

Improving Health Span in Space and on Earth

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Knowledge for Tomorrow



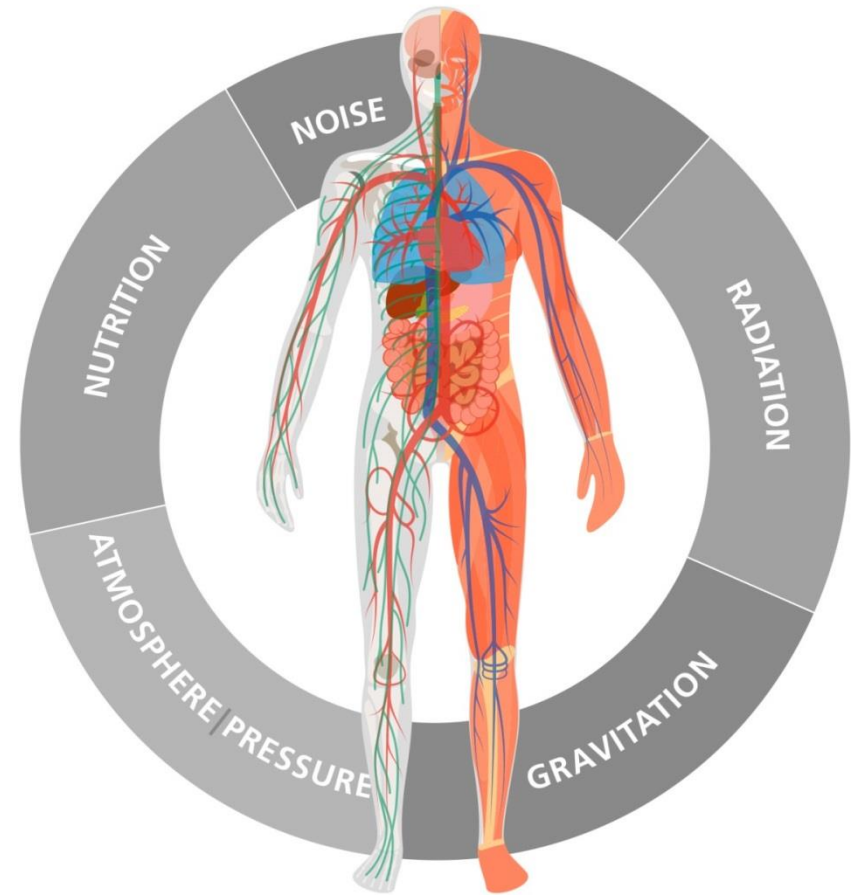
Environmental Influences on Human Health

Nervous system and
behavior

Musculoskeletal system

Metabolism

Cardiovascular system



Cell ↔ Human

Organ ↔ Organ

Space ↔ Earth



Research under space conditions



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Highly controlled environments at :envihab

Highend research ward

Hypobaric chamber

Shortarm centrifuge

3T PET-MR

Physiology module

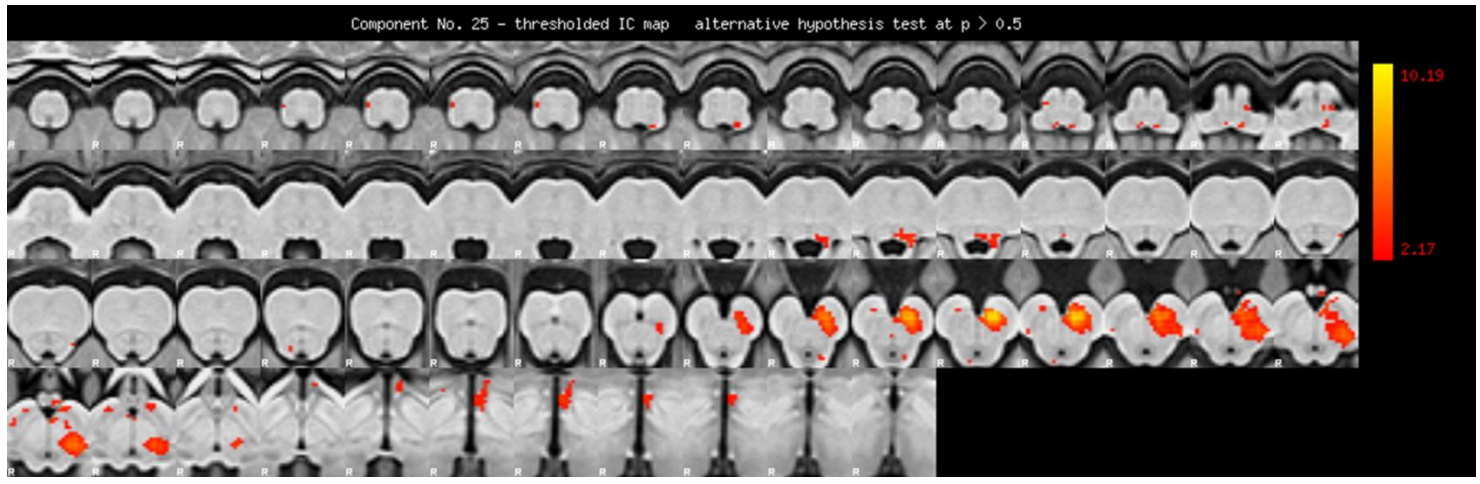
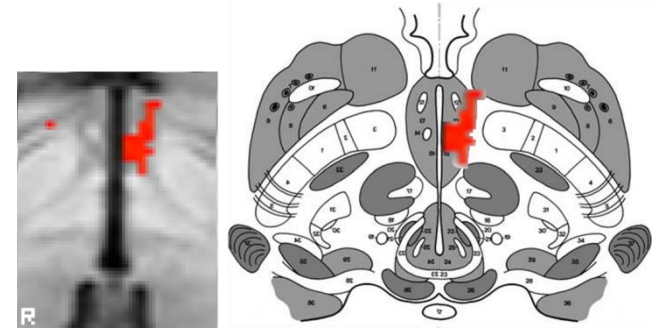
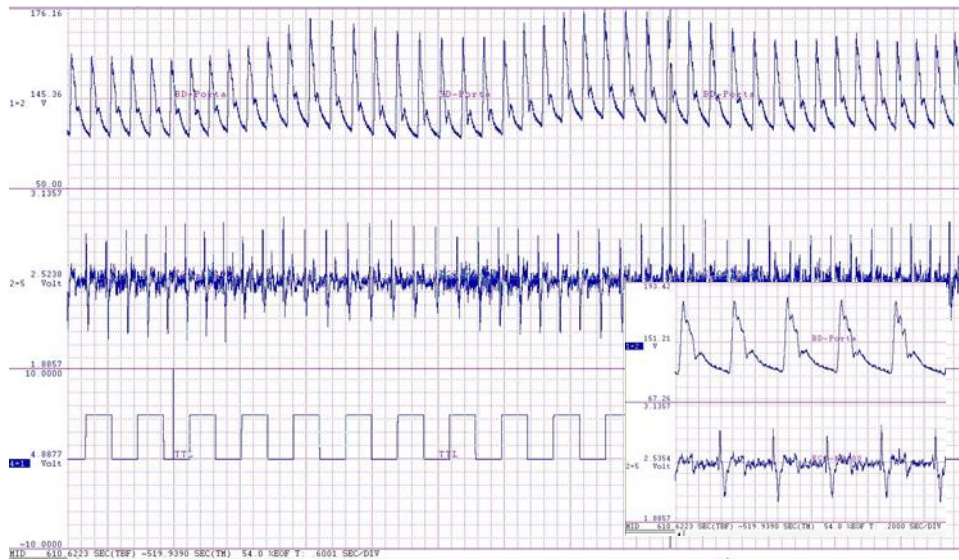
Psychology module



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Brainstem fMRI – interface to environment

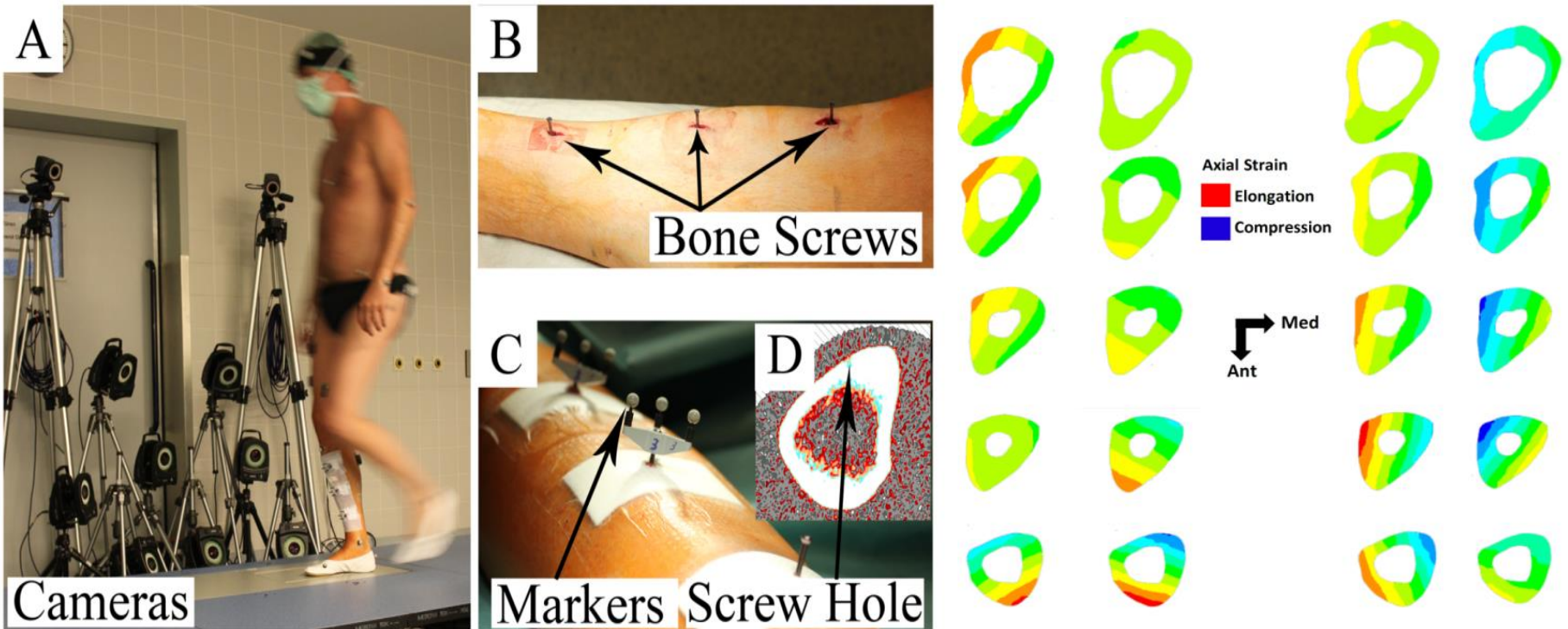


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Combating muscle and bone wasting

- Microgravity, aging, chronic disease: Muscle and bone wasting
- State-of-the-art human physiology and mathematical modeling yields stimulus-response relationship
- Rational countermeasures in space and on Earth



Combating muscle and bone wasting

Head-down bedrest as model for weightlessness



Jumps as countermeasure for bone and muscle



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Train like an astronaut – pediatric orthopedic and neurologic rehabilitation

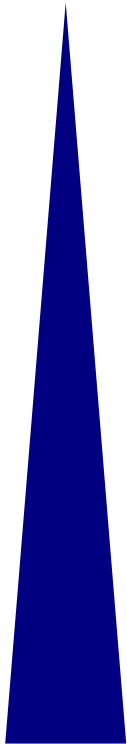


- **Studies in patients provide unique insight in human physiology**

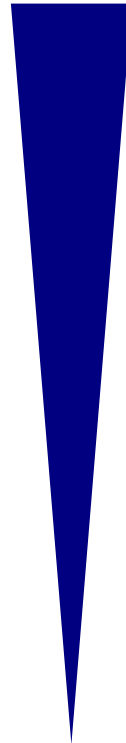


Volume shifts in weightlessness

Earth



Space



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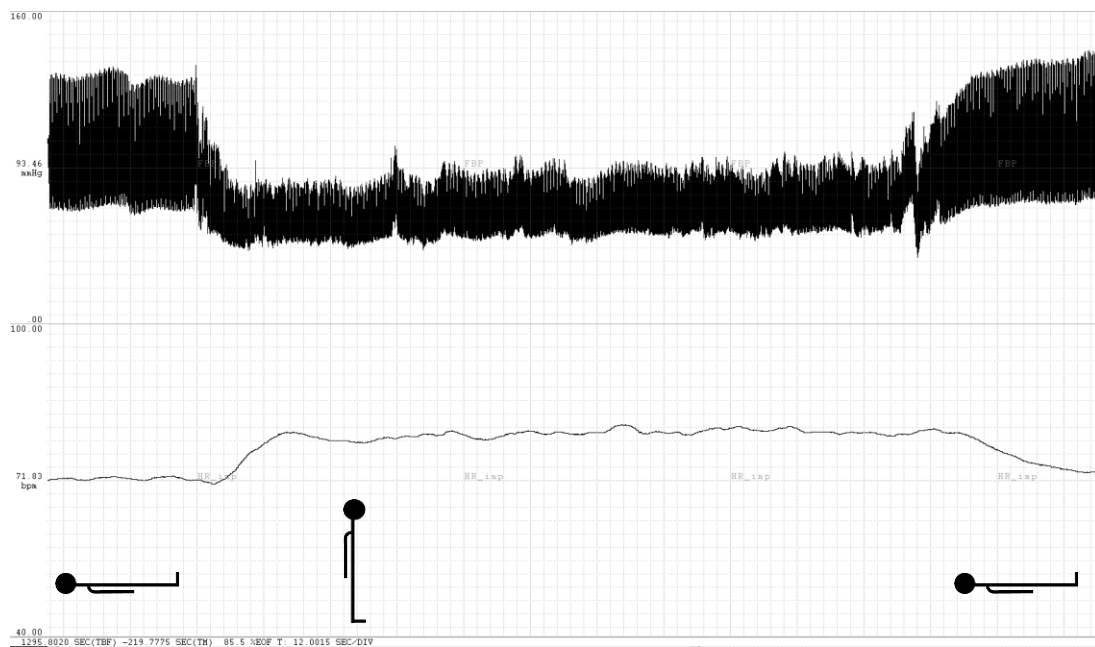
A patient who cannot stand

Autoimmune autonomic ganglionopathy

Continued symptoms on immunosuppressive therapy (plasma exchange + medications)



Mit anti-g Hose 10 min Stehen möglich

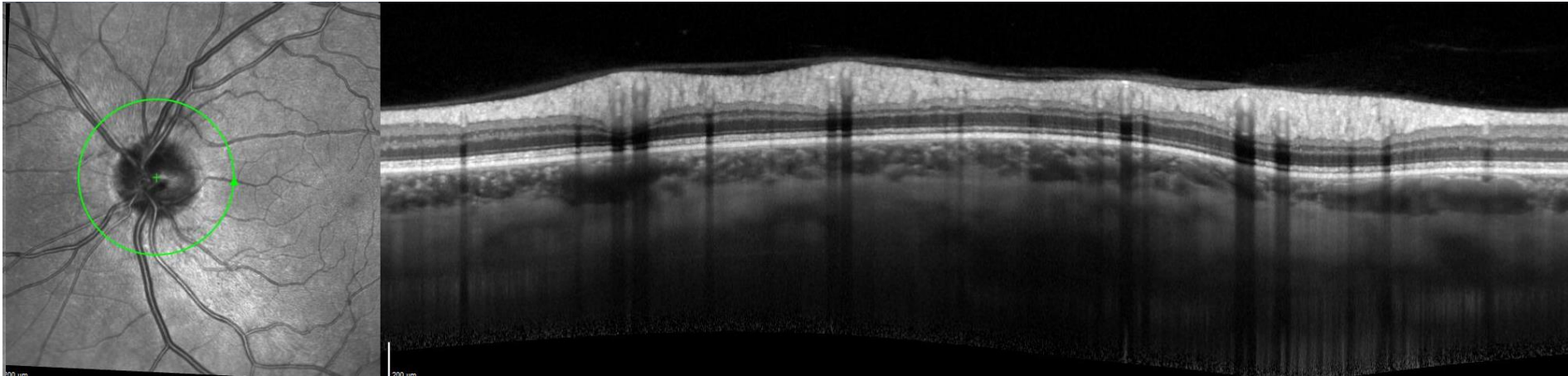


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Mitigating ocular risks in space

Space associated neuroocular syndrome



- Space associated neuroocular syndrome threatens ocular health
- NASA/DLR bedrest study - 30 days -6° headdown + 0.5% ambient CO_2
- Optical coherence tomography: thickened retinal nerve fiber layer
- Future study: testing hypergravity as SANS countermeasure during bedrest (:envihab centrifuge)



Artificial gravity as countermeasure



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Exploiting gravitation as treatment?

Open angle glaucoma

Acute mountain sickness



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Improving Health Span in Space and on Earth

- Extreme environmental conditions in space:
 - Weightlessness, altered circadian rhythms, confinement, altered atmosphere, radiation, scarce resources
- Physiological changes akin to premature ageing:
 - Muscle/bone loss, cardiovascular deconditioning, radiation damage
- Technology enables novel research methodologies and countermeasures
- **Application on earth to improve healthspan among other societal challenges**



The C.R.O.P.[®] laboratory at DLR

Addressing the liquid manure challenge

- Filter contains natural biofilm for waste degradation
- Urine and liquid manure as substrate
- Produces fertilizer
- Originally developed for closed loop life support systems in space
- Upscaling for liquid manure disposal

