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Metis INSTRUMENT for the Solar Orbiter Mission

MANAGEMENT PLAN

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and the Metis Consortium:

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CNR - Institute for Photonics and Nanotechnology, Padova, Italy
INAF – IASF, IAPS, OAA, OACN, OACt, OAPa, OATo, OATs, Italy
Laboratoire d'Astrophysique de Marseille, France
Max-Planck-Institute für Sonnensystemforschung, Germany
Naval Research Laboratory, USA
Politecnico of Turin, Italy
Universities of Florence, Padua, Italy
University of Athens, Greece



prepared by G. Nicolini

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Change Log

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15/01/2008	1	0	all	First Issue
02/11/2009	2	0	all	
01/04/2010	2	1	all	Updated schedule and consortium organization
03/04/2010	3	0	All	General revision for IPDR
08/03/2014	3	1	All	General update for D-PDR
	4	0		
15/12/2015	4	1	1	Rewording
			2	Rewording
			2.1	Rewording, List of institutes updated in Table 1 WBS 20000 updated
			2.2.1	In Table 3 D. Moses association changed from NRL to NASA L. Strachan (NRL) added as Co-I List of Associate Scientists and Key Persons updated
			4.X	Rewording
			8	Launch date updated
18/04/2017	4	2	2	PI duties expanded
			2.2.1	Co-I's and Key persons lists updated
			8	PFM delivery date updated
			9	[AD-2] added

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1 General Introduction

Scope of this document is to describe the instrument team organization and the management plan of the Metis project for the Solar Orbiter Mission.

The Management Plan is organized in two distinct volumes.

- In Volume I the overall scientific team organization and the interfaces versus the European Space Agency are described.
- In Volume II the Industrial Team organization, and the interfaces versus ASI are described.

This document describes a plan aimed to guarantee full and appropriate management of the project and to be compliant with the requirements reported in the applicable issue of the Solar Orbiter EID-A [AD-1].

This document includes the personnel roles, contributions and activities, and the list of the affiliate institutes and agencies.

Metis is an international project which includes the contributions of three countries: Italy, Czech Republic and Germany.

The management structure is such to provide a functional organization and, at the same time, proper evidence of all involved partners.

Italy is providing the main contribution to the Metis project; the PI is Italian and the Italian Space Agency is the Lead Funding Agency.

2 Instrument Organization and Responsibilities

The Metis project is implemented by an International Consortium led by the Italian Space Agency, with the contributions of two major partners:

Max Plank Institute fuer Sonnensystemforschung - MPS (Germany), and
Czech Space Office (Czech Republic).

Principal Investigator of the Metis project is Ester Antonucci, INAF-Osservatorio Astrofisico di Torino.

Experiment Manager of the project is Giampiero Naletto, University of Padua,

Experiment Scientist is Silvano Fineschi, INAF-Osservatorio Astrofisico di Torino and
Instrument Scientist is Marco Romoli, University of Florence.

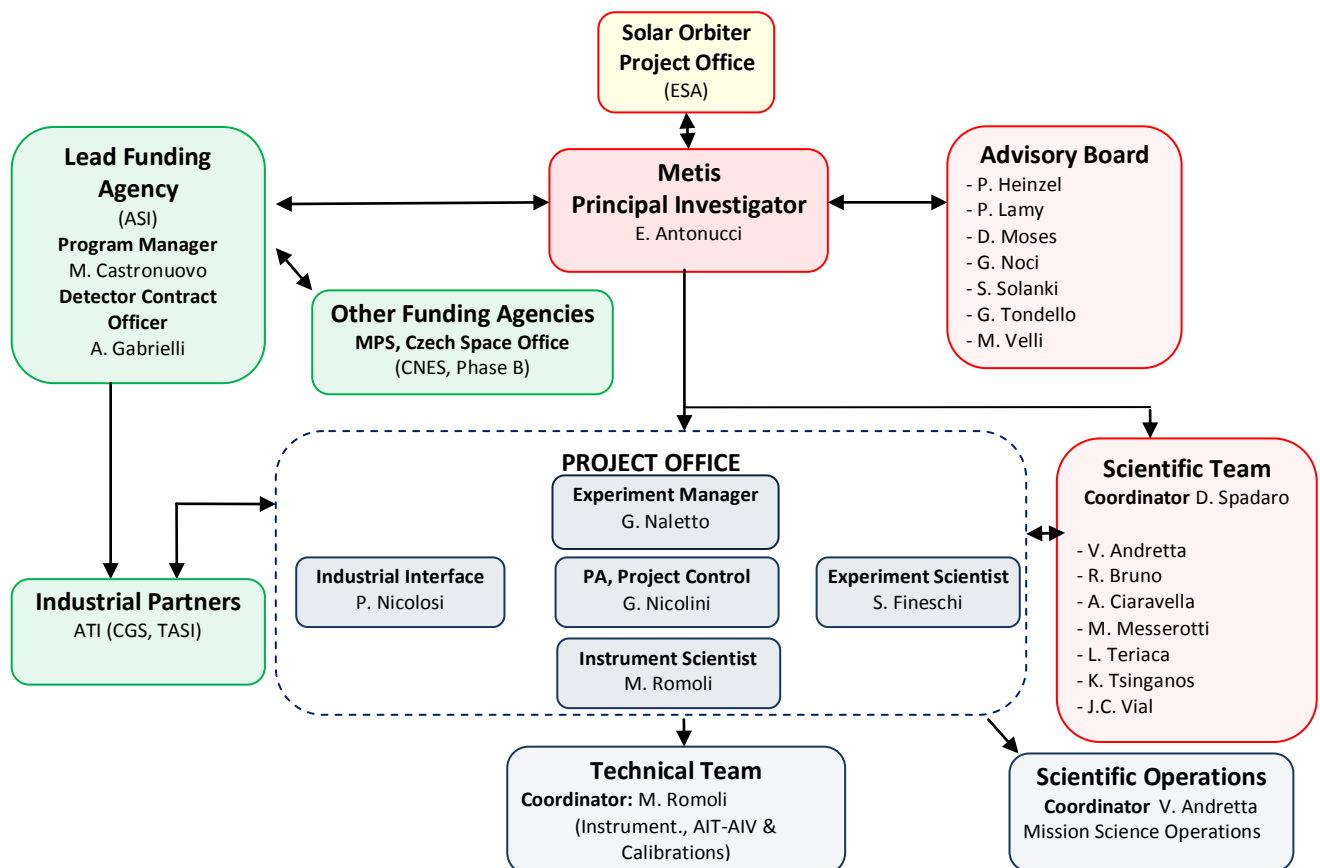


Figure 1: Metis top level organizational chart

Metis PI duties are in line with the requirements listed in [AD-1] and specifically she shall be responsible for:

- Sole managerial and decision making, interfacing with the ESA Solar Orbiter Project Office.
- Providing financial control in order to assure necessary resources to achieve the agreed delivery dates of all deliverables including technical data and instrument models.
- Providing instrument support to system level anomaly investigations, tests, reviews, operations and scientific activities arranged by ESA.

- d) Creating and maintaining a EID Part B which details the instrument design and interfaces answering requirements stated in the EID part A.
- e) Ensuring compliance with all ITAR regulations in a timely manner.
- f) Support and attendance to Science Working Team meetings as called by the ESA Project Scientist.
- g) Submission on regular basis of the Science Performance Reports to the Science Working Team.
- h) Complying with the scientific data policy of the Agency, as defined in the Science Management Plan [AD-2].
- i) Exploiting the mission scientific results and assuring their diffusion, providing scientific data and relevant calibration products to the Solar Orbiter archive with all the necessary equipment and SW to process the data.
- j) Making available the necessary resources to support all in-orbit mission phases at the MOC/SOC as well the preparation and implementation of the mission and science operations up to end of the mission, indicating the single point of contact and verifying the correctness of the software updates.
- k) Supporting the data processing and analysis, providing suitable hardware and software facilities and manpower, delivering preliminary and final calibrated data to SOC as agreed with the SWT.
- l) Providing due acknowledgement to ESA in all published material, supporting ESA science communications and PR activities in a timely manner.
- m) Providing the Review Data Package for each instrument level review 2 weeks in advance to the agreed kick-off date
- n) Processing and delivering to SO archive of Level 1b, level 2 and Level 3 data products

The PI is supported by the Metis Advisory Board, including senior scientists of the countries forming the Metis consortium.

A Deputy Principal Investigator can be temporarily appointed by the PI to take the role in case she should not be available.

The role of the **Metis Experiment Manager** is attributed to Giampiero Naletto, University of Padua. The Experiment Manager shall:

- ensure, in coordination with the PI, the efficiency of the management scheme,
- manage the day to day activities of the instrument development team and
- support the PI in maintaining a EID Part B which details the instrument design and interfaces, compliant with the requirements stated in the EID part A [AD-1].

The Experiment Manager leads the **Project Office** formed by an Experiment Scientist, a Consortium Product Assurance Manager/Project Control, an Industrial Interface Liason and the Instrument Scientist.

The **Experiment Scientist** role is attributed to Silvano Fineschi (INAF-OATo). He shall ensure the compatibility of the instrument definition and performances and the scientific objectives defined by the Science Team.

The **Consortium Product Assurance Manager** role is assigned to Gianalfredo Nicolini (INAF-OATo). He also supports the Experiment Manager in his activity of **Project Control**.

The role of **Industrial Interface Manager** is attributed to Piergiorgio Nicolosi (University of Padua) to take care of the interactions with the industrial partners during the implementation phase.

The **Technical Team** is coordinated by the **Instrument Scientist**, role attributed to Marco Romoli (University of Florence). His main tasks are:

- definition of the instrument element and system parameters and performances
- development of the instrument element, at the component and system level (when applicable)
- integration and test activities at element level
- in flight commissioning and engineering and calibration operations.

The **Technical Team** shall continue to support the Metis project along the realization of all models. **Co-Investigators, Key Personnel** are identified with their specific experience in the technical aspects relevant to the Metis development. According to their knowledge and experience, the Technical Team members are assigned specific tasks related to the critical aspects of the project.

The **Science Team**, coordinated by Daniele Spadaro (INAF-OACt), has the tasks of identifying the scientific objectives of the Metis investigation, defining the scientific requirements, interacting with the technical management of the project in order to guarantee that the science requirements are satisfied by the adopted technical solutions. The Science Team is supported by **Co-Investigators** and **Associate Scientists**.

2.1 Metis Consortium

The consortium is formed by the following Italian institutions: Istituto Nazionale di Astrofisica (INAF), Universities of Calabria, Catania, Florence, L'Aquila, Padua, Palermo, Perugia, Roma II and Urbino, Politecnico di Torino, Consiglio Nazionale delle Ricerche – Institute for Photonics and Nanotechnology (CNR-IFN), Padua, and SPIN, i Genova. INAF is the leading scientific institution.

The consortium includes the following foreign institutions:

- Astronomical Institute of the Czech Academy of Science (AIAS), Czech Republic
- Institut d'Astrophysique Spatiale (IAS), France
- Laboratoire d'Astrophysique de Marseille (LAM), France
- Max-Planck-Institut für Sonnensystemforschung (MPS) Goettingen, Germany
- Mullard Space Science Laboratory, UK
- Naval Research Laboratory (NRL), USA
- Royal Observatory of Belgium, Belgium
- University of Athens, Greece
- University of Michigan, US
- University of St. Andrews, UK.

The Italian Space Agency (ASI) shall provide the entire Metis instrument with the exception of the hardware contributions of the following foreign partners:

- 1) MPS shall provide the UV and the VL camera assemblies (the latter funded by ASI).
- 2) IAS shall provide the two light weight mirrors blanks (M1 and M2).

In Appendix 1, the letters of commitments of MPS and of the Space Technologies and Satellite Systems Department of the Czech Republic Ministry of Transport are included.

Industrial partner of the consortium for the Metis design and development is the “Associazione Temporanea d’Impresa” (ATI) formed by OHB - Compagnia Generale per lo Spazio (CGS) Milano and Thales Alenia Space Italia (TAS-I) Torino .

The mirrors procured by AIAS will be developed and manufactured by TOPTEC (Czech Republic).

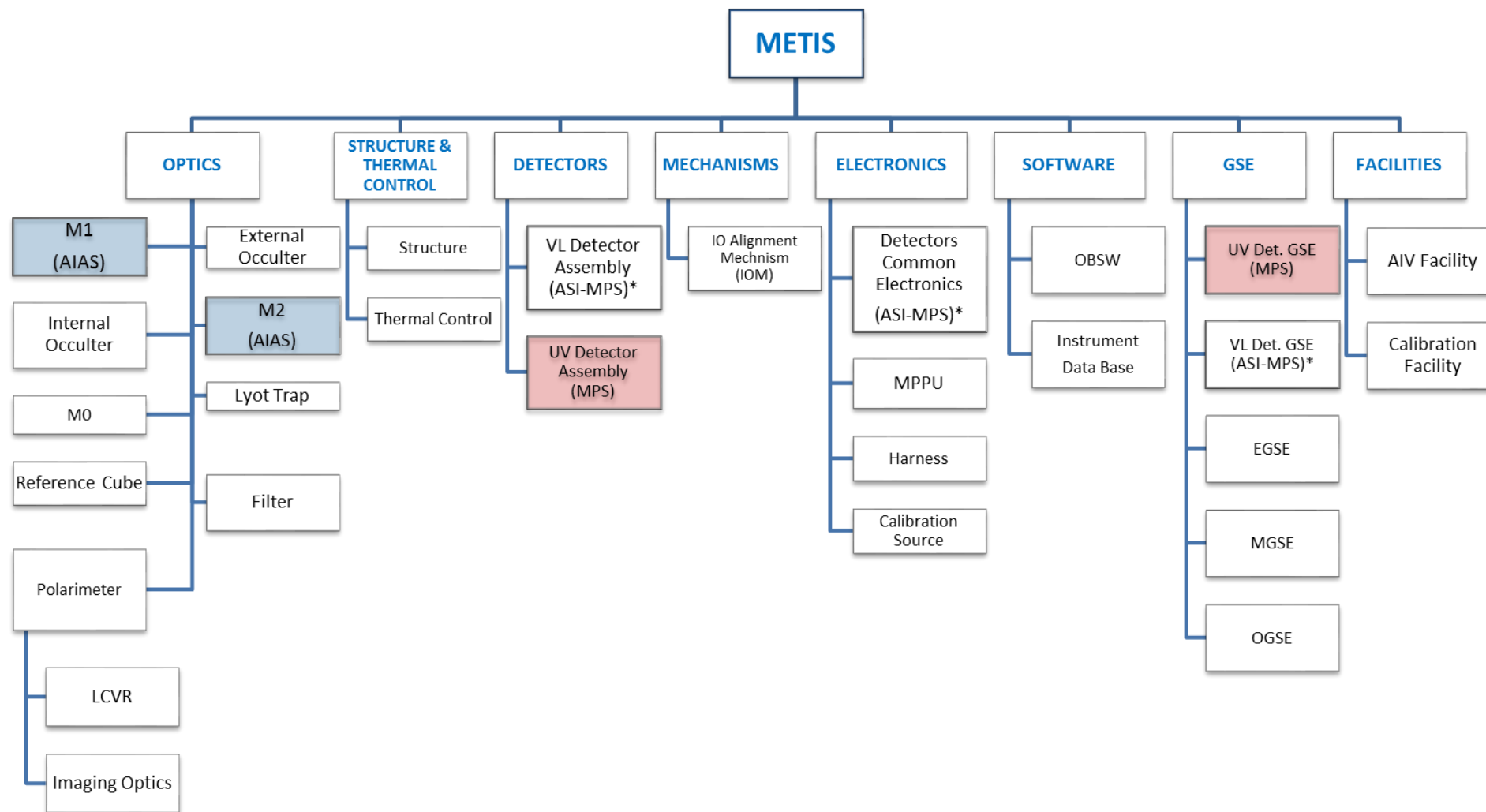
Metis consortium is detailed in Table 1, the contribution to the project in terms of activities and hardware is described for each foreign institute.

For reference, in Figure 2 the Metis HW tree is shown. The WBS is illustrated in Figure 3 through Figure 6.

Institute	Country	Activities	HW Contribution
AIAS	Cz	Support to the Optical Design Characterization of the mirrors M1, M2 Data reduction and scientific analysis Instrument AIV	Telescope mirrors M1, M2
CNR-IFN	I	Instrument Design Instrument Development Instrument AIV Data reduction and scientific analysis	
CNR-SPIN	I	Scientific Analysis	
CNRS-IAS	F	Scientific Objectives Definition Data reduction and scientific analysis	
INAF-IASF	I	Instrument Development (Detectors) Instrument AIV	
INAF-IAPS	I	Data reduction and scientific analysis	
INAF-OAA	I	Instrument Design Instrument Development Instrument AIV Data reduction and scientific analysis Scientific Operations Outreach	
INAF-OACN	I	Scientific Investigation Data Analysis SW Data reduction and scientific analysis Observing modes definition and plan Scientific Operations	
INAF-OACt	I	Scientific Investigation Data reduction and scientific analysis Observing modes definition and planning Scientific Operations	
INAF-OAPa	I	Scientific Investigation Data reduction and scientific analysis Scientific Operations	
INAF.OAR	I	Data reduction and scientific analysis	
INAF-OATo	I	PI-ship Instrument design Instrument development Instrument AIV Scientific Operations Observing modes definition and planning Data Analysis SW Data reduction and scientific analysis Data archive Outreach	
INAF-OATs	I	Data Archive and Scientific Analysis	

Institute	Country	Activities	HW Contribution
LAM	F	Support to instrument Design and Development Data reduction and scientific analysis (Phase B)	
MPS	D	Instrument development Instrument AIV Observing modes definition and planning Scientific Operations Data reduction and scientific analysis	VL and UV Detector assemblies
NRL	USA	Instrument Design Scientific Operations Data reduction and scientific analysis	
MSSL	UK	Data reduction and scientific analysis	
Politecnico of Torino	I	Onboard Software Data analysis Software and compression	
ROB	B	Data reduction and scientific analysis	
University of Athens	GR	Data reduction and scientific analysis	
University of L'Aquila	I	Data reduction and scientific analysis	
University of Calabria	I	Data reduction and scientific analysis	
University of Catania	I	Scientific Operations Data reduction and scientific analysis Outreach	
University of Florence	I	Instrument Scientist Instrument Development Instrument Design Scientific Requirements Instrument AIV Data reduction and scientific analysis Scientific Operations Outreach	
University of Michigan	US	Data reduction and scientific analysis	
University of Padua	I	Metis Instrument Manager Instrument Development Instrument AIV Operations Data reduction and scientific analysis	
University of Palermo	I	Data reduction and scientific analysis	
University of Perugia	I	Data reduction and scientific analysis	
University of Roma II	I	Data Analysis SW Data reduction and scientific analysis	
University of Urbino	I	Data reduction and scientific analysis	
University St. Andrews	UK	Data reduction and scientific analysis	

Table 1: Metis consortium composition



(*) HW developed by MPS under ASI contract

Figure 2: Metis HW Tree

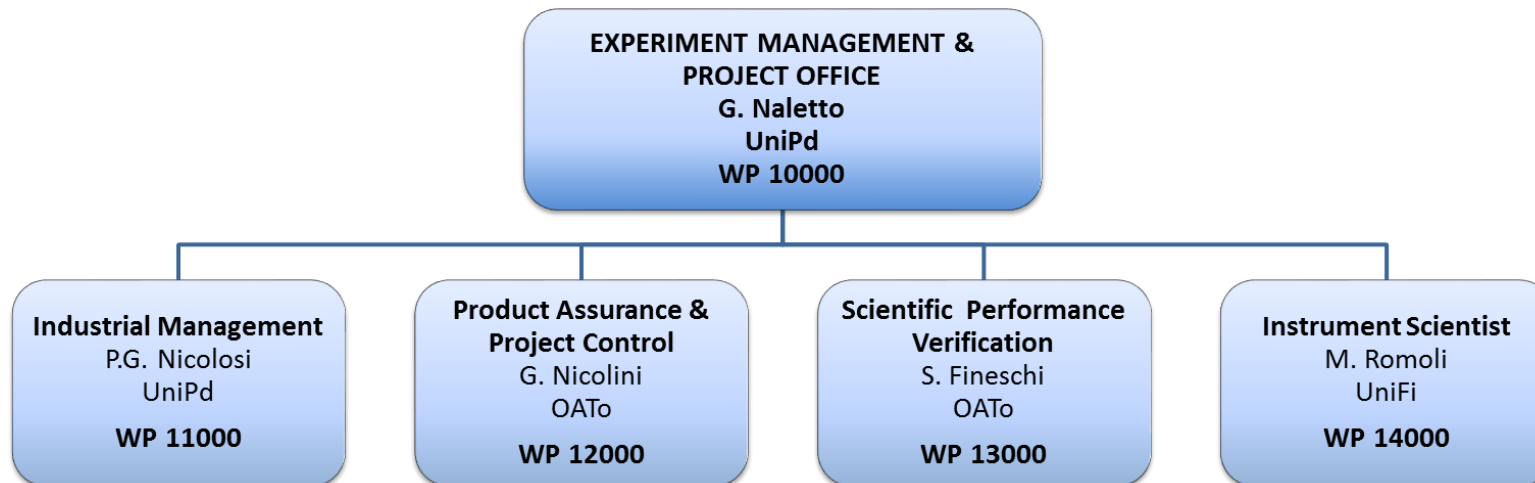


Figure 3: WP 10000 Project Office (Technical Management) structure

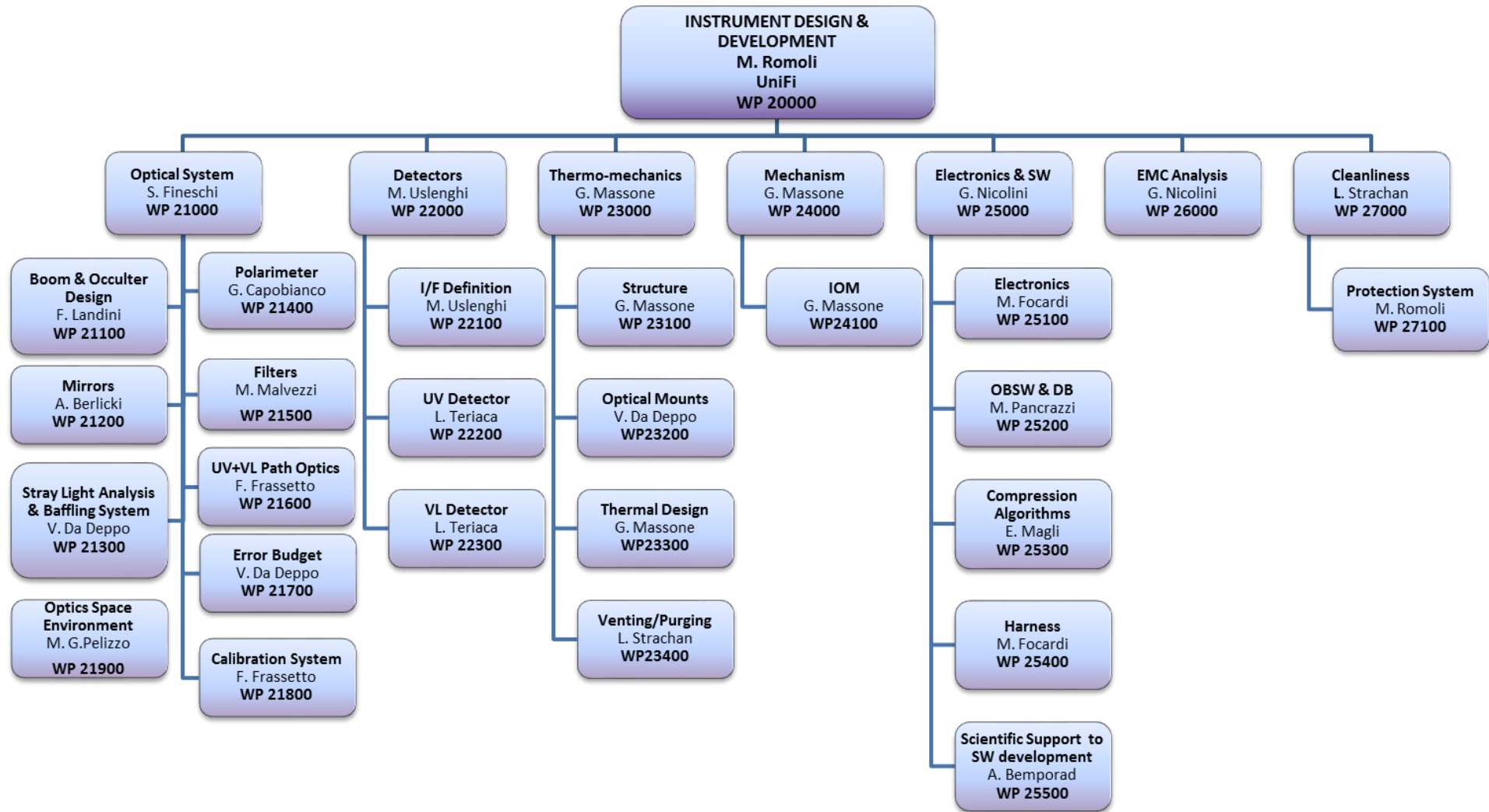


Figure 4: WP 20000 Instrument Design and Development structure

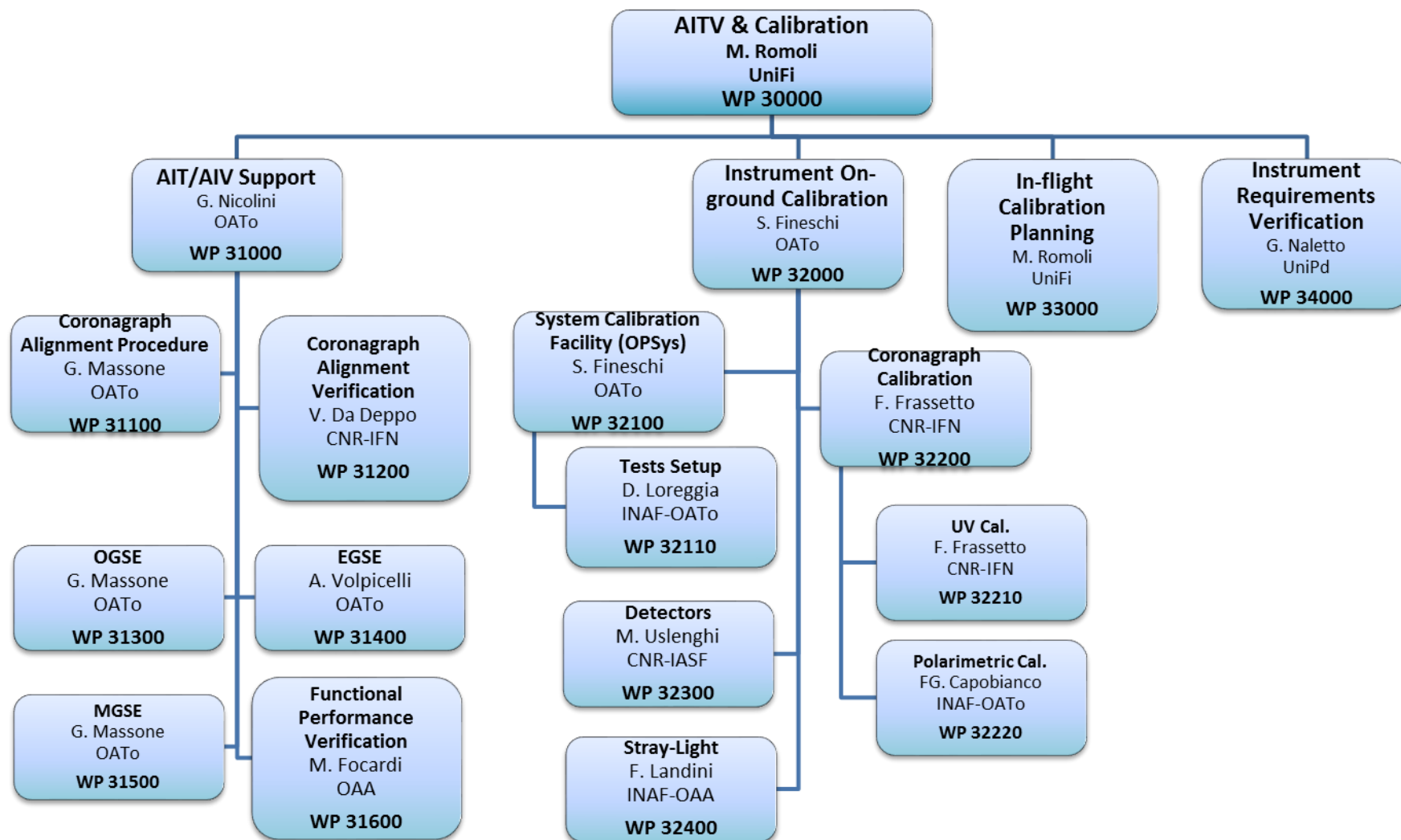


Figure 5: WP 30000 AITV & Calibration structure

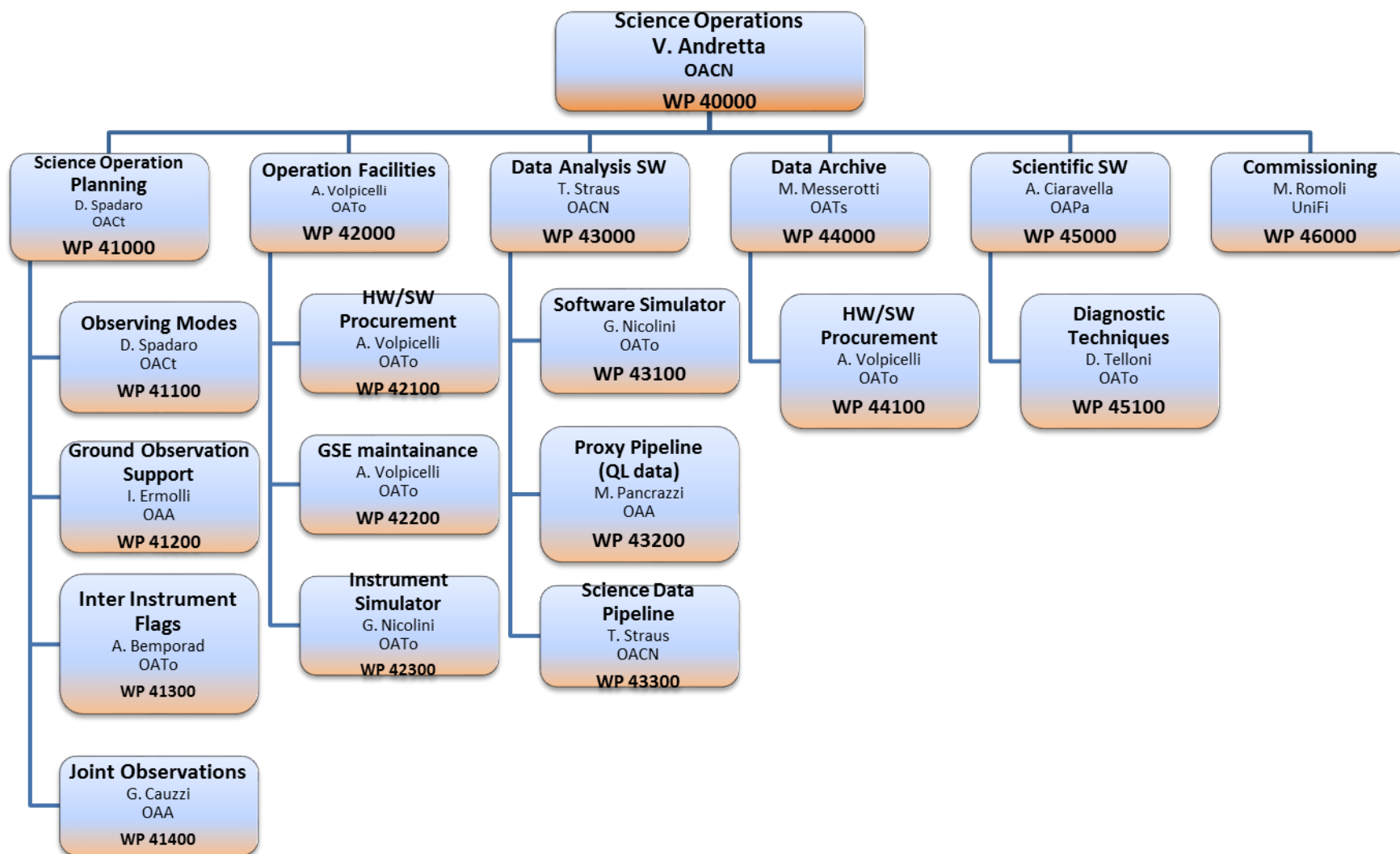


Figure 6: WP 40000 Operation & Science structure

2.2 Metis Detailed Organizational Structure

2.2.1 Metis Science Team

In the tables hereafter, the detailed Metis organizational structure is illustrated according to the following subdivision:

- Top level structure
- Co-I's,
- Key persons
- Associate scientists

Co-I's are scientific personnel responsible for providing a deliverable linked to their specific activity (as listed in the following tables) based on their individual areas of expertise. For example, Co-Is listed with science analysis as their Metis activity would analyse the data returned from Metis related to their individual area of expertise and deliver a yearly Metis Technical Report containing a copy of published papers in refereed journals and presentations at both consortium and open science meetings.

Key persons are scientific and technical personnel involved in the development, testing of the instrument, scientific operations, data reduction and archiving.

Associate scientists are scientists that will support the investigation team in the scientific analysis of the Metis data and in the joint science with other Solar Orbiter instruments and other space mission and ground based instruments.

The tables report for each individual the institute affiliation and activities in the program.

Name	Role	Affiliation and Address	Contact informations
Ester Antonucci	PI	INAF Osservatorio Astrofisico di Torino Via dell'Osservatorio, 20 10025 Pino Torinese TO, Italy	+39 011 8101913 Office +39 011 8101930 Fax antonucci@oato.inaf.it
Silvano Fineschi	Metis Experiment Scientist Co-I	INAF Osservatorio Astrofisico di Torino Via dell'Osservatorio, 20 10025 Pino Torinese TO, Italy	+39 011 8101919 Office +39 011 8101930 Fax fineschi@oato.inaf.it
Giampiero Naletto	Metis Experiment Manager Co-I	University of Padua - Department of Information Engineering Via Gradenigo, 6/B 35131 Padua PD, Italy	+39 049 8277646 Office +39 049 8277699 Fax naletto@dei.unipd.it
Gianalfredo Nicolini	Product Assurance Project Control Co-I	INAF Osservatorio Astrofisico di Torino Via dell'Osservatorio, 20 10025 Pino Torinese TO, Italy	+39 011 8101918 Office +39 011 8101930 Fax nicolini@oato.inaf.it
Piergiorgio Nicolosi	Metis Industrial Interface Manager Co-I	University of Padua - Department of Information Engineering Via Gradenigo, 6/B 35131 Padua PD, Italy	+39 049 8277674 Office +39 049 8277699 Fax nicolosi@dei.unipd.it
Marco Romoli	Metis Instrument Scientist Co-I	University of Florence Department of Physics and Astronomy Largo Enrico Fermi, 2 50125 Florence FI, Italy	+39 055 2755233 Office marco.romoli@unifi.it

Table 2: Metis top level structure and characters

Name	Role	Activity	Affiliation
Lucia Abbo	Co-I	Data reduction and scientific analysis	Ass. INAF Italy
Vincenzo Andretta	Co-I	Scientific operations Data reduction and scientific analysis	INAF-OACN Italy
Frederic Auchère	Co-I	Data Reduction and Scientific Analysis Diagnostics techniques	CNRS-IAS France
Alessandro Bemporad	Co-I	Observing modes planning Scientific operations Data reduction and scientific analysis	INAF-OATo Italy
Arkadiusz Berlicki	Co-I	Instrument design and development Data reduction and scientific analysis	AIAS Czech Rep.
Roberto Bruno	Co-I	Data Reduction and Scientific Analysis	INAF-IAPS Italy
Gerardo Capobianco	Co-I	Instrument Design and Development Instrument test and calibration Data reduction and scientific analysis	INAF-OATo Italy
Angela Ciaravella	Co-I	Scientific SW Data reduction and scientific analysis	INAF-OAPa Italy
Vania Da Deppo	Co-I	Instrument Design and Development Instrument test and calibration Data reduction and scientific analysis	CNR-IFN Italy
Raffaella D'Amicis	Co-I	Scientific operations Data reduction and scientific analysis	INAF-IAPS Italy
Silvano Fineschi	Co-I	Experiment Scientist Instrument Design and Development Instrument test and calibration Data reduction and scientific analysis	INAF-OATo Italy
Fabio Frassetto	Co-I	Instrument Design and Development Instrument test and calibration	CNR-IFN Italy
Mauro Focardi	Co-I	Instrument Design and Development Instrument test and calibration Data reduction and scientific analysis	INAF-OAA Italy
Peter Hardi	Co-I	Instrument Design and Development – Detectors Scientific analysis	MPS Germany
Petr Heinzel	Co-I	Advisory Board Member Scientific analysis	AIAS Czech Rep.
Philippe Lamy	Co-I	Advisory Board Member Scientific analysis	LAM France
Federico Landini	Co-I	Instrument test and calibration Data reduction and scientific analysis	INAF-OAA Italy
Alessandro Lanzafame	Co-I	Scientific operations Data reduction and scientific analysis	INAF-OACt Italy
Marco Malvezzi	Co-I	Instrument Development	Ass. INAF Italy
Giuseppe Massone	Co-I	Instrument Design and Development Instrument AITV and calibration	INAF-OATo Italy
Mauro Messerotti	Co-I	Scientific Team Data Archive and Scientific Analysis	INAF-OATs Italy

Name	Role	Activity	Affiliation
Daniel Moses	Co-I	Advisory Board	NASA USA
Giampiero Naletto	Co-I	Experiment Manager Data reduction and scientific analysis	UniPd Italy
Gianalfredo Nicolini	Co-I	Project Control Instrument Design and Development Instrument AITV and calibration Data reduction and scientific analysis	INAF-OATo
Piergiorgio Nicolosi	Co-I	Industrial Interface Manager	UniPd Italy
Giancarlo Noci	Co-I	Advisory Board Member	Ass. INAF Italy
Maurizio Pancrazzi	Co-I	Instrument Design and Development Instrument test and calibration Data reduction and scientific analysis	INAF-OAA Italy
Maria Guglielmina Pelizzo	Co-I	Instrument Design and Development Instrument test and calibration	CNR-IFN Italy
Luca Poletto	Co-I	Instrument Design and Development Instrument test and calibration	CNR-IFN Italy
Marco Romoli	Co-I	Instrument Scientist Instrument Design and Development Instrument AITV and calibration Data reduction and scientific analysis	UniFi Italy
Clementina Sasso	Co-I	Data reduction and scientific analysis	INAF-OACN Italy
Udo Schuele	Co-I	Instrument Development Instrument test and calibration	MPS Germany
Sami Solanki	Co-I	Advisory Board Member Scientific Analysis	MPS Germany
Daniele Spadaro	Co-I	Scientific Team Coordinator Observing modes definition planning Scientific Analysis	INAF-OACt Italy
Leonard Strachan	Co-I	Instrument Design and Development Data reduction and scientific analysis	NRL USA
Thomas Straus	Co-I	Data Analysis SW Data reduction and scientific analysis	INAF-OACN Italy
Roberto Susino	Co-I	Data reduction and scientific analysis	INAF-OATo Italy
Daniele Telloni	Co-I	Diagnostics techniques Data reduction and scientific analysis	INAF-OATo Italy
Luca Teriaca	Co-I	Instrument Development - UV Detectors Data reduction and scientific analysis	MPS Germany
Giuseppe Tondello	Co-I	Advisory Board Member	UniPd Italy
Kanaris Tsinganos	Co-I	Scientific analysis	Uni Athens Greece
Michela Uslenghi	Co-I	Instrument Design and Development Instrument test and calibration	INAF-IASF Italy

Name	Role	Activity	Affiliation
Marco Velli	Co-I	Advisory Board Member Scientific analysis	UniFi Italy
Rita Ventura	Co-I	Observing modes definition planning Diagnostics techniques Data reduction and scientific analysis	INAF-OACt Italy
Jean-Claude Vial	Co-I	Scientific analysis	CNRS-IAS France
Joachim Woch	Co-I	Intrument Design and Development - Detectors	MPS Germany

Table 3: Metis Co-I's

Name	Role	Activity	Affiliation
Francesco Berrilli	Ass. Scientist	Data reduction and scientific analysis	UniRm2
Maurizio Busso	Ass. Scientist	Data reduction and scientific analysis	UniPg
Vincenzo Carbone	Ass. Scientist	Data reduction and scientific analysis	UniCal
Gianna Cauzzi	Ass. Scientist	Data reduction and scientific analysis	INAF-OAA
Alain Jody Corso	Key Person	Instrument Design and Development Instrument test and calibration	CNR-IFN
Dario Del Moro	Key Person	Scientific SW Data reduction and scientific analysis	UniRm2
Giulio Del Zanna	Ass. Scientist	Data reduction and scientific analysis	MSSL
Sergio Dolei	Ass. Scientist	Data reduction and scientific analysis	INAF-OACt
Reiner Enge	Key Person	Instrument Design and Development	MPS
Ilaria Ermolli	Ass. Scientist	Data reduction and scientific analysis	INAF-OAR
Catia Grimaldi	Ass. Scientist	Data reduction and scientific analysis	UniUrbino
Stanislav Gunar	Key Person	Instrument Design and Development	AIAS
Klaus Heerlein	Key Person	Instrument Design and Development	MPS
Enrico Landi	Ass. Scientist	Data reduction and scientific analysis	Univ Michigan
Simone Landi	Ass. Scientist	Data reduction and scientific analysis	UniFi
Egidio Landi degli Innocenti	Ass. Scientist	Scientific analysis	UniFi
Fabio Lepreti	Ass. Scientist	Data reduction and scientific analysis	UniCal
Davide Loreggia	Key Person	Instrument test and calibration	INAF-OATo
Enrico Magli	Key Person	On board Software and compression	PoliTo
Anna Maria Massone	Ass. Scientist	Data reduction and scientific analysis	CNR-SPIN
Paolo Pagano	Ass. Scientist	Data reduction and scientific analysis	Univ. St. Andrews UK
Susanna Parenti	Ass. Scientist	Data reduction and scientific analysis	Royal Obs. Belgium
Giovanni Peres	Ass. Scientist	Data reduction and scientific analysis	OAPa
Ermanno Pietropaolo	Ass. Scientist	Data reduction and scientific analysis	UniAQ
Giannina Poletto	Ass. Scientist	Data reduction and scientific analysis	Ass. INAF
Stefano Pucci	Ass. Scientist	Data reduction and scientific analysis	UniFi
Eric Quemerais	Ass. Scientist	Data reduction and scientific analysis	CNR-IFN
Fabio Reale	Ass. Scientist	Data reduction and scientific analysis	UniPa
Marco Ricci	Key Person	On board Software and compression	PoliTo
Paolo Romano	Ass. Scientist	Scientific Operations Data reduction and scientific analysis	INAF-OACt
Pavol Schwartz	Key Person	Instrument Design and Development	AIAS
Giuseppe Severino	Ass. Scientist	Data reduction and scientific analysis	INAF-OACN
Cecilia Tubiana	Ass. Scientist	Data reduction and scientific analysis	MPS
Enrico Verroi	Key Person	Instrument Design and Development Instrument test	UniPd
Sebastien Vives	Key Person	Instrument Design Instrument test	LAM
Antonio Volpicelli	Key Person	EGSE Design and Development Data reduction and archive	INAF-OATo
Stephan Werner	Key Person	Instrument Design and Development	MPS
Gaetano Zimbardo	Ass. Scientist	Data reduction and scientific analysis	UniCal

Name	Role	Activity	Affiliation
Francesca Zuccarello	Ass. Scientist	Data reduction and scientific analysis	UniCatania
Paola Zuppella	Key Person	Optical systems alignment and tests	CNR-IFN

Table 4: Metis associate scientists and key persons

2.2.2 Metis Industrial Team

The Industrial Team which is carrying out the Phase B2/C/D of Metis in support to the Scientific Consortium, under contract by the Italian Space Agency (ASI), identified as “ATI” (Associazione Temporanea d’Impresa), is composed by:

- OHB Compagnia Generale per lo Spazio (CGS)
- Thales Alenia Space Italia (TAS-I)

The roles, organization and sub-contracting structure of the industrial team is described in RD-3.

3 Communications within the programme

Accordingly to the EID-A requirements all formal communication concerning technical and programmatic aspects will be made between the Principal Investigator and the ESA Project Manager.

The Principal Investigator provides an interface to allow electronic transfer of data (documentation, progress reports including schedule information, changes, technical data, etc.) to be accessed by the ESA selected Prime and the ESA Project Office. The interfaces are compatible with the Agency's scientific project infrastructure

4 Project phasing and planning

The baseline Master Schedule in line with the Solar Orbiter Project Schedule covering all the instrument programme activities identified in the Work Breakdown Structure is detailed in [RD-2].

This schedule covers:

- Overall instrument programme
- Individual instrument models
- Instrument model integration and testing
- Detailed bar chart of critical activities.

4.1 *Metis resources allocation*

4.1.1 Instrument Development Phase

The instrument development phase will last 8 years inclusive of the launch foreseen in 2018 and considering the beginning of the activities in 2010.

4.1.2 Instrument Science Operation Phase

The nominal plus extension phase lasts about 8.3 years. Metis requires commissioning and calibration operations after launch during the cruise phase before the beginning of the nominal mission.

4.1.3 Data reduction and scientific analysis

Data reduction will be performed during commissioning in the cruise phase. Data reduction and scientific analysis will be performed in parallel with calibration and scientific operations during the science nominal and extended mission phases.

Therefore, the duration of these activities is approximately 10.6 years (2.3 years of cruise phase, 8.3 years of nominal plus extension phase).

4.1.4 Data Archival Phase

This phase will last at least 10 years from launch until the end of the extended mission.

4.2 HW procurement

The HW tree is shown for reference in Figure 2. In Figure 3 through Figure 6, the Metis WBS is shown in detail.

According to the Metis HW-tree and WBS, the main part of the Metis hardware is provided by the Italian Space Agency and developed by the Italian industry (ATI).

The project foresees the procurements of remaining HW parts from the following foreign partners:

- MPS will provide the UV and the VL detector assemblies (the latter funded by ASI).
- AIAS will provide the M1 and M2 mirrors (manufactured by TOPTEC).

5 Meetings and reviews

The PI shall organize regular and ad-hoc (to address critical subjects at the time) progress meetings with the Solar Orbiter Project Office including instrument members as required.

The PI shall provide the resources to prepare review data packages to support the review processes at instrument, ground segment and mission level as defined in the EID-A.

In detail:

- a) Instrument Level
 - i. Instrument Preliminary Design Review, IPDR
 - ii. Instrument Critical Design Review, ICDR
 - iii. Instrument Qualification Review, IQR
 - iv. Instrument PFM Acceptance Review, IFAR
 - v. Other Reviews as required (e.g. Test Readiness Reviews (TRR), Pre-Environment Review (PER), Post-Test Review (PTR), etc)
- b) Ground Segment Level
 - i. Ground Segment Requirements Review
 - ii. Ground Segment Design Review
 - iii. Ground Segment Implementation Review
 - iv. Ground Segment Readiness Review
- c) Mission Level
 - i. System Requirements Review
 - ii. Preliminary Design Review
 - iii. Critical Design Review
 - iv. Qualification Review
 - v. Flight Acceptance Review
 - vi. Flight Readiness Review
 - vii. Mission Commissioning Results Review
 - viii. Other Reviews as required

5.1 Instrument Progress Meetings

These meetings will be conducted between the ESA Project Office / the selected Prime and the PI with the objective of ensuring that the interface technical design integrity of the experiment and its compatibility with the spacecraft system and instrument programmatic are proceeding in a manner which will not jeopardize the overall programme.

These meetings will be held periodically on the premises of the PI or the instrument Prime, during the design, development and verification programme of the instrument. Detailed technical problems occurring on either side of the interface will be addressed at these meetings and corrective actions, including their schedule impact, agreed and implemented.

The PI will maintain and publish minutes of meetings to all participants and stake holders in the instrument.

5.2 Mission Reviews

The objective of the Mission Reviews is to ascertain the satisfactory status of advancement and to verify the compliance of the technical and programmatic progresses with the overall programme requirements. Mission Reviews shall consist in the global assessment of Spacecraft, Instruments

Ground Segment and Launcher. The Principal Investigator will attend to these Mission Reviews if relevant for the Metis investigation or if requested by ESA Project Office.

5.3 Instrument Reviews

Instrument Reviews will be conducted by the ESA Project Office for each instrument selected for the Solar Orbiter Programme. The objectives will be to ensure that the instrument design will achieve the anticipated science objectives and that it complies with the technical interface requirements of the EID. Programmatic aspects like scheduled delivery dates and their compatibility with system level requirements will also be screened.

The PI and his scientific and technical team will support the review and its panel and board sessions with appropriate manpower, expertise and the documentation requested/defined by ESA Project Office.

6 Configuration management

The PI will ensure that all HW, SW and documentation will be fully traceable with history and exact definition of date or hardware at all times accordingly to the Solar Orbiter Project documentation coding system.

The PI will set up the necessary organization and means for satisfying the objectives and requirements of configuration management and will impose the same configuration management requirements on contractors and suppliers.

6.1 Configuration and change control

The PI will set up a configuration and change control procedure such that the status of all aspects of the Metis experiment like the design and manufacturing of hardware and development of software can be unambiguously defined at any time, allowing at the same time ESA Project Office to conduct a configuration audit at any point in the programme in order to obtain the up-to-date status of the instrument.

After finalization and approval of EID-B and EID-A, changes of these documents shall be handled using an Engineering Change Request (ECR) and deviations or not fulfilments from the requirements defined in EID A, B will be handled using the Request for Waiver (RFW) form defined by the Solar Orbiter programme.

7 Deliverable items

Accordingly to the programme requirements (ref [AD-1]), Metis project deliverable items are listed below.

7.1 *Deliverables to the spacecraft*

- All relevant interface documentation (EID-B) throughout the project lifetime.
- The Structural Mathematical Model (SMM) of the instrument, as defined in [AD-1], accompanied by an Interface Geometrical Mathematical Model (ITMM)
- The Thermal Mathematical Model (TMM) of the instrument, as defined in [AD-1], accompanied by an Interface Thermal Mathematical Model (ITMM) and a Detailed Thermal Geometrical Model (DGMM)
- The Computer Aided Design (CAD) Model of the instrument
- The Electrical Model (EM),
- The (calibrated) Flight Model (PFM),
- The (calibrated) Flight Spares (FS).

Each unit delivery will include, as appropriate, not only the instrument hardware, but also the on-board software, the required mechanical and electrical ground support equipment, its End Item Data Package (content defined in [AD-1]) and any hardware, software or document needed to correctly operate, integrate or calibrate the instrument.

The Metis project will support the system level integration and test activities as well as the launch preparation by supplying the appropriate manpower and expertise.

8 Schedules

Metis investigation is compatible with the predefined Solar Orbiter programme schedule to meet the launch in 2018.

The planning of the project will be compliant to the requirement of delivering to the programme the foreseen models with the actual timeline:

- EM: March 2016
- PFM: April 2017

The PI has defined a preliminary Instrument Master Schedule in the form of Gantt diagram to organize the project activities in a conformant manner with the overall Solar Orbiter Master Schedule.

The actual Metis schedule is detailed in [RD-2].

9 Document References

9.1 *Applicable Documents*

AD-1 Experiment Interface Document – Part A – ref. SOL-EST-IF-0050 – Issue 5.0 - 16 March 2015

AD-2 Science Management Plan - ref. SCI-S/2007/157, issue 1.0, rev. -,

9.2 *Reference Documents and Publications*

RD-1 Metis Experiment Interface Document – Part B - ref. METIS-OATO-ICD-001 – Issue 4.1 - December 2015

RD-2 Metis Master Schedule –METIS-ATI-CH-001 – Issue 2

RD-3 Metis Project Management Plan –METIS-ATI-PLN-010 – Issue 1 - March 2014

10 Acronyms

AIAS	Astronomy Institute of Czech Academy of Science
AIT	Assembly, Integration and Test
AIV	Assembly, Integration and Verification
ASI	Agenzia Spaziale Italiana
CAD	Computer Aided Design
CGS	Compagnia Generale dello Spazio
CNR	Consiglio Nazionale delle Ricerche
CNRS	Centre National de la Recherche Scientifique
Co-I	Co-Investigator
DGMM	Detailed Thermal Geometrical Model
EGSE	Electrical Ground Support Equipment
EID A	Experiment Interface Document Part A
EIDB	Experiment Interface Document Part B
EM	Electrical Model
EM	Experiment Manager
EMC	Electro Magnetic Compatibility
EO	External Occulter
ESA	European Space Agency
FS	Flight Spare
GSE	Ground Support Equipment
HW	Hardware
IAPS	Istituto di Astrofisica e Planetologia Spaziali
IAS	Institute d'Astrophysique Spatiale
IASF	Istituto di Astrofisica Spaziale e Fisica cosmica
ICDR	Instrument Critical Design Review
I/F	InterFace
IFAR	Instrument PFM Acceptance Review
IFN	Istituto di Fotonica e Nanotecnologie
IGMM	Interface Geometrical Mathematical Model
INAF	Istituto Nazionale di AstroFisica
IO	Internal Occulter
IOM	Internal Occulter Mechanism
IPDR	Instrument Preliminary Design Review
IQR	Instrument Qualification Review
ITMM	Interface Thermal Mathematical Model
LAM	Laboratoire d'Astrophysique de Marseille
LCVR	Liquid Crystal Variable Retarder
M0	Sun-disk rejection mirror of the coronagraph
M1	Primary mirror of the coronagraph
M2	Secondary mirror of the coronagraph
MCP	Micro Channel Plate
MGSE	Mechanical Ground Support Equipment
MOC	Mission Operation Center
MPPU	Metis Processing & Power Unit
MPS	Max-Planck-Institut fuer Sonnensystemforschung
MSSL	Mullard Space Science Laboratory

N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NRL	Naval Research Laboratory
OAA	Osservatorio Astrofisico di Arcetri
OACN	Osservatorio Astronomico di Capodimonte Napoli
OACt	Osservatorio Astrofisico di Catania
OAPa	Osservatorio Astronomico di Palermo
OAR	Osservatorio Astronomico di Roma
OATo	Osservatorio Astrofisico di Torino
OATs	Osservatorio Astronomico di Trieste
OBSW	On Board Soft Ware
OGSE	Optical Ground Support Equipment
OPSys	Optical Payload Systems Facility
PA	Product Assurance
PER	Pre-Environment Review
PFM	Proto Flight Model
PI	Principal Investigator
PoliTo	Politecnico di Torino
PTR	Post-Test Review
QL	Quick Look
RD-n	Reference Document n
ROB	Royal Observatory of Belgium
S/C	Spacecraft
SW	Software
SMM	Structural Mathematical Model
SO	Solar Orbiter
SPIN	Su Perconductors, oxides and other IN novative materials and devices
STOM	Structural Thermal Optical Model
TAS	Thales Alenia Space
TM	Telemetry
TMM	Thermal Mathematical Model
TRR	Test Readiness Review
UniAq	Università di L'Aquila
UniCal	Università della Calabria
UniCt	Università di Catania
UniFi	Università di Florence
UniPd	Università di Padua
UniPg	Università di Perugia
UniRm2	Università di Roma II – Tor Vergata
UniUr	Università di Urbino
UV	Ultraviolet
UVD	Ultraviolet Detector
VL	Visible Light
VLD	Visible Light Detector
WBS	Work Breakdown Structure

Annex 1

Letters of commitments of MPS and of the Space Technologies and Satellite Systems Department of the Czech Republic Ministry of Transport



Czech Republic
Ministry of Transport

Dr. Václav Kobera
Director
Space Technologies and Satellite Systems Department

Prague 27th February 2012
Ref: 17/2012-710-ESA/2

Dear Sir,

Following the decision of the Minister of Transport's Coordination Council for Space Activities dated February 17, 2012, I have the pleasure to inform you that the Czech Republic supports the Czech participation in C/D phases of the METIS project in the framework of the ESA's Solar Orbiter mission. The participation in the project will be funded through the Czech contribution to the ESA PRODEX programme.

I believe that the participation of the Czech academia and industry in the METIS project will contribute to success of the Solar Orbiter mission.

Yours faithfully,

Mr. Prof. Ester Antonucci
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Via Osservatorio 20
10025 Torinese (Torino), Italy

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May 17, 2010

Contribution of the Max Planck Institute for Solar System Research to the METIS instrument aboard Solar Orbiter

The Max Planck Institute for Solar System Research (MPS) is committed – subject to funding by the German space agency DLR - to provide the following hardware contribution to the METIS instrument, selected as part of the payload of the ESA mission Solar Orbiter: the CMOS-APS sensor and readout electronic circuitry of the focal plane assembly for the METIS UV channel (intensified APS camera). The APS sensor will be the STAR1000 imaging chip produced by Cypress, a space qualified and radiation hard device. The APS will be delivered with a low noise, 14-bit FPGA board designed at MPS with radiation hard components to be qualified for space flight. The FPGA Board can also control the operating voltage of the camera's intensifier, a UV-sensitive multi-channel plate intensifier to be provided by the METIS Team. It will be delivered with the operating software for camera configuration and image acquisition by a computer. The above components will be delivered ready to be mounted to the intensifier and integrated into the instrument. An external power supply and an USB readout board for image transfer to a PC system are also provided for laboratory testing.

The MPS will also provide assistance during testing and characterization of the intensified APS camera.

The MPS personnel involved in the project comprises an engineering team formed by Dr. Udo Schühle, Dr. Iancu Pardowitz, Rainer Enge and Stephan Werner and two Co-Is, Prof. Dr. Sami K. Solanki and Dr. Luca Teriaca.

Yours sincerely,



Prof. Sami K. Solanki

cc: Prof. Ester Antonoucci, INAF

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