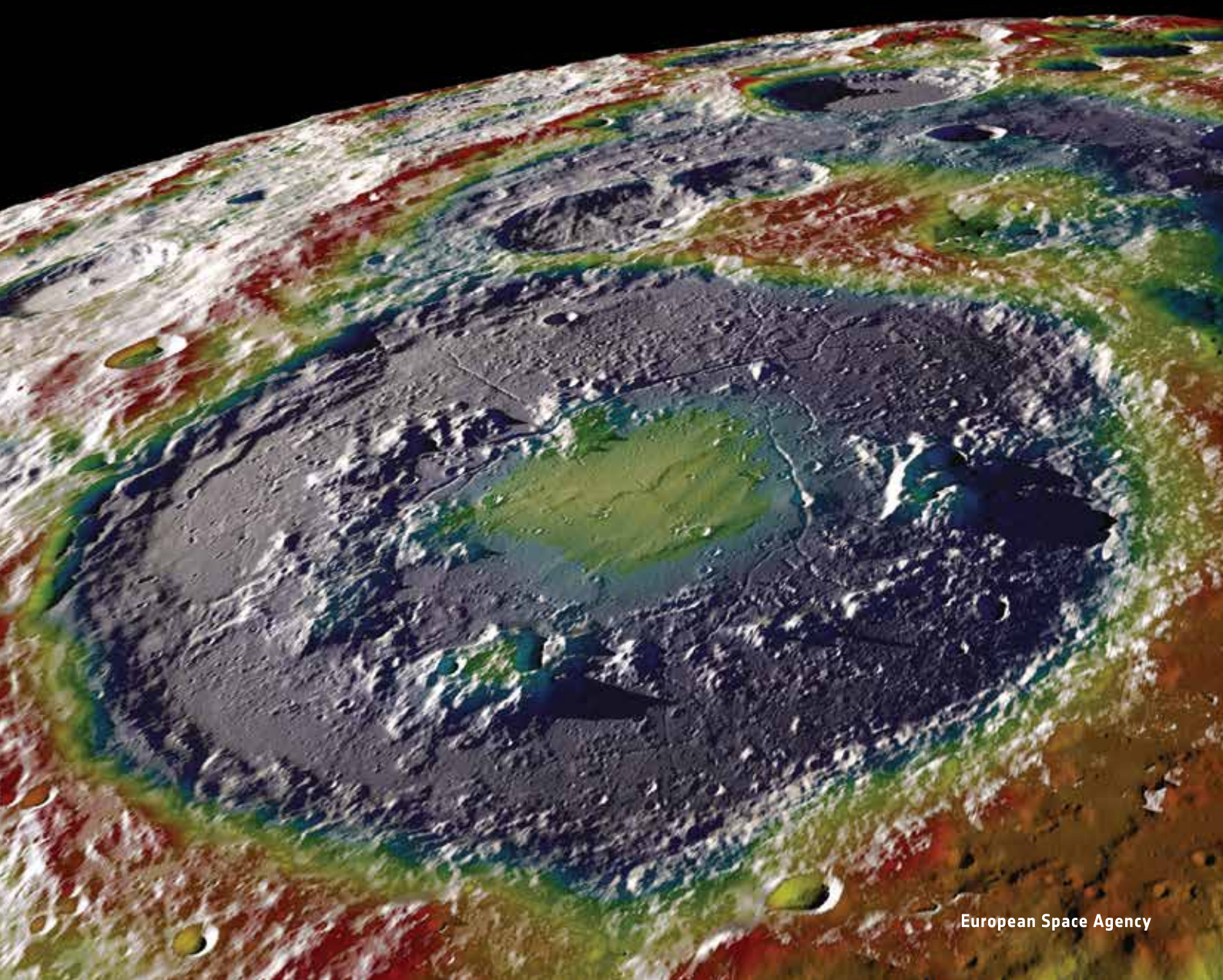
→ MOON 2020-2030

A new era of human and robotic exploration
Draft programme



European Space Agency

Time	MONDAY 14	TUESDAY 15		WEDNESDAY 16	
	Newton 2	Newton 1	Newton 2	Newton 1	Newton 2
AM	Exploration Technology Showcase	Opening plenary		Splinter B1 Student Team Presentations	Splinter B2
PM	Exploration Technology Showcase	Splinter A1	Splinter A2	Final plenary Student Prize Award	
				Panel discussion on "Vision 2030"	
Evening		Poster session (ERASMUS)			
		Social Dinner			

Monday 14 December

NEWTON 2

Exploration Technology Showcase (Chairs: Alessandro Bergamasco and Giorgio Saccoccia)

Technology roadmap building blocks

09:00	Giorgio Saccoccia (ESA)	Use of ESA exploration technology roadmaps in support of Moon initiatives and technology prioritisation
09:30	Guillermo Ortega (ESA)	Visual navigation, hazard detection and avoidance
09:45	Diego De Rosa (ESA)	PILOT: An ESA product for safe and precise landing of future lunar and planetary missions
09:55	Hans Krüger (DLR)	Absolute autonomous navigation for lunar orbit
10:05	Marco Ciarambino (POLIMI)	On ground testing facilities network to step forward in TRL enhancement for Moon exploration
10:15	Henri Barde (ESA)	Surface mobility elements
10:30	Peter Visscher (ODG)	Canadian lunar rover prototype and TRL-6 Drivetrain development
10:40	Clive Neal (University of Notre Dame)	Targeted lunar nearside sample return: important advance for technology development and lunar science
10:50	**Coffee break**	
11:10	All	Discussion on HDA, landing, and surface mobility technology
11:30	Lionel Gaillard (ESA)	Sample acquisition, processing and containment systems
11:45	Gianfranco Visentin (ESA)	Telerobotics and autonomous control systems
12:00	Junichi Haruyama	Unprecedented Zipangu Underworld of the Moon Exploration (UZUME) - A Japanese plan for lunar cave exploration
12:15	David Perigo (ESA)	Storable propulsion module and equipment
12:30	Mathias Rohrbeck (OHB)	High thrust liquid propulsion stages: A vital building block for human exploration of the Moon
12:40	All	Discussion on ESA Technology Building Blocks
13:00	**Lunch**	

Habitation and life support

14:00	François Gaubert (ESA)	Habitation systems
14:15	Jeffrey A. Hoffman (MIT)	Enabling technologies to support human life in permanent lunar base
14:25	Jack J.W.A. van Loon (VUmc)	Moon as a stepping stone for Mars: centrifuges on the Moon
14:35	Hady Ghassabian Gilan (SGAC)	Expandable dome design for future lunar habitats
14:45	Chris Gilbert (LIQUIFER)	European technologies for crew habitats and food production in space
14:55	Aidan Cowley (ESA)	The European Astronaut Centre – An operational ecosystem for future lunar exploration scenarios
15:05	Peter Weiss (COMEX)	The COMEX hydrosphere for simulations of future human and robotic missions to the Moon
15:15	Walter Tesch (Blue Innovations)	Hydrothermal carbonization: A key for closed-loop life support systems and food production?
15:25	Diego Urbina (Space Applications Services)	Prototype of an advanced human-machine interaction system for the spacesuit of the future in the frame of the MOONWALK project
15:35	All	Discussion on habitation systems, LSS, and suit technology

Regolith derived construction and surface environment and effects

16:05	Enrico Dini (D-Shape)	3D printed lunar habitats, using lunar regolith
16:15	**Coffee break**	
16:25	Laurent Pambaguian (ESA)	3D printing technologies toward establishing human settlement on the Moon: The viewpoint of ESA materials scientists
16:35	Ugo Lafont (ESA)	Toward on-the Moon and on-planet 3D printing
16:45	Fabrice Cipriani (ESA)	Diagnostic tools for environmental effects on surface exploration systems
16:55	Jean-Charles Matéo-Vélez (ONERA)	Equipment reliability under the Moon's dusty environment –ONERA's contribution
17:05	All	Discussion – Regolith-derived constructions and knowledge gaps and research priorities for surface environment and effects
17:30	End	

Tuesday 15 December

NEWTON 1 & 2

Plenary (Moderator: Raffaella Pappalardo, Chairs: James Carpenter, Bernhard Hufenbach)

09:00	Welcome and Introduction	
09:10	Opening talk	
09:30	Opening panel discussion: Agency plans and international cooperation	
10:55	**Coffee break**	
11:15	Ben Bussey (APL)	Science opportunities of cislunar space and the lunar surface
11:45	Greg Sadlier (London Economics)	Economic impacts of an international lunar exploration endeavour
12:15	Anu Ojha (National Space Academy)	Educating and inspiring through lunar education
12:45	Giorgio Saccoccia (ESA)	Report from Technology Day
13:00	**Lunch**	

NEWTON 1

Splinter A1 (Chairs: James Carpenter and Bernhard Hufenbach)

Partner plans and scenarios

14:00	Lev M. Zelenyi (IKI)	Russian lunar programme: The initial robotic stage
14:15	John Guidi (NASA)	NASA journey to Mars
14:30	Naoki Sato (JAXA)	Japanese space exploration scenario
14:45	Martin Picard (CSA)	Preamble to the next steps in exploration of the Moon by 2020-2030

From ISS to a cislunar habitat

15:00	Vladimir Soloviev (Energia)	The ISS as a platform for technology development in the interests of human Moon missions
15:15	Uwe Derz (Airbus DS)	Free Flyer in EML2: A vision for The Earth-Moon Libration Point 2
15:30	Matthew Duggan (Boeing)	Concepts for international cislunar platform supporting lunar exploration
15:45	Michèle Lavagna (POLIMI)	Large service structure in Earth-Moon L1: Feasibility, exploitation and technology needs
16:00	All	Discussion - key elements and capabilities of a cislunar habitat

16:20 Coffee break

Robotic precursors

16:40	V. I. Tretyakov (IKI)	Lunar robotic missions for Moon polar regions, as precursors for manned lunar flights
16:55	Bérengère Houdou (ESA)	ESA/Roscomos partnership in lunar surface exploration
17:10	Terrence Fong (NASA)	Development of the Resource Prospector planetary rover
17:25	Mikhail Ya. Marov (IPGP)	Lunar basic network
17:40	All	Discussion: How robotic precursors prepare for human missions
18:00	End	

NEWTON 2

Splinter A2 (Chairs: Clive Neal and Ian Crawford)

Planetary science priorities and requirements

14:00	David A. Kring (USRA-LPI)	Analyses of robotic traverses & sample sites in the Schrödinger basin for the HERACLES human-assisted lunar sample return mission concept
14:15	Makiko Ohtake (JAXA)	Science goal and mission plan for the future lunar exploration discussed in Japan
14:30	All	Discussion on planetary science drivers for lunar missions

Sample return and curation

14:50	Ryan A. Zeigler (NASA)	Curating NASA's astromaterials collections: Past, present, and future
15:05	John Robert Brucato (INAF)	Curation facility study for Moon sample return mission
15:20	Mahesh Anand (OU)	Lunar polar sample return – An opportunity to unravel the history of volatiles and organics in the inner Solar System
15:35	Martin Whitehouse (Swedish Museum of Natural History)	Current and future analytical capabilities for lunar return samples - A case for Secondary Ion Mass Spectrometry (SIMS)
15:50	All	Discussion on major factors and requirements for sample return missions and the curation of samples

16:15 Coffee break

Physics and astronomy aspirations and requirements

16:35	Albert-Jan Boonstra (ASTRON)	Long wavelength radio astronomy & lunar exploration
16:50	Jingye Yan (NSSC)	DSL: A concept of low frequency radio telescope at lunar orbit
17:05	Claudio Maccone (IAA)	The United Nations to protect the Moon's farside from man-made radio noise
17:20	Thomas. M. Eubanks (Asteroid Initiatives)	Lunar farside radio astronomy base facilitated by lunar lift
17:35	All	Discussion on needs and enabling requirements for radio astronomy
18:00	End	

ERASMUS

18:00	Poster session
20:00	End

Wednesday 16 December

NEWTON 1

Splinter B1 (Chairs: Katherine Joy and Ralf Jaumann)

Resource extraction from regolith and lunar volatiles

09:00	Clive Neal	Moon 2020-2030 and the LEAG Lunar Exploration Roadmap
09:15	Thorsten Denk (PSA-CIEMAT)	Solar thermal lunar regolith reduction for oxygen production
09:30	Matthias Sperl (DLR)	Granular matter in low and zero gravity
09:45	Dana Hurley (APL)	Evaluations of existing data sets pertaining to lunar polar volatiles
10:00	Anthony Colaprete (NASA)	Resource prospector: mission goals, relevance and site
10:15	James Carpenter (ESA)	Exploring cold trapped volatiles: ESA activities for resource prospecting at the poles
10:30	Mahesh Anand (OU)	Exploration for lunar polar volatiles: considerations and recommendations

10:45 Coffee break

11:05	Craig Hardgrove (Arizona State University)	The lunar polar hydrogen mapper Cubesat mission
11:20	Tatsuaki Hashimoto (JAXA)	Japanese lunar polar exploration mission
11:35	All	Discussion on resources and lunar volatiles – Knowledge gaps, approaches, coordination and partnership models

ESA Moon Challenge Presentations

12:00	Team 1 Presentation
12:20	Team 2 Presentation
12:40	Team 3 Presentation

13:00 Lunch

NEWTON 2

Splinter B2 (Chairs: Armin Wedler and Kip V. Hodges)

Industry perspectives and private sector driven approaches

09:00	Benjamin Donahue (Boeing)	Lunar robotic and human mission approaches and concepts
09:15	Gerrit Hausmann (OHB)	OHB visions for future lunar exploration
09:30	Thomas Diedrich (Airbus DS)	Lunar exploration missions: status and recent developments at Airbus DS GmbH
09:45	Andrew Barton (XPRIZE)	The Google Lunar XPRIZE – Past, present and future
10:00	John Thornton (Astrobotic)	Commercial lunar delivery to enable the Lunar Exploration Vision 2030
10:15	David Iron (Lunar Mission One)	The Lunar Mission One public-private partnership

10:30 Coffee break

10:50	Jonathan Friend (SSTL)	A first step towards a lunar communications system
11:05	All	Discussion – What opportunities exist for the private sector, which roles can the private sector play, and how can PPPs support the goals of both public and private sectors?

Advancing human-robotic operations and analogue experiments

11:25	Trine Marie Stene (SINTEF)	Preparing for the unexpected
11:40	Jessica Grenouilleau (ESA)	Multi-purpose end-to-end robotics operations network: Preparing the cooperation between humans and robots
11:55	Neal Y. Lii (DLR)	Finding suitable telerobotics solutions for space exploration: A look into the Kontur-2 and Meteron Supvis-Justin experiments
12:10	Tom Hoppenbrouwers (Space Applications Services)	Analogues for preparing robotic and human exploration on the Moon
12:25	Peter Weiss (COMEX)	MOONWALK: Simulation of future astronaut-robot cooperation at the Marseilles subsea analogue
12:40	All	Discussion – Human-robotic operations in analogue experiments

13:00 Lunch

NEWTON 1 & 2

Plenary: Humans and Robots Together (Chairs: Dan Lester and Markus Landgraf)

14:00	Richard Schilling (St. Barth's Hospital)	How surgeons use robots to treat the human heart in vivo
14:25	Markus Landgraf (ESA)	HERACLES: A possible EML2-based human-robotic architecture with near-term lunar surface exploration objectives
14:40	James Head (Brown University)	Exploration of planetary crusts: A human-robotic exploration design reference campaign to the Lunar Orientale Basin
14:55	Kip V. Hodges (Arizona State University)	The need for science operations research in preparing for coordinated human and robotic exploration
15:10	Dan Lester (Exinetics)	Exploration telepresence: Gateway to human engagement with the Solar System
15:25	Igor Mitrofanov (IKI)	The concept of Human-Robotic Integrated Mission (HRIM) for Moon exploration
15:40	Albert Abdrakhimov (Vernadsky Institute)	Results and lessons of the Lunokhod 1/2 and Yutu missions
15:55	Oleg Saprykin (TsNIIMash)	The methodology of comparing the effectiveness of different scenarios for lunar exploration by manned and automatic means
16:15	Shahrzad Hosseini (ESA)	Award of the prizes for the ESA Moon Challenge
16:45	All	Plenary discussion: Vision 2030
18:00	End	

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