

General Support Technology Programme

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General Support Technology Programme

esa

Ensuring the right technology with the right maturity is available at the right time

- Part of **ESA's Optional Programmes**
- All ESA Members (22) plus Canada and Slovenia are participating
- Covering all technology disciplines and applications except Telecom
- GSTP subscription: 1,5B€ (0.5B€ @ Space19+)
- Work plans/ frameworks (e.g. de-risk) /Announcement of Opportunity





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GSTP Objectives





Enabling missions of ESA and national programmes by developing technology



Fostering **innovation** by creating new products



Supporting the **competitiveness** of European industry



Improve European **technological non-dependence** and availability of European sources for **critical technologies**



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GSTP Element Structure



ELEMENT 1 ELEMENT 2 **ELEMENT 3** Develop Make Fly (Small Missions) Development of technologies Market driven, industry Envelope which hosts and products from low TRL to projects such as satellites (for initiated, co-funded qualification technology demonstration), ISS payloads, technology flight opportunities







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- G617-241TA, Assessments to prepare and **de-risk technology** developments <200 K€, duration < 9 months
- GT17-137TI, Preparation of **enabling space technologies/capabilities** < €500K per activity
- G61A-036QT, Assessing the use of **advanced manufacturing** to improve and expand space hardware capabilities -> <€250K, duration < 12 months
- GT17-136TI, Activities to **bridge national technology** developments <€250K, ۲ duration < 12 months

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GSTP Element 1 - Compendia 2019

Published on EMITS News

ESA Driven: ~150 activities

- **Generic Technologies and Techniques**
- Advance Manufacturing

Industry Driven: ~50 activities

- Operations Innovation
- Digital Engineering/Design to Produce
- Cybersecurity
- Artificial Intelligence

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Market Oriented Activities (GSTP Element 2 Make)



EMITS Call - AO9834 - Permanently open Announcement of Opportunity for co-funded activities





GSTP Element 3 Fly







- In-orbit Demonstration of technologies and products
 - Essential for products requiring **flight heritage** for customers
 - Does **not** include technology development (Element 1)
- Flight **opportunities** are identified with ESA projects/primes/National agencies
- Cubesat framework
 - support the implementation of cubesat missions for space technology demonstrations as well as space sciences and applications
 - implementation shall cover the different tasks that go from the mission study to the operations infrastructure and support
 - <=2.5M€
- Accommodation/assessment study framework
 - Experiment accommodation evaluation

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GOMX-3 (3U) demonstrating new platform technologies

PICASSO (3U) studying the atmosphere RadCube (3U) measuring space radiation and magnetic field

Sunstorm (2U) measuring X-Ray fluxes LUMIO & VMMO(2x12U) measuring lunar surface impact hazards & in-situresources

Rendezvous Autonomous Cubesats Experiment (RACE)



Mission concept:

- two 6U CubeSats
- launched together in a 12U POD
- separate deployment & commissioning
- series of docking and fly around manoeuvres
- testbed for different GNC algorithms

Delta Phase A/B needed

Launch Q4 2022

RACE will open up the path to completely new space system architectures based on aggregation that are not feasible or cost-effective today due to launcher fairing constraints

European Space Agency

-Rendezvous & docking -Target close fly-around **Future applications:** -autonomous on-orbit assembly of large structures using building blocks -on-orbit servicing/inspection

Demo of:

Miniaturised Asteroid Remote Geophysical Observer (M-ARGO)





M-ARGO will lower the entry-level cost of deep space exploration by over an order of magnitude, leading to fleets of nano-probes for e.g. in-situ resource exploration of NEOs

Objectives:

- Demonstrate critical technologies & operations for stand-alone deep space CubeSats in the relevant environment
- Rendezvous with a Near Earth Object (NEO)
- Physical characterisation of NEO with a small payload suite for in-situ resource exploration purposes

Mission concept:

- First stand-alone deep space CubeSat (12U XL)
- piggyback launch to Sun-Earth L2 transfer or lunar swing-by
- 1-3 year low-thrust interplanetary transfer
- 6-month close proximity ops at NEO target
 - 140 different NEO targets accessible

Atmospheric Re-entry Research Demonstration



- Project: QARMAN
- Contractor: Von Karman Institute (Belgium)
- Platform: 3U CubeSat
- Payloads:
 - o Spectrometer for in-situ re-entry plasma analysis
 - o Temperature, pressure, strain sensors
- Mission:
 - First CubeSat designed to survive re-entry & collect data on the re-entry environment for future missions
 - Passive aerodynamic drag attitude stabilisation (SiC)
 - o In-flight telemetry data relay via the Iridium system
- Launch: Deployed from ISS on 19/02/2020
- Status: satellite stable & healthy, commissioning ongoing, re-entry predicted in Jan. 2021

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Sun-Earth Radiometry Demonstration

- Project: SIMBA
- Contractor: Royal Meteorological Institute, KU Leuven (Belgium)
- Platform: 3U CubeSat (ISISpace)
- Payloads:
 - Absolute cavity radiometer (RMIB)
 - o 3-axis ADCS with star tracker & reaction wheels (KUL)
- Mission:
 - o Total Solar Irradiance, Earth Radiation Budget
 - o Precision 3-axis pointing demo
- Launch: TBC 2020 to SSO 530 km (Vega SSMS)
- Status: Delivered for launch







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Atmospheric Science Demonstration

- Project: P.I.C.A.S.S.O.
- Contractor: Belgian Institute of Space Aeronomy (BISA), VTT (Finland), Clyde Space (UK)
- Platform: 3U CubeSat (Clyde Space) with 3-axis pointing
- Payloads:
 - VISION multi-spectral imager with Fabry-Perot Interferometer (VTT) -> technology to be used in Altius
 - Sweeping Langmuir Probe (BISA)
- Mission:
 - Stratospheric Ozone & Mesospheric Temperature profiles via solar occultation measurements
 - o Ionospheric Electron density in-situ measurements
- Launch: TBC 2020 to SSO 530 km (Vega SSMS)
- Status: delivered for launch







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Solar X-ray Activity Monitoring Demonstration

- Project: Sunstorm
- Contractor: Reaktor Space Labs (FI)
- Platform: 2U CubeSat (RSL) with 3-axis pointing
- Payloads:
 - Solar X-ray flux Monitor (XFM) by Isaware (FI), ASRO (FI),
 Oxford Instruments (UK), Talvioja Consulting (FI)
 - Candidate to be flown on the Lagrange space weather mission to Sun-Earth L5 Lagrange point
- Mission:
 - Monitoring of X-rays emitted by the Sun in the energy range
 1.5–25 keV to 1% accuracy at 1 minute intervals
- Launch: Q2 2021 to SSO <600 km
- Status: CDR successful, system AIV commencing





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In-Situ Space Weather Demonstration

- Project: RadCube
- Contractor: C3S (HU), MTA EK (HU), ICL (UK), Astronika (PL)
- Platform: 3U CubeSat (C3S) with 3-axis pointing
- Payloads:
 - RadMag including electron/proton/cosmic ray particle detector (MTA EK), magnetometer (Imperial) on boom (Astronika)
 - Radiation Hardness Assurance board (ESA)
- Mission:
 - In-situ Radiation environment & Magnetic field monitoring for future space weather services (data provision to ESA SWS)
 - o Characterisation of Radiation effects on EEE components
- Launch: Q3 2021 to SSO <600 km
- Status: CDR completed, system AIV in progress



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GNSS Reflectometry Demonstration

- Project: PRETTY
- Contractor: RUAG Austria, TU Graz, Seibersdorf Labs
- Platform: 3U CubeSat (TU Graz) with 3-axis pointing
- Payloads:
 - Software-defined GNSS-Reflectometry receiver & L-band multi-patch antenna (RUAG, TU Graz)
 - o Radiation dosimeter (Seibersdorf Labs)
- Mission:
 - First CubeSat to exploit GNSS-R grazing altimetry technique to measure sea state, ice and ocean currents at high precision
 - o Characterisation of radiation dose environment
- Launch: Q4 2021 to SSO <600 km
- Status: Phase C ongoing, CDR planned in Sept. 2020



Credit: TU Graz

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Next Gen. Constellation Technology Demonstration

- Project: GOMX-5
- Prime contractor: GomSpace (DK)
- Platform: 12U CubeSat
- IOD Mission:
 - Large orbit transfers using electric propulsion (delta-V >280 m/s)
 - High rate X-Band downlink comms (>225 Mbps) using Reflectarray High Gain antenna
 - o High accuracy GNSS PPP Receiver & Dual-band GNSS antenna
 - o Additional 6 IOD Payloads from European industry
- Launch: Q2 2022 SSO 500 km, EP apogee raise 800-1000 km
- Status: PDR successful (Dec. 2019), funded for Phase C/D
- Payload consolidation & Phase C/D KO before July 2020



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Stellar Spectroscopy Demonstration



- Project: CubeSpec
- Contractor: KU Leuven, Amos (BE)
- Platform: 6U CubeSat with arcsecond 3-axis pointing
- Payloads:
 - High resolving power (50,000) UV/VIS spectrometer configurable for different science cases
 - o Athermal opto-mechanical design
 - Fine Guidance Sensor with piezo-electric tip-tilt mirror in the ADCS control loop
- Mission:
 - Baseline: Asteroseismology of bright stars (VIS mag. 4)
 - o Other: Rayleigh scattering in exoplanet clouds (UV)
 - o Observations: 20 min. every orbit for 1-3 months
- Launch: Q2 2023 to dawn-dusk SSO <600 km
- Status: Phase A/B ongoing since Jan. 2020 ESA UNCLASSIFIED - For Official Use



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LUMIO (LUnar Meteoroid Impacts Observer)





• 12U CubeSat platform

- High frame rate camera
- Observes meteoroid impact flashes on the lunar far side for science & exploration hazard assessment

PoliMi (mission lead, optical nav & ops) Leonardo (camera payload) ISISpace NL (system eng., AIV & P/F) S&T Norway (payload OBSW)

Potential launch opportunities:

- NASA SLS Artemis-2 (lunar swingby)
- NASA Commercial Lunar Payload Services (lunar orbit)

Mission profile:

- Earth-Moon L2 halo orbit
- Far side night observations
- Day time optical navigation (full disk)

Propulsion trade-offs:

- Chemical vs. electric
- Delta-V 150-250 m/s depending on launch option

Status:

Phase A study kicked off in Feb. 2020 Funding TBC for Phase B/C/D

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VMMO (Volatile & Mineralogy Mapping Orbiter)



Charting the Moon's water ice in permanently shadowed polar regions at high resolution (<100m) & high accuracy using a dual-channel fibre laser spectrometer





MPB (prime & laser p/l) Surrey (platform & rad p/l) Winnipeg Uni (Science) York Uni (Science) NGC (GNC) Deimos (GNC) Critical Software (OBSW)

Potential launch opportunities:

- NASA SLS Artemis (lunar swingby)
- NASA Commercial Lunar Payload Services (lunar orbit)

Mission profile:

- Low altitude frozen polar orbit
- Payload ops @40-80 km south pole
- Laser altimetry & comms experiment

Propulsion trade-offs:

- Chemical vs. electric
- Delta-V 150-250 m/s depending on launch option

Status:

Phase A study kicked off in Feb. 2020 Funding TBC for Phase B/C/D

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