

Current NEO-related Activities in Germany

Alan Harris

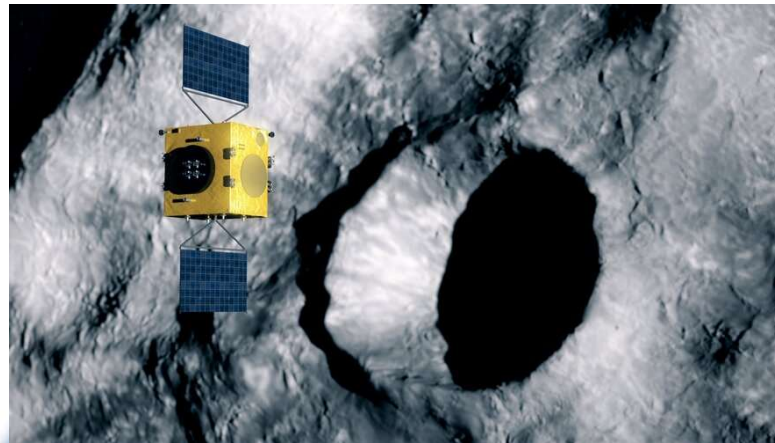
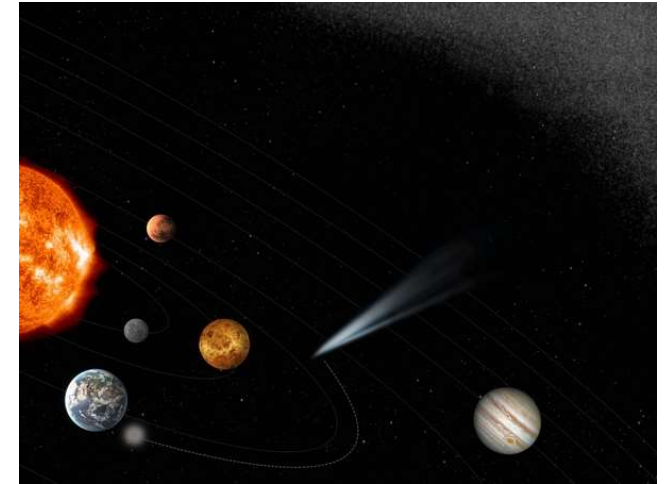
DLR Institute of Planetary Research, Berlin

Including text & images provided by:

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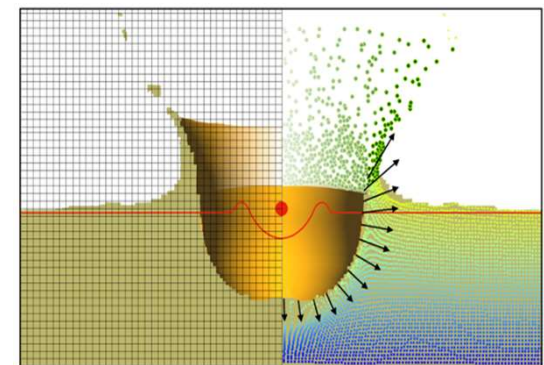
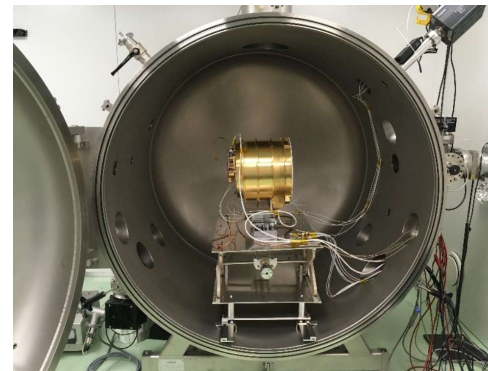
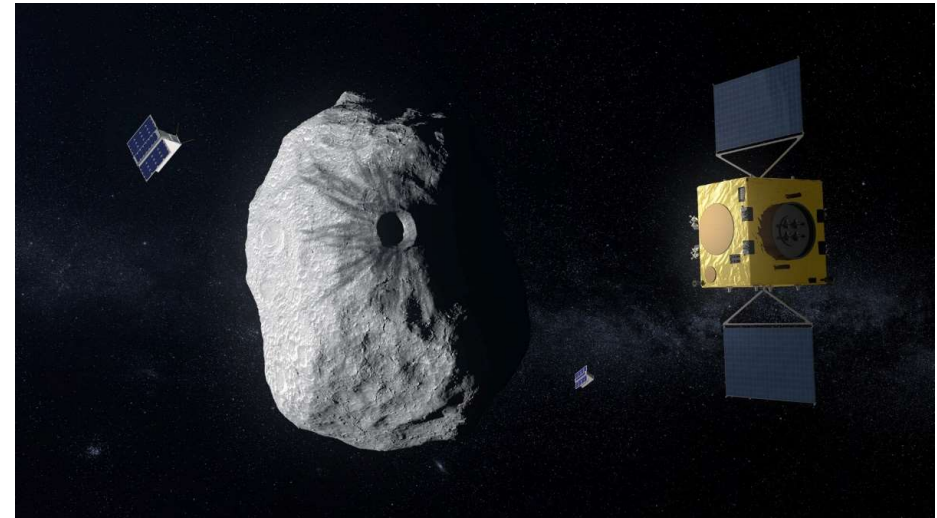


Knowledge for Tomorrow



Main NEO-related Missions and Projects with German participation

1. **Hera** – Europe’s reconnaissance mission to Didymos and Dimorphos, following and complementing NASA’s DART impactor. Launch scheduled for 2024.
2. **Destiny+** – JAXA/DLR mission to 3200 Phaethon.
3. **Hayabusa2 extended mission** – to NEO 1998 KY26 (arrival 2031), after flyby of 2001 CC21 in 2026.
4. **Asteroid Characterization** – ESA contract (MfN, Berlin), Jan 2023 – Dec. 2025. Impact experiments and simulations related to the DART/Hera missions (collaboration with TU Munich).



Hera

- Hera is the European reconnaissance mission to the Didymos system which complements NASA's kinetic-impactor mission, DART, with the aim of returning precise information on the effects of the DART impact.
- Germany participates primarily via industry but is also well represented in the core investigation team by:
S. Ulamec, DLR (Management Board Member),
J.-B. Vincent, DLR (PI of the Asteroid Framing Cameras, Data Analysis WG Lead),
K. Wünnemann, Museum für Naturkunde, Berlin (Impact Modeling WG Lead).
- The German aerospace company, OHB* System AG, Bremen, is the ESA prime contractor for Hera and is responsible for the design and construction of the spacecraft. The Asteroid Framing Cameras are provided by the German company Jena-Optronik.
- Launch date: 2024; arrival: end 2026; duration of operations: at least 6 months.

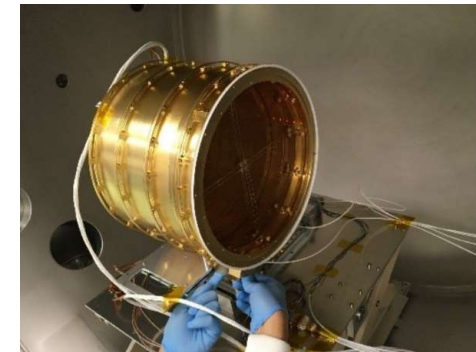
(*OHB = "Otto Hydraulik Bremen" originally. Since 1991: "Orbital- und Hydrotechnologie Bremen-System".)



DESTINY+ (=Demonstration and Experiment of Space Technology for INterplanetary voYage

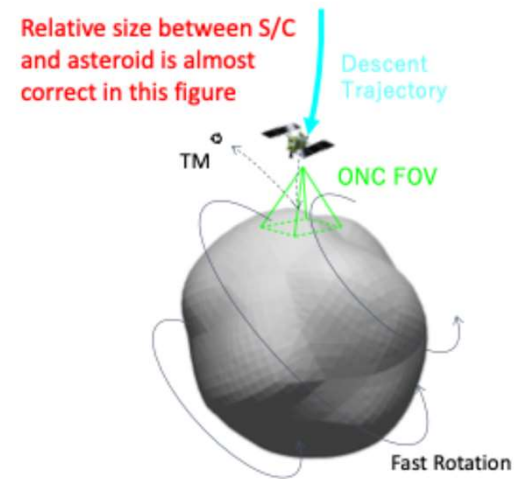
JAXA, Univ. Stuttgart, DLR

- DESTINY+, selected by the Japanese space agency JAXA/ISAS for launch in 2024, will fly by the active asteroid (3200) Phaethon in early 2028 and observe dust using a dust analyzer and map its surface to understand the mechanisms of dust ejection. The spacecraft will pass as close as 500 km to the surface of Phaethon at a speed of 36 km/s.
- The scientific payload consists of a telescopic camera, a multi-band camera, and the DESTINY+ Dust Analyzer (DDA), provided by the Univ. of Stuttgart with support from DLR.
- The engineering model of the DESTINY+ Dust Analyzer (DDA) is undergoing tests at a new dust accelerator designed for test and calibration purposes, which became operational in March 2022 at the Univ. of Stuttgart. DDA is the main instrument of JAXA's interplanetary German-Japanese mission DESTINY+ and is being developed at the Univ. of Stuttgart in cooperation with industry.



Hayabusa2 extended mission

- DLR membership in Science Team
- Arrival at 1998 KY26 in 2031



NEO 1998 KY26 and Hayabusa2

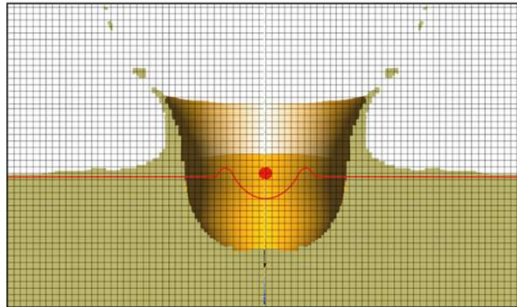
D ~ 30 m, rotation period ~ 10 min.



Asteroid Characterization (ESA contract, Jan 2023 – Dec. 2025)

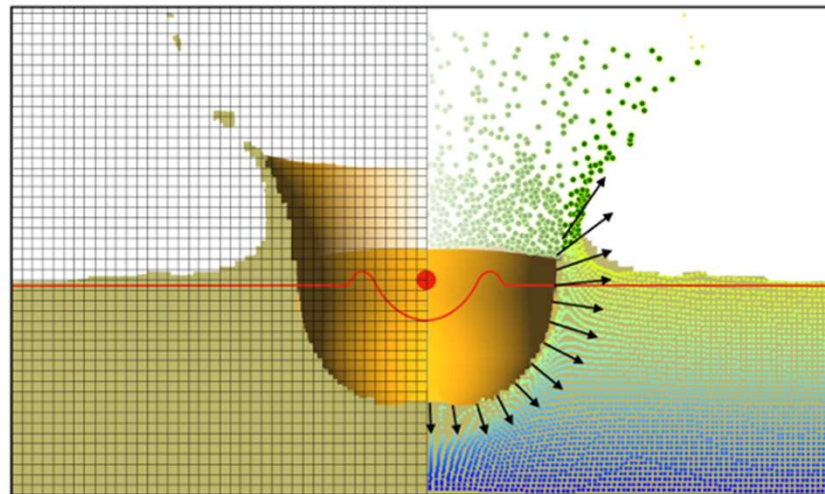
Project to develop **efficient modelling strategies** to simulate **impact cratering** on asteroids under **micro-gravity** conditions and in **low strength regime**.

Grid-based codes



Particle-based codes

Adjusted/Modified approach



Coupling, merging, or adjusting different numerical approaches based on a suite of existing software tools



Other Activities and Projects with German Involvement Relevant to Planetary Defence

- German Space Situational Awareness Centre
- Contributions to JAXA Mars Moons eXploration (MMX) Mission
- Comet Interceptor
- Psyche



German Space Situational Awareness Centre (“Weltraumlagezentrum”)

- Established on July 1, 2009, it became part of the new German Armed Forces Space Command on July 13, 2021. The Centre is commanded by a civilian/military dual leadership (DLR/Bundeswehr) and is situated near the town of Uedem, near the German-Dutch border.
- It is tasked with protecting German space-based civilian and military systems. Its brief includes publishing forecasts of the entry of objects into the Earth's atmosphere and the potential for damage (includes asteroids in addition to space debris - the Centre operates in collaboration with ESA).
- The Centre would likely play an important role in providing information and advice to federal and state governments in Germany in the event of a persistent and significant impact hazard.



Contributions to JAXA Mars Moons eXploration (MMX) Mission

- JAXA Mission to investigate the Martian moons, Phobos and Deimos, including sample return from Phobos. Launch in 2024.
- Germany (DLR) is involved in the MMX Science Board including participation in the science teams on “Early Solar System Evolution”, “Surface Science and Geology” and “Origins of Phobos and Deimos”
- Provision of CNES-DLR Rover as contribution to the MMX Mission:
 - Rover System with 4 Scientific instruments.
Rover PI’s: S. Ulamec (DLR) and P. Michel (CNRS)
 - Raman Spectrometer, RAX (DLR, with contributions from INTA and JAXA)
 - Radiometer (miniRAD) (DLR)



Comet Interceptor

- The Comet Interceptor (CI) will be the first mission to visit a long-period comet just starting its journey into the inner Solar System. Comprising 3 spacecraft (A & B2 from ESA, B1 from JAXA), CI will wait at L2 for a suitable target, then move off to intercept it as it approaches the Earth's orbit. The three spacecraft will perform simultaneous observations from multiple points around the object.
- The Multilateral Agreement of participating agencies, including DLR, was approved by ESA in 2022 and entered into force on 30 May 2023. It shall remain in force until at least 8 years after launch of the mission.
- The prime contractor is OHB Italia, a subsidiary of the German OHB company. OHB Germany and Sweden are sub-contractors. Launch is scheduled for 2029 (co-rider with ESA's ARIEL mission).
- DLR is providing the focal plane array electronics for the CoCa camera and will contribute s/w to the MANIAC mass spectrometer (probe A). TU Braunschweig provides a magnetometer (probe B2).



Psyche

- NASA mission to main-belt asteroid Psyche. Launches tomorrow (12. Oct. 2023)! Arrives Aug. 2029.
- German involvement: DLR Institute of Planetary Research, Berlin; data analysis, production of digital terrain models.



Credit: NASA/JPL-Caltech

