

LIVING IN SPACE CONFERENCE 2025

Integrative Space Health, Agentic AI, and Precision Medicine

**A systems biology and technology framework for
sustaining human life beyond Earth**

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**Training NextGen Leaders, Analog Astronauts, Scientists,
Innovators, Imagineers, Explorers for HUMANITY 2.0**



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What Does It Mean to Live in Space



‘Living systems science for extra-terrestrial adaptation’

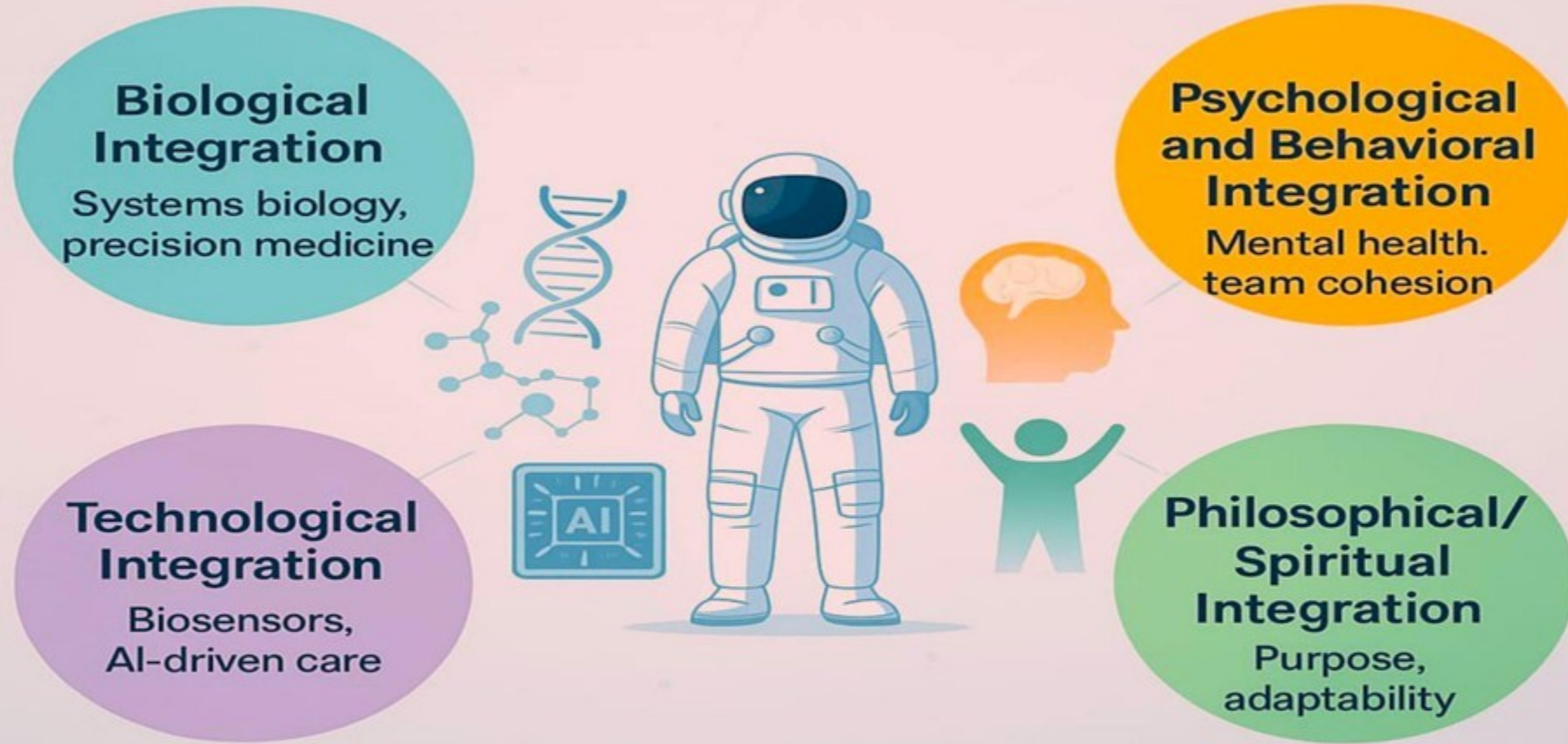
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Integrative Space Health



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BIOLOGICAL INTEGRATION

Systems Biology and Precision Medicine for Astronaut Adaptation



Genomics

Epigenetic and
immune gene
changes in
microgravity

Epigenetic and
immune gene changes
in microgravity



Metabolomics

Altered energy
and oxidative stress
pathways

Altered energy and
oxidative stress
pathways



Precision PK

AI-modeled dosing
for altered drug
metabolism

AI-modeled dosing
for altered drug
metabolism

Examples of Systems Biology and Precision Medicine



Metabolomics

Oxidative stress pathways



Genomics

Altered gene expression



Precision Pharmacokinetics

Medication efficacy

Psychological and Behavioral Integration



Mental Health

Epigenetic
and immune
gene changes



Wellness



Team Cohesion

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Technological Integration



Biosensors



AI-Driven Care



Remote Monitoring

Philosophical/Spiritual Integration



Overview Effect



Purpose



Adaptability



Inner Space

The 4Ps of Integrative Space Health

Physical

Maintaining strength, endurance, and musculoskeletal health in microgravity

Physiological

Regulating biological systems through multi-omics and precision medicine

Psychological

Sustaining cognition, emotional stability, and crew dynamics in isolation

Philosophical

Preserving meaning, adaptability, and purpose in the vastness of space



Analog Habitats as Testbeds for Space Colonization



MMAARS Habitat



MAU Nepal Base Camp



NASA HERA



UND ILMAH



Concordia Station



Agentic AI for Space Health



Predictive Health Monitoring
anticipates emerging risks via data analytics & biosensing

Autonomous Medical Support
delivers diagnostics, triage & treatment when ground support is delayed



Ethical Decision Systems
ensures AI actions align with crew norms, cognitive sovereignty & safety

Adaptive Crew Coaching
guides behavior, resilience & system use in mission-relevant context

How Agentic AI Supports Astronauts' Space Health

Autonomous Monitoring

Continuously tracks astronauts' vital signs and environmental conditions

Personalized Interventions

Develops tailored health recommendations based on real-time data

Proactive Problem-Solving

Identifies potential health issues early and suggests preventive actions



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MMAARS Project K.I.R.K. & SpaceGuardianGPT: Pioneering Agentic AI for Astronautics

Project K.I.R.K. (Kindness, Integrity, Resilience, Kinship)

Crew-level Agentic AI network fostering empathy, emotica reigation, ethical reasoning, and collective intelligence models

SpaceGuardianGPT

Personal AI companion tailored to psychological and cognitive profiler during isolation, Enabling adaptive dialogue, mission reflection, and self-optimization through AI empathy engines

Pioneering Contribution

First integrated framework uniting multi-agent emotional AI and ethical ecision systems for analog and spaceflight crews under mas and deep space missions

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DIGITAL TWIN & PRECISION MEDICINE



VASTX

A Digital Twin
a virtual replica of
an astronaut
continuously
synchronizing with
their physical state

Precision Medicine

A tailored healthcare
approach based on
individualized data
to optimize
astronaut health
and performance



Virtual Astronaut Simulation for Therapeutics and Exploration

*Enabling safe space exploration through
adaptive AI precision, predictive,
preventative, personalized pharmacology
powered by Digital Twins*

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AR/XR for Mental Health and Behavioral Resilience in Space



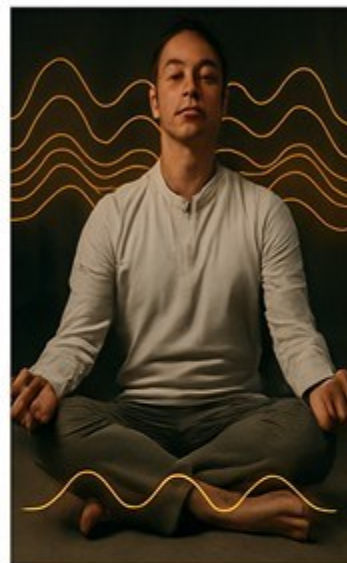
Augmented reality (AR) and extended reality (XR) experiences blend the real and digital world to improve and mitigate mental health issues by enhancing cognitive abilities and strengthening behavioral resilience.

Applications in Analog Missions



Sleep: Delta & 432 Hz

Using deep Delta brainwave entrainment combined with 432 Hz tones to promote restorative sleep during high-stress, confined missions



Anxiety: 528Hz + Breath

Pairing 528 Hz "love frequency" sound therapy with controlled breathing to reduce anxiety and maintain crew emotional stability.



Fatigue: Gamma (40Hz)

Stimulating brain activity with 40Hz Gamma tones to boost alertness and cognitive performance in long duration mission tasks.



Conflict: Alpha Group Sync

Synchronizing team Alpha brainwaves through shared sound sessions to improve cohesion and reduce interpersonal tension.

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Translating Space Medicine to Planetary Health

3D Bioprinting of Organoids



Microgravity enhances tissue printing for regenerative medicine

Disease Modeling in Microgravity



Organoids and cellcultures reveal new targets for drug discovery

AI & Telemedicine



Space-derived medical autonomy improves remote

ca

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A FUTURE OF LIVING IN SPACE

Integrative space health, agentic AI, and precision medicine are redefining how humanity adapts, survives, and thrives beyond Earth.

Through the fusion of biological insight, intelligent systems, and human-centered design, we are creating sustainable frameworks for interplanetary life – where astronauts evolve from explorers to pioneers of a multi-planetary civilization.

The journey to the stars begins within – where science, technology unite to shape the future of human evolution.

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THANK YOU
Q & A

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