

Department of Biomedical and Neuromotor Sciences  
Alma Mater Studiorum - University of Bologna

# Soppressione metabolica prolungata: stato dell'arte, prospettive e applicazioni

Matteo Cerri M.D., Ph.D.

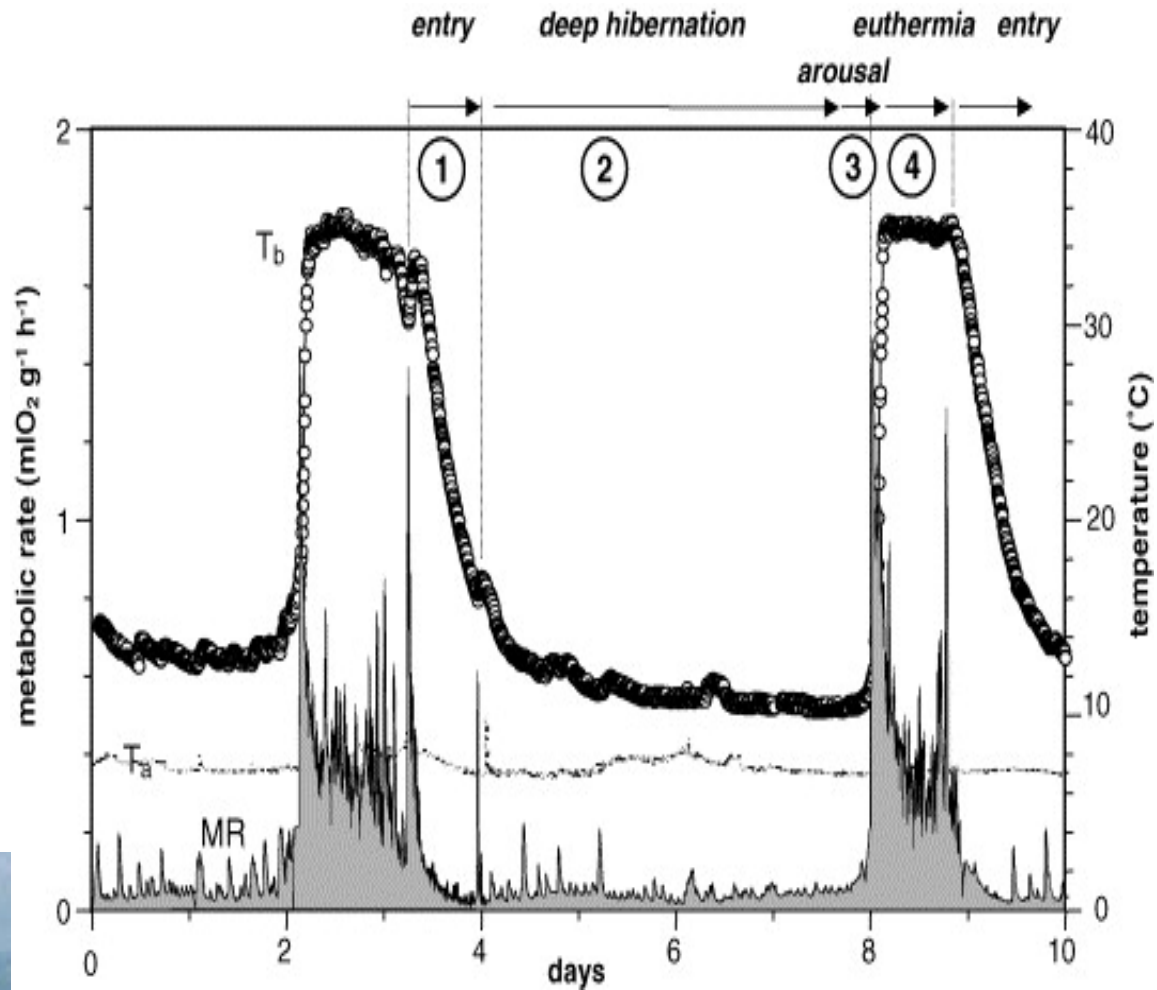


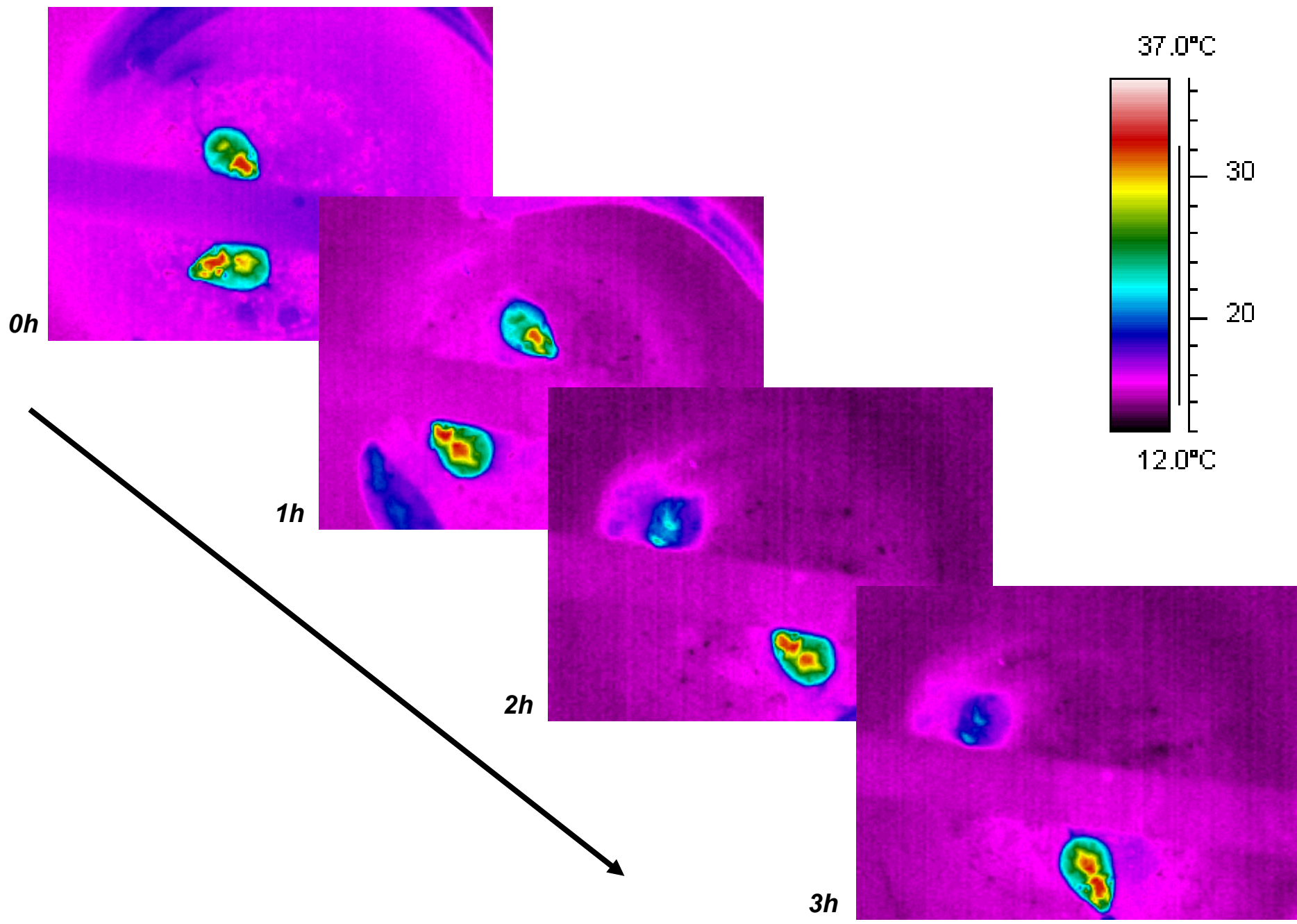
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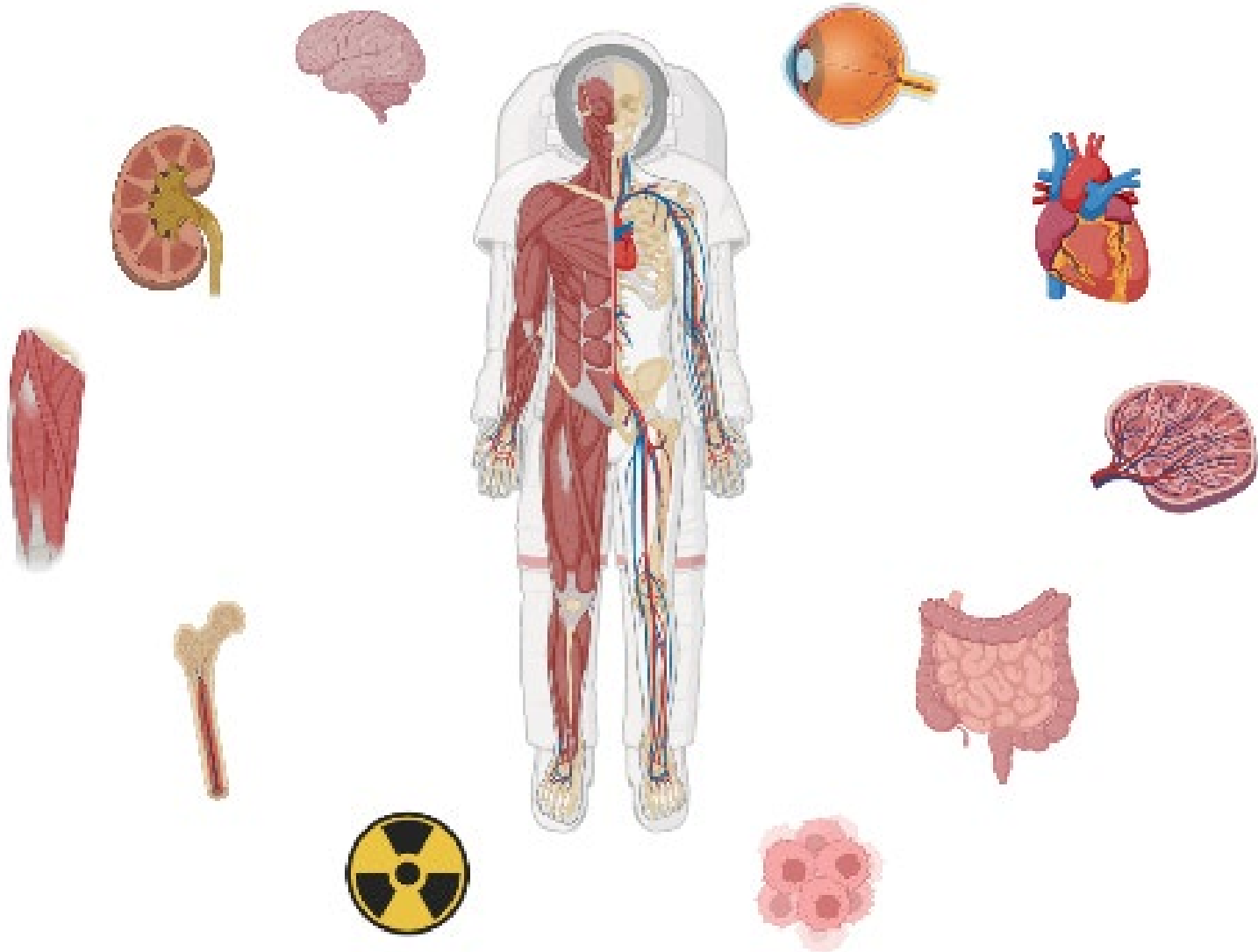
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# Che cosa è l'ibernazione?

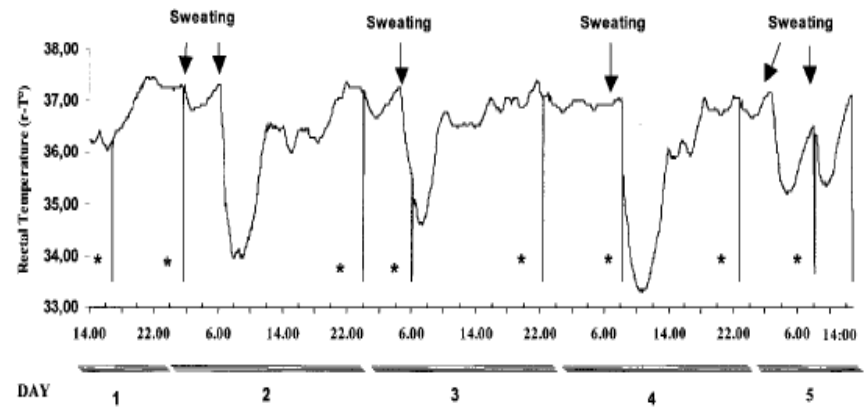
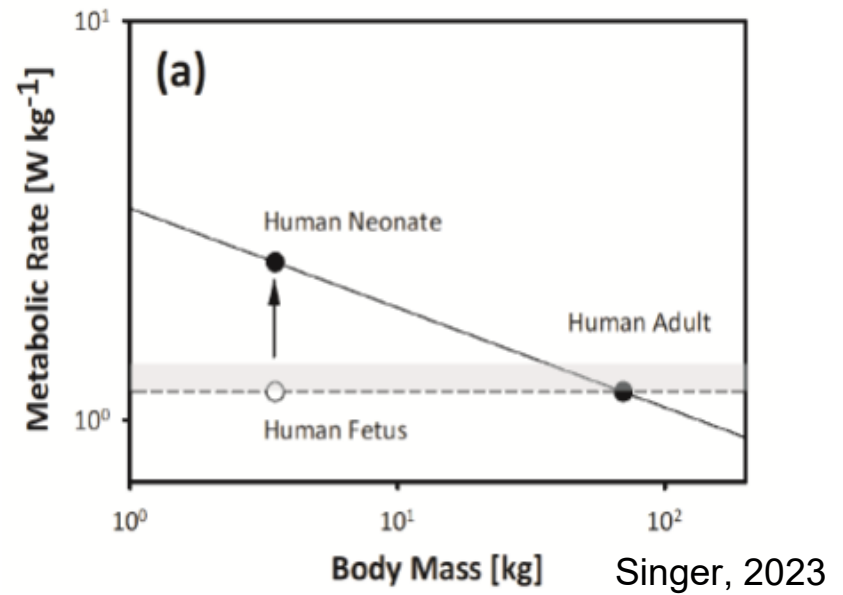




# L'ibernazione come contromisura all'esposizione prolungata nello spazio



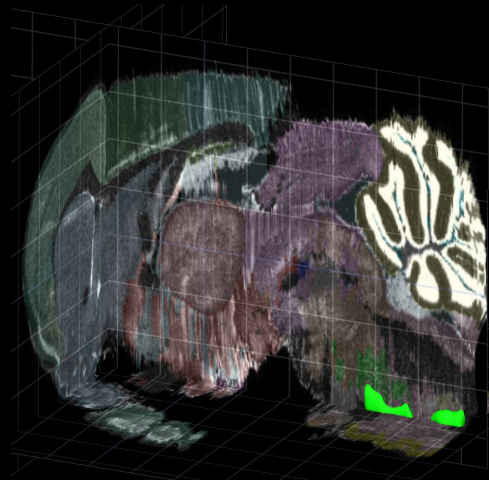
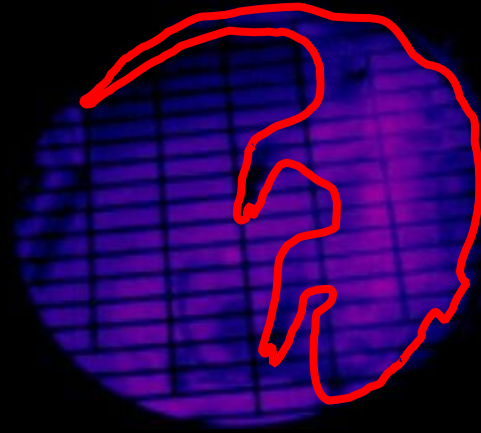
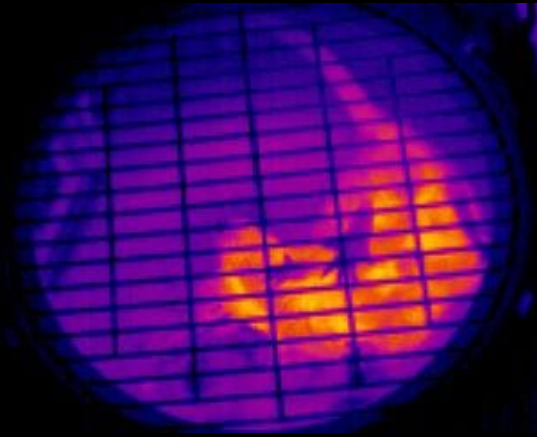
# Casi di ibernazione umana nella letteratura medica



Magnifico et al., 2022



# Sviluppo tecnologico



**Raphe Pallidus**

# Team e risorse

## advanced concepts team biomimetics



ESA

PREPARING FOR THE FUTURE

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## HIBERNATION



Hibernaculum

Prolonged human presence in space has been studied extensively only in Earth orbiting space stations. Manned missions beyond Earth's orbit, require addressing further challenges: e.g. distances exclude effective tele-operation; travel times, distances and the absence of safe abort and return options add physiological stress; travel times require novel closed-cycle life support systems; robotic extravehicular activities require the development of hardware for semi-autonomous exploratory, inspection and maintenance tasks, partly tele-controlled by human operators inside the spacecraft. These few examples suggest that if the endeavour of interplanetary manned spaceflight has to become a realistic future possibility, the technological support to astronauts

will need to be substantially developed.

## TOPICAL TEAM ON HIBERNATION

The Future Technology Advisory Panel has been created in order to identify 'enabling' technologies; these technologies shall enable the potential for scientific discoveries and breakthroughs in future science missions for ESA. The FTAP prepares recommendations to ESA's Directorate of Technical and Quality Management regarding enabling technologies for future science projects and on potential actions to implement with respect to these technologies.

Within its mandate the FTAP has identified the controlled use of TOPOR & HIBERNATION as a possibly game-changing technology for human spaceflight. It is conceivable that lowering the metabolic rate of Astronauts would not only lead to reduced consumption of air, water and food supplies, but it might also

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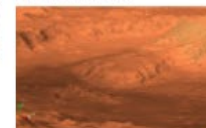
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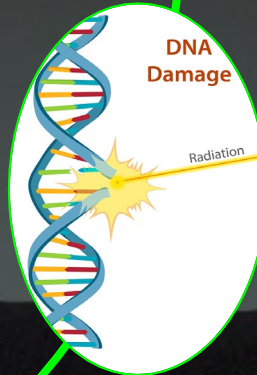


### What is hot ...



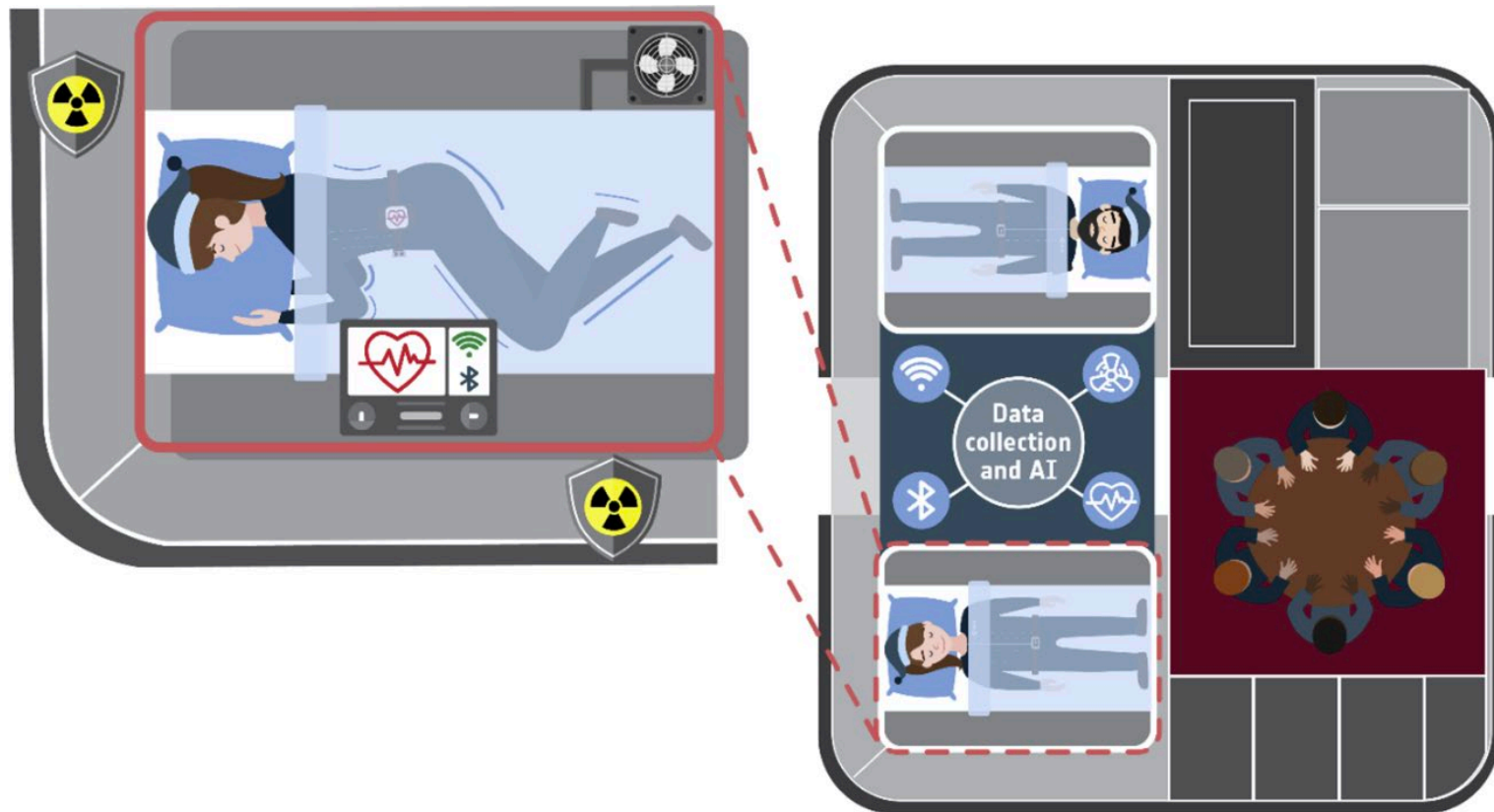
Visualisation of Mars Express Datasets using Immersive Virtual Reality

# Multidisciplinarietà e trasferimento tecnologico





# Ricadute scientifiche in ambito spaziale



Choukér et al.,

European space agency's hibernation (torpor) strategy for deep space missions: Linking biology to engineering

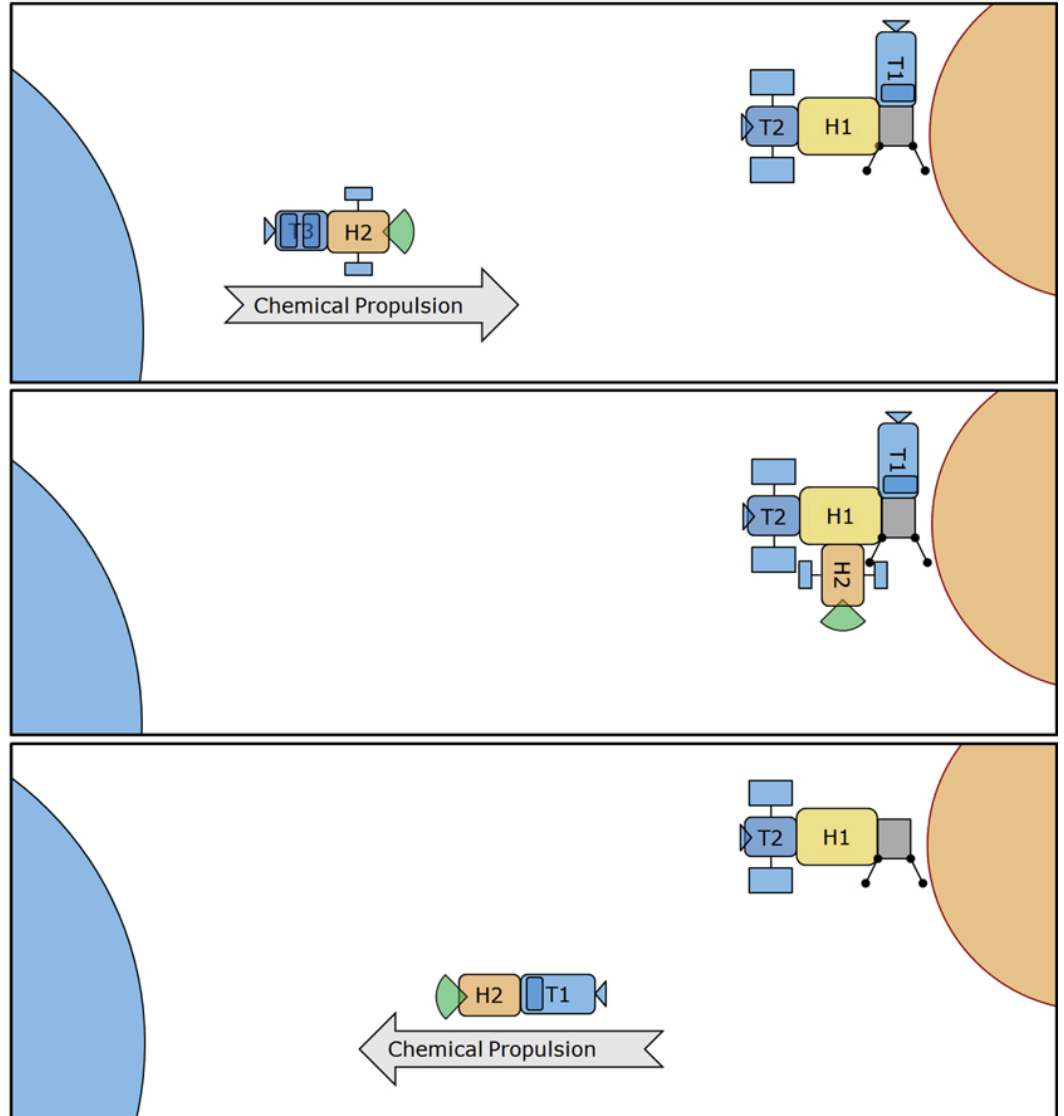
Neurosci Biobehav Rev. 2021 Dec;131:618-626.

Cargo and Mars habitat H1  
launches  
(prior opportunity)

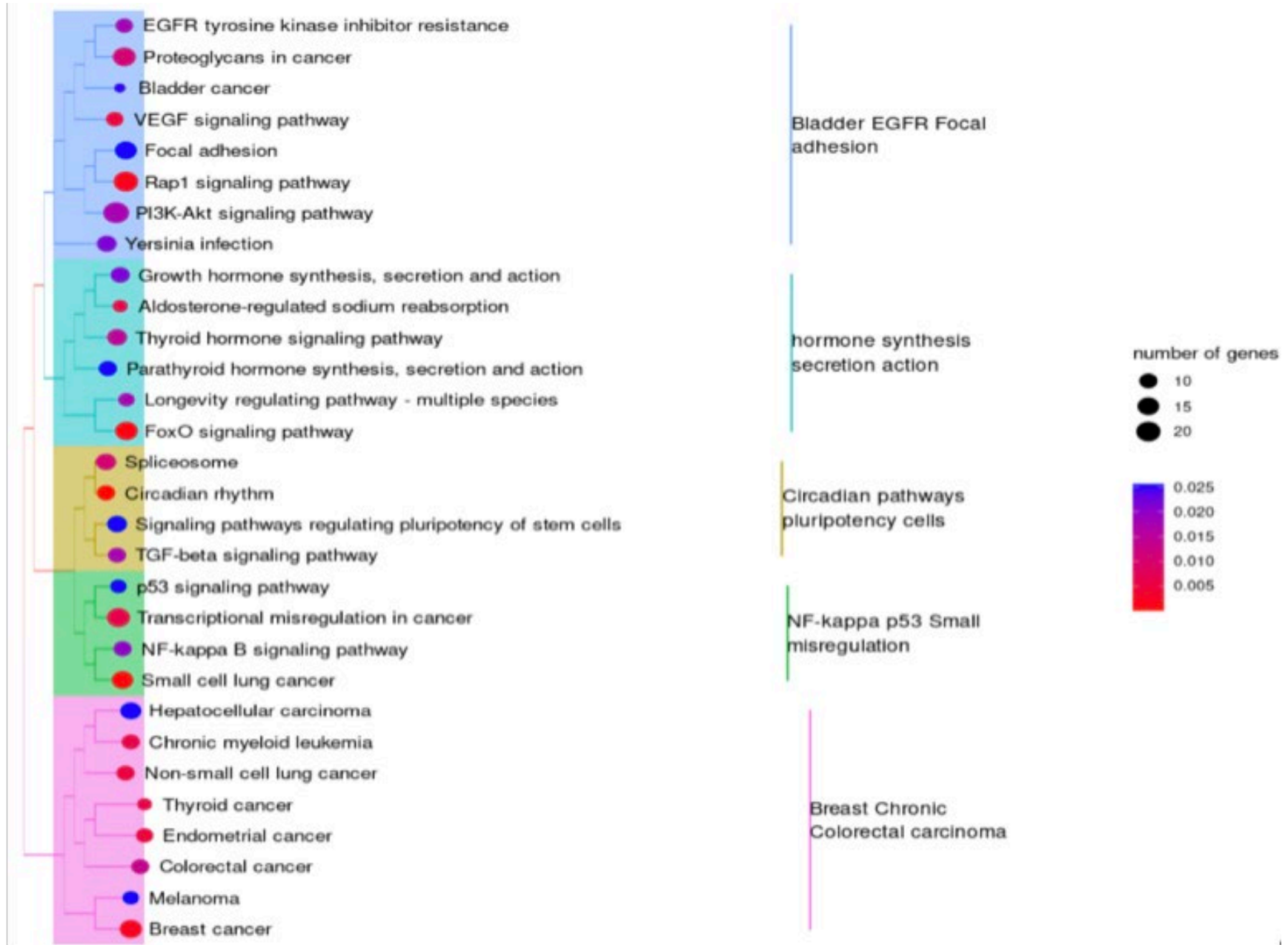
Crew and Hibernation habitat H2

Mars stay  
(including surface stay)

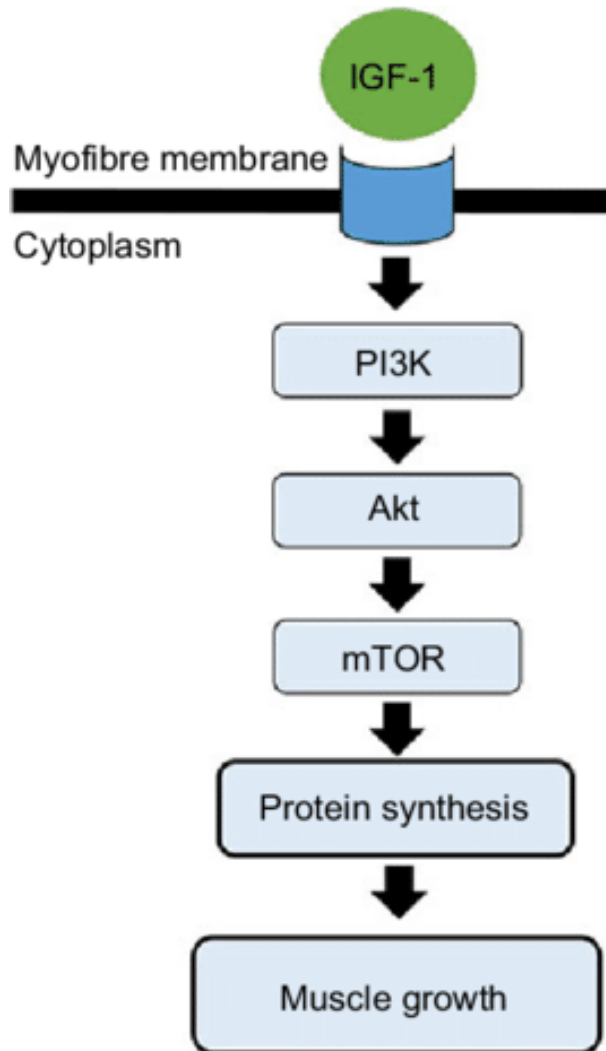
Earth return



# Adattamenti molecolari del muscolo scheletrico al torpore sintetico

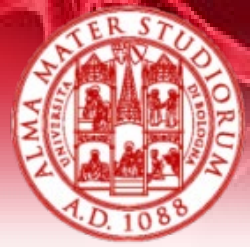


# PI3K-Akt



PI3K-Akt, whose activation (following exercise, insulin or focal adhesion stimulation) is responsible for the **muscular protein biogenesis**. At the same time, PI3K-Akt triggers the suppression of the muscular catabolism proteasome-mediated by phosphorylating, and thus inhibiting, FoxO. The balancing between muscular anabolism and catabolism (and thus PI3K-Akt and FoxO signaling pathways) seems to be one of the key processes allowing hibernating animals, which experience long periods of immobility, the avoidance of muscular atrophy.





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# Grazie per l'attenzione

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