safety-critical users, in particular in areas with reduced GEO visibility. In addition, SISNET is a straightforward but powerful tool allowing

investigating atmosphere, EGNOS characteristics and performance at a very reduced cost. This is of major importance, in particular to provide hands-on experience in GNSS, for instance in the Universities.

Numerous applications based on those tools include rail monitoring, car navigation, or guiding blind people. Especially in the latter, the SISNeT.s Internet two-way communication adds significant value.

Czech Republic proposes to further develop the ESA.s SISNET-related existing tools (with the possibility of including a dedicated SISNET node in Czech Rep.), according to the requirements from the GNSS-1 Project Office, and to use them for development of concrete applications. Apart from the potential of the applications, the project will:

- Promote use of EGNOS and SISNeT in new EU countries
- Increase important hands-on know-how in Czech Republic and promote preparation of local companies for utilisation of GNSS in Europe and seed the knowhow in application design for Galileo
- Deliver additional SISNeT-based tools functionality to ESA for the European users benefit.