ATHENA - Study Status & Schedule

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ATHENA – Schedule to MFR: Key short-term dates

- 02/08/2018 SPO-AIT method recommendation to Exec.
- 30/08/2018 SPO-HO PR#2
- 12/09/2018 Decision on SPO-AIT method
- 18/09/2018 WFI P-PRR KO
- 01/10/2018 ICC response
- 10/10/2018 (TBC) SR#2 (decision point for proceeding with SC Prime A2)
- 12/10/2018 Primes deliver Phase Ax datapack
- 15/10/2018 SIM updated design documented
- 31/10/2018 WFI P-PRR Board Meeting (PRR concludes)
- 01/11/2018 (TBC) KO SC Phase A2
- 15/01/2019 SPO-HO PR#3
- 01/02/2019 (TBC) X-IFU P-PRR KO
- …
- 31/07/2019 Finish SC Phase A2
- 01/09/2019 Start MFR
- 01/11/2019 MFR concludes

ATHENA – Mission Status

Mission Architecture is stable at L2

- A-64 performance update anticipates additional mass (HEO performance section of the new A-6 User Manual Issue 1.0, which gives **8.2 – 8.4 tonnes** for a 0.9e6 km x 250 km @ 6° orbit, close to L2 injection conditions considered by ATHENA)
- With our modestly higher apogee (1.3e6 km), we anticipated ~**8.1 tonnes** could be available (considering orbital energy equation and conservative assumptions on mass fraction of upper stage)
- We have just been advised, w/o yet receiving justification, to adopt **7.2 tonnes**
    - For me this is excessive margin taking on the launcher side
- At the moment, if the PLs stay within the resource envelopes defined currently, we can comfortably fly the CORE mission
    - Was supposing with ~8.1 tonnes that a slightly bigger mirror would be possible
- L1<>L2 decision point is at MFR – still need to check the optical load on the FP due to oblique Earth-light which is the only identified showstopper to adopting L2 if recommended
- nb: Since multiple cost-estimates have all demonstrated a ~20% over-cost w.r.t. the CaC-limit, we currently are not addressing cost in a systematic way

ATHENA – SC Design Status [i]

redacted

ATHENA – SC Design Status [ii]

- ΔΔMCR status

- PhAx status

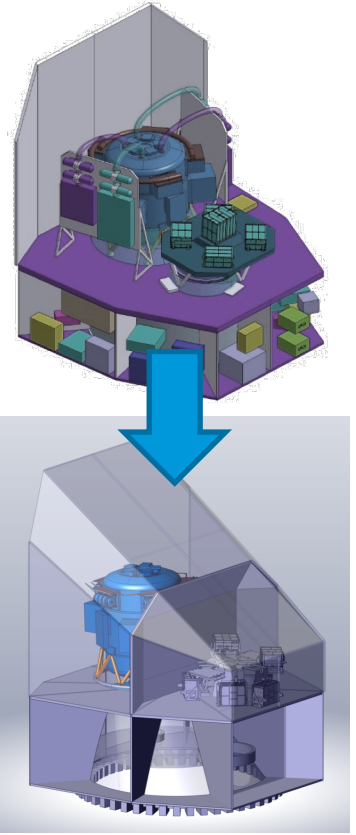
redacted

With a system margin of 24% and due to the mass increase of mainly the FMS and the SIM, the launch mass is not compliant to the 7000 kg (system margin of 21.7%)

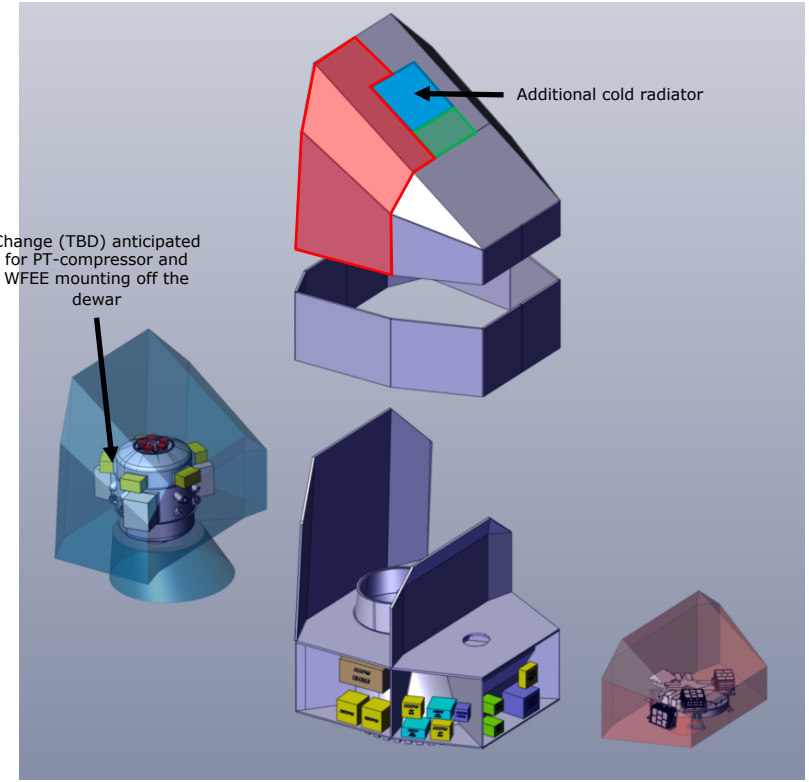
SIM – Design Status [i]

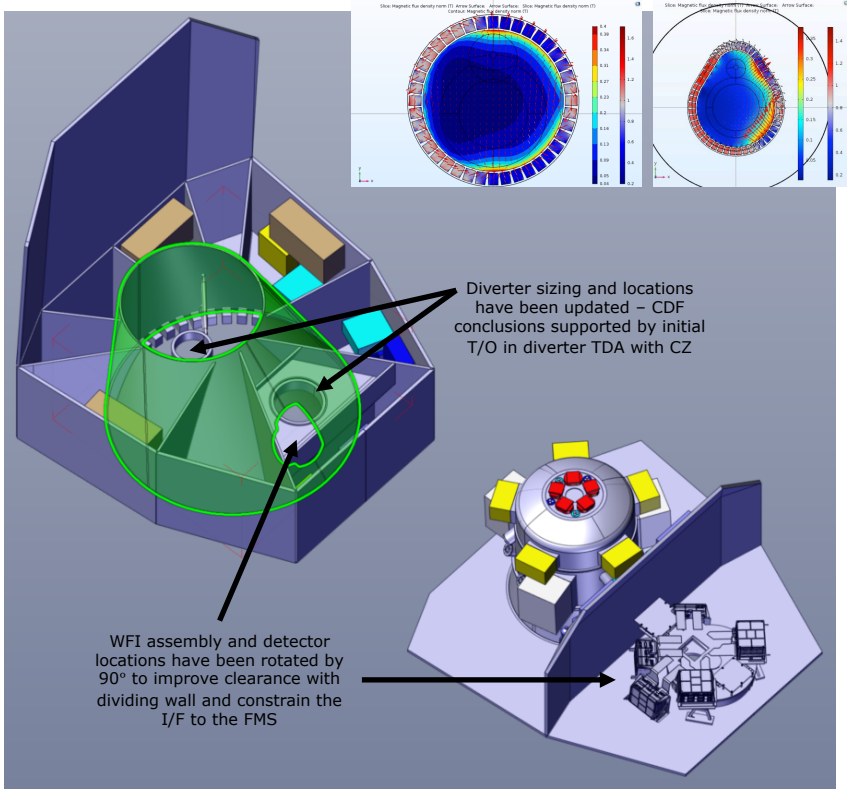
SIM Update performed March → September to support X-IFU reconf.

- Updated SIM design is ~finished, ready for return to SC Primes at start of their Phase A2
- We have implemented a modest lateral-stretch of the SIM – this simultaneously:
    - Accommodates X-IFU IPCS (dewar Ø increase)
    - Allows insertion of separating wall to increase modularity
    - Increases available area for cold radiator (LHP transport) needed for the IPCS
- Mass optimisation: Changed structural concept to 'swept cone' direct I/F to X-IFU I/F ring, and re-worked the magnetic diverter positions/mounting (conclusions supported by initial T/O from magnetic diverter TDA)
- FEM analysis currently underway to determine the allowed X-IFU mass allocation, which keeps the SIM within the mass currently provided to the SC Primes (**1899 kg** Nominal Mass)
- Current X-IFU allocation number is ~**770 kg** Nominal Mass (TBC) exc. PL system margin
    - cf. **709 kg** provided in June for the original cold outer-vessel baseline
- i.e. X-IFU have ~**61 kg** Nominal Mass to spend to make the transition from the original cold outer-vessel baseline to the new IPCS baseline
    - We suppose it is not quite enough (have not received IPCS mass budget yet)



SIM – Design Status [ii]





ATHENA – ESA TDAs

T216-022MM [Large Area X-Ray Window]
T217-061MM [Large Area Optical Filter]

C220-010MT [WFI CH Ethane LHP dev.]
C220-041FM [FPM Development Model]
C204-119FM [Magnetic Diverter]
C221-012FT [Low T rad. Panel with embedded HPs]
C220-001FT [Passive Vibration Control]

C216-136MM [SPO MM Ruggedisation – Phase 3]
C216-008MM [Inner SPO Module]
C216-134MM [Outer SPO Module]
C216-140MM [True Wolter CCN3]
C216-149MM [SPO EQM]
C216-135MM [Prep. Of coated X-ray MP Prod.]
C216-144FT [Coating process optimisation]
C216-128MM [SPO Manufacturing Facility Design]
S216-116FA [Multilayer SPO Stack & Test]
T204-117EE [Charged particle scattering in optics]
T204-120EE [Focusing of micrometeorites]
C216-129FT [Synchrotron Beam-time Bessy II]
C216-130FT [Bessy II Enhanced Performance]
C216-005MM [Panter Upgrade]
C216-131FT [Thermal equip. & large optics acc.]
C216-153MM [Advanced/Compact SPO Test Fac.]
C216-154MM [SPO HO Optimisation]
C216-148MM [SPO EQM - preparation]

C221-005FI [Cryogenic Vib. Isolator & disconnect]
C221-006FI [Super Cond. Flex Harness]
C217-043FM [TES Array Optimisation – Prod & Test]
C217-044FM [Large Area TES]
C217-031FI [Opt of a European TES array]
C217-065FM [SQUID development]

C220-032MC [15K Pulse Tube Cooler]
T220-053MC [Advanced 2K Joule Thompson Cooler]
C221-001MT [Detector Cooling System to 50mK]
C221-003FI [Hydrogen Phase ESU 15-20K]
C221-007FM [Low vib. 15K PT EM inc. CDE]
C221-038FM [2K JT EM inc. CDE]

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C220-038FM [Instrument Selection Mechanism]
C215-127FT [Dev. Of large-angle Flexible pivots]
C215-128FM [ATHENA HDRM]

C205-106EC [High Accuracy STR]
C217-067FM [On-Board Metrology]

C216-132FT [SPO Modelling & Simulation]
C204-110EC [AREMBES Background Model]

Fast Timeline Generation
Fast Planning S/W
T209-001EC [Autonomous ToO]

T224-004QT [Additive manufactured metallic optical bench]
C216-127MM (A,B) & CCNs [SPO AIT]
T216-103MM [Novel In-vacuum alignment]
C216-007MM [Telescope MS & Optics int. demonstrator]
C216-142MM [X-ray facility design & ver. for flight mirror]
C216-150FT [Panter beam-time provision]

ATHENA – Main Risks to MFR

Main risks to passing MFR

- X-IFU definition – we need a consolidated mass budget soon, and confirmation that the PT/WFEE gantry can be either (i) I/F'd to the existing I/F, or (ii) to +/- Y real-estate that is available
- WFI-CH thermal I/F requirements - PRR documentation is not justifying required temperature/power sufficiently, and we are paranoid about the stability of this I/F
- We are going to update our PL I/F definition prior to SC Prime A2 KO (~01/11) as outcome of ICC and WFI PRR – this *could* involve some modest additional allocation to the PLs for SC Phase A2 if the mass is available from A-64 and it is considered to be warranted
    - But then PLs must try and stick to the envelopes defined!
- SPO-HO showing some good progress, though risk remains of not achieving sufficient performance by time of MFR (term 'sufficient' still being debated)
- Uncertainty on A-64 performance to L2 is seen as an opportunity, but precise limit need to be known at MFR so we don't make a mistake either way (believe current communicated mass is too conservative)
- Overall the fuzziness is slowly coming into focus – by MFR we must reach sufficient definition (PLs, A-64…), even though not everything will necessarily be fully aligned, to confidently select a baseline for B1