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**Mobile Asteroid Surface Scout (MASCOT) – Design, Development and Delivery
of a Small Asteroid Lander aboard HAYABUSA-2**

Jan Thimo Grundmann^(1,2), Uli Auster^(15,16), Volodymyr Baturkin^(1,3), Anthony Bellion^(19,20), Jean-Pierre Bibring^(26,27), Jens Biele^(30,31), Pierre Bousquet^(19,21), Luca Celotti⁽³⁴⁾, Céline Cenac-Morthe^(19,22), Federico Cordero⁽³⁵⁾, Muriel Deleuze^(19,23), Corinne Evesque^(26,28), Ross Findlay^(1,4), Stéphane Fredon^(19,24), Karl-Heinz Glaßmeier^(15,17), David Granena^(19,25), Christian Grimm^(1,5), Matthias Grott^(36,37), Vincent Hamm^(26,29), Jeffrey Hendrikse⁽⁴⁰⁾, David Hercik^(15,18), Tra-Mi Ho^(1,6), Ralf Jaumann^(36,38), Christian Krause^(30,32), Ronald Kroth⁽⁴¹⁾, Eugen Ksenik^(1,7), Caroline Lange^(1,8), Michael Lange^(42,43), Olaf Mierheim^(42,44), Tatsuaki Okada⁽⁴⁵⁾, Josef Reill^(46,47), Nicole Schmitz^(36,39), Hans-Jürgen Sedlmayr^(46,48), Maria Talapina^(1,9), Sirinart Tangruamsub^(1,10), Nawarat Termtanasombat^(1,11), Stephan Ulamec^(30,33), Elisabet Wejmo^(1,12), Michael Wrasmann^(1,13), T Yoshimitsu⁽⁴⁵⁾, Christian Ziach^(1,14), and the MASCOT Team⁽⁶⁾

⁽¹⁾ *DLR Institute of Space Systems, Robert-Hooke-Str. 7, 28359 Bremen, Germany*

⁽²⁾ +49-(0)421-24420-1107,

⁽³⁾ +49-(0)421-24420-1610,

⁽⁴⁾ +49-(0)228-447-231,

⁽⁵⁾ +49-(0)421-24420-1266,

⁽⁶⁾ +49-(0)421-24420-1171,

⁽⁷⁾ +49-(0)421-24420-1247,

⁽⁸⁾ +49-(0)421-24420-1159,

⁽⁹⁾ +49-(0)421-24420-1305,

⁽¹¹⁾ +49-(0)421-24420-1210,

⁽¹²⁾ +49-(0)421-24420-1107,

⁽¹³⁾ +49-(0)421-24420-1278,

⁽¹⁴⁾ +49-(0)421-24420-1181,

⁽¹⁵⁾ *Institute for Geophysics and Extraterrestrial Physics, Technical University
Braunschweig, Germany*

⁽¹⁹⁾ *Centre National d'Etudes Spatiales CNES, 18 avenue Edouard Belin, 31401 -
Toulouse Cedex 9, France*

⁽²⁰⁾ *DCT/RF/AN, Service Antennes, BPi 3602, +33 (0)5 61 27 47 94,*

⁽²¹⁾ *DCT/PO/PM, Planetology & Microgravity projects, BPi 2003, (33) 5.61.28.17.18,*

⁽²²⁾ *DCT/TV/EL, +33 5 61 28 21 94,*

⁽²³⁾ +33 561 274 847,

⁽²⁴⁾ +33 5 61 28 30 21,

- ⁽²⁵⁾ DCT/TV/EL, BPi: 2213, +33 5 61 28 34 08,
- ⁽²⁶⁾ IAS - Institut d'Astrophysique Spatiale, Université Paris Sud - Bat 121, 91405
ORSAY CEDEX, France
⁽²⁸⁾ +33 (0)1 69 85 85 24,
⁽²⁹⁾ +33 (0)1 69858684,
- ⁽³⁰⁾ DLR Space Operations and Astronaut Training – MUSC, 51147 Köln, Germany,
⁽³¹⁾ +49-2203-601-4563,
⁽³²⁾ +49-2203-601-3048,
⁽³³⁾ +49-2203-601-4567,
- ⁽³⁴⁾ Active Space Technologies, Rudower Chaussee 29, 12489 Berlin, Germany,
⁽³⁵⁾ VEGA, Darmstadt, Germany,
- ⁽³⁶⁾ DLR Institute of Planetary Research, Rutherfordstr. 2, 12489 Berlin
⁽³⁷⁾ +49-(0)30 67055-419,
⁽³⁸⁾ +49-(0)30-67055-400,
⁽³⁹⁾ +49-(0)30 67055-456,
- ⁽⁴⁰⁾ EADS Astrium, Friedrichshafen, Germany,
- ⁽⁴¹⁾ MAGSON GmbH, Carl-Scheele-Str. 14, 12489 Berlin, Germany,
- ⁽⁴²⁾ DLR Institute of Composite Structures and Adaptive Systems – Composite
Design, Lilienthalplatz 7, 38108 Braunschweig, Germany
⁽⁴³⁾ +49-(0)531-295-3223,
⁽⁴⁴⁾ +49-(0)531-295-3224,
- ⁽⁴⁵⁾ Japan Aerospace Exploration Agency (JAXA), Institute of Space and
Astronautical Science (ISAS), 3-1-1 Yoshinodai, Chuo-ku, Sagami-hara, Kanagawa
252-5210, JAPAN
- ⁽⁴⁶⁾ DLR Robotics and Mechatronics Center, 82234 Wessling, Germany
⁽⁴⁷⁾ +49-(0)8153-28-3563,
⁽⁴⁸⁾ +49-(0)8153-28-3532,

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ABSTRACT

MASCOT is a small asteroid lander launched on December 3rd, 2014, aboard the Japanese HAYABUSA-2 asteroid sample-return mission towards the 980 m diameter C-type near-Earth asteroid (162173) 1999 JU₃.

MASCOT carries four full-scale asteroid science instruments and an uprighting and relocation device within a shoebox-sized 10 kg spacecraft; a complete lander comparable in mass and volume to a medium-sized science instrument on interplanetary missions.

Asteroid surface science will be obtained by: MicrOmega, a hyperspectral near- to mid-infrared soil microscope provided by IAS; MasCAM, a wide-angle Si CMOS camera with multicolour LED illumination unit; MARA, a multichannel thermal infrared surface radiometer; the magnetometer, MasMAG, provided by the Technical University of Braunschweig; and as a byproduct of an array of attitude and other sensors providing data on the conditions on the lander's surfaces.

MASCOT uses a highly integrated, ultra-lightweight truss-frame structure made from a CFRP-foam sandwich. It has three internal mechanisms: a preload release mechanism, to release the structural preload applied for launch across the

separation mechanism interface; a separation mechanism, to realize the ejection of MASCOT from the semi-recessed stowed position within HAYABUSA-2; and the mobility mechanism, for uprighting and hopping. MASCOT uses semi-passive thermal control with Multi-Layer Insulation, two heatpipes and a radiator for heat rejection during operational phases, and heaters for thermal control of the battery and the main electronics during cruise. MASCOT is powered by a primary battery during its on-asteroid operational phase, but supplied by HAYABUSA-2 during cruise for check-out and calibration operations as well as thermal control. All housekeeping and scientific data is transmitted to Earth via a relay link with the HAYABUSA-2 main-spacecraft, also during cruise operations. The link uses redundant omnidirectional UHF-Band transceivers and patch antennae on the lander. The MASCOT On-Board Computer is a dual redundant system providing data storage, instrument interfacing, command and data handling, as well as autonomous surface operation functions. Knowledge of the lander's attitude on the asteroid is key to the success of its uprighting and hopping function. The attitude is determined by a threefold set of sensors: optical distance sensors, photo electric cells and thermal sensors. A range of experimental sensors is also carried.

MASCOT was build by the German Aerospace Center, DLR, with contributions from the French space agency, CNES.

The system design, science instruments, and operational concept of MASCOT will be presented, with sidenotes on the development of the mission and its integration with HAYABUSA-2.
