

From Earth to Space: A Journey Through Radiation Biology and Human Exploration

Prof Sarah Baatout

Belgian Nuclear Research Centre, SCK CEN, Mol, Belgium

Faculty of Bioengineering Sciences, Gent University, Belgium

Catholic University of Leuven, KULeuven, Belgium

sarah.baatout@sckcen.be



Space exploration begins with people and sciences

My journey: from oncology to space biology

UCL
Université
catholique
de Louvain

MSc in Biology,
PhD in Oncology



sck cen
Belgian Nuclear Research Centre

**"Électrons libres", le
documentaire qui célèbre
les femmes scientifiques**


UNIVERSITEIT
GENT


UNIVERSITÉ
DE NAMUR

KU LEUVEN

Postdoc
Researcher in radiobiology
Head of Unit
Deputy Director in Nuclear M

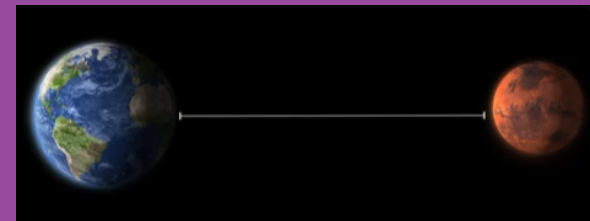
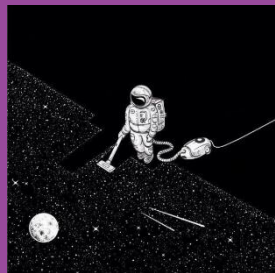


© Tous droits réservés

sck cen

Physical stresses

Psychological stresses

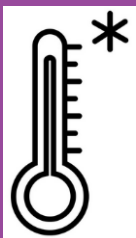


Microgravity & change of gravity fields

Radiations

Vacuum of space

Isolation & Confined Space

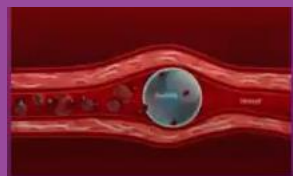


Lunar dust

T° extremes

Continuously purified atmosphere

Distance from Earth



Threat of space debris

Limited resource

Off gasing from organic compounds

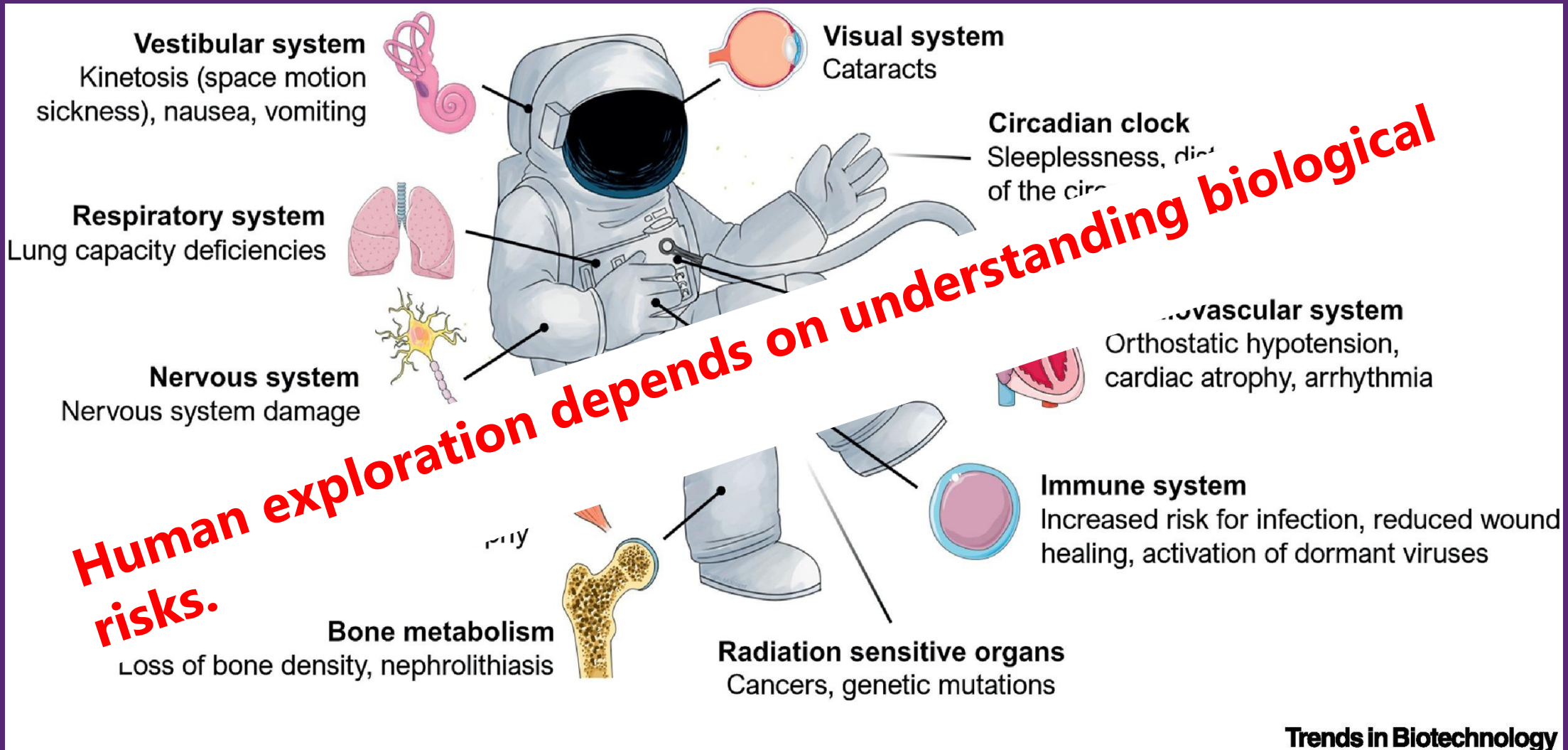
Decompression sickness

Sleep disturbances
Altered day:/night cycles

Workload



Effects of space on humans



Moroni, Rehnberg, Baatout et al, Trends in Biotechnology, 2022

Individual impact varies between astronauts.
Most effects are reversible when coming back on Earth.

Space radiation (beyond LEO) = showstopper

Solar wind

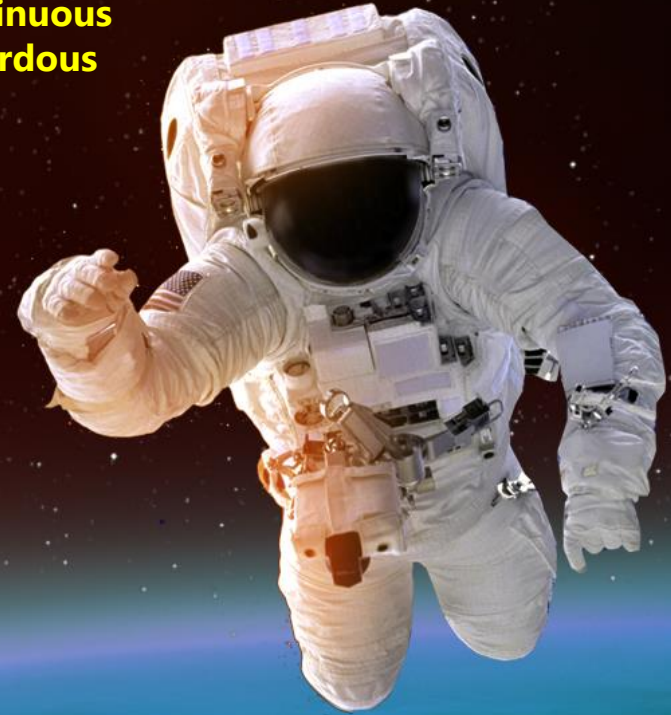
- Low energy e⁻, p⁺ & α particles
- Continuous
- Low hazard

Solar particle events

- High energy protons
- Intermittent (1-2 days)
- Very hazardous

Galactic cosmic rays

- 87% high energy protons + 12% alpha particles
- Heavy ions <Fe, 100s Mev to 1 GeV
- Continuous
- Hazardous





Human Space Exploration Moon & Mars

Connecting nuclear sciences & space exploration

- Space health research
- Ground-based simulation studies
- International collaborations
- Translational value for medicine on Earth

Which radiation & impact
Space radiation dosimetry

How to assure electronic
Radiation hard design & testing

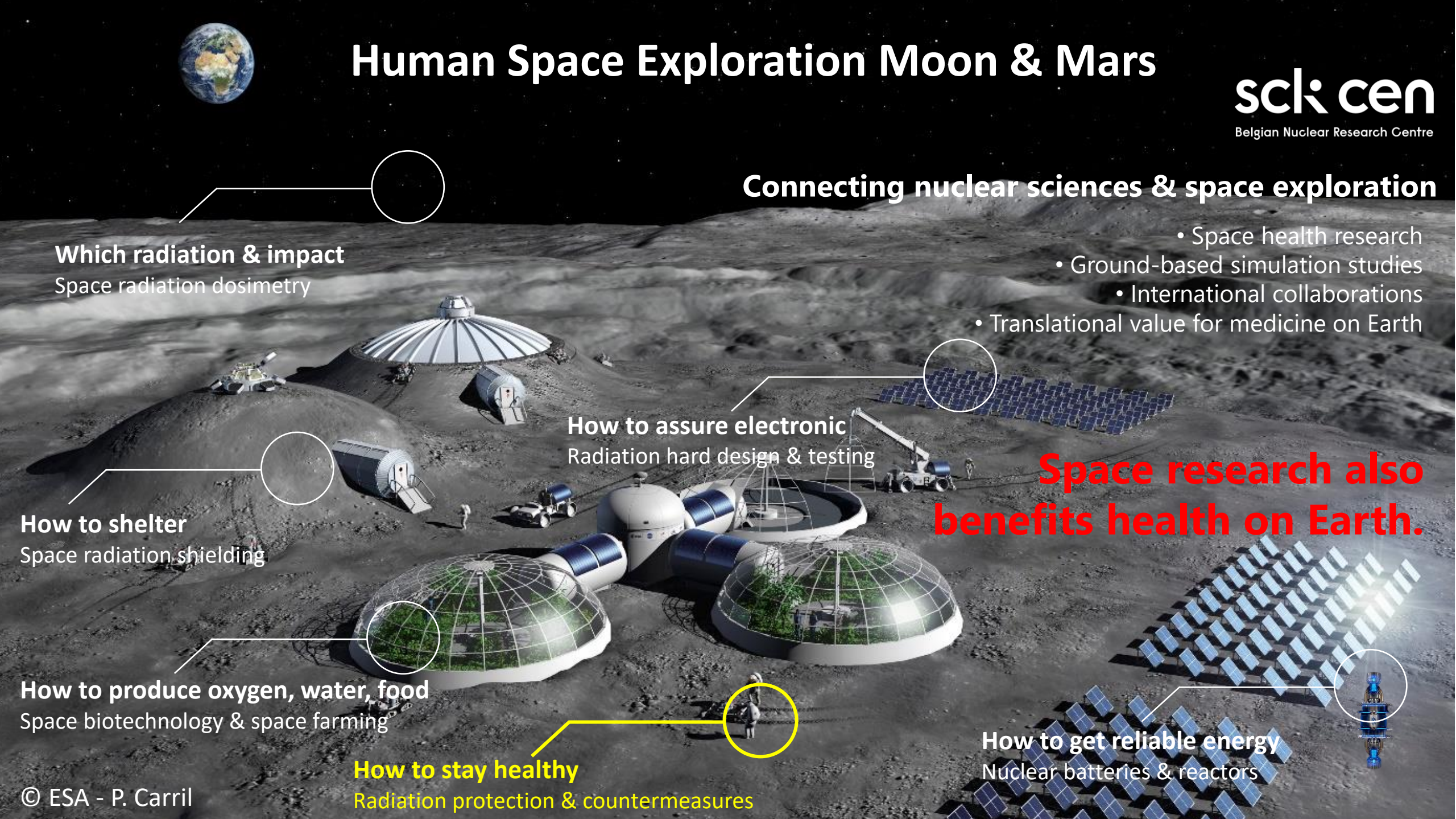
**Space research also
benefits health on Earth.**

How to shelter
Space radiation shielding

How to produce oxygen, water, food
Space biotechnology & space farming

How to stay healthy
Radiation protection & countermeasures

How to get reliable energy
Nuclear batteries & reactors



Women in Science and Space

- Positive evolution over recent years
- Increased visibility and leadership roles
- Diversity strengthens science
- Importance of:
 - mentoring
 - role models
 - equal opportunities
- **Talent should never be constrained by gender.**



From top left to right: Caroline Herschel, Katherine Johnson, Samantha Cristoforetti, From bottom left to right: Helen Sharman, Claudie Haigneré, Valentina Tereshkova.

Training the next generation in Space Sector



- Supervision of MSc and PhD students
- International teaching activities
- Interdisciplinary education
- Collaboration between:
 - academia
 - research institutes
 - agencies
 - industry

Future challenges cannot be solved in isolation



Looking ahead

- Space exploration is a multidisciplinary challenge
- Science and education drive innovation
- Partnerships create impact
- Curiosity and ambition *together*.



*The future of space exploration will not be built
by one discipline or one institution,
it will be built by people working together.*

Thank you

