



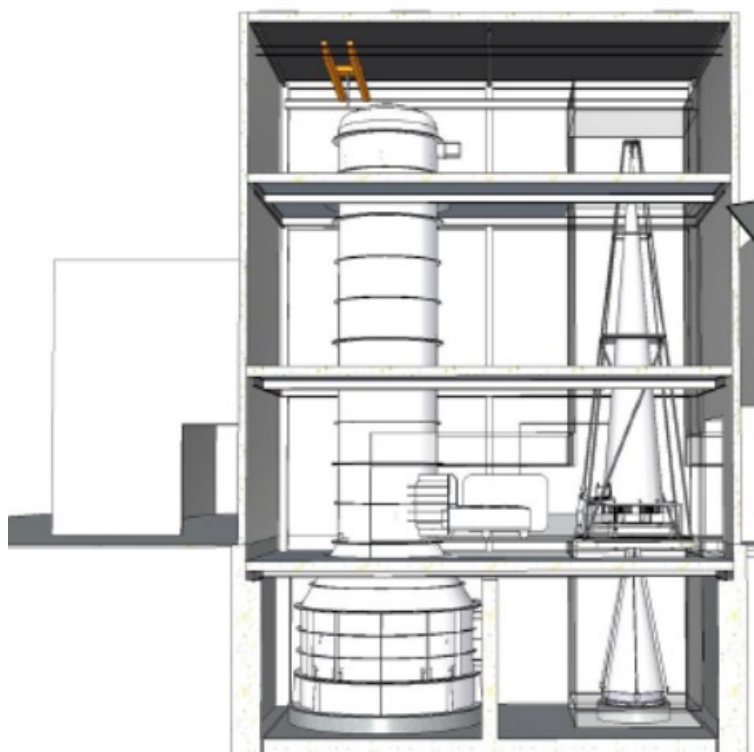
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| <b>Authors</b>          | MORETTI, Alberto, Tordi, M., Marioni, F., USLENGHI, MICHELA, Amisano, Franco, SIRONI, GIORGIA   |
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# VERT-X Design of Vertical X-Ray Test Facility for ATHENA

## TN18 COST ESTIMATE FOR THE XRS FACILITY DEVELOPMENT

Doc: VTX-OAB-IPM-REP-001

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## VERT-X Design of Vertical X-Ray Test Facility for ATHENA



### CHANGE RECORDS

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### AUTHORS AND RESPONSIBLES

|              |                           |            |  |
|--------------|---------------------------|------------|--|
| Document:    | VTX-OAB-IPM-REP-001       |            |  |
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| Date:        | 02/10/2020                |            |  |
| Prepared by: | A. Moretti (INAF- OAB)    | Signed by: |  |
|              | M. Tordi (EIE)            |            |  |
|              | F. Marioni (MLS)          |            |  |
|              | M. Uslenghi (INAF – IASF) |            |  |
|              | F. Amisano (GPAP)         |            |  |
|              | G. Sironi (INAF)          |            |  |
|              |                           |            |  |
| Checked by:  | A. Moretti (INAF - OAB)   | Signed by: |  |
| Approved by: | S. Basso (INAF - OAB)     | Signed by: |  |
| Released by: | A. Moretti (INAF - OAB)   | Signed by: |  |

### CONTRIBUTING ENTITIES

|                      |                  |
|----------------------|------------------|
| INAF – OAB           | Partner          |
| INAF - IASF          | Partner          |
| Media Lario          | Partner          |
| EIE                  | Partner          |
| GP Advanced Projects | Partner          |
| BCV                  | External Service |

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# VERT-X Design of Vertical X-Ray Test Facility for ATHENA



## 1. INTRODUCTION

### 1.1. SCOPE

The scope of the present document is the illustration of VERT-X facility development cost estimate, following the outcomes of the Detailed Design Review (DDR) and the study activities up to the Final Review (FR).

### 1.2. APPLICABILITY

The present document is one of the deliverables related to the FR milestone.

It is intended to present the cost estimate for the development of VERT-X facility, providing a reference for the future studies and activities about it.

### 1.3. ROADMAP

| Document section                                      | Content description                                              |
|-------------------------------------------------------|------------------------------------------------------------------|
| Section 2 (Applicable and reference documents)        | List of applicable documents and reference documents.            |
| Section 3 (VERT-X facility development cost estimate) | Details of cost estimate for the development of VERT-X facility. |

Table 1-1: Roadmap of the document

## VERT-X Design of Vertical X-Ray Test Facility for ATHENA



## 2. APPLICABLE AND REFERENCE DOCUMENTS

### 2.1. APPLICABLE DOCUMENTS

|     |                          |                                                                                     |
|-----|--------------------------|-------------------------------------------------------------------------------------|
| AD1 | AO/1-9549/18/NL/AR - SOW | X-ray Raster Scan Facility for the ATHENA Mirror Assembly SOW                       |
| AD2 | VERT-INAFOAB-001         | VERTICAL X-Ray (VERT-X) Technical Proposal                                          |
| AD3 | ESA-TECMMO-RS-014713     | Updated Requirements for the ATHENA VERT-X following the System Requirements Review |

### 2.2. REFERENCE DOCUMENTS

|     |                     |                             |
|-----|---------------------|-----------------------------|
| RD1 | VTX-OAB-ISE-REP-003 | D5 Detailed Design Document |
| RD2 |                     |                             |

## VERT-X Design of Vertical X-Ray Test Facility for ATHENA



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### 2.3. GENERAL SPECIFICATIONS AND STANDARD DOCUMENTS

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|     |            |                                      |
|-----|------------|--------------------------------------|
| SD1 | ECSS-M-40A | Configuration management             |
| SD2 | ECSS-M-50A | Information/documentation management |

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### 2.4. LIST OF ACRONYMS

|        |                                                  |
|--------|--------------------------------------------------|
| AD     | Applicable Document                              |
| AIT    | Assembly, Integration and Testing                |
| DDR    | Detailed Design Review                           |
| DRW    | Drawing                                          |
| EIE    | European Industrial Engineering                  |
| ESA    | European Space Agency                            |
| FR     | Final Review                                     |
| GPAP   | GP Advanced Projects                             |
| I/F    | Interface                                        |
| IASF   | Istituto di AstroFisica Spaziale (INAF, Milano)  |
| INAF   | Istituto Nazionale di AstroFisica                |
| ITT    | Invitation To Tender                             |
| MA     | Mirror Assembly                                  |
| MLS    | Media Lario S.r.l.                               |
| MM     | Mirror Module                                    |
| OAB    | Osservatorio Astronomico di Brera (INAF, Milano) |
| PDR    | Preliminary Design Review                        |
| RD     | Reference Document                               |
| ROM    | Rough Order of Magnitude                         |
| RS     | Raster Scan                                      |
| SD     | Standard Document                                |
| SOW    | Statement of Work                                |
| SRR    | System Requirements Review                       |
| TBA    | To Be Assessed                                   |
| TBC    | To Be Controlled                                 |
| TBD    | To Be Defined                                    |
| TEC    | Technical Note                                   |
| TVC    | Thermal Vacuum Chamber                           |
| VERT-X | VERTICAL X-Ray                                   |
| VTX    | VERT-X                                           |
| XRS    | X-ray Raster Scanner                             |
| XSA    | X-ray Source Assembly                            |
| XYZS   | (x, y, z) stage                                  |

## VERT-X Design of Vertical X-Ray Test Facility for ATHENA

### 3. VERT-X FACILITY DEVELOPMENT COST ESTIMATE

| DESCRIPTION                |                            | COST             |                  |                   | Status         |
|----------------------------|----------------------------|------------------|------------------|-------------------|----------------|
|                            |                            | Phase 1          | Phase 2          | TOTAL             |                |
| <b>Raster Scan</b>         |                            | <b>1.500.000</b> | <b>500.000</b>   | <b>2.000.000</b>  | <b>ongoing</b> |
|                            | control system             |                  |                  |                   |                |
|                            | X-scan                     |                  | 500.000          |                   |                |
|                            | Y-scan                     |                  |                  |                   |                |
|                            | base                       |                  |                  |                   |                |
|                            | alt-alt mount (Tube)       |                  |                  |                   |                |
|                            | Tip-tilt metrology         |                  |                  |                   |                |
| <b>Source + collimator</b> |                            | <b>1.000.000</b> | <b>180.000</b>   | <b>1.180.000</b>  | <b>ongoing</b> |
|                            | X-ray source (loan)        | 230.000          | 150.000          | 380.000           |                |
|                            | X-ray collimator           | 620.000          |                  | 620.000           |                |
|                            | Filter wheel / Mask        |                  | 30.000           | 30.000            | ongoing        |
|                            | Interfaces and Integration | 50.000           |                  | 150.000           |                |
| <b>Detection system</b>    |                            | <b>0</b>         | <b>800.000</b>   | <b>800.000</b>    | <b>ongoing</b> |
|                            | Positioner                 |                  | 150.000          |                   |                |
|                            | Detector (with GSE)        |                  | 650.000          |                   | ongoing        |
| <b>GSE</b>                 |                            |                  | <b>450.000</b>   | <b>450.000</b>    |                |
|                            | Trolley                    |                  | 300.000          |                   | ongoing        |
|                            | Building                   |                  |                  |                   | ongoing        |
|                            | Control system             |                  | 150.000          |                   |                |
| <b>Laser Trackers</b>      |                            |                  | <b>570.000</b>   | <b>570.000</b>    | <b>ongoing</b> |
| <b>TVC</b>                 |                            | <b>0</b>         | <b>6.680.000</b> | <b>6.680.000</b>  |                |
|                            | Control system             |                  | 70.000           |                   |                |
|                            | Vacuum vessel              |                  | 4.200.000        |                   | ongoing        |
|                            | Vacuum pumping sys.        |                  | 410.000          |                   |                |
|                            | MAM Shroud                 |                  | 300.000          |                   | ongoing        |
|                            | Thermal Control Sys.       |                  | 1.700.000        | TBC               | ongoing        |
| <b>Other Costs</b>         |                            | 100000           |                  |                   |                |
| <b>TOTAL</b>               |                            | <b>2.500.000</b> | <b>9.180.000</b> | <b>11.680.000</b> |                |
| Contingency                |                            |                  |                  | 10%               |                |
| <b>TOTAL</b>               |                            | <b>2.500.000</b> |                  | <b>12.848.000</b> |                |

## VERT-X Design of Vertical X-Ray Test Facility for ATHENA



The items interfaces and integration together with other costs include all the INAF, BCV and GPAP activities in the first phase. Phase 2 X-ray source costs consist in both the final purchase and further customization of the window. The detector cost refers to the current baseline for which we had an offer meeting all the project requirements. Due to the quick development of the CMOS detector we expect that the detector cost will be much lower.

We underline that some additional costs shall be intended as tbc, namely the Thermal Control System of the vacuum chamber. Here we include into this definition not only the thermal shroud and its control unit, used to generate temperature gradients on the MAM: we refer here to the whole shroud which might be necessary to keep the inner volume of the vessel within the required value.

Its quantification requires the definition of the HVAC system of the building: if the HVAC system of the building is capable to keep the control the temperature within  $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ , then the TVC would not require a thermal shroud for the stabilization.

On the other side, if the HVAC is not able to satisfy such requirement, then it is necessary to equip the vacuum vessel with a thermal shroud.

The cost for the X-scan in Phase 2 includes also every additional cost due to packing & unpacking, integration on site, final commissioning in vacuum of the entire machine.

The cost breakdown for the linear metrology was updated taking into account for the integration of the laser trackers, including their respective vacuum cases.

The cost for the trolley refers to the integrated solution which is capable to move the integrated MAM - Gravity Release – MAIS back and forth between SPO-AIT and VERT-X.

An additional column is provided to highlight those elements whose development will require a certain advancement / check during Phase1.

## VERT-X Design of Vertical X-Ray Test Facility for ATHENA



-- END OF DOCUMENT --