INTEGRAL
International Gamma-Ray Astrophysics Laboratory

Science Management Plan

ESA/SPC(94)1, rev.2, annex
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Contents

DOCUMENT CHANGE RECORD[1]

Date	Rev.	Change	Reference
08 Dec 2003	1	Removed TBC in Section 5.2.5	SPC Meeting 5/6 Nov 2003
04 Apr 2005	2	Section 3.11 (User Group) added	ASTRO(2004)19

[1]Document changes after June 1994

1 Scope

The INTEGRAL (International Gamma-Ray Astrophysics Laboratory) is an ESA led mission in collaboration with Russia and NASA. INTEGRAL will be designed and operated as a guest observer facility (observatory). The aim of this document, the INTEGRAL Science Management Plan is to outline the management scheme for the conduct of the science programme following mission selection and up to and including the post-operations phase.

The main areas addressed in this INTEGRAL Science Management Plan are the contacts with the scientific community through external scientific teams, participation in the programme, roles and general requirements for Principal Investigators and Mission Scientists, the structure of the observing programme and the establishment and use of the observatory including share of observing time. The plan does not describe the management for the development of instruments or the INTEGRAL Science Data Centre (ISDC).

While development in the areas described above will proceed in parallel, they are treated separately within the management plan. The interfaces between the various participants in the programme are identified. The plan for and content of the calls for scientific instruments, INTEGRAL Science Data Centre and Mission Scientist proposals are outlined corresponding to the Announcement of Opportunity for INTEGRAL.

The detailed description of the scientific objectives, the design reference model payload, spacecraft and system design, science operations and management are published as ESA SCI(93)1 in April 1993 (Report on the Phase A Study).

The Science Programme Committee is requested to give its approval to the proposed Science Management Plan of INTEGRAL.

2 Mission Overview

2.1 Introduction

The International Gamma-Ray Astrophysics Laboratory (INTEGRAL) is dedicated to the fine spectroscopy and accurate imaging of celestial gamma-ray sources in the energy range of 15 keV to 10 MeV. INTEGRAL is the second medium-size mission (M2) of the ESA long term scientific plan Horizon 2000 and will be launched in 2001. INTEGRAL will be operated as an observatory type mission with most of the observing time available to the astronomical community at large. The scientific objectives of the mission, the reference model payload which can achieve these objectives and the baseline mission scenario are described in detail in the INTEGRAL Phase A Study Report ESA SCI(93)1.

ESA will be responsible for the overall spacecraft and mission design, service module procurement, procurement of the payload module (without instruments), instrument integration into the payload module, integration of the payload module onto the spacecraft service module, system testing, spacecraft operations, acquisition and distribution of data and the INTEGRAL Science Operations Centre (ISOC). Each of the scientific instruments will be provided by a Principal Investigator (PI) nationally funded through an institute or an international group of institutes. The INTEGRAL Science Data Centre (ISDC), located in Europe, will also be provided by the science community via a PI through national funding.

There are two possible launcher scenarios: In one scenario, Russia would provide a PROTON launcher and the launch facilities and may contribute to the ISDC. In the other scenario, an ARIANE 5 launcher and launch facilities would be provided by ESA.

NASA may contribute to the science instruments and to the ISDC through the US science community and may provide one or possibly two ground stations.

2.2 Scientific Objectives, Observational Requirements and Design Reference Model Payload

The INTEGRAL mission will offer a major step forward in the field of gamma-ray astronomy. The scientific objectives which will be addressed by INTEGRAL will require high spectral resolution and fine imaging combined with high sensitivity (see INTEGRAL Phase A report, ESA SCI(93)1).

A list of principal scientific objectives is as follows:

- Detailed spectroscopic studies and precise source locations within the Galactic Centre region.
- Detailed physical diagnostics of compact objects (white dwarfs, neutron stars, black hole candidates) at gamma-ray energies
- Detailed study of the explosion dynamics of supernovae.
- Discover previously unknown Galactic supernovae and novae and determine rates.
- Map emission of 1.8 MeV line from ^{26}Al on different angular scales throughout the Galactic plane.
- Map emission of Galactic 511 keV annihilation line and determine phases of the interstellar gas in which positrons annihilate.
- Map Galactic continuum gamma-ray emission to investigate contribution from individual sources.
- Broad band coverage (optical, x-ray, gamma-ray) of gamma-ray burst phenomena including accurate location in simultaneous measurements.
- Repeated scanning of the Galactic plane to detect and monitor high energy transient events.
- Detailed imaging and spectroscopic studies on typically 100 or more active galactic nuclei (AGN). Provide means to study polarization properties.
- Detailed investigations on AGN log N-log S and the cosmic high energy background.
- Investigate gamma-ray emission from galaxies to study population of cosmic ray electrons.
- Spectrally resolved images of clusters of galaxies to study distribution of matter, dynamical state of the clusters and evolution with redshift.

In order to meet these objectives the INTEGRAL reference model payload resulting from Phase A comprises four separate instruments (two main instruments and two monitors) which:

- cover an extended energy range
- provide narrow line spectroscopy
- provide broadline spectroscopy
- provide source positioning
- provide a Galactic Plane survey
- study gamma-ray bursts (including x-ray and optical range)
- provide imaging/mapping of extended sources
- provide fine timing measurements of sources
- measure the polarization characteristics of sources

The two main instruments, each having very good spectral and angular resolution but being differently optimized for complementarity in order to achieve overall excellent performance, are:

1. A cooled Germanium *SPECTROMETER* providing high spectral resolution (2 keV at 1 MeV), high line sensitivity, degree mapping of diffuse source emission and medium (degree) imaging capability.

2. A high angular resolution telescope (*IMAGER*) (17' FWHM) providing accurate source positioning, high continuum and good broadline sensitivity and medium spectral capability.

In addition, two monitor instruments will provide complementary observations in other wavebands:

1. The X-Ray Monitor (*XRM*) will extend the continuous spectral coverage of the payload down to a few keV and will provide the best position information of the payload.

2. An Optical Transient Camera (*OTC*) will search for, position and study the optical counterparts of gamma-ray bursts.

In summary, the following key instrumental characteristics have been defined:

- Wide operational bandwidth (15 keV to 10 MeV) for the *IMAGER* and *SPECTROMETER*.

- High resolution spectroscopy from 15 keV to 10 MeV ($E/\Delta E = 500$ @ 1 MeV).

- Imaging with $17'$ FWHM angular resolution and accurate source positioning ($\sim 1'$) within a field of view of ~ 50 square degrees.

- High sensitivity. Line: 1.5×10^{-6} ph cm^{-2} s^{-1}; Continuum: 3×10^{-8} ph cm^{-2} s^{-1} keV^{-1}, at E = 1 MeV, 3σ in 10^6 s.

- Polarization sensitivity: 10 mCrab, $\phi \sim$ degrees, 3σ in 10^6 s.

- Concurrent monitoring in X-ray (4 keV $-$ 100 keV) and optical (550 nm $-$ 850 nm) bands.

2.3 Spacecraft Description

The spacecraft configurations have been based on a modular approach. Two separate modules, the Payload Module (PLM) and the Service Module (SVM) have been conceived to allow for independent and parallel development and verification.

The Payload Module (PLM) carries all scientific instruments and provides a highly stable support together with the attitude sensors which have co-alignment requirements, especially the fine pointing sun sensors and the star trackers. The PLM consists of a payload platform which carries the detector assemblies of *IMAGER*, *SPECTROMETER* and *X-RAY MONITOR* and the corresponding electronic units. Also those spacecraft units interfacing with the payload (power distribution unit and remote terminal unit) are accommodated on the payload platform. A box type support structure carries the masks at a distance of about 4 meters from the detectors. The *OPTICAL TRANSIENT CAMERA* and the star trackers are also accommodated on this structure.

The SVM is common for INTEGRAL and the XMM satellite. It consists of a central tube with top and bottom platforms and with shear walls. The central tube provides the interface to the launcher at the lower end and the interface to the PLM at the upper end. The shear walls carry the spacecraft subsystems.

The attitude and orbit control subsystem consists of a conventional system of star trackers, gyros and reaction wheels plus a bi-propellant reaction control system for momentum unloading and orbit manoeuvres. The thrusters are located at the bottom of satellite, avoiding any problem of contamination with sensors or instruments. The attitude control characteristics are given in in the Table 1 below.

Solar aspect angle (sky coverage)	
from launch to 2 years	$\pm 40^\circ$ (64% coverage at any time)
from 2 to 5 years after launch	$\pm 30^\circ$ (50% coverage at any time)
Pointing	
Absolute pointing error	$15'$
Absolute roll error	$75'$
Relative pointing error	$1'$/15 minutes
Relative roll error	$5'$/15 minutes
Pointing reconstitution (a posteriori)	$1'$
Slew	5°/minute

Table 1: INTEGRAL System Parameters

The data handling subsystem is based on packet telemetry and telecommands. It will not perform data processing for the instruments as these are considered to be autonomous. The power distribution is based on solar arrays, eclipse batteries feeding a standard 28 V bus.

The S-band radio frequency subsystem will transmit telemetry at a rate of 40 kbps for payload plus 3 kbps of spacecraft housekeeping data. The antennae are mounted on deployable booms to ensure a global coverage without obstruction.

2.4 System Aspects

INTEGRAL will be launched in 2001 into a high eccentric orbit allowing long uninterrupted observations. The nominal mission lifetime will be 2 years. The consumables are dimensioned for an extended mission duration of 5 years.

Two options are considered to launch INTEGRAL: In one option, INTEGRAL will be launched by a PROTON launcher into an orbit with the following parameters:

Period: 72^{hr}, Apogee: 115000 km, Perigee: 48000 km, Inclination: 51.6°, Argument of perigee: 270°.

In the other option, INTEGRAL will be launched by an ARIANE 5 launcher into an orbit with the following parameters:

Period: 24^{hr}, Apogee: 68000 km, Perigee: 4000 km, Inclination: 65°, Argument of perigee: 270°.

Due to radiation background induced into the instruments, scientific observations will not be conducted at altitudes below 40000 km. The PROTON orbit guarantees that the spacecraft will spend 100% of its operational life outside the radiation belts (above 40000 km altitude). Using the ARIANE 5, the spacecraft will spend 70% of its orbital time above the nominal 40000 km altitude where observations are feasible.

INTEGRAL will be operated as an observatory. Telemetry coverage is obtained using one ESA ground station and possibly one or two NASA stations. The science ground segment consists of ESOC, the INTEGRAL Science Operations Centre (ISOC) and the INTEGRAL Science Data Centre (ISDC). The science data will be processed and archived by the ISDC, located in Europe, under the science operational responsibility of the ISOC at ESA. Details of the science ground segment are described in Section 5.

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3 External Scientific Teams

At completion of the INTEGRAL AO process, the following external INTEGRAL teams will be established:

- INTEGRAL Science Working Team
- Time Allocation Committee

3.1 INTEGRAL Science Working Team

The INTEGRAL Science Working Team (ISWT) will monitor and advise on all aspects of INTEGRAL which affect its scientific performance. The external members of the ISWT will be:

- the Principal Investigators (PIs) whose instruments have been selected for flight (see below for further information concerning main instruments)
- the Principal Investigator who will lead the international collaboration to establish and operate the ISDC,
- Mission Scientists – being independent of the PI teams – who provide scientific input to the programme and advise on science operations and development of instruments and ISDC.
- In case a PROTON launcher will be used, Russia will be invited to nominate one scientist formally acting as a representative for Russia providing the PROTON launcher.
- In case NASA provided ground station(s) will be used, USA will be invited to nominate one scientist formally acting as a representative for USA providing the ground station(s).

The INTEGRAL main instruments are the *SPECTROMETER* and *IMAGER* as studied during Phase A (see also Section 2.2). They constitute the core part of the overall scientific objectives for INTEGRAL. Considering the potential size and complexity for these main instruments, as well as the possible involvement of a large scientific community providing these instruments through international collaborations, it is planned – pending final instrument selection following the AO process – that the selected PI for each main instrument shall nominate one scientist who is an active member of the PI team and who represents a major participating country other than the one providing financial support for the PI. This nominated scientist will be a member of the ISWT and shall actively support his PI in fulfilling all ISWT related tasks, and both possibly dividing particular responsibilities for space hardware and science ground segment. He will be invited to participate in all regular meetings of the ISWT and associated technical meetings organised by the ESA Project Office.

Detailed information about the roles of the ISWT members is provided in Section 4. The ESA INTEGRAL Project Scientist will be the chairman of the ISWT; one of the Mission Scientists, elected from and by themselves, will be vice-chairman. The ISWT will advise the ESA INTEGRAL Programme directly and its chairman will make regular progress reports to the Astronomy Working Group (AWG). In addition to regular meetings of the entire team, there will be, as need arises, meetings of sub-groups of the ISWT to address specific problems. The full ISWT will be kept informed of these meetings.

It is anticipated, that the composition of the ISWT will remain until the nominal end of the mission (launch + 2 years). The Mission Scientists (see Section 4.3) will be appointed for 3 years though there will be the possibility for extension for further terms and continuity will be assured. All other ISWT members will serve for the full duration of the programme.
The tasks of the INTEGRAL Science Working Team are to:

1. maximize the scientific return of INTEGRAL within the boundary conditions
2. ensure that INTEGRAL maintains its principal characteristic as an observatory satisfying the objectives of the scientific community at large
3. act as a focus for the interest of the scientific community in INTEGRAL
4. maintain contact with the wider astronomical community on matters specific to INTEGRAL (e.g. coordinated observations, science operations and General Observer interface) and to provide a route, so that it can advise ESA on INTEGRAL's scientific goals from a general point of view

These tasks will be achieved by:

1. reviewing, in the light of recent results, the scientific goals of INTEGRAL at regular intervals while considering the technical boundary conditions of the spacecraft
2. advising on the scientific aspects of the development of the INTEGRAL instrumentation
3. establish the core observing programme based on the scientific objectives of INTEGRAL
4. identifying areas of overlap, complementarity, redundancy and omission between instruments both in function and in operation and optimizing the scientific use of the instruments
5. identifying and implementing a simple operational approach
6. identifying a coherent calibration and performance verification policy both on the ground and also in orbit
7. participating in the major project reviews
8. performing specific tasks as needed during the project's development

Concerning the ISDC, the ISWT is required to oversee the ISDC activities by addressing the tasks of science operations, science data processing and analysis. In particular, the ISWT will be responsible to

- optimise the core observing programme from an operational point of view
- advise on the development of the science ground segment of the observatory including the ISDC with particular reference to the operational scenario, software, observatory products and the INTEGRAL database structure
- monitor and actively support the ISDC activities during operation to ensure they correspond to the needs of the scientific users community.

Guaranteed observing time for members of the ISWT will be allocated as described in Section 5 of this plan.

When attending meetings of the INTEGRAL Science Working Team (ISWT), the Mission Scientist(s) from ESA member states will have their travel expenses and per diem paid by ESA. All other ISWT members are expected to provide their own funding for these meetings. ESA will host ISWT meetings.

3.1.1 ISWT and Users Group during extended mission phase

The tasks of the ISWT as described in the previous section are valid for the development and the nominal operational phases of the mission.

For the INTEGRAL mission in its extended phase (see e.g. section 5.2.5) ESA has decided to implement an INTEGRAL Users Group (IUG) which will be charged to:

1. Advise the Project Scientist on all matters relevant to maximising the scientific return of INTEGRAL within the boundary conditions.
2. Advise the Project Scientist on how to ensure that INTEGRAL maintains the principal characteristics of an observatory satisfying the objectives of the scientific community at large.
3. Act as a focus for the interests of the scientific community in INTEGRAL and act as an advocate for INTEGRAL within that community.
4. Maintain contact with the wider scientific community on matters specific to INTEGRAL (e.g. coordinated observations, science operations and General Observer interface) and to provide a route so that the community can advise ESA on INTEGRAL's scientific goals from a general point of view.
5. Monitor the ISOC and ISDC activities to ensure that they best meet the needs of the user community within the resources available.
6. Participate in major programme reviews.

Consequently, the tasks of the ISWT during the extended mission phase will focus on:

- Establishing and optimizing the Core Programme
- Identifying and maintaining a coherent calibration and performance verification policy
- Participation in major programme reviews
- Advising on the maintenance and possible further enhancement of the science ground segment with particular reference to the operational scenario, observatory products and database structure.

3.2 Time Allocation Committee (TAC)

One single international scientific Time Allocation Committee (TAC) will be established by ESA two years before launch. The composition of the TAC will be arranged such that conflicts of interests with proposers will be avoided. Furthermore, the composition of the TAC will reflect the contributions made by the different partners to the INTEGRAL programme. After consultation with the international partners and the AWG, the members of this committee shall be appointed by the ESA Director of Scientific Programmes for a period of 4 years, assuming a nominal mission lifetime of 2 years.

The function of the TAC will be to select observing proposals made by the science community at large (the General Observers (GO)) for the general programme (see Section 5 for details). In particular, the TAC will:

- establish criteria for GO observing proposal selection,
- review and categorize proposals on scientific merit, priority and in the light of the scientific objectives of INTEGRAL
- recommend to ESA the assignment of observing time.

The allocation of observing time is described in Section 5.

There will be one call for observation proposals (AOs) per year for the general programme (i.e. two AO's in total for a nominal 2 year mission). The first AO will be issued not less than one year prior to launch.

The time allocation process performed by the TAC will be supported by the ISOC (assisted as needed by the ISDC). The ISOC will be responsible for preparing the Announcement of Opportunity (AO) for INTEGRAL observations, supplying – in collaboration with instrument PI teams – all the relevant technical documentation (users manuals, instrument performance descriptions, instrumental constraints, etc.). The ISOC will also receive the GO proposals and assess their technical feasibility, assisted as needed by the ISDC, prior to the TAC meeting. The ISOC and ISDC teams will also provide status reports on payload state-of-health, consumables, reports on the conduct of operations etc. These reports will be made available to the TAC prior to the assessments of the proposals.

When attending meetings, hosted by ESA, TAC members from ESA member states will have their travel expenses and per diem paid by ESA.

4 INTEGRAL Programme Participation

4.1 Introduction and Schedule

Through publication of the INTEGRAL Announcement of Opportunity, the scientific community will be invited to participate in the INTEGRAL programme by:

1. providing scientific instruments,
2. providing the INTEGRAL Science Data Centre (ISDC),
3. interfacing through the Mission Scientists representing the scientific community at large, and,
4. providing scientific proposals for the general observing programme

Further information about the participation in the INTEGRAL programme through provision of instruments and the ISDC, and participation as Mission Scientists as well as the tasks for the other external ISWT members is provided in the following sections, while information about the participation of the scientific community in the general observing programme is given in Section 5.

An Announcement of Opportunity (AO) to solicit proposals for the instrument Principal Investigators (PI's), for the ISDC PI and for the Mission Scientist positions will be released after approval of the Science Management Plan by the SPC. Concerning PI's, this AO will be open to the scientific groups within those European States which participate in the ESA Scientific Programme and to the scientific groups in the United States of America (via NASA) in accordance with the ESA/NASA agreement on the principle of reciprocity. Scientific groups in Russia are invited to join (as Co-Investigators) proposing teams in ESA member states or in the USA. Concerning the call for the ISDC it is noted, that the ISDC will be located within Europe (ESA member state) with a PI from an ESA member state.

Concerning Mission Scientists, the AO will be open to candidates from ESA member states, USA and Russia. It is planned to appoint in total three Mission Scientists who cover all specific tasks as described in Section 4.3 and in the AO. In case that not all tasks are fully covered and/or new tasks and new areas of independent expert advise require attention during the course of the programme, the number of appointed Mission Scientists may be increased by the ESA Scientific Directorate following standard procedures.

During the INTEGRAL AO process, individuals will be able to submit proposals in more than one category. However, success for an individual as a PI or Co-I will automatically remove his candidature for a Mission Scientist position.

After release of the AO, ESA will hold a briefing meeting for interested parties. The schedule for the complete AO cycle is given in Table 2, the baseline INTEGRAL programme schedule following completion of the AO process is outlined in Table 3.

As indicated in Section 3.1, in case a PROTON launcher will be used, Russia will be invited to nominate one scientist formally acting as a representative for Russia providing the PROTON launcher. This scientist will become a member of the ISWT. In case NASA provided ground station(s) will be used, USA will be invited to nominate one scientist formally acting as a representative for USA providing the ground station(s). This scientist will become a member of the ISWT.

Issue of AO	01 Jul 1994
Submission of questions for briefing	01 Sep 1994
General briefing meeting	13 Sep 1994
Proposals due	05 Dec 1994
Appoint evaluation committee	08 Dec 1994
Evaluation phase	05 Dec 1994 – 23 Feb 1995
Prelim. recommendation by eval. committee	23 Feb 1995
Clarification with potential PI's	23 Feb 1995 – 24 Apr 1995
Discussion with funding agencies	23 Feb 1995 – 24 Apr 1995
Final recommendation by eval. committee	24 Apr 1995
AWG/SSAC review	May 1995
SPC selection of payload and ISDC	Jun 1995
Appointment of Mission Scientists	Jun 1995

Table 2: Schedule for INTEGRAL AO cycle.

Issue spacecraft ITT phase B	Jul 1995
Spacecraft phase B	Apr 1996 – May 1997
Spacecraft phase C/D	Jun 1997 – Nov 2000
Instrument STM delivery	Dec 1997
Instrument EM delivery	Mar 1998
Instrument FM delivery	Jun 1999
ISDC/ISOC build-up phase	Jun 1995 – Apr 1999
ISDC/ISOC operational	Apr 1999
Flight acceptance review	Nov 2000
Launch	Apr 2001
End nominal mission	Apr 2003
Archiving phase (after end nominal mission)	2003 – 2005

Table 3: INTEGRAL programme schedule.

4.2 Programme Participation as Principal Investigators for Instruments and INTEGRAL Science Data Centre

4.2.1 Roles and General Requirements

The proposals for the instruments and the INTEGRAL Science Data Centre (ISDC) shall be made bearing in mind the scientific and operational objectives of the INTEGRAL programme and the current programme definition and constraints. It is emphasized that there is a need for a complementarity of the *SPECTROMETER* and *IMAGER*, individually optimized for spectroscopy and imaging respectively. In addition, the *XRM* is optimized for low energy extension of the main instruments and the *OTC* shall monitor the common field of view of all other instruments for high energy transients. The instrument complement will be optimized to accomplish the overall scientific aims of the mission. As a result, proposals may need to be amended after submission, in joint discussions between ESA and the proposer(s). The proposed instruments and ISDC must comply with the technical requirements contained in the AO documents. However, if proposers feel that a greatly improved scientific return together with a mature and proven instrument concept may be obtained by exceeding one or more of these constraints, they may identify this as an option in their proposal, justifying it in the scientific section and explaining it in the technical section.

Each instrument group and the ISDC group shall be headed by a single person, designated as the Principal Investigator (PI). The PI shall establish an efficient management scheme especially in the case where many institutes are providing sub-assemblies or sub-systems. This may require the establishment of a steering committee within each team providing an instrument or the ISDC. Details of the management structure within a team, including membership of the steering committee, will be agreed after selection through the establishment of the Experiment Implementation Agreement (Section 4.2.7) and the Experiment Interface Documents (see below).

The proposal must demonstrate that the PI has adequate control over all aspects of the programme, including direct access to adequate financial resources, so that the responsibilities of the PI can be met. Principal Investigators are at all times responsible for the funding arrangements of the instruments and ISDC and the management thereof. A funding margin should be provided, not only to provide for development evolution, but also to finance instrument (or ISDC) interface changes resulting from the parallel development of instrument, spacecraft and ground segment. The PI's shall not assume any funding from ESA for any part of their programme. In this context, use of ESA facilities by investigators will be on a cost reimbursement basis, other than those facilities associated with spacecraft assembly, integration and verification. The PI shall represent the single point formal interface for the instrument and ISDC programmes with the ESA Project Office.

After selection, an Experiment Interface Document (EID) will be established for each instrument and the ISDC. A draft EID will be contained in the AO package. This EID defines the INTEGRAL technical and programmatic requirements (including management and control procedures), specifies in detail the interface information applicable to each instrument/ISDC and specifies the planning applicable to each instrument/ISDC. The EID becomes the formal interface control document and formal reference for all progress reporting and it shall be placed under formal configuration and change control once agreed and signed off by the parties involved.

In general, the PI is responsible for ensuring that the complete instrument and ISDC programmes are implemented and executed within the constraints of the approved INTEGRAL programme. The responsibilities shall include, but are not necessarily limited to, the following:

4.2.2 Responsibilities for PI's for Instruments

Management

1. Take full responsibility for the instrument programmes at all times and to retain full authority within the instrument team over all aspects related to procurement and execution of the programme. In this context the PI shall be able to make commitments and make decisions on behalf of all other participants in the instrument team (as represented for instance in the team steering committee).
2. Establish an efficient and effective managerial scheme which will be used for all aspects of the instrument programme.
3. Define the role and responsibilities of each Co-Investigator (Co-I)
4. Identify (by name) key team members responsible for science management, technical management and operational management and, if deemed necessary, identify members of the instrument steering committee
5. Organise the effort, assign tasks and guide other members of the team of investigators.
6. Provide the formal managerial interface of the instrument to the ESA Project Office and support ESA management requirements (e.g. status reports, progress reviews, programme reviews, change procedures, product assurance etc.) as defined in the EID.

Scientific

1. Attend meetings of the INTEGRAL ISWT and supporting groups as appropriate, to report on instrument development, and to take a full and active part in their work.
2. Ensure adequate calibration analysis of all parts of the instrument both on ground and also in orbit.
3. Support the ISDC and ISOC in the definition of the science operations.
4. Participate in the definition of the core observing programme.
5. Exploit to full depth the scientific results of the mission.

Hardware

1. Define the functional requirements of the instrument and its ancillary equipment (e.g. MGSE, EGSE, IGSE).
2. Ensure the development, construction, testing and delivery of the instrument. This shall be in accordance with the standards, technical and programmatic requirements outlined in the AO including its ANNEXES and subsequently reflected in the approved Experiment Interface Document.
3. Ensure adequate calibration of all parts of the instrument both on ground and also in orbit.
4. Ensure that the design and construction of the instrumentation, and its development test and calibration programmes are appropriate to the objectives and lifetime of the mission, and reflect properly the environmental and interface constraints under which the instru-

At the end of the evaluation phase and after confirmation of the funding and endorsement by the relevant national authorities, the evaluation committee will recommend both a final payload complement and the ISDC to the advisory bodies of the Agency. Based on the advice of the AWG and SSAC, the recommendation will be presented by the Executive to the SPC for approval. The selected proposals will be announced following approval by the ESA SPC. Following selection, ESA will confirm participation of PI's and CO-I's. The schedule for proposal evaluation and selection is shown in Section 4.1.

This process will be completed in time to allow the resources allocated to – and interfaces of – each instrument and ISDC to be adequately defined prior to detailed contact with industry for the Phase B of the satellite.

4.2.5 Evaluation Criteria for Instrument Proposals

The selection criteria for individual proposals will include the following (not in order of importance):

- Merit of specific scientific objectives of proposed instrument.
- Scientific compatibility with global mission objectives of INTEGRAL.
- Ability of proposed instrumentation to satisfy its scientific objectives.
- Suitability of proposed instrumentation for INTEGRAL General Observers.
- Technical feasibility of proposed instrumentation
- Reliability and space qualification of proposed instrumentation (especially previous space heritage of detectors and other sub-systems).
- Development status of proposed instrumentation.
- Technical compatibility with available spacecraft resources and mission constraints.
- Operational constraints and complexity
- Adequacy of proposed data analysis plan
- Competence and experience of the team in all relevant areas (e.g. scientific, space technology, proposed techniques, software development and technology etc.).
- Adequacy of proposed management scheme (including organigramme, project manager, roles of Co-I's etc.) to ensure a timely execution of instrument development and associated tasks and post launch support.
- Adequacy of human resources and institutional support to ensure a timely execution of instrument development and associated tasks.
- Previous experience in managing a space instrumentation programme.
- Credibility and compliance of costing of proposed development programme.
- Compliance with all applicable management, reporting and product assurance requirements.
- Financial impact upon ESA of proposed instrumentation.
- Assurance of adequate funding for proposed instrumentation.

For the overall integrated complement of the payload for INTEGRAL, the selection criteria will include:

- Results of the evaluation of the individual proposals on the basis of the evaluation criteria listed above.
- Overall scientific merit of the complete payload with respect to meeting the INTEGRAL scientific objectives.
- Technical compatibility with available spacecraft resources and mission constraints.
- Compatibility with programme constraints

Following the selection of instruments and INTEGRAL SDC, an Experiment Implementation Agreement will be drawn up involving the PI, Co-I's, their institutes, national funding agencies and ESA to cover all aspects of their relationship.

It is emphasized that the Experiment Implementation Agreement needs to be established before the final selection of the instruments and the ISDC can be confirmed.

4.2.8 Monitoring of Instrument and INTEGRAL SDC Development

ESA will monitor the progress of the design, development and verification of the scientific instruments and the ISDC. The PI's have to demonstrate to ESA in regular reports and during formal reviews compliance with the scientific mission goals, the spacecraft system constraints, the spacecraft interfaces and the programme schedule as defined in the mutually agreed Experiment Interface Document. The scientific performance will be monitored by the ESA Project Scientist who may draw on support of the ISWT as a whole. The technical and programmatic compliance will be monitored by a dedicated engineer of the ESA INTEGRAL project team.

4.3 Programme Participation as Mission Scientists

4.3.1 Roles, Requirements and Responsibilities

The role of the Mission Scientist is to provide input to the INTEGRAL Science Working Team (ISWT) independently of the instrument and ISDC groups. The Mission Scientists shall be scientists with a high international reputation in astrophysics. Proposals from applicants in any branch of astronomy will be considered. They shall be capable of making personal contributions to the INTEGRAL programme during both development and operational phases.

Concerning Mission Scientists, the AO will be open to candidates from ESA member states, USA and Russia. It is planned to appoint in total three Mission Scientists who cover all specific tasks as described in this section and in the AO. In case that not all tasks are fully covered and/or new tasks and new areas of independent expert advise require attention during the course of the programme, the number of appointed Mission Scientists may be increased by the ESA Scientific Directorate following standard procedures.
In particular, the following specific tasks shall be covered by the Mission Scientists:

- Monitor the progress for instrument development with the emphasis to provide independent analysis on system level in view of the overall mission objectives and instrument complementarity.
- Monitor the progress for the ISDC development with the emphasis to provide independent analysis on system level in view of the overall mission and science ground segment objectives.
- Provide independent expert advice on science operations.
- Optimise the scientific core observing programme based on the scientific objectives of INTEGRAL.

In general, the Mission Scientists are expected to:

- attend all meetings of the ISWT and to take a full and active part in its work,
- participate in the major reviews of the INTEGRAL programme,
- establish and maintain close contact – through the Project Scientist – with the development of the INTEGRAL programme, and,
- provide a report to the AWG, on a yearly basis, on the fulfillment of their appointed tasks.

4.3.2 Selection Procedure and Criteria

The Mission Scientist proposals will be evaluated and reviewed by the AWG with support from the Project and – where appropriate – by additional scientists. The SSAC will make recommendations to the ESA Executive. The ESA Director of Scientific Programmes will appoint the Mission Scientists for a fixed (renewable) period of 3 years. The selection procedure will be arranged to eliminate conflicts of interest. All appointed Mission Scientists shall fully cover all tasks as specified in Section 4.3.1.

The following criteria will be used in assessing the individual proposals:

1. Full experience of proposer in one or more areas as particularly specified in Section 4.3.1.
2. Merit of proposed general contribution to INTEGRAL.
3. Relevance of mission themes to the overall INTEGRAL objectives.
4. Stated availability of time.

4.4 Programme Participation as Scientists nominated by Russia and USA

As indicated in Section 3.1, in case a PROTON launcher will be used, Russia will be invited to nominate one scientist formally acting as a representative for Russia providing the PROTON launcher. This scientist will become a member of the ISWT. In case NASA provided ground station(s) will be used, USA will be invited to nominate one scientist formally acting as a representative for USA providing the ground station(s). This scientist will become a member of the ISWT.

4.4.1 Roles, Requirements and Responsibilities

These scientists shall provide input to the ISWT independently of PI teams and Mission Scientists. They shall be scientists with a high international reputation in astrophysics and they shall be capable of making personal contributions to the INTEGRAL programme during both development and operational phases. In particular they shall be active members of the ISWT and they shall take a full and active part in its work following the outline of tasks for the ISWT as shown in Section 3.1 of this plan. In general, it is expected that these scientists attend meetings of the INTEGRAL ISWT and exploit to full depth the scientific results of the mission.

5 Science Operations and Observations Management

This section describes the basic concept of the INTEGRAL observing programme, the participation of the science community in the observing programme and a description of the science ground segment.

5.1 Overview

INTEGRAL will be operated as an observatory type mission. Its nominal lifetime is 2 years. Consumables are designed for a possible extension of up to 5 years.

Most of the observing time (Figure 2) which will be available for scientific investigations (open time) will be awarded to scientists (General Observers (GO)) who have submitted an observation proposal selected by the Time Allocation Committee (TAC). This part of the programme will be called the general programme.

A fraction of the total observing time will be reserved for the PI teams who have developed and delivered the instruments and the INTEGRAL Science Data Center (ISDC), for the INTEGRAL Science Operations Centre (ISOC, via the ESA Project Scientist), for the scientists representing the participating partners Russia and USA, and for the Mission Scientists. This is the guaranteed time for the INTEGRAL Science Working Team (ISWT). This part of the programme will be called the core programme.

In addition, immediately after launch, there will be a period of performance verification and calibrations. Particular attention will be paid to react to targets of opportunities (TOOs) through the course of the mission.

For the general programme (see Figure 1 for reference), the ISOC will issue calls for observing proposals to the science community. The user community at large (see Section 5.2.3) as well as the ISWT may submit proposals which will be reviewed on their scientific merit by the Time Allocation Committee (TAC, see Section 3). The ISOC (assisted as needed by the ISDC) will support the TAC in the proposal evaluation by assessing the proposals on their technical feasibility.

After the observing programme has been established by the TAC (general programme) and the ISWT (core programme), the ISOC will define, schedule and optimise the observing timeline and will communicate instrument status parameters required for the individual observations to ESOC. Spacecraft operations and all real time contacts with spacecraft and payload will be under the responsibility of ESOC via ESA and NASA ground stations.

Raw science data from the INTEGRAL spacecraft will be distributed by ESOC to the ISDC for further processing. The ISDC will have the responsibility for raw data processing, to provide the scientific community (General Observers and ISWT) with the data products and the required analysis software, and for the archiving of the data for future uses. Results of quick-look analysis and instrument monitoring at the ISDC which require an update of the instrument status parameters for the observations will be communicated to the ISOC to be implemented in the observing timeline. The ISDC will fully support the user community and will also help the INTEGRAL General Observers from the preparation of observation proposals to the actual data analysis. The ISDC activities will be overseen by the ISWT in fulfilling its operational tasks.

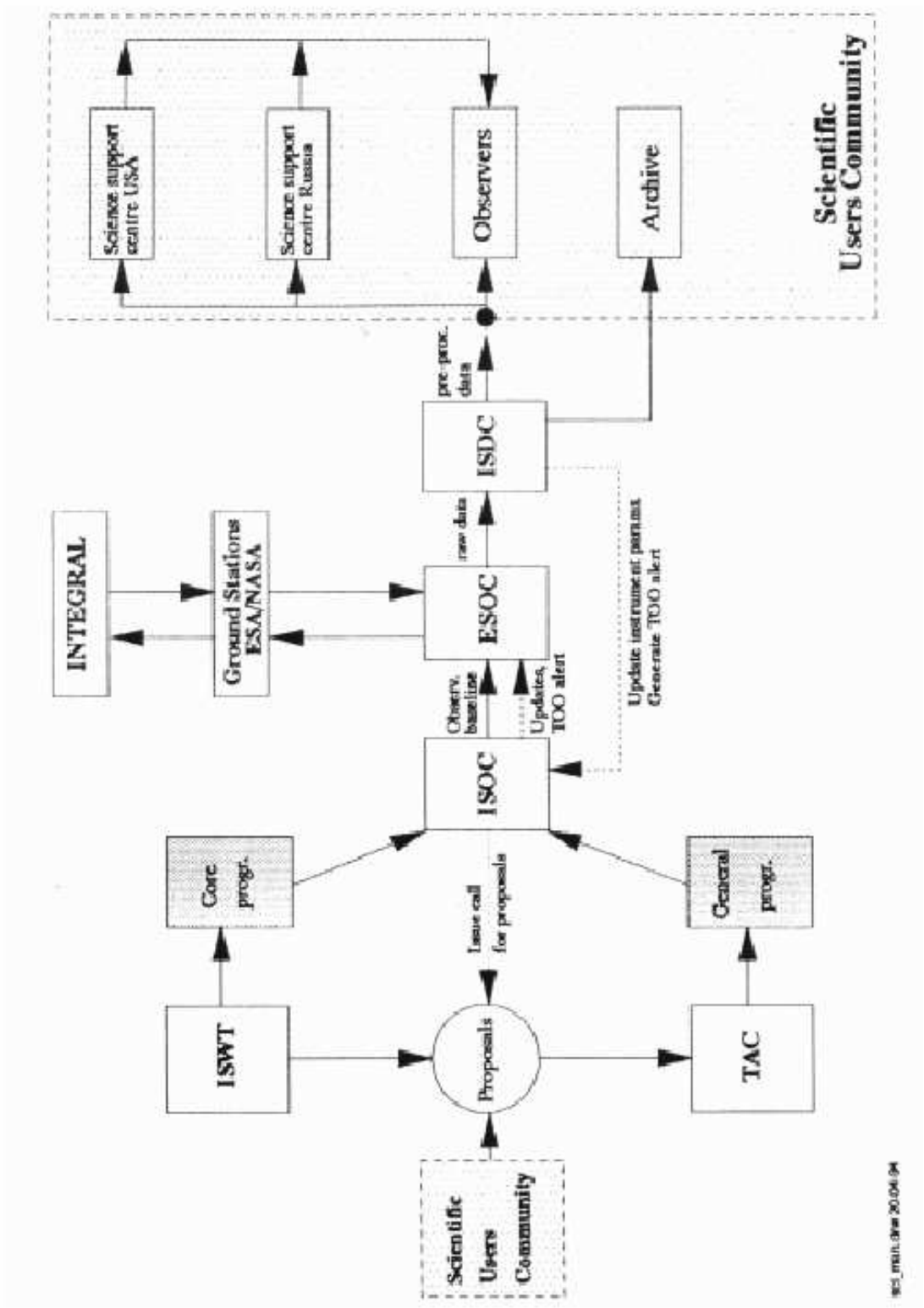

Figure 1: Overview INTEGRAL Science Management

Targets of Opportunities (TOOs) are expected to occur during the mission. These events are not foreseeable and their scientific importance often requires alterations of the current observing baseline. TOOs should be routinely detected by the ISDC or could be received from other space missions or ground observatories. An alert will be generated and the ESA Project Scientist at the ISOC will decide on a possible change of the mission time line; consultancy with the TAC chairman will be sought for. The decision being taken, the ESA Project Scientist will instruct ESOC to implement the change.

All pre-processed data (output) will be made available by the ISDC to the General Observers (general programme) and ISWT (core programme). Local science support centres in USA and in Russia can also serve to further distribute the processed data and to assist the General Observers in further scientific analysis. The implementation of these science support centres in USA and Russia (if they participate) will be the responsibility of these partners. The European science support centre, however, will be an integrated function of the ISDC.

The INTEGRAL data rights will follow the established rules (cf. ESA/C(98)93). All data will be assembled by the ISDC in one single public archive one year after they have been made available for scientific analysis. Up-to-date copies of the public INTEGRAL data archive will also be made available at ESA (via the ISOC) and at the local science support centres in USA and Russia.

5.2 Observing Programme and Observing Time

The observing programme consists of several phases:

1. Performance verification and calibrations
2. Core Programme
3. General Programme
4. Targets of Opportunities

The observing time throughout the observing programme is divided into:

- Guaranteed time
- Open time
- Time for targets of opportunity

Scientific observations may be conducted throughout the full duration of a PROTON orbit and during about 70% of the time spent on the ARIANE 5 orbit (i.e. when the spacecraft is above 40000 km altitude). The term observing time as used in this document is understood to mean that time during which the scientific instruments on INTEGRAL are in nominal operation, less idle time and less time necessary for slewing, uplink commands, calibration, testing and maintenance.

The phases of the observing programme are schematically shown in Figure 2.

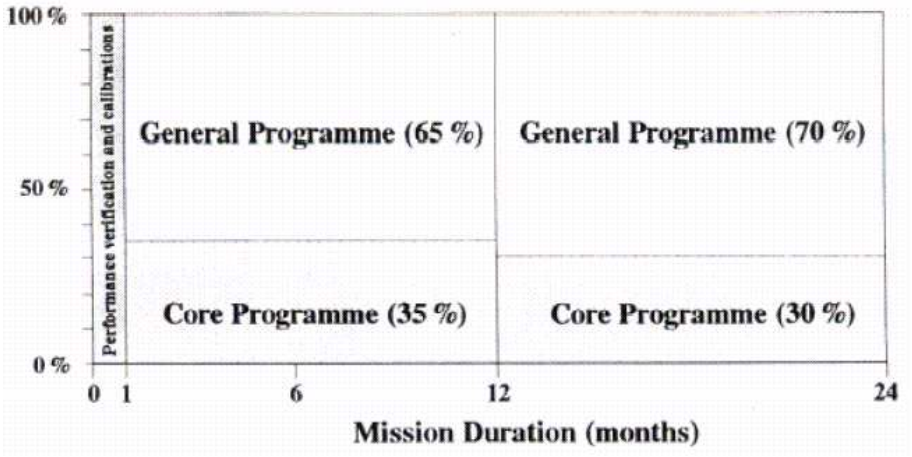

Figure 2: Schematic breakdown of the observing programme into three main phases during the 2 year baseline mission (targets of opportunities not shown).

5.2.1 Performance Verification and Calibrations

This element of the programme will start immediately after launch with engineering verifications of the payload and will evolve into a full scientific characterisation of the instruments. The observations (pointings) for this period will be selected by the instrument PIs and the ESA Project Scientist. The period dedicated to performance verification and calibrations is expected to last for approximately 1 month (TBC).

5.2.2 Core Programme and Guaranteed Time

The core programme baseline will consist of pointed observations and of scans along the Galactic plane which will be performed at regular time intervals spread over the duration of the mission. The ISWT will define the the core programme in full detail. The core programme will use 35% of the total observing time during the first year after launch and 30% of the total observing time during the second year after launch (see Figure 2). Details of the core programme are provided below.

Most of the guaranteed observing time for the core programme shall be devoted to pointed observations (targets) selected by the individual members of the INTEGRAL Science Working Team (ISWT). The remaining part of the guaranteed observing time for the core programme will consist of a regular survey of the Galactic plane. Scans along the plane will be performed at regular intervals (e.g. once per day) during the mission, and the resulting survey will allow to detect transient sources and measure in a systematic way their duty cycles and their luminosity function, two measurements that have not been performed to date and which are essential to the understanding of the nature of these sources. Monitoring selected parts of the Galactic plane with sufficient deep exposure will also reveal yet unknown persistent sources (see ESA SCI(93)1 for further details). It is important to find such sources early in the mission so that time can be allocated for deeper observations later in the mission. With current instrument performance parameters (e.g. sensitivity, field of view) it is estimated that the survey will use about 12% of the total observing time during the nominal mission duration of 2 years. The detailed planning of the survey scans is a task of the ISWT.

Reactions to and observations of possible Targets of Opportunity during the core programme will be performed as described in Section 5.2.4.

The observing time used during the core programme is the guaranteed time for the members of the ISWT in return for their contributions to the programme. The final division of the guaranteed time between the various members is the responsibility of the ISWT within limits established by the Agency at the time of selection. These limits will also take into account the final payload complement and ISDC which has been selected. Further subdivision between Co-I's is the responsibility of the individual PI.

If the PROTON launcher is used, the overall return to the Russian science community (via ISWT members) will be 24% during the core programme. If NASA ground stations will be used, the overall return to the US science community (via an ISWT member) will be 3% during the core programme.

A possible scenario to share the guaranteed time of the core programme within the ISWT, subject to finalisation (see above), is shown in Table 4.

ISWT member	PROTON (%)	ARIANE 5 (%)
PI Imager	23	31
PI Spectrometer	23	31
Russian representative (launcher)	23	–
PI's (Monitors)	15	19
PI ISDC	9	12
All Mission Scientists and ISOC (Project Scientist)	4	4
US representative (ground stations)	3	3
Total	100	100

Table 4: Proposed share of guaranteed time during the core programme (pointed observations and survey). The core programme uses 35% of the total observing time during the first year, and 30% of the total observing time during the second year of the nominal 2 year mission.

It has been assumed that all Mission Scientists would serve for the full length of the programme; otherwise a portion according to the length of service will be applied.

As it is the case for the General Observers during the general programme (see Section 5.2.3), the individual ISWT member will receive the data from all instruments for his portion of the guaranteed observation time as defined above.

However, for those PI's who provide instruments, the following alternative to this baseline, pending approval by the ISWT, is proposed: An instrument PI will receive the data from his instrument only, however, not only for his portion of the guaranteed observation time as defined above, but for a significant number (or possibly all) of the core programme observations as defined by the other instrument PI's: Because of the co-alignment of all instruments and their overlapping fields of view, this alternative suggests that instrument PI's jointly maximize the number of selected common gamma-ray targets within the common field of view, by establishing a joint observing programme for their allocated observing times, thereby optimising the science return.

Concerning the data from the Galactic plane survey it is recommended that these data be used as a common scientific database and that the shares shown in Table 4 indicate the lead in research (including lead in data analysis together with lead of joint publications).

After the ISWT has established the core programme, all details will be made available to the TAC and published in the first call for observing proposals for the general programme. This will give an overview of the observing potential of the observatory.

All the data obtained during the full core programme (pointed observations and survey) will be publicly available through the archive one year after the data have been processed and released by the ISDC.

ESA will have – in knowledge of the ISWT – unlimited access to all mission data being obtained, processed and analysed before archiving, for the sole purpose of public relations.

5.2.3 General Programme and Open Time

The general programme will be open to the scientific community of ESA member states and of the participating partners (Russia, USA) which can apply for observing time by responding to a call for observation proposals (AO). This part of the observing programme will represent 65% of the overall observing time during the first year, and 70% during the second year of the nominal 2 year mission, and uses it as open time (see Figure 2).

There will be one call for observation proposals (AO) per year for the general programme. The first one will be issued by the ISOC not less than one year prior to launch. The members of the ISWT (including their teams) will also be allowed to submit proposals.

Observation time will be allocated for all the data (from all instruments) acquired during a pointing. The durations of individual pointings in this part of the programme will last from typically one hour up to 2 weeks. There will be the possibility to make proposals for observations dependent on the occurrence of a phenomenon, for example transient sources or supernovae in nearby galaxies. The scheduling will be flexible enough to modify the observation timeline to accommodate these targets of opportunity. Reactions to and observations of Targets of Opportunity will be performed as described in Section 5.2.4.

The proposals will be evaluated by the international TAC (see Section 3) on their scientific merit.

In consideration of the possible participation of Russia (as defined in the ESA/Russia Memorandum of Understanding), the Russian General Observers will obtain a portion of the observing time during the general programme, i.e. a portion of the open time corresponding to 27%, if the PROTON launcher is used, and a portion of the open time corresponding to 5% if ESA decides to use the ARIANE 5 launcher.

No partner should have any advantage or disadvantage on the allocation of targets within their respective share.

The selected observer will receive the data from all instruments pertinent to his/her observation from the ISDC in Europe or through local science support centres (in USA and Russia) and these data will remain his/her propriety for one year after receipt of the ISDC products. Data from any observation may be used within the proprietary period – and in agreement with the observer – by the ISDC and ISOC for the mandatory and critical tasks of instrument health control, engineering trend analysis and instrument (re-) calibration only, but they cannot be used for independent scientific analysis and publication by the ISDC and ISOC during this period. In exceptional cases, General Observers may have access to the raw data of their observing time – data which are not pre-processed by the ISDC – provided the case is scientifically justified and agreed by the ESA Project Scientist who will consult with PI's.

All the data obtained during the general programme will be made public through the archive one year after the date at which they were processed and released by the INTEGRAL SDC (i.e. sent to the proposer).

ESA will have – in knowledge of the General Observer – unlimited access to all mission data being obtained, processed and analysed before archiving, for the sole purpose of public relations.

5.2.4 Observation of Targets of Opportunity

As described above, INTEGRAL will – within the core programme – regularly perform a Galactic survey: This will yield approximately one target of opportunity (TOO) per month. Other TOOs will naturally occur during the general programme (which, as described above, would allow the possibility to accept proposals for potential TOO observations). These TOO events can not be foreseen and the scientific importance often warrants immediate alterations to the observing baseline. The TOO should be discovered in the routine scrutiny of the INTEGRAL data performed by the INTEGRAL SDC, but could also be suggested to the ISDC or ISOC by outside information (i.e. other space missions or ground observatories). In case the ISDC discovers a TOO during the core and/or open programme – or is informed otherwise by other observatories – it will inform the ESA Project Scientist at the ISOC. The ESA Project Scientist will decide on a possible change of the mission time line; consultancy with the TAC chairman will be sought for. The ESA Project Scientist will coordinate actions in case of contingencies. This decision being taken, instruction is given by the ESA Project Scientist to ESOC to implement the change. It is estimated that the whole process should take place within 24 hours. This allows about 10 hours for the ISDC to discover the TOO, 2 hours to communicate with the ESA Project Scientist and 12 hours for ESOC to react.

Data analysis of TOO's detected and observed during the Galactic plane scans (being part of the core programme) will be performed by the ISWT through organisation and co-ordination by the Project Scientist.

Proposals for TOO observations during the general programme may be submitted to the TAC for review in response to the AO for scientific observations with INTEGRAL. Successful proposers (General Observers) will conduct and analyse their TOO data within the framework of their accepted proposal in collaboration with assigned ISDC and ISOC support. Data analysis of TOO's (during the general programme) which are not covered by accepted observing proposals will be performed by the ISWT through organisation and co-ordination by the Project Scientist in collaboration with the serendipitous proposer.

All the data obtained from TOO observations will be publicly available one year after the data have been processed and released by the ISDC.

ESA will have – in knowledge of the ISWT/General Observer – unlimited access to all mission data being obtained, processed and analysed before archiving, for the sole purpose of public relations.

5.2.5 Observations during the Extended Mission Lifetime

An extended phase of the mission, following the end of the nominal 2 year mission lifetime and being dependent on the technical status of the spacecraft and payload and the available budget, could last – if technically feasible and approved – from launch plus two years up to launch plus five years.

Pending approval of the extended mission phase, the core programme (possibly including a continuation of the Galactic plane survey) shall use 25% of the total observation time as guaranteed time with a possible share among the ISWT members as shown in Table 4, and 75% of the total observation time as open time during the general programme.

A final share of the observing time for ISWT and General Observers including General Observers sponsored from agencies other than ESA, NASA and Russia for this extended phase will be defined by the Agency in co-ordination with the ISWT and the participating partners.

5.3 Science Ground Segment

The science ground segment (Figure 1) consists of three major elements: ESOC, the INTEGRAL Science Operations Centre (ISOC) and the INTEGRAL Science Data Centre (ISDC). Possible local science support centres in USA and Russia can be implemented under the responsibility of these partners.

The key areas of responsibility for the science ground segment elements include:

- The ISOC is responsible for the definition of scientific operations including the instrument configuration for each observation, the mission planning and implementation of the observing programme, and the management of the development of the software for all participants (ISDC and instrument teams) to be implemented and operated at the ISDC and ISOC.

- ESOC will implement the observing programme within the system constraints into an operational command sequence, will perform all spacecraft operations and maintenance tasks and provide the ISDC with payload telemetry plus auxiliary spacecraft data.

- The ISDC is responsible for processing the science data including instrument status monitoring and quick-look, recognition of TOO's, provision of the mission products including archive, and support of General Observers.

Further details are given in Sections 5.3.1, 5.3.2, 5.3.3 below.

ESOC and ISOC functions will be provided by ESA, and the ISDC will be located in Europe headed by a European PI following the AO selection process.

The "mission profile" of the ISOC and ISDC is currently based on a linear build up phase until launch minus 2 years when full staff complement is reached. Full complement is available from launch minus 2 years up to the end of the nominal mission phase at launch plus 2 years followed by a linear run-down phase until launch plus 4 years in case no extension of the mission is foreseen.

5.3.1 European Space Operations Centre (ESOC)

ESOC, located in Darmstadt, Germany,

1. is responsible for the spacecraft operations and all real time contacts with the spacecraft and payload,
2. will directly supply the ISDC in Europe with raw science telemetry, housekeeping and relevant auxiliary spacecraft data in an agreed format over communication links within minutes of the data arrival at ESOC,
3. will provide the ISOC with a subset of payload data (e.g. instrument status data for instrument parameter set-up and simulator),
4. is responsible for the data lines in Europe,
5. will perform anomaly checks (out of limit checks) for a set of parameters for both spacecraft and payload in real time, and notify ISOC on payload anomalies
6. expects to follow a time line and not to have to react in real time. This means that no experiment adjustments are possible during a nominal observation (during the verification phase and in case of anomalies and emergencies this is of course not applicable). TOOs are, however, foreseen. In case of an alert ESOC will receive requests from the ESA Project Scientist at the ISOC to modify the observing programme.

5.3.2 INTEGRAL Science Operations Centre (ISOC)

The functions and responsibilities of the ISOC are outlined below.

- Responsible for the definition of scientific operations including the instrument configuration for each observation, with PI team support through expertise (training) for e.g. instrument simulator and set-up parameters. The level of expertise support shall be refined with the ESA Project Office and the instrument PI's and will be defined in the EID.
- Responsible for the mission planning (scheduling) and implementation of the observing programme. This includes the establishment of all relevant software (e.g. mission planning, time line generation etc.)
- Define guidelines and standards for and manage the development of the software (architecture, standards, commonality, configuration control etc.) for all participants to be implemented and operated at the ISDC and ISOC.
- Prepare AO's for observations and assess together with the ISDC the technical feasibility of proposals and make assessments available to the Time Allocation Committee.
- Decide on the generation of an alert for Targets of Opportunity in order to change/interrupt the observing programme.
- Keep an archive of all scientific data as created and maintained by the ISDC.
- Support PI teams in developing software and science and payload operations (through

6 Acronyms and Abbreviations

AGN	Active Galactic Nuclei
AO	Announcement of Opportunity
AWG	Astronomy Working Group
Co-I	Co-Investigator
EGSE	Electrical Ground Support Equipment
EID	Experiment Interface Document
EM	Engineering Model
ESA	European Space Agency
ESOC	European Space Operations Centre
FM	Flight Model
FWHM	Full Width at Half Maximum
GO	General Observer
IGSE	Instrument Ground Support Equipment
INTEGRAL	International Gamma-Ray Astrophysics Laboratory
ISDC	INTEGRAL Science Data Centre
ISOC	INTEGRAL Science Operations Centre
ISWT	INTEGRAL Science Working Team
ITT	Invitation to Tender
IUG	INTEGRAL User Group
kbps	kilobits per second
keV	kilo electron Volts
MeV	Mega electron Volts
MGSE	Mechanical Ground Support Equipment
NASA	National Aeronautics and Space Administration
OTC	Optical Transient Camera
PI	Principal Investigator
PLM	Payload Module
SPC	Science Programme Committee
SSAC	Space Science Advisory Committee
STM	Structure and Thermal Model
SVM	Service Module
TAC	Time Allocation Committee
TBC	To Be Confirmed
TOO	Target of Opportunity
XRM	X-Ray Monitor
XMM	X-Ray Multiple Mirror Mission