JUICE - JUpiter ICy moons Explorer
GIPER Ganymede Ice PEnetrating Radar
Part I: Instrument Scientific and Technical Plan

Instrument Consortia

Principal Investigator
J. Sommer
Luleå University of Technology, Rymdcampus 1, 981 92 Kiruna, Sweden
jansom-1@student.ltu.se

Instrument Project Manager
M. Olsen
Luleå University of Technology, Rymdcampus 1, 981 92 Kiruna, Sweden
morols-1@student.ltu.se

Instrument Technical Manager
O. Sarwar
Luleå University of Technology, Rymdcampus 1, 981 92 Kiruna, Sweden
omasar-1@student.ltu.se

Lead Funding Agency

Acme Space Agency

http://home.roadrunner.com/~tuco/looney/acme.html

Prepared by:	**GIPER team**
Reference no.:	**GIPER-ScTch-01**
Revision:	**1**
Date of Issue:	**December 15, 2012**
Status:	**Draft**

Acronyms

AO: Announcement of Opportunity
EID-A: Experiment Interface Document - Part A
EGSE: Electronic Ground Support Equipment
GIPER: Ganymede Ice PEnetrating Radar
JUICE: JUpiter ICy moons Explorer
LEO: Letter of Endorsement
LFA: Lead Funding Agency
PI: Principal Investigator
SciRD: Science Requirements Document
SHARAD: Mars SHAllow RADar sounder

Document Approvals

Principle Investigator

Jan Sommer

Project Manager

Morten Olsen

Technical Manager

Omair Sarwar

Document Change Record

Table 1 – *Document Change Record for GIPER Ganymede Ice PEnetrating Radar, Part I: Instrument Scientific and Technical Plan*

Doc. reference	**Change date**	**Change Description**
GIPER-ScTch-01	December 15, 2012	1st release

Contents

1. Introduction

The GIPER instrument consortium answer to the ESA Announcement of Opportunity (AO)[1] for the L1 class JUpiter ICy moons Explorer (JUICE) mission.

1.1. **JUICE Mission Overview.** ESA L1 mission selected May 2012 in Cosmic Vision programme. Expected launch date 2022. 7.5 year cruise to Jupiter. Orbit insertion 2030 around Jupiter including phase studies of Europa and Callisto. September 2032 orbit insertion around Ganymede. Nominal mission end 2033. Russian Ganymede lander.

2. Scientific Objectives

The scientific outcome of this instrument proposal is in accordance with ESA Science Requirements Document (SciRD)[2] and addresses many of the scientific investigations proposed in the ESA JUICE Assessment Study Report[3].

2.1. **Introduction.**

2.2. **Scientific Goals.**

2.3. **Scientific Performance Requirements.**

3. Instrument Performance

4. Technical Description and Design

The proposed instrument has been designed in accordance to ESA Experiment Interface Document - Part A (EID-A) for the JUICE mission[4].

4.1. **Design Overview.**

4.2. **Instrument Design Elements.**

4.3. **Technical Resources.**

4.4. **Instrument Spacecraft Requirements.** This mission assumes that an altimeter instrument is included in the JUICE mission scientific instrument package. Altimeter is needed to estimate the surface clutter and surface slope.

5. Summary of Instrument Interfaces

6. On-ground and In-flight Test and Calibration

Functional, EMC, Thermal-Vacuum, Vibration. For Electronic Ground Support Equipment (EGSE) a Ganymede Ice PEnetrating Radar (GIPER) raw signal simulator will be developed by the instrument consortia. The raw signal simulator will be similar to the one developed for the Mars SHAllow RADar sounder (SHARAD) instrument[5] and allow testing of the signal processing chain and to develop a Ganymede transfer function considering the orbit altitude and surface clutter and sub-surface dielectric interfaces. In-flight internal calibration (transmitted signal looped to receiver and data sent to ground) In-flight external calibration (unprocessed data of reflected signals from a flat surface region of Ganymede is sent to ground)

Figure 1 – *Mars Echo Gen-*

7. System Level Assembly, Integration and Verification

7.1. **Requirements.**

7.2. **Deliverable Models.** Two models of the proposed instrument will be developed:

- Engineering Model - To test and verify the instruments functional and technical requirements as well as the instrument performance.

- Protoflight Model - will be build using full flight standard components and tested at qualification levels.

7.3. **System Level Testing.**

8. Flight Operations Concept

The instrument modes are inherited from the SHARAD instrument[7].

8.1. **Nominal Operations.** Operation modes: Low data rate, high data rate, calibration, receive only

8.2. **Other Modes.** Silent Modes: Off, Heating Support modes: Check/init, standby, warm-up, idle

9. Science Ground Segment Concept

9.1. **Implementation concept for the Science Ground Segment.**

9.2. **Planning of payload operations.**

9.3. **On-Board Software Maintenance.**

10. Data Reduction, Scientific Analysis and Archival Plans

11. Organization

11.1. **Management Structure.** (Please note, some of the contents in this section are fictive and should not be taken literally.)

Dr. Jan Sommer is the instrument Principal Investigator (PI). He has an extensive background studying planet geology, especially on Mars. This study will enhance our knowledge of planet inner structures, geology and provide better understanding of planet formations and evolution.

Morten Olsen is the project manager. With experience as project manager for previous successful space instruments, he will manage the project schedules and budgets.

Omair Sarwar is the technical manager. With extended engineering experience in radar systems, he will ensure that the instrument meets the performance requirements, proper instrument verification and qualification in accordance with ESA space standards.

11.2. **Budget.** ACME Space Agency is the Lead Funding Agency (LFA) for this instrument proposal. A Letter of Endorsement (LEO) has been issued ensuring funding for the project during the instrument development phase, in-flight operations and post operations activities.

References

[1] *Announcement of Opportunity for the JUICE Payload*. ESA/SRE(2012)4. 2012.

[2] *JUpier ICy Moons Explorer(JUICE) Science Requirements Document*. JUI-EST-SGS-RS-001. 2012.

[3] *JUICE Exploring the emergence of habitable worlds around gas giants, Assessment Study Report*. ESA/SRE(2011)18. 2011.

[4] JUICE study team. *JUICE - JUpiter ICy Moons Explorer, Experiment Interface Document - Part A*. JUICE-EST-SYS-EID-001. 2012.

[5] A. Giovanni and S. Giuseppe. "Raw signal simulator for SHARAD". In: *Remote Sensing in Transition*. European Association of Remote Sensing Laboratories. 2004.

[6] G. Alberti et al. "Echoes Generation Systems: SHARAD Experience". In: *Spie's Europe International Symposium, Remote Sensing Europe*. 2005.

[7] Alenia Spazio. *SHARAD SHALLOW SOUNDER Technical Concept*. Retrieved online december 15th, 2012. 2005.

Appendix A. Some Appendix