“**Sp**ace **R**adiation **I**nduced **T**umorigenesis by high **Z** particles: modeling and experimental studies” - **SPRITZ**

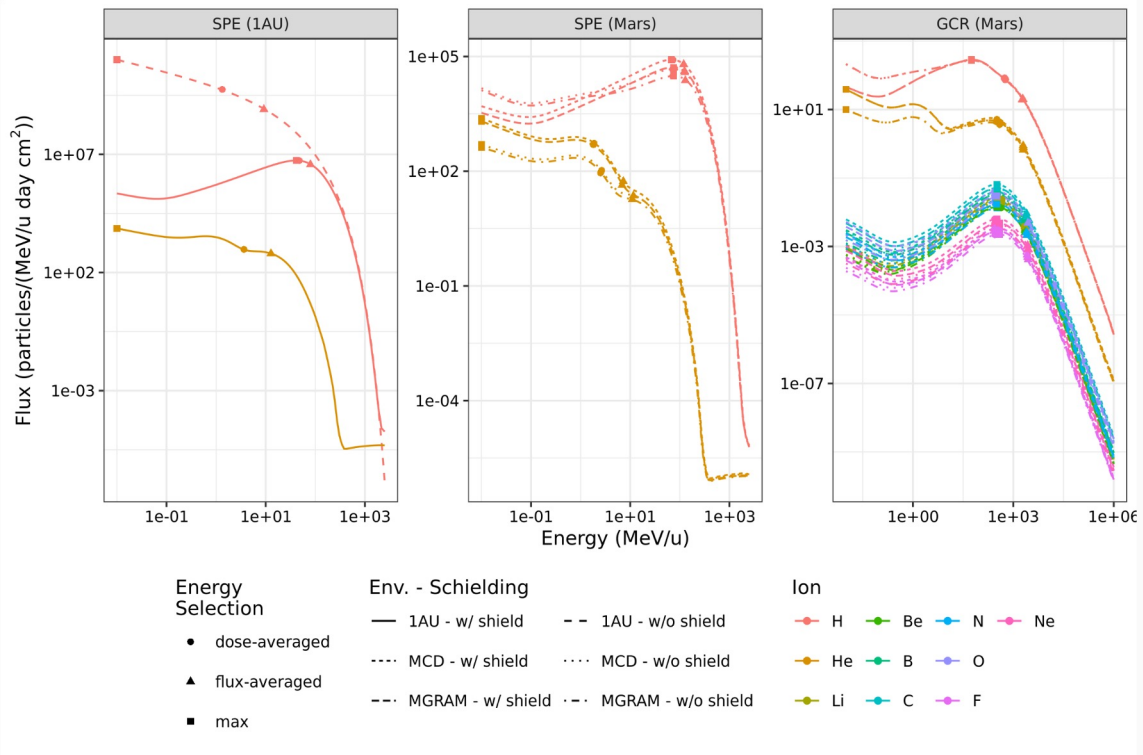
Context - Radioprotection in Space Missions

There is an ongoing research and studies to develop effective solutions and tools for the prevention and mitigation of radiation damage in space missions:

1. characterization of the radiative environment in space habitat;

1. effects of radiation on living organisms and in particular on astronauts considering also variable gravitational conditions;

1. the development and validation of tools useful for simulating and predicting these effects based on new scenarios, in order to be able to estimate the effectiveness of the proposed solutions.



Progetto MGM - ASI funding

Call: Development of projects/scientific experiments in the field of studying the effects of radiation exposure and altered gravity on biological systems, and the development of countermeasures for risk mitigation in future space exploration scenarios beyond LEO (Line A: Radiation)

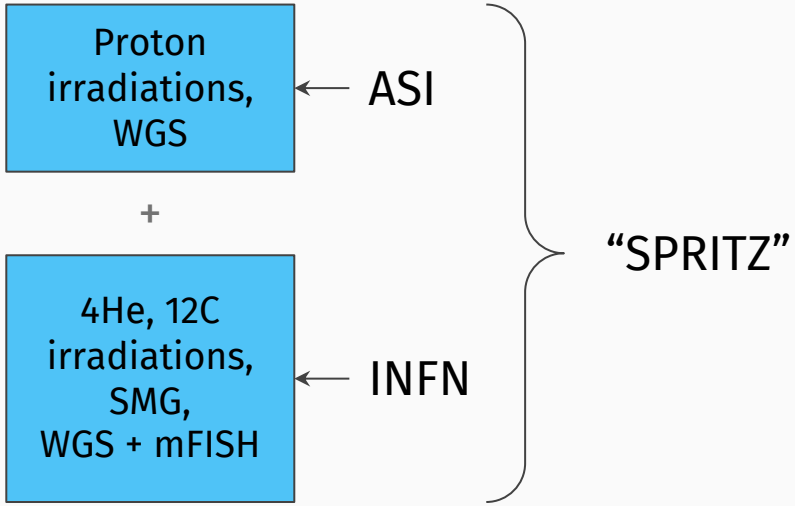
MGM (*Microdosimetric Genomic Model*): *Sviluppo e validazione di un modello microdosimetrico genomico per la predizione di mutazioni radio-indotte in ambiente spaziale*

3 year project founded with 492.977,80. €

- **[aizoOn] aizoOn Consulting s.r.l.** € 200.000,00
- **[UniTN] Università di Trento** € 49.988,20
- **[INFN] Istituto Nazionale di Fisica Nucleare (RM3, TIFPA)** € 77.216,00
- **[IRCCS] Istituto Romagnolo per lo Studio dei Tumori "Dino Amadori"** € 79.973,60
- **[AOUBO] Azienda Ospedaliera Universitaria di Bologna – Policlinico Sant'Orsola** € 85.800,00

Objectives

1. To use whole-genome sequencing (**WGS**) and multicolor Fluorescence In Situ Hybridization (**mFISH**) to characterize the genomic impact of ionizing radiation on a **healthy human cell line**. Different **particles (proton, 4He, 12C)**, **energies**, **doses** and **dose rates**, simulating the relevant conditions of habitats in space environments, will be used.
2. To mimic the space environment in terms of simulated microgravity (**SMG**) and to investigate the genomic impact combined with ionizing radiation.
3. To develop a **microdosimetric model** to evaluate the probability of DNA alterations and to predict the risk of oncological mutation under radiation exposure for varying irradiation parameters (particle, energy, dose and dose-rate) relevant in space mission scenarios.
    a. The developed model will be included in an **open source software** for potential applications in space radiation and **hadrontherapy**.



Struttura esperimento

INFN - RM3 (Phys, Bio) [RM]	Andrea Attili (RN), Francesco Berardinelli, Antonio Antoccia
INFN - TIFPA / UniTN (Phys, Bio) [TN]	Alessandra Bisio, Emanuele Scifoni, Francesco Tommasino
IBFM-CNR (Institute of bioimaging and molecular physiology) / INFN - LNS	Marco Calvaruso, Luigi Minafra, Gaia Pucci, Giorgio Russo
AizoOn [TO]	Lorenzo Manganaro
IRCCS / AOUBO [BO]	Anna Tesei, Lidia Strigari
University of Science and Technology of Oran (LAAR) [Oran - Algeria]	Dib Anis Samy Amine, Benhalouche Saadia

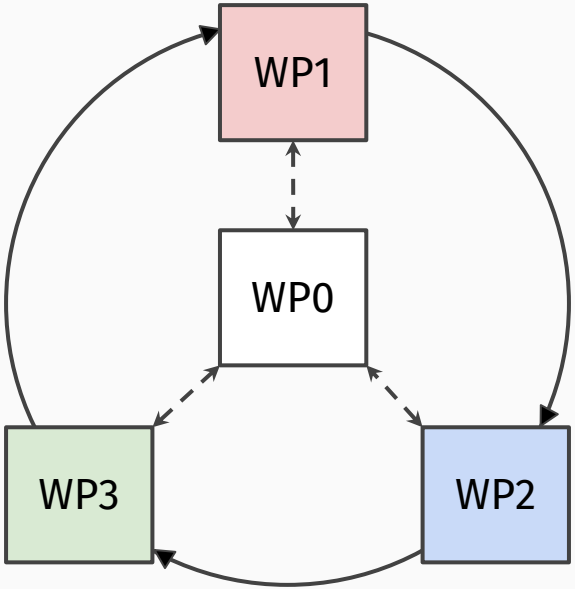
Struttura esperimento

WP0 - **Coordination, Data Management**
{RM3 (Phys)}

WP1 - **Experimental Setup, Cell Irradiation**
{TIFPA, IBFM-CNR, UniTN, RM3 (Bio)} ← {APSS, CNAO}

WP2 - **Sequencing, FISH, Bioinformatics**
{UniTN, RM3 (Bio), aiZoon, IRCSS, AOUBO}

WP3 - **Simulations, Modeling**
{RM3 (Phys), TIFPA, UniTN (Phys), LAAR}



The Campaign of Measurements @ APSS (protons) and CNAO (^{4}He, ^{12}C)

Immortalized Cell Cultures

AG01522-hTERT

Proton Irradiation

Doses: 0.5 - 2Gy
Energies 70 – 150 MeV
Dose rate: 1 Gy/min

24 hours Simulated Microgravity

Sample Recovery

Pell

Next Generation Sequencing

Proton Irradiation

Doses: 0.5 - 2Gy
Energies 70 – 150 MeV
Dose rate: 1 Gy/min

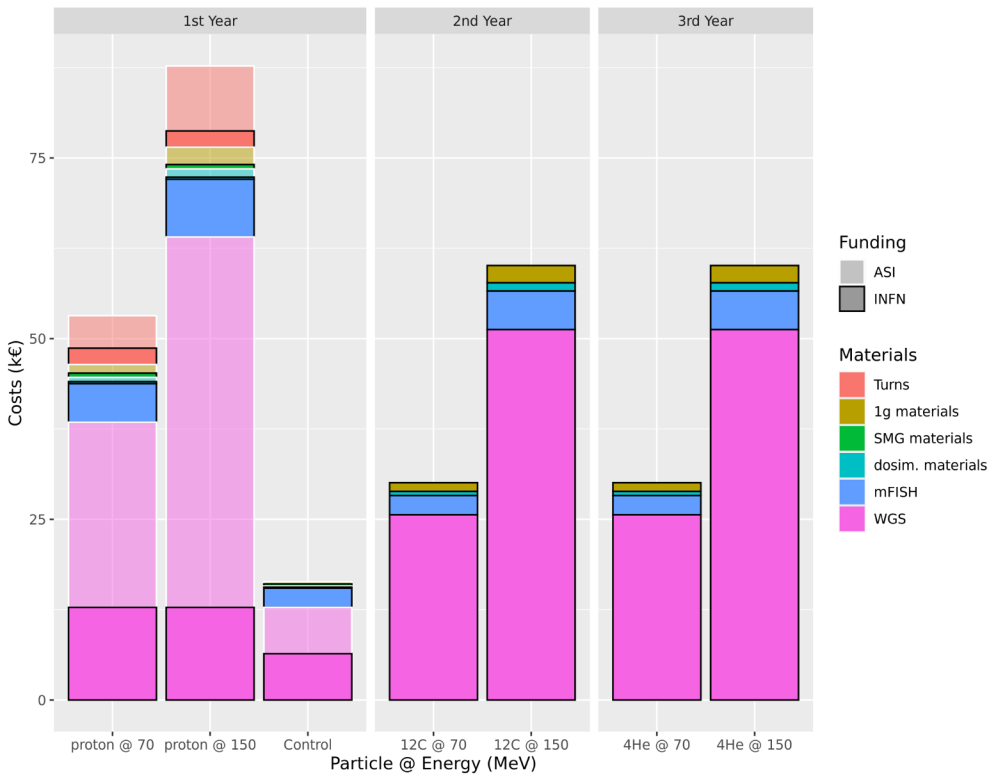
1G controls

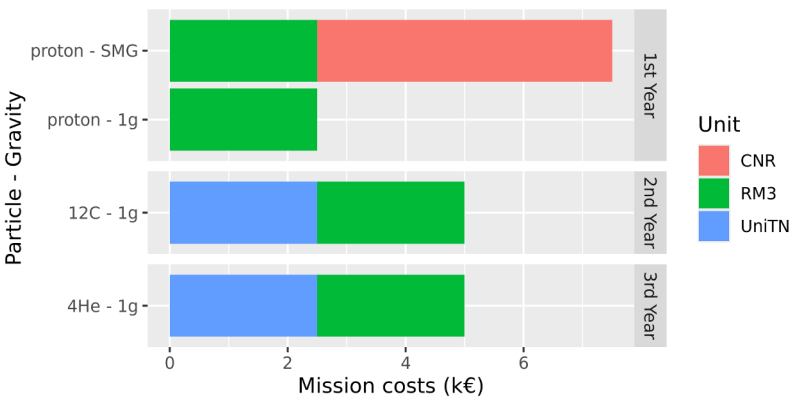
Sample Recovery

Pell

Next Generation Sequencing

Costs Estimates - Consumables & Missions





	Consumables	Missions
1st year	55 k€ (+ 102 k€ ASI)	10 k€
2nd year	90 k€	5 k€
3rd year	90 k€	5 k€
Tot.	235 k€	20 k€

FTE

- Marco Calvaruso – 0,5
- Luigi Minafra – 0,4
- Gaia Pucci – 0,5
- Giorgio Russo – 0,1