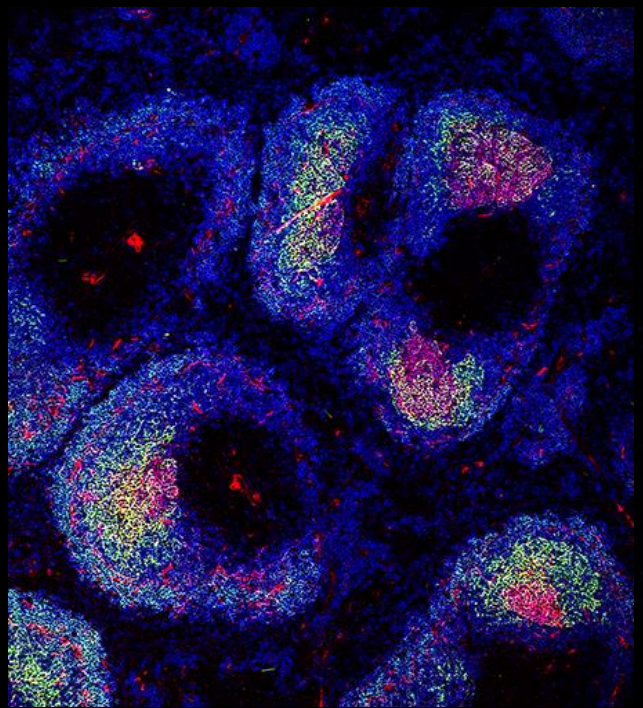
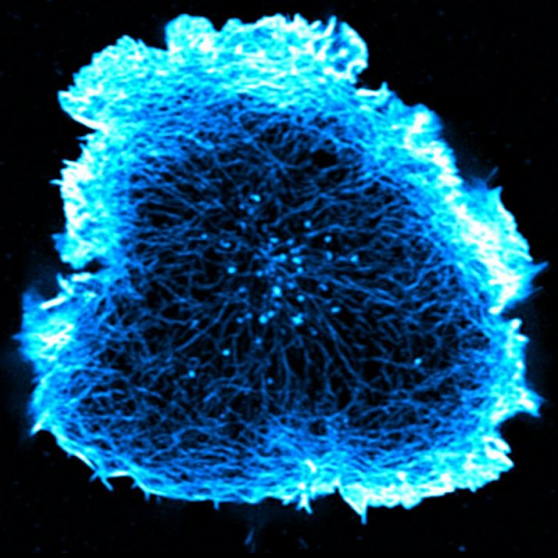
Understanding immune deficiency in extreme environments

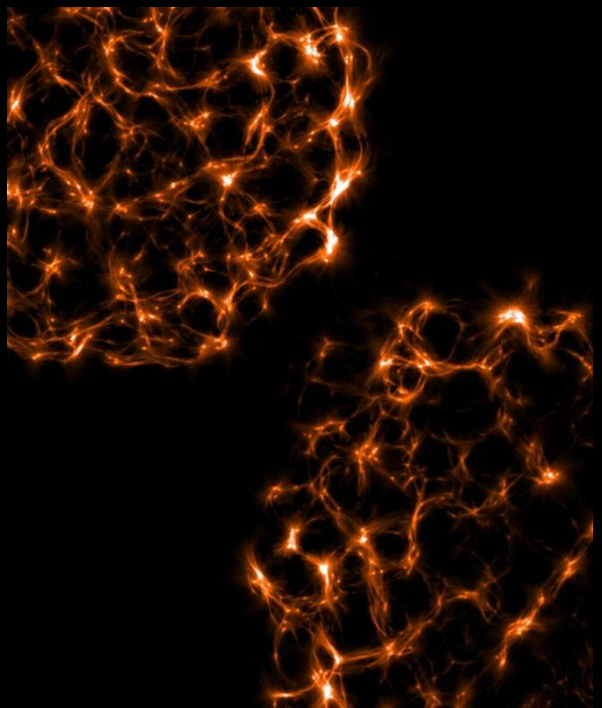
Lisa Westerberg, Ph.D.

Karolinska Institutet

Dept of Microbiology Tumor and Cell Biology







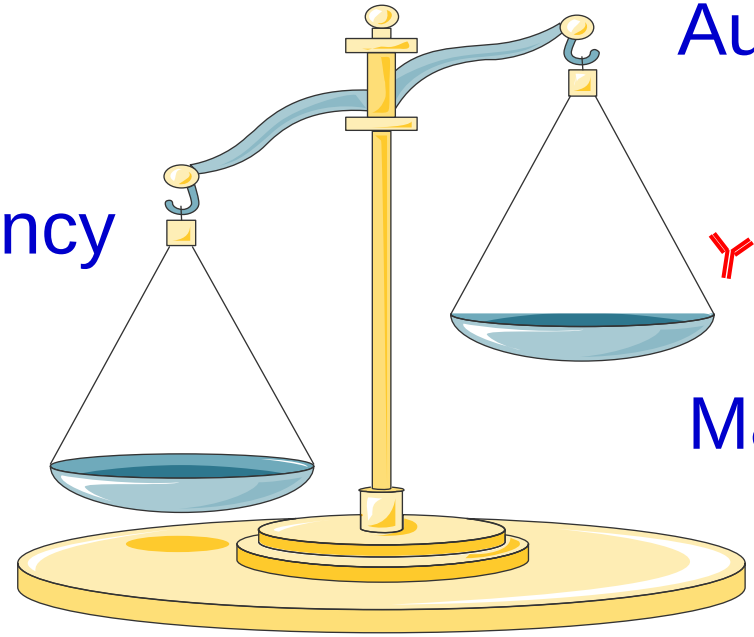
Primary immunodeficiency diseases

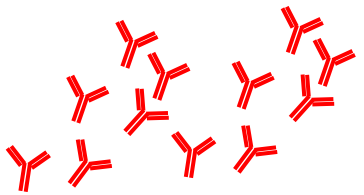
Inborn errors of immune cells – most often monogenetic mutations

Autoimmunity

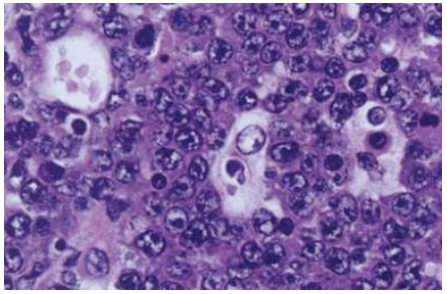
Immunodeficiency

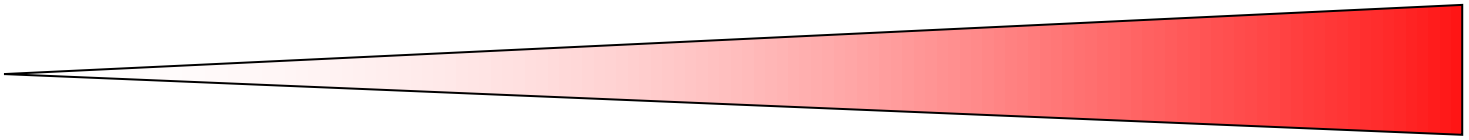
Boy with
Wiskott-Aldrich syndrome





Malignancies





Activity of actin regulators

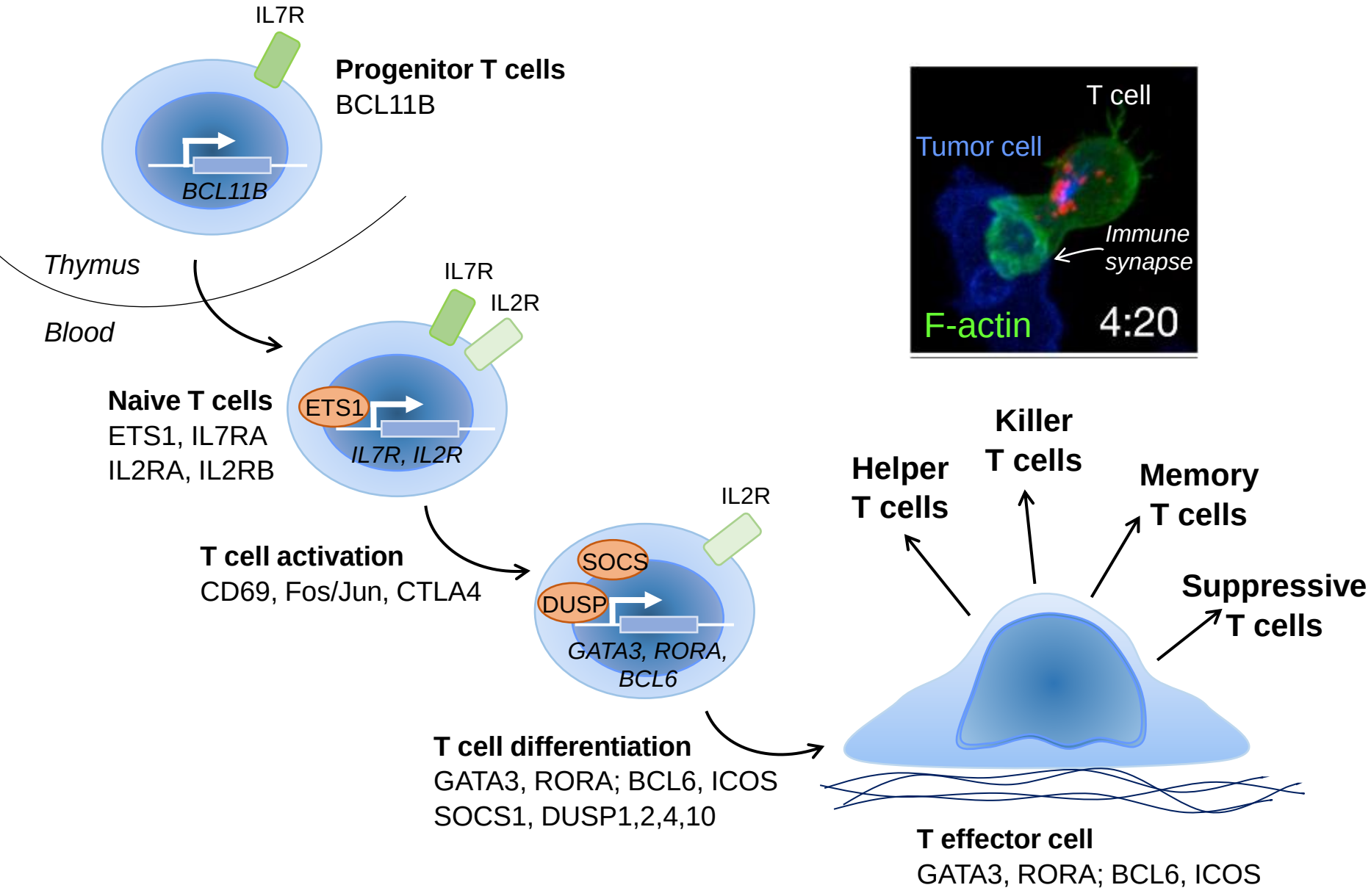
The immune system during space flights - induced immune deficiency?

Recurrent Infections
Reactivation of latent virus

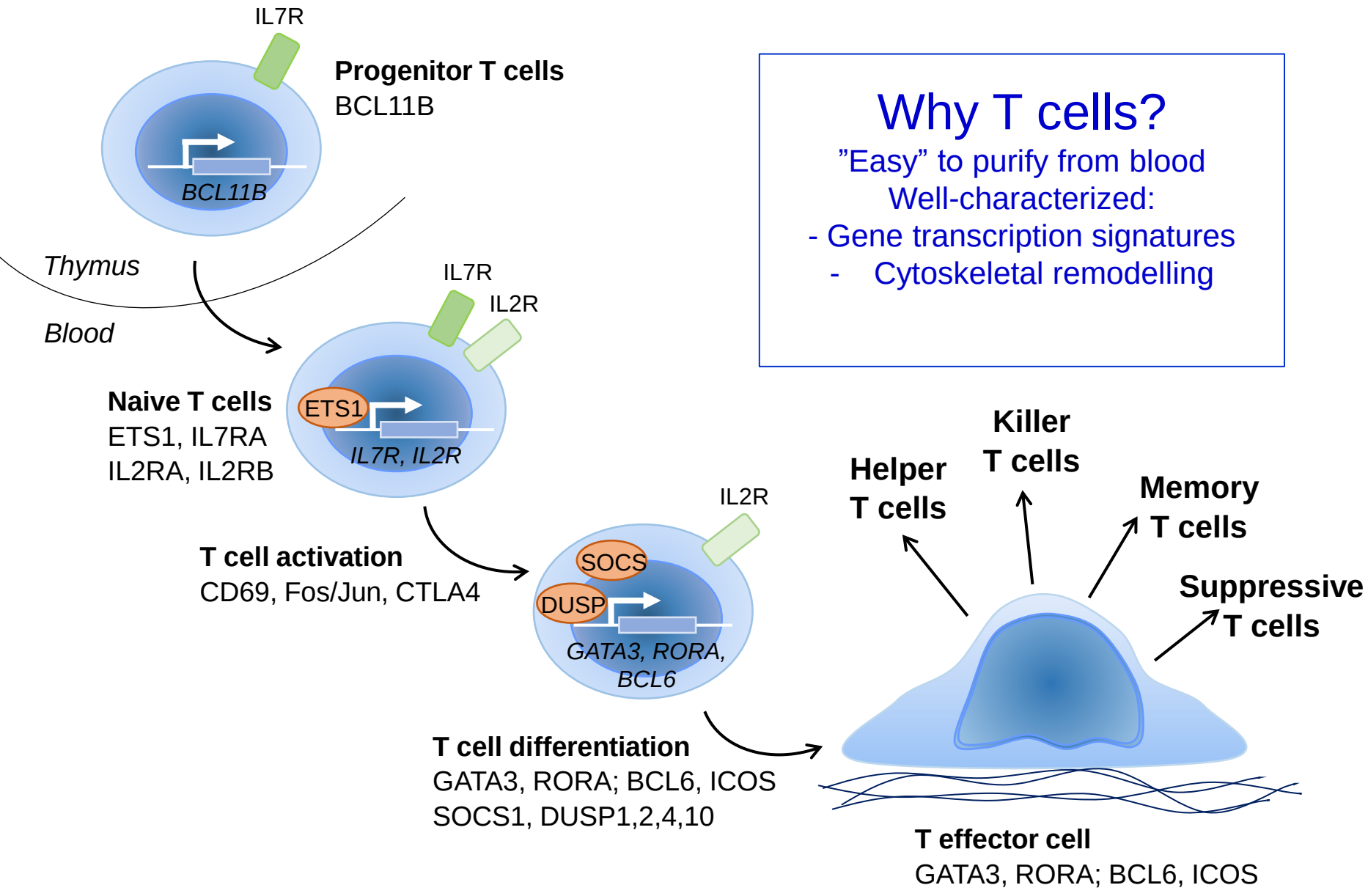
Eczema
Autoimmunity
Cancer
(Radiation)

Crucian et al, Frontiers Immunol 2018

T cell development, activation, and differentiation



T cell development, activation, and differentiation



Why T cells?

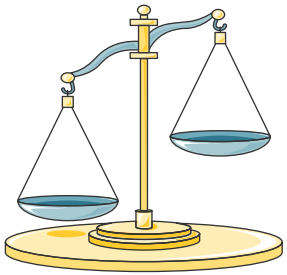
”Easy” to purify from blood

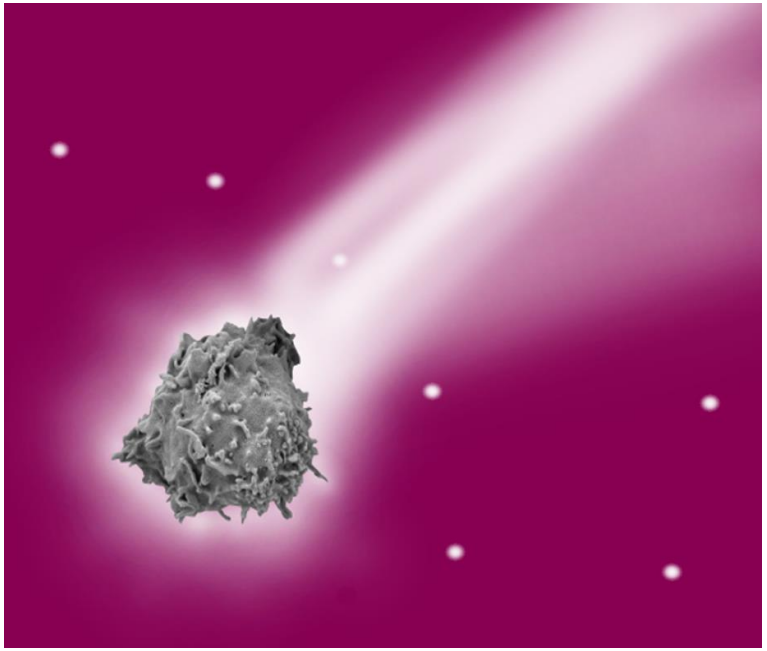
Well-characterized:

- Gene transcription signatures
- Cytoskeletal remodelling

Overall goal:

To understand the impact of microgravity during exposure (minutes – days – weeks) on the T cell cytoskeleton and signaling

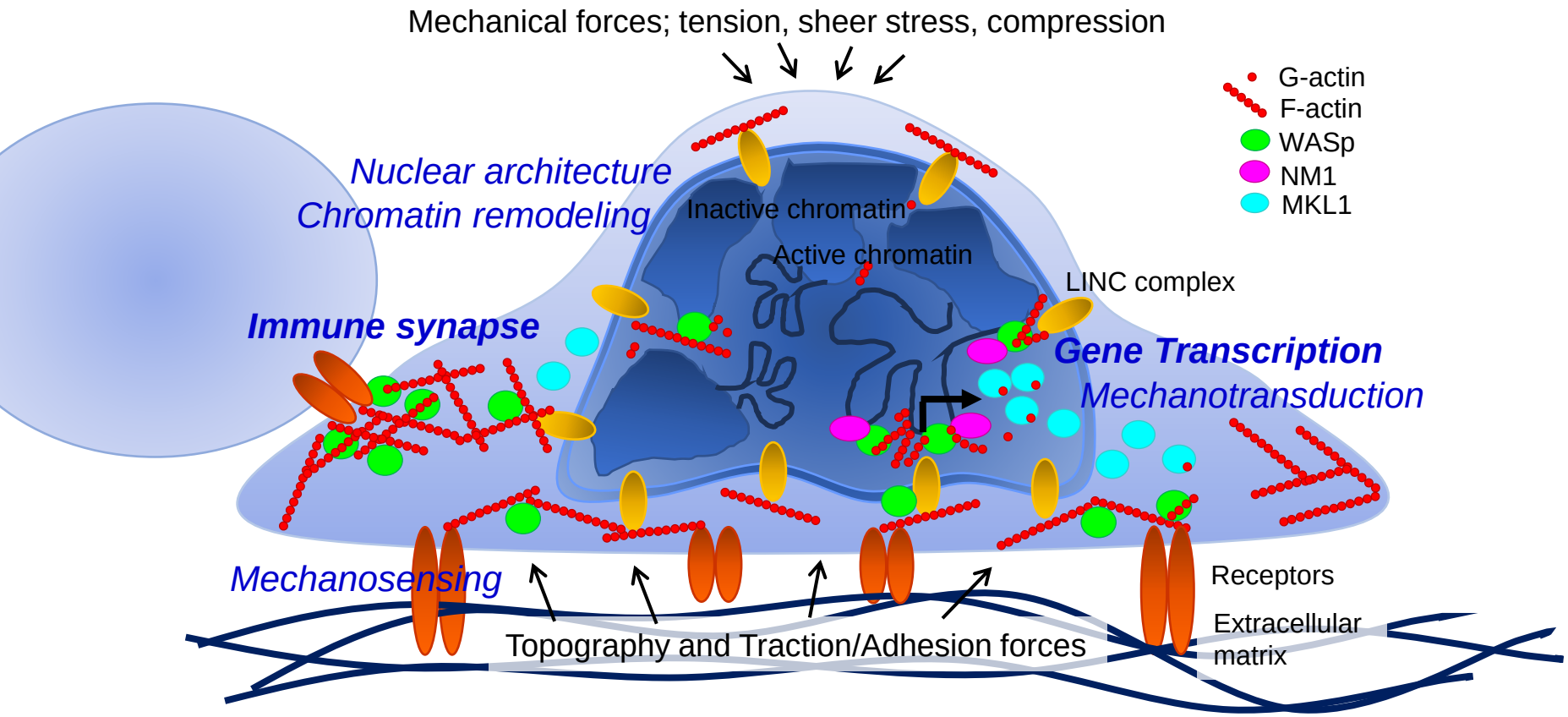




Working Hypothesis:

Microgravity leads to disturbance of the transcriptional regulation for T cell activation

Loss-of-gravity (microgravity) effects on immune (T) cells



Space Projects Westerberg lab Immunodeficiency Group

Ongoing microgravity experiments

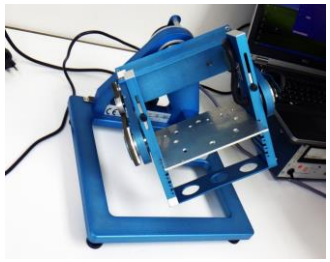
DLR, Germany

Human and Mouse T Cells

- Viability
- Kinetics
- Countermeasures

Gene-targeted cells

Status: Final analysis

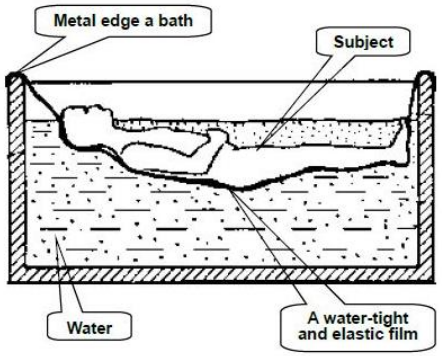


IBMP, Moscow

Human T cells

- Gene profiles before, during, after microgravity
- Functional assays
- Proteomics

Status: Final analysis



dry immersion system

Rymdstyrelsen
Swedish National Space Agency

New: ESA CORA project

T Cells In Microgravity

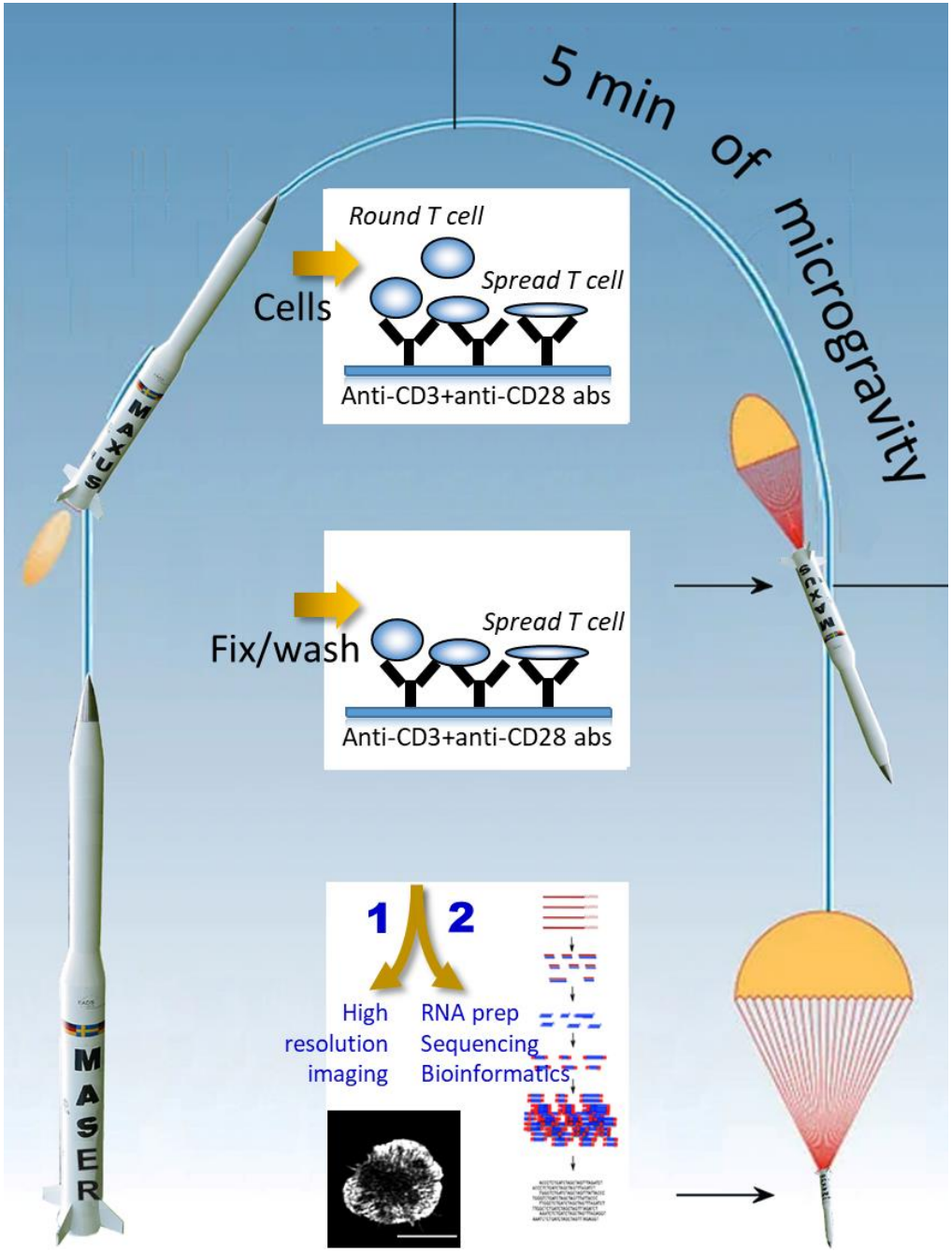
High resolution microscopy and deep gene expression profiling to find the T cell gravisensor

micACTin

Sounding rocket at Esrange, SSC

Planned launch in June 2023

Status: Assay development started



IBMP Institute of Biomedical Problems Moscow
Sergey Ponomarev

New York University Abu Dhabi
Piergiorgio Percipalle

DLR - German Aerospace Center
Ruth Hemmersbach
Christian Liemersdorf

Swedish Space Cooperation
Alf Vaerneus
Gunnar Florin

Sioux Technologies
Edwin Langerak

University College London
Adrian Thrasher
Siobhan Burns

Leuven University
Peter Vandenberghe

Moscow Childrens Hospital
Anna Shcherbina

Fiocruz Rio de Janerio
Vinicius Cotta de Almeida

Karolinska Institutet
Claudia Kutter
John Andersson
Susanne Nylén
Klas Kärre
David Lane
Liv Eidsmo

The immune system during space flights

2021 ESA Roadmaps in Physiology:
Immunology *with Sarah Baatout and Jean-Pol Frippiat*

- Study the effect on all immune cells
- Integrate immune system data – Omnics approaches (database)
- Study the interaction with the surroundings: contamination, dust, radiation
- Use diverse model systems, ground based and space platforms
- Monitor the immune system as a readout for health and disease
- Develop new technology – flow cytometry and microscopy for space

➢ **Ultimate Goal: Identify countermeasures for long space flights**

esa
European Space Agency

Rymdstyrelsen
Swedish National Space Agency