Comet-I Full Team meeting - Status of activities at ESA

SCI-FC

ESA ESTEC

07/07/2022

Presentation layout

- Study activities and project status:
  - Recent events.
  - System level.
  - Areas calling for attention
  - Payload.
  - Specific topics.
- Next steps.
- Conclusions.

Recall of planning & key milestones

- **Planning is critical for Comet-I (F-Mission).**
- **We have met the planning of the definition phase, reaching mission adoption in June 2022!**
- Fast track development project: phase A/B in less than 2 year, phase C/D/E1 in 5 years (to remain in budget).
- **Launch ready by mid 2028 latest (independently from ARIEL, storing the S/C if it was necessary**).

System milestone	Date	
Industrial KO	Oct 2020	**Definition Phase**
S-PRR	Mar 2021	
S-SRR	Sep 2021	
S-PDR	Q2 2022	
Mission Adoption	**June 2022**	
Prime selection	Q3/Q4 2022	**Implementation Phase**
Start of phase C/D	Jan 2023	
S-CDR	Q4 2024	
S-QAR	Dec 2027	
Launch ready(*)	Mid-2028	

5 yr

(*) including 6 month margin.

Instruments milestone	Date
Phase A KO	Jan-Feb 2020
I-PRR	Sep-Nov 2020
I-SRR	May-July 2021
I-PDR	April 2022
Mission Adoption	**June 2022**
I-CDR	July 2023
STM delivery to prime	Q1 2024
EM delivery to prime	Q2 2024
B2 instrument QR	Q3-Q4 2025
B2 PFMs delivery to prime	Q4 2025
A instruments QR	Q1-Q2 2026
A PFMs delivery to prime	Q1-Q2 2026

~ 3.5 yr

~ 4 yr

Recall of planning & key milestones

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Key role played by the instrument teams:

- To date we have respected the work plan (PDR's / adoption).
- Respecting the instruments development schedule is critical to project success (PFMs in less than 4 yr from now). **Possible thanks to pre-developments and heritage.**
- Delays in the delivery of instruments models will inevitably disrupt higher level activities and lead to delta costs (**not affordable for an F-mission**).
- Very important **to start phase C/D work as soon as possible**, with the support of the funding agencies.
- Critical to take into account the parts shortage and procurement time of all long lead items.

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~ 3.5 yr

~ 4 yr

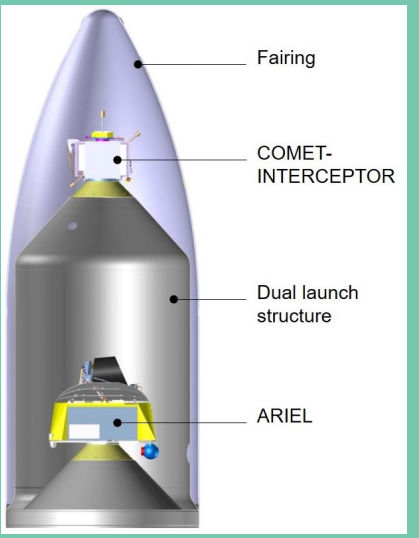
Project status – Key events since last meeting

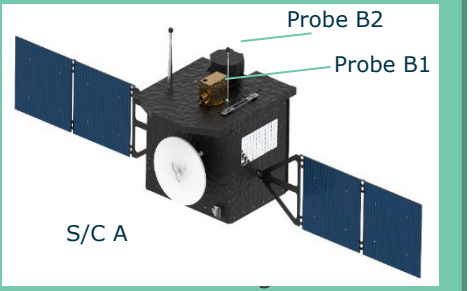
- **Project requirements baseline** (e.g. MRD, SRDs, EID-A, including final payload to platform interface requirements), consolidated and released to industry as applicable to satellite PDR and final proposals for Phase C/D/E1 – 28 Feb 2022.
- **Satellite System Requirements Review (S-SRR) formally closed** on last 7 March 2022.
- **Phase B2 completed**. Final meetings held with each industrial contractor in the first half of April.
- The competing prime contractors refined their design solutions for both SC A and probe B2 for S-PDR.
- **Change Request issued by ESA on 1 April 2022**, calling for PDR data pack and final proposals.
- Final proposals for phase C/D/E1 received on 20 May 2022.
- **Instruments PDR started on 17 March and completed on 20 June 2022!**
- **Satellite PDR started on 21 April and completed on 23 June 2022!**

- **Comet-I adopted by SPC on 8 June 2022! Implementation is a joint responsibility!**

System level activities – Recent progress (1)

- Technical preparatory activities (focused on platform equipment) finalised.
- Configurations of SC A and of PB2 stable (pending some optimisation).
- PL accommodation finalised (only a few issues to be resolved).
- P/L interface requirements (including EMC requirements) frozen and part of the SRD (thus formally applicable to the prime contractors).
- New cycle of thermal and mechanical analysis at SC level performed.
- Guidance Navigation Control and AOCS analysis and design reached a level commensurate to PDR (including equipment selection).
- Preliminary design of the Chemical Propulsion and Sub-system.
- COMS architecture finalised (including LGA configuration to enable a low data rate link during the Close Approach phase).
- Design of the dust shield consolidated, including mechanical analysis.
- Dust protective measures for the solar arrays defined.
- Updating of resource budgets (control of SC dry mass remains a concern).
- Both consortia completed the selection of the equipment suppliers.

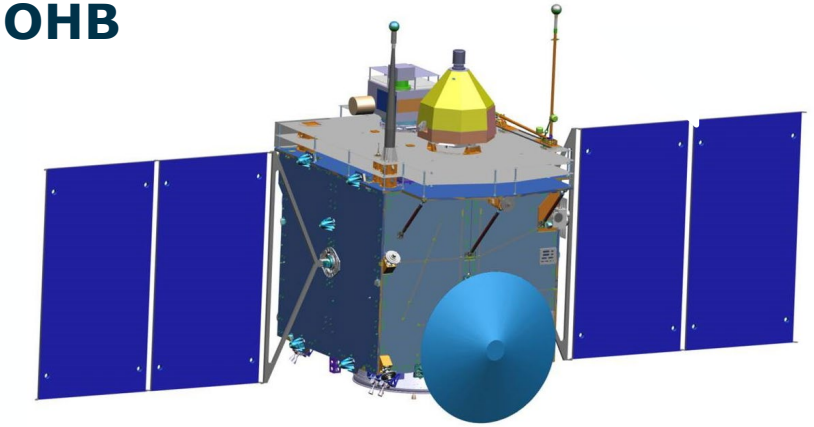




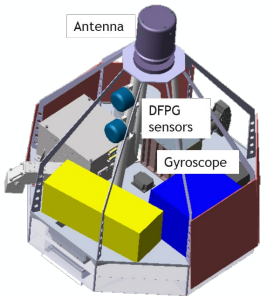
Phase B configuration.

System level activities – Recent progress (2)

OHB

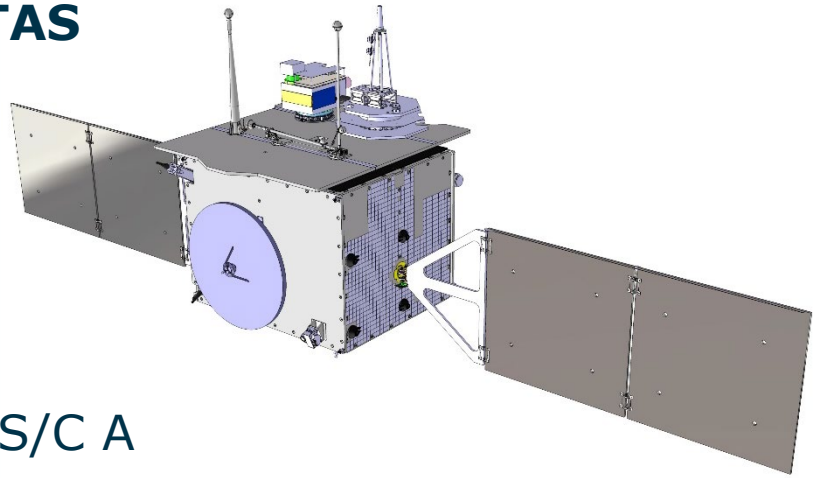


S/C A

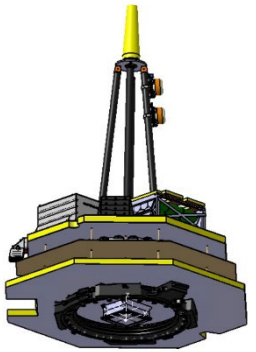


Probe B2 (SENER)

TAS



S/C A



Probe B2 (Deimos)

Main design features:

- Dimensions: ~ 2.2 x 2.0 x 2.7 m3
- COMS:
  - X-band, fixed HGA + LGAs.
  - Inter Satellite Link in S-band
- Chemical Propulsion.
- S/C A platform based on design heritage with recurring equipment (avionics).
- Probe B2 new design (equipment subject to preparatory activities).
- Design maturity commensurate to PDR.
- Design solution compliant with key mission objectives.

System level activities - Areas calling for attention

S/C A and mission level:

- **Mass budget**: further erosion of margins confirmed at PDR, but min required delta-V secured.
- **Navigation**: demanding performance to meet the delivery errors. To date analysis confirmed feasibility.
- **Mission survivability**: dust shield design consolidated, local measure adopted by exposed P/L sensors.

Probe B2:

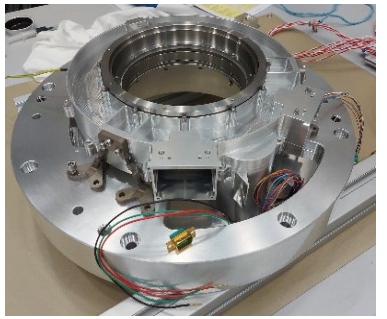
- **Operations after separation:** analysis confirmed a lifetime ~ 30 hrs (see P/L reference operations plan).
- **Platform equipment:** PDR confirmed that specific units requiring delta-qualification (e.g. existing Inter Satellite Link equipment requires changes to meet the mission requirements). Actions taken to mitigate the risk to phase C/D.
- **Attitude reconstruction:** solution based on 3-axis gyro + 2 sun sensors is part of the design baseline.

Probe B1:

- **Interface requirements** further consolidated. Joint ESA-JAXA review held in first half of April 2022. Important to remain within allocated resource budgets.
- **JAXA presently running their SRR**. Selection of industrial partner planned in Q4 / 2022.

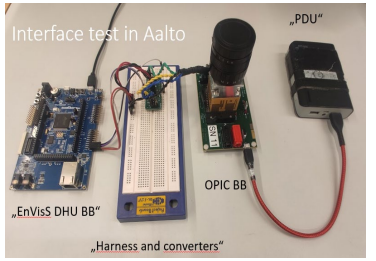
Instruments status – Recent progress

- **Instrument consortia are stable and confirmed (approved MLA)**.
- Regular contacts with instrument teams show steady progress and improved design maturity.
- **Interfaces between scientific instruments and platforms** (S/C A and probe B2) consolidated:
  - Interface requirements translated to the SRD and formally applicable to the S/C prime.
  - A few open issues (detailed accommodation solution) and modest adaptation required following prime selection (to account for specific design solutions).
- **Pre-development activities are nearing completion:**
  - Breadboarding work supported the I-PDR and **de-risked the implementation phase.**
  - Completion of all pre-developments expected by end 2022.
  - Maintain full consistency with heritage an results. **No design changes!**
- The **Preliminary Design Review** (I-PDR) was satisfactorily completed, however the board highlighted the existing **schedule risk and need to secure the planning**.
- **Now emphasis is on**: timely funding, <u>start of implementation phase</u>, ensuring work continuity.



RMA EBB

Compliment boom



OPIC-EnVisS IF test

Timely Start of Phase C/D activities

- Mission adoption → **Joint responsibility to deliver, implementing the project within the given boundaries!**
- Critical for the instrument teams **to continue progressing in Q3 and Q4 2022**, securing funding for a smooth transition from definition to implementation phase → key element in consolidating the schedule.
- **In case instruments activities include industrial procurements**, preparation for their implementation should already have started (e.g. contractor selection process, internal approvals, securing budgets).
- ESA has highlighted the need for **a swift transition to phase C/D** at the recent NPMC meeting, inviting all national agencies to support the instrument teams and the project.
- Preparation of procurements under ESA responsibility (e.g. PRODEX) has started.
- Important for the **instrument teams to maintain work continuity and start phase C/D**:
    - Securing internal funding while waiting for external resource approvals.
    - Finalising & submitting any remaining funding proposals.
    - Consolidating the team manpower.
    - Order Long Lead Items.
    - Start industrial procurements.

Procurement of EEE parts and LLI

- Following the pandemic, **EEE parts shortages and procurement delays have occurred**.
- ESA has investigated the issue with support from ALTER. Status updates are provided by email:
  - **CPSA** (Coordinated Parts Selection Agent) services are available to the instrument teams to address EEE issues.
  - See web-based tool available at https://www.doeeet.com/.
  - Update on procurement times: delays depend on part types and suppliers, thus calling for specific attention.

- **REMINDER - Recommendations** were already passed on and are here recalled:

  - Define list of design and list of electronics parts as early as possible.
  - Pay attention also to breadboard/EM/EQM and part for test equipment.
  - Contact suppliers and explore situation & alternatives before placing the order.
  - Place orders as soon as possible (in particular for long lead items).
  - Procure through space component procurement agencies, franchised distributors or directly from manufacturer. There are many warnings about counterfeit!
  - Stay informed and follow up on orders placed, keeping ESA in the loop.

Next steps

- At system level industrial activities (Bridging Phase) will continue for the remaining part of 2022.
- Negotiations in Q4 2022 → TARGET: **start of phase C/D in January 2023**.
- Formal appointment of the Science Working Team (ongoing, followed by WG's).
- Next events for the science Payload:
  - 4-5th October 2022 instruments progress meeting (PM#9).
  - Interface meeting with selected prime contractor (2nd half of Oct, early Nov 22).
  - January 2023: instruments progress meeting (PM#10).
  - Preview on I-CDR planning: Apr to Sep 2023 (dates TBC).
- Concerning EMs and PFMs:
  - EMs and STMs to be available by beginning of February 2024 (~ 20 months from now):
    - STM approach will be confirmed following prime selection.
    - EMs playing a key role for performing EFM tests at satellite level.
  - PFMs: Nov 2025 for probe B2, Feb 2026 for SC A units
    - No calibration activities possible at S/C level.

Conclusions

- **The ESA team thanks the Instrument and Science Teams for the support to phase A/B.**
- **PDR level and Mission adoption achieved in approx 3 yr from proposal selection!**
- Selection of the prime contractor in progress → **next priority for the project.**
- Nomination of SWT and WG's planned in Q4/22. **The ESA team needs support!**

- **Comet Interceptor is an ambitious project:**
  - aggressive phase A/B, many parties involved,
  - a 'one shot' mission (with a yet to be identified target),
  - High schedule risk and tight programmatic boundaries.
- **Joint responsibility to meet the F-mission expectations!**

- **Critical to start phase C/D as soon as possible both at payload and system level!**

Thank you

F-mission boundaries - Reminder

WARNING: let us remain realistic …… CI is no Inspector Gadget!

Comet-I is a **'scouting mission'**, thus necessarily generalist, capable of returning key target parameters, not to produce ultra-accurate measurements in all domains → optimised PL complement.

Nobody should expect CI to combine the capability of L-class missions within the F-mission budget…. → **compromises required**.

Comet-I to deliver important science, but commensurate with the budget.

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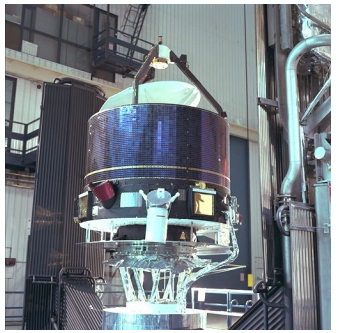

Giotto

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Rosetta

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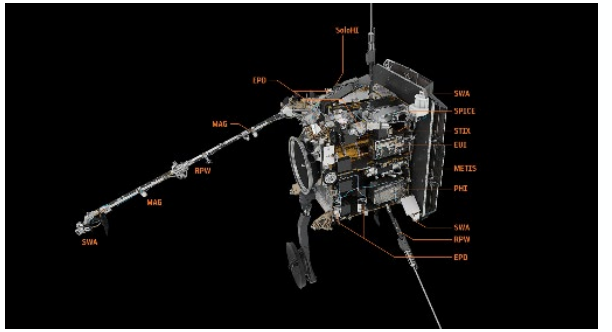

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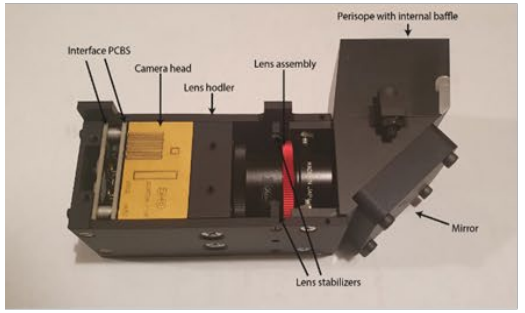
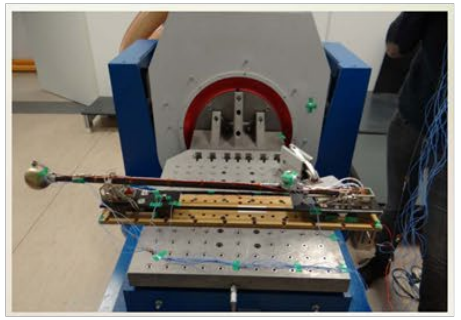
Instruments status – Pre-developments activities

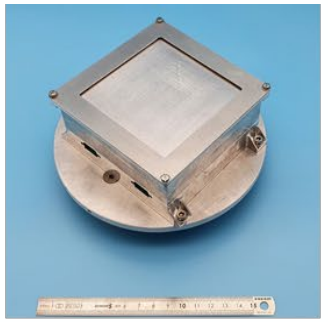
Key role of pre-developments is achieving the I-PDR objectives!



OPIC prototype

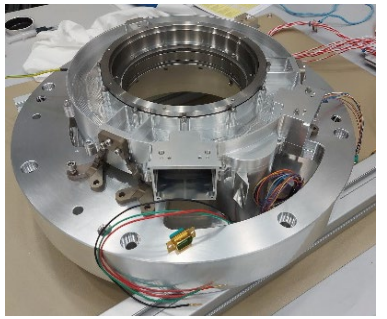


FGM-A boom with merged sensor test



DISC prototype

LEES sensor head prototype



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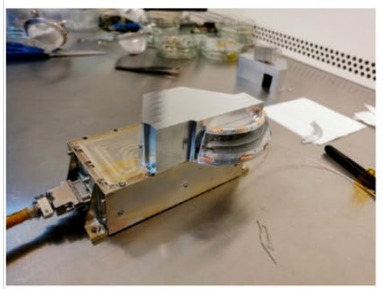
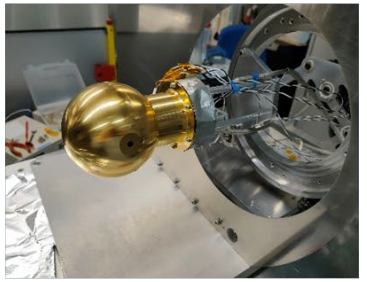
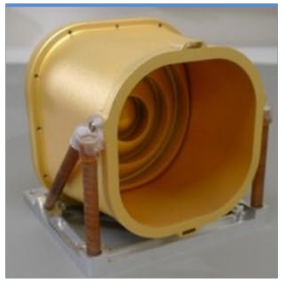


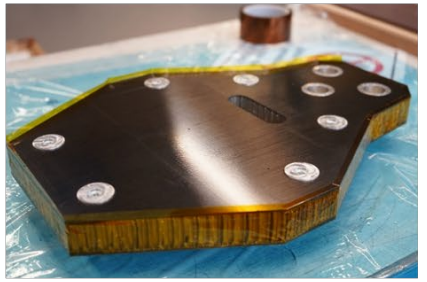
SCIENA energetic neutrals atom sensor



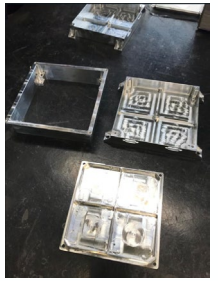
MANiaC NDG antechamber



MIRMIS calibration unit

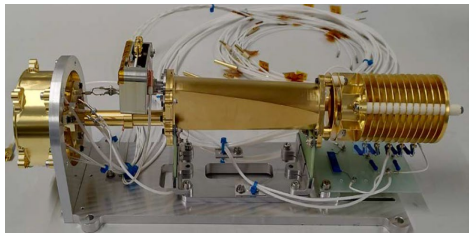


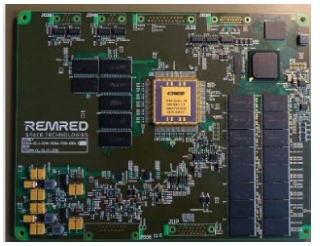
Baseplate of CoCa



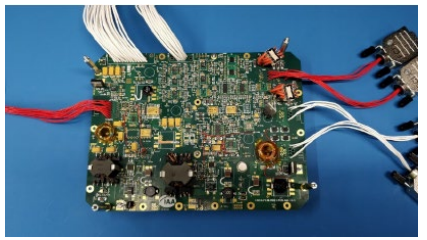
DISC housing

Compliment boom

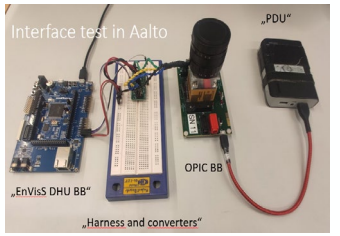




CoCa DPM



CoCa PSU



OPIC-EnVisS IF test