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Authors	ZUSI, MICHELE, SIMIONI, EMANUELE, POLITI, ROMOLO, CAPRIA, MARIA TERESA, CAPACCIONI, FABRIZIO, Doressoundiram, Alain, PALUMBO, PASQUALE, Vincendon, Mathieu, CREMONESE, Gabriele
Affiliation of first author	IAPS Roma
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BC-SIM-TR-021

SIMBIO-SYS Instrument

CheckOut #02 Test Report

Michele Zusi¹, Emanuele Simioni², Romolo Politi¹,
Maria Teresa Capria¹, Fabrizio Capaccioni¹, Alain Doressoundiram³, Pasquale
Palumbo⁵, Mathieu Vincendon⁴,
Gabriele Cremonese²

¹INAF-IAPS, Via Fosso del Cavaliere 100, 00133, Rome, Italy

²INAF-OAPd, Vicolo Osservatorio 5, 35122, Padua, Italy

³LESIA (Observatoire de Paris - PSL, Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique), 92195 Meudon Cedex, France

⁴CNRS (Institut d'Astrophysique Spatiale), Université Paris Sud, 91405, Orsay, France

⁵Università Parthenope, Centro Direzionale Isola C4, 80133, Naples, Italy

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Edited by	
	Michele Zusi
	Emanuele Simioni
	Romolo Politi
Approved by	
	Gabriele Cremonese

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1. Introduction

1.1. Scope

This document will briefly report the results of the tests performed during the Instrument Checkout (ICO) # 02 for the Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem (SIMBIO-SYS) whose details are reported in [RD.1].

1.2. Reference document

- [RD.1] BC-SIM-PL-004_-SIMBIO-SYS_Checkout_02_Test_Summary_Issue1_Revision0,
[10.20371/INAF/TechRep/100](https://doi.org/10.20371/INAF/TechRep/100)
- [RD.2] BC-SIM-TN-003_-Reports_and_Note_Layout_and_Flow,
[10.20371/INAF/TechRep/36](https://doi.org/10.20371/INAF/TechRep/36)
- [RD.3] BC-SIM-TR-018_-HRIC ICO2 Report,
[10.20371/INAF/TechRep/100](https://doi.org/10.20371/INAF/TechRep/100)
- [RD.4] BC-SIM-TR-019_-STC_ICO#02_report,
[10.20371/INAF/TechRep/138](https://doi.org/10.20371/INAF/TechRep/138)
- [RD.5] BC-SIM-TR-020_-VIHI_ICO#02_report
- [RD.6] BC-SIM-TN-004_-SIMBIO-SYS_FOP_update_after_NECP,
[10.20371/INAF/TechRep/58](https://doi.org/10.20371/INAF/TechRep/58)
- [RD.7] BC-SIM-GAF-MA-002 10 001 – SIMBIO-SYS User Manual
- [RD.8] BC-SIM-TR-005_-SIMBIO-SYS_NECP_Test_Report_Issue1_Revision0,
[10.20371/INAF/TechRep/42](https://doi.org/10.20371/INAF/TechRep/42)
- [RD.9] BC-SIM-TR-015_-SIMBIO-SYS_ICO#01_Test_Report_Issue1_Revision0,
[10.20371/INAF/TechRep/98](https://doi.org/10.20371/INAF/TechRep/98)

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1.3. Acronyms

APID	Application Process IDentifier
ASW	Application SoftWare
CSV	Comma Separated Values
FPA	Focal Plane Assembly
FOP	Flight Operation Procedure
HK	Housekeeping
HRIC	High spatial Resolution Imaging Channel
ICO	Instrument Checkout
ME	Main Electronics
NECP	Near Earth Commissioning Phase
OBCP	On-Board Control Procedure
PDOR	Payload Direct Operation Request
PDS	Planetary Data System
PE	Proximity Electronics
PNG	Portable Network Graphics
PSC	Packet Sequence Control
SIMBIO-SYS	Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem
SSC	Source Sequence Count
SSMM	Solid State Mass Memory
STC	STereo imaging Channel
S/C	Space-Craft
TC	TeleCommand
TEC	Thermo-Electric Cooler
TM	Telemetry
VIHI	VIsible and Hyper-spectral Imaging channel
XML	eXtensible Markup Language

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1.4. Document format and repository

This document is compliant with the SIMBIO-SYS Report and Note Layout and Flow [RD.2] and will be archived both on the INAF Open Access repository and the SIMBIO-SYS team Archive.

1.5. Document organization

This document is organized in sections whose topics are listed as follows:

- Section 2 – ICO#02 objectives, with a brief description of the performance and inter-channel tests executed.
- Section 3 – ICO#02 implementation, with a brief description of the Flight Operation Procedures (FOPs) and Payload Direct Operation Requests (PDORs) used to perform the required tests and a discussion on the obtained results. More details are reported in each channel report ([RD.3], [RD.4] and [RD.5]).

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2. ICO#02 Objective

The scope of the SIMBIO-SYS ICO#02 was to verify the health status of the instrument at channel level 1 year after launch. To do this, two kinds of tests were defined (see [RD.1] for details):

1. **Functional Tests**, to verify the functionality of all the SIMBIO-SYS units (i.e., ME, HRIC, STC, and VIHI) and their components (e.g., TECs, Detectors, etc.).
2. **Performance Tests**, to monitor the evolution of the performance of all the SIMBIO-SYS channels (i.e., HRIC, STC, and VIHI) with respect to the results obtained during the on-ground calibration campaign and the tests performed during the Cruise.

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3. Test Implementation

The SIMBIO-SYS ICO#02 tests have been executed November 27th, 2019. In this document, after a brief introduction on the foreseen tests, their results are summarized evidencing eventual issues, more deeply discussed in referenced Technical Notes ([RD.3], [RD.4] and [RD.5]).

All tests described in the following sections have been executed by means of proper FOPs, On-Board Control Procedures (OBCPs), and PDORs whose description can be found in [RD.1]. All the tests used the last version of SIBIOSYS FOPs (detailed in [RD.6]).

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3.1. SIMBIO-SYS Functional Tests

3.1.1. HRIC Functional Test

3.1.1.1. Scope

The aim of this test is to check the channel functionality and its capability to perform some science acquisitions.

3.1.1.2. Results and discussion

As indicted in the test definition reported in [RD.1], the HRIC TEC has been switch-on using the nominal activation parameters reported (see [RD.7]) while the S/C was guaranteeing a hotter thermal environment (i.e., higher Cold Finger temperature – see sections 2.2 of [RD.3] and [RD.4]) by means of higher thresholds for the heaters. With this new thermal configuration, the **TEC current profile was nominal, and all the test has been executed as expected**. As a final remark, a not expected fluctuation of the detector reset level (around the 0.1% of the dynamical range) has been observed. More details on the test results can be found in [RD.3]. Same fluctuation was revealed on the STC data analysis (see [RD.4]).

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3.1.2. STC Functional Test

3.1.2.1. Scope

The aim of this test is to check the functionality of the channel units and the capability to perform some science acquisitions.

3.1.2.2. Results and discussion

As per the HRIC Functional Test, the **STC TEC activation was nominal**. Apart for a SpW error of out-of-limit on "STC last event TC Timer Ovrfl." which has been correctly (as expected) managed by the Main Electronics (ME) Application SoftWare (ASW), **the test has been executed as expected**. More details on the test results can be found in [RD.4].

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3.2. SIMBIO-SYS Performance Tests

3.2.1. HRIC Performance Test

3.2.1.1. Scope

The aim of this test is to perform several science acquisitions to evaluate the channel Dark Current (DC) performance after 1 year from launch.

3.2.1.2. Results and discussion

The test was executed **with no errors**. The obtained data, once reduced by the scientific team, demonstrate the channel performances are in line with what expected because aligned with the one obtained during the on-ground calibration campaign and after the tests executed during NECP. More details on the test results can be found in [RD.3].

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3.2.2. STC Performance Test

3.2.2.1. Scope

The aim of this test is to perform several science acquisitions to evaluate the channel DC performance after 1 year from launch.

3.2.2.2. Results and discussion

As per the HRIC channel the test was executed **with no errors** and the obtained data demonstrate the channel performances are in line with what expected. More details on the test results can be found in [RD.4].

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3.2.3. STC All-FPA Test

3.2.3.1. Scope

The aim of this test is to perform several science acquisitions to evaluate the channel DC performance after 6 months from launch.

3.2.3.2. Results and discussion

As per the HRIC channel the test was executed **with no errors** and the obtained data demonstrate the channel performances are in line with what expected. More details on the test results can be found in [RD.4].

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3.2.4. VIHI Internal Calibration

3.2.4.1. Scope

The scope of this test was to perform a VIHI internal calibration using the LED with its nominal current; in addition, with reference to the issue 4 raised in NECP and summarized in Section 4.2 of [RD.8], the nominal shutter operability has been verified.

This specific test also covers the functional verification of the channel.

3.2.4.2. Results and discussion

The Thermo-Electric Cooler (TEC) activation, **differently from what expected**, follows a hard start due to a wrong thermal configuration determining a peak of about 1 A in the current. This problem seems to be similar to the one found (and then solved) for the cameras and not seen before just for an insufficient sampling rate of the HK. Further analyses are required to identify if a solution like the one identified for the cameras could be applied also for the VIHI channel.

Apart from this issue, the test continued with **no other issues**.

As per both cameras, the obtained VIHI data demonstrate the channel performances are in line with what expected. More details on the test results can be found [RD.5].

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4. Conclusions

4.1. Summary

During the SIMBIO-SYS ICO#02, some tests have been executed to evaluate the instrument's health status and the evolution of its performance after 1 year journey. With these tests, all the units (i.e., ME, HRIC, STC, and VIHI) have operated nominally, allowing us to check their operativity and performance. The obtained results demonstrate that all SIMBIO-SYS units and subsystems work nominally.

Finally, during the ICO#02, it has been possible to validate some improvements in Ground Segment Equipment (GSE) and the data analysis tools developed by the team.

4.2. Open issues

During the execution of the ICO#02 tests, the following issues raised:

#	Name	Description	Occurrence	Connected ARs
1	LFB	Not expected fluctuation of the detector reset level	HRIC Functional Test	-
2	SpW-error	SIMB HK discarded to SPW error and YSS40408 SIMB PE HK Frame Restart	STC Functional Test	-
3	TEC-current	Peak in the TEC current during activation	VIHI Performance Test	-

The status of the issues at the end of ICO#02 phase is reported in following table:

#	Name	Status at the end of the NECP
1	TEC-INIT	Closed: both HRIC and STC have to use the nominal TEC activation parameters while the S/C has to use new (higher) threshold for the heaters that controls the CF temperature.
2	ME-GRANULARITY	Open: it has been found that the ME granularity managing TC execution could be modified by the Repetition Time (RT)

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		parameter of a Science TC determining that some TC can be accepted but not executed (see section 4.2 of [RD.9]).
3	LFB	Open: Both HRIC and STC channels reports a not expected fluctuation of the detector reset level (around the 0.1% of the dynamical range).
4	SpW-error	Closed: it has been verified the issue was unexpected but correctly managed by the ME ASW.
5	VIHI TEC-current	Open: a study is required to find out new parameters to be used in Cruise conditions.