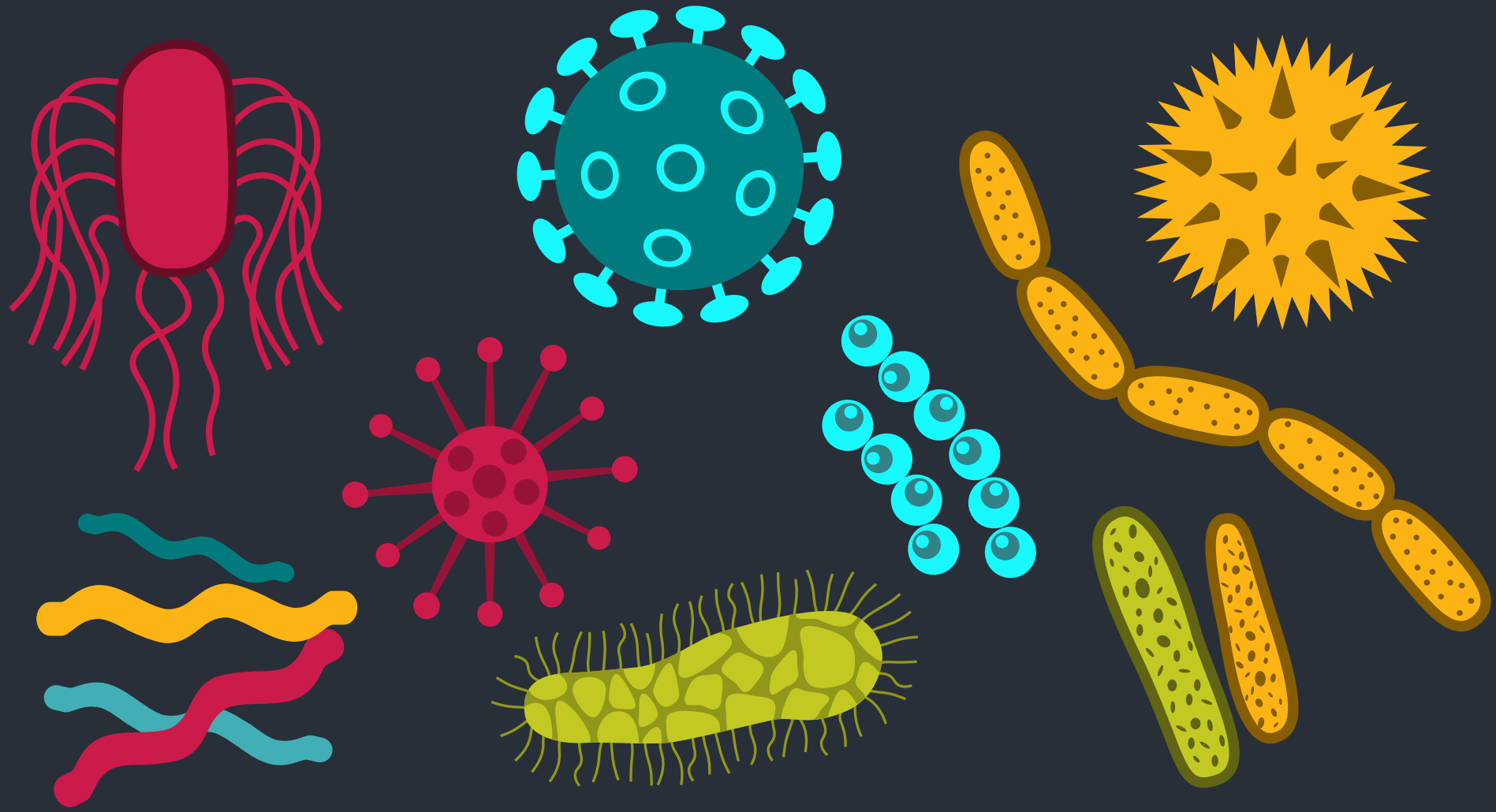

Riunione Referee
AMS Italia
Roma-Sapienza
Policlinico S.Orsola (Bologna)

Partecipazione all’unita di crisi di INFN Roma COVID-19



AMS Roma group activities in 2020/21

1. Support AMS operations at POCC-CERN
2. Research in Space Radiation (GCRs,…)
3. Research in Space Radiobiology in collaboration with Policlinico S.Orsola

https://ams02.space/collaboration/institute/infn-rome-and-sapienza-university

AMS Roma Group 2020/21

- Alessandro Bartoloni – INFN (0.9 FTE)
- Bruno Borgia – INFN & Sapienza (-)
- Emiliano Loi – Sapienza (0.5)
- Elena Solfaroli Camillocci - Sapienza (0.1)
- Miriam Santoro – Policlinico S.Orsola (0.5)
- Lidia Strigari – INFN Policlinico S.Orsola (0.7)
- Silvia Strolin – Policlinico S.Orsola (0.5)
- Vincenzo Valente – GARR Associate (-)

	FTE e Richieste (Keuro) per il 2021					
Persone	FTE	Missioni	Consumi	Servizi	Inventariabile	Totale
7	3,7	24	2	2	2	30

AMS PRL published HEP spires statistics (06/2019 vs 06/2020)

PHYSICAL REVIEW LETTERS

Highlights Recent Accepted Collections Authors Referees Search Press About

Citation summary results	***2019***	***2020***
Total number of papers analyzed:	**15**	**17**
Total number of citations:	**3300**	**4064**
Average citations per paper:	**220**	**239**
Breakdown of papers by citations		
Renowned papers (500+)	**1**	**3**
Famous papers (250-499)	**3**	**4**
Very well-known papers (100-249)	**4**	**1**
Well-known papers (50-99)	**2**	**3**
Known papers (10-49)	**4**	**4**
Less known papers (1-9)	**1**	**2**
Unknown papers (0)	**0**	**0**

Properties of Neon, Magnesium, and Silicon Primary Cosmic Rays Results from the Alpha Magnetic Spectrometer

M. Aguilar *et al.* (AMS Collaboration)
Phys. Rev. Lett. **124**, 211102 – Published 29 May 2020

Just published !

Istituto Nazionale di Fisica Nucleare

CONCORSO PER IL CONFERIMENTO

DI N. 5 BORSE DI STUDIO PER ATTIVITA' DI FORMAZIONE SCIENTIFICA

PER STUDENTI UNIVERSITARI

AMS

Proponente: Alessandro Bartoloni

Titolo tesi: Strategy for preventing radiobiological effects in space. Keyword:SpaceRadiation, AMS02, ISS, Radiobiology. Collaborating Institute:Fisica Sanitaria Policlinico S.Orsola-Malpighi ,Bologna.

Descrizione: The Alpha Magnetic Spectrometer (AMS) is the most powerful and sensitive cosmic-ray detector ever deployed in space to produce a complete inventory of charged particles and nuclei in cosmic rays near Earth in the rigidity (momentum/charge) range from GV to few TVs. Its physics goals are the study of cosmic-ray properties and space radiation environment, indirect search for Dark Matter and direct searches for primordial antimatter, exotic form of matter. To the light of the AMS02 measurements of charged particle in space the student will study possible models for predicting the radiation induced risk for astronauts and identifying possible strategies for its mitigation.

AMS

Proponente: Alessandro Bartoloni

Titolo tesi:Lunar Gateway Applications for Space Radiobiology.Keyword:ARTEMIS project , Space Radiation, AMS02, Radiobiology Collaborating Institute: Fisica Sanitaria Policlinico S.Orsola-Malpighi ,Bologna.

Descrizione: The Alpha Magnetic Spectrometer (AMS) is the most powerful and sensitive cosmic-ray detector ever deployed in space to produce a complete inventory of charged particles and nuclei in cosmic rays near Earth in the rigidity (momentum/charge) range from GV to few TVs. Its physics goals are the study of cosmic-ray properties and space radiation environment, indirect search for Dark Matter and direct searches for primordial antimatter, exotic form of matter. . The student will investigate possible space radiation applications to be proposed for the Lunar Gateway infrastructure. The Lunar Gateway is an in-development space station, intended to serve also as science laboratory and one of the main spacecraft of the ARTEMIS spaceflight program agenda.

AMS

Proponente: Alessandro Bartoloni

Titolo tesi:AMS02 Charged Particle characterization for Space Radiobioloy investigations. Keyword:Cosmic Rays, Space Radiation, AMS02, Radiobiology.Collaborating Institute: CERN – Ginevra.

Descrizione: The Alpha Magnetic Spectrometer (AMS) is the most powerful and sensitive cosmic-ray detector ever deployed in space to produce a complete inventory of charged particles and nuclei in cosmic rays near Earth in the rigidity (momentum/charge) range from GV to few TVs. Its physics goals are the study of cosmic-ray properties and space radiation environment, indirect search for Dark Matter and direct searches for primordial antimatter, exotic form of matter. The student will investigate the potentiality of AMS02 measurements in the field of space radiobiology.

Part of the AMS02 experiment was built at Rome (INFN & Sapienza)

The INFN Roma and the Sapienza university joined the AMS collaboration in 2001.

The group has taken part to the construction of the Transition Radiation Detector (TRD), having as main task the responsibility to develop the slow control electronics of the GAS System of the TRD (UG-Crate).

The UG-CRATE was part of a safety-critical system and the group took care of all the phases of the development (Design–Test-Integrate-Fly) following the NASA requirements.

Design

2001-2003
- Engineering Modules to test system functionalities

Test

2004-2005
- Qualification Modules to space qualify (EMC-Thermo/Vacuum-Vibration Test)

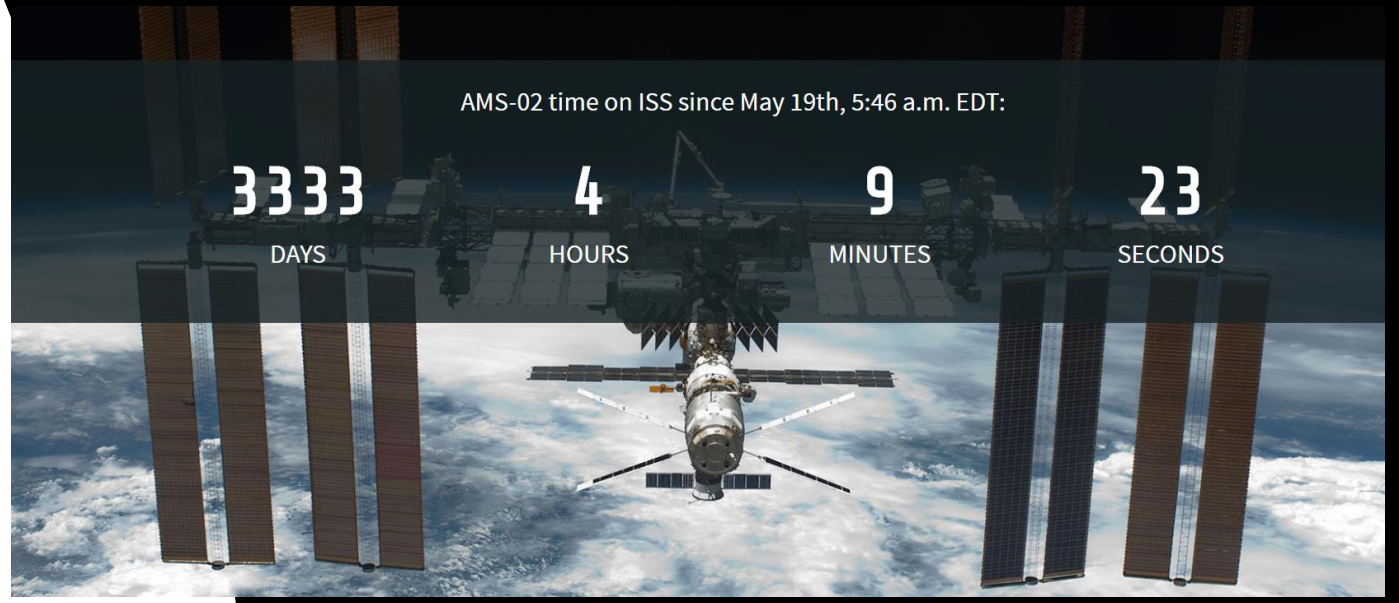
Integrate

2006-2008
- Flight & Spare Modules Production and qualification of electronics now installed on the ISS

Fly

2009-2011
- UGFD-Crate Assembly in AMSW and Space Qualification at ESA-ESTEC
- Launch ops at NASA-MSFC

Roma group supports AMS operation at POCC-CERN



By the end of January the original cooling system of the tracker was upgraded and will enable AMS to continue to operate throughout the lifetime of the ISS (2028).

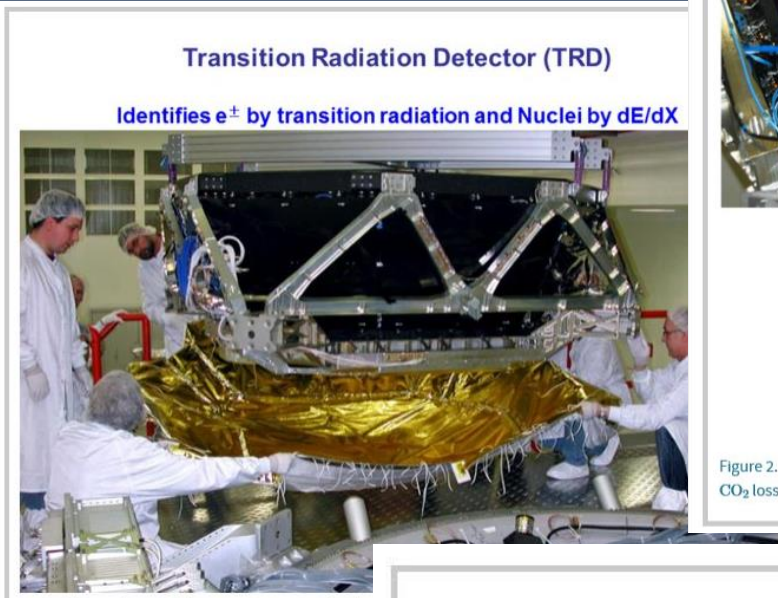


Figure 1. Installation of the TRD onto AMS. The pho

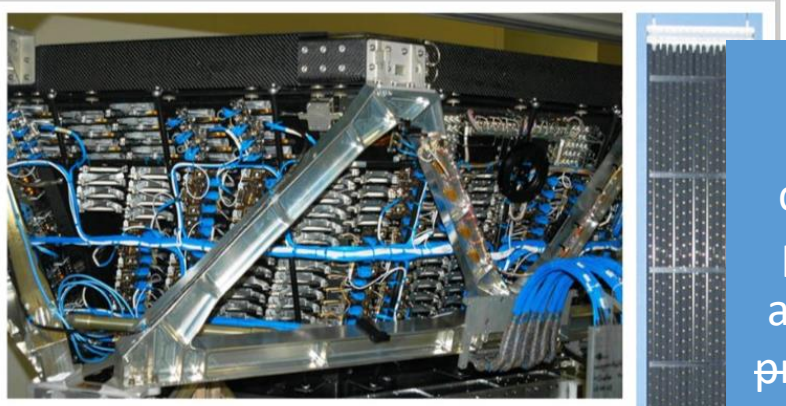


Figure 2. (Upper left) The construction of the TRD, (right) one of the 328 16-tube modules, (lower left) total CO_2 loss rate over eight years showing that the TRD has a lifetime >20 years.

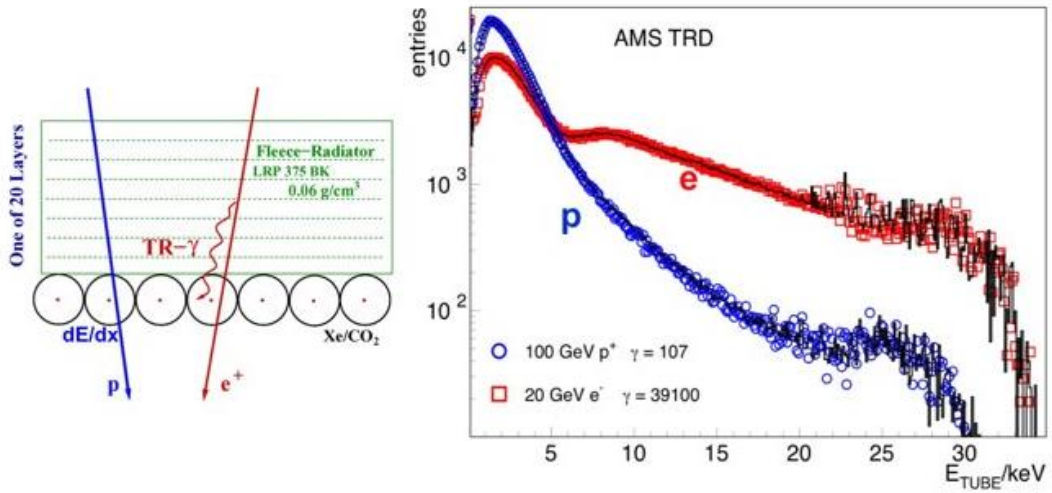


Figure 3. When proton pass the tubes, it leaves dE/dX signal. For positron and electron, due to there high Lorenz factor, they will emit transition radiation.

Partecipazione all'attività di analisi e presa dati dell'esperimento AMS-02, occupandosi della calibrazione e del monitoraggio del rivelatore TRD per l'identificazione di particelle nello spazio. Tale attività comprende anche la partecipazione ai turni ~~presso il POCC di AMS al CERN~~ nella posizione TEE in cui vengono controllate le attività dei rivelatori "Tracker" e "TRD"

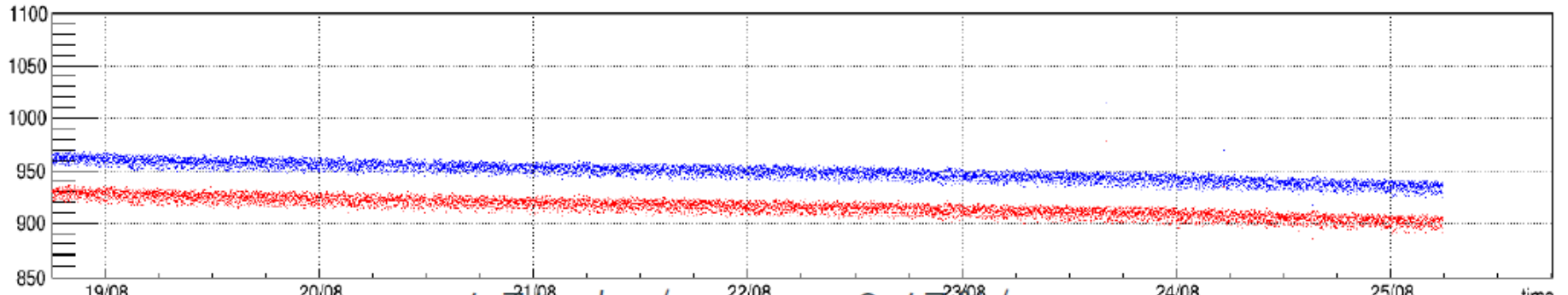
Payload Operation Control Centre (POCC)

ROMA supports the TRD operation in space (remote operations)

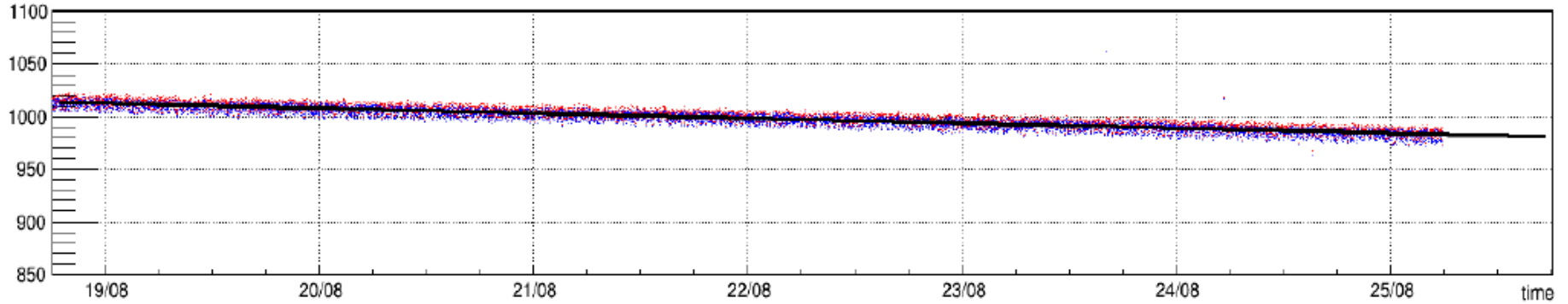
04/2020-08/2020

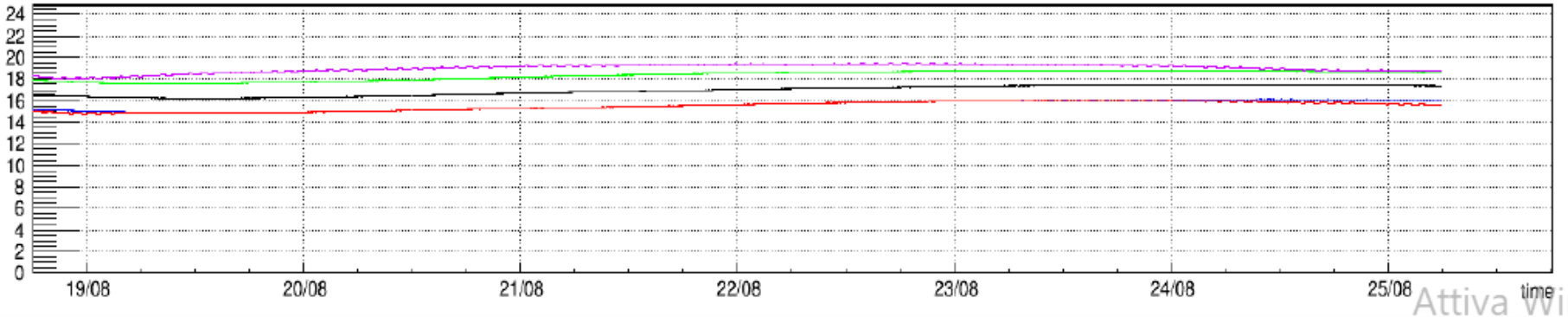
2 persons - 3 «slots» 6 days each

Pressure and Temperature in the TRD over last week

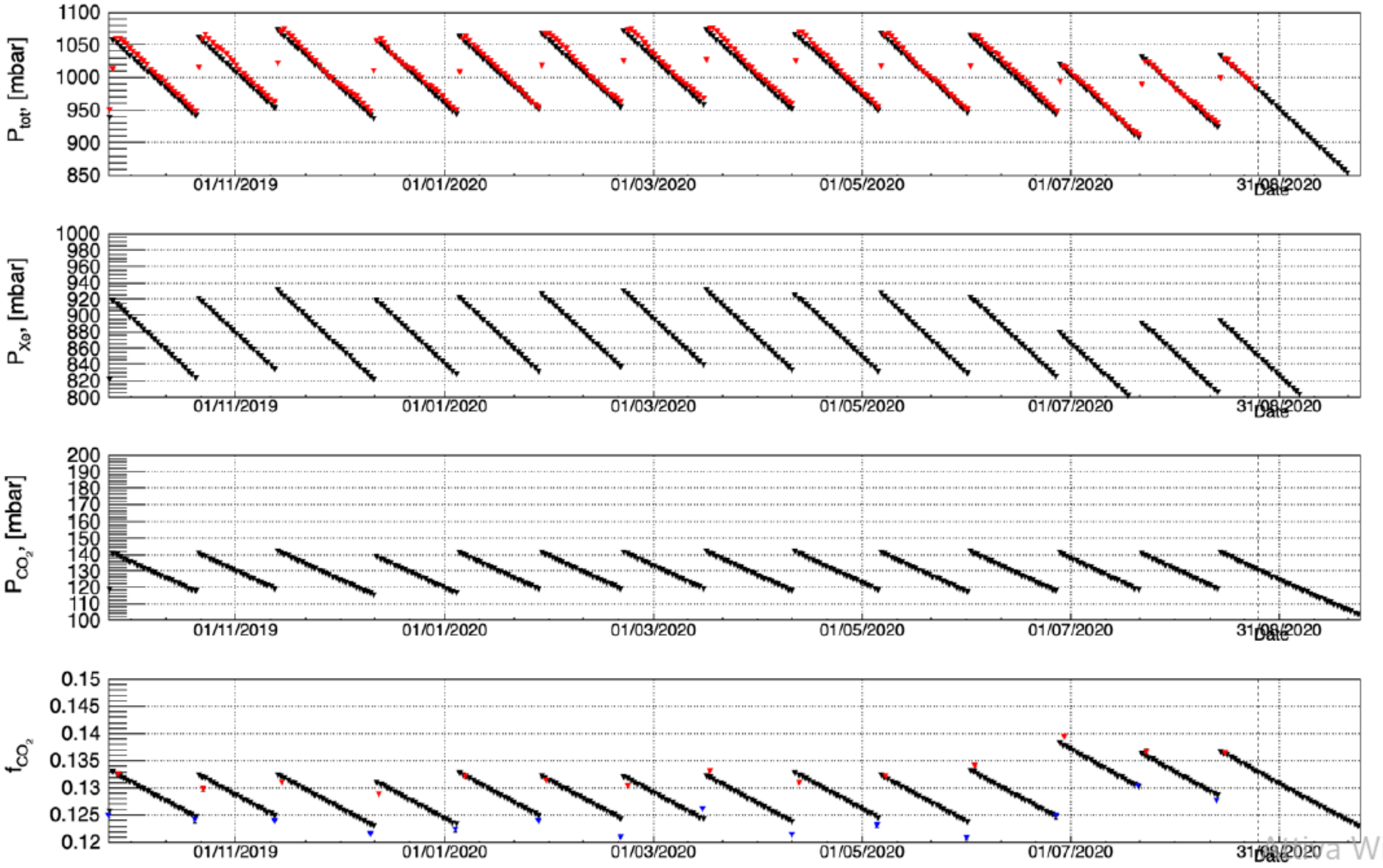


$-4.74\ mbar/day \Rightarrow -0.47\ \%/day$

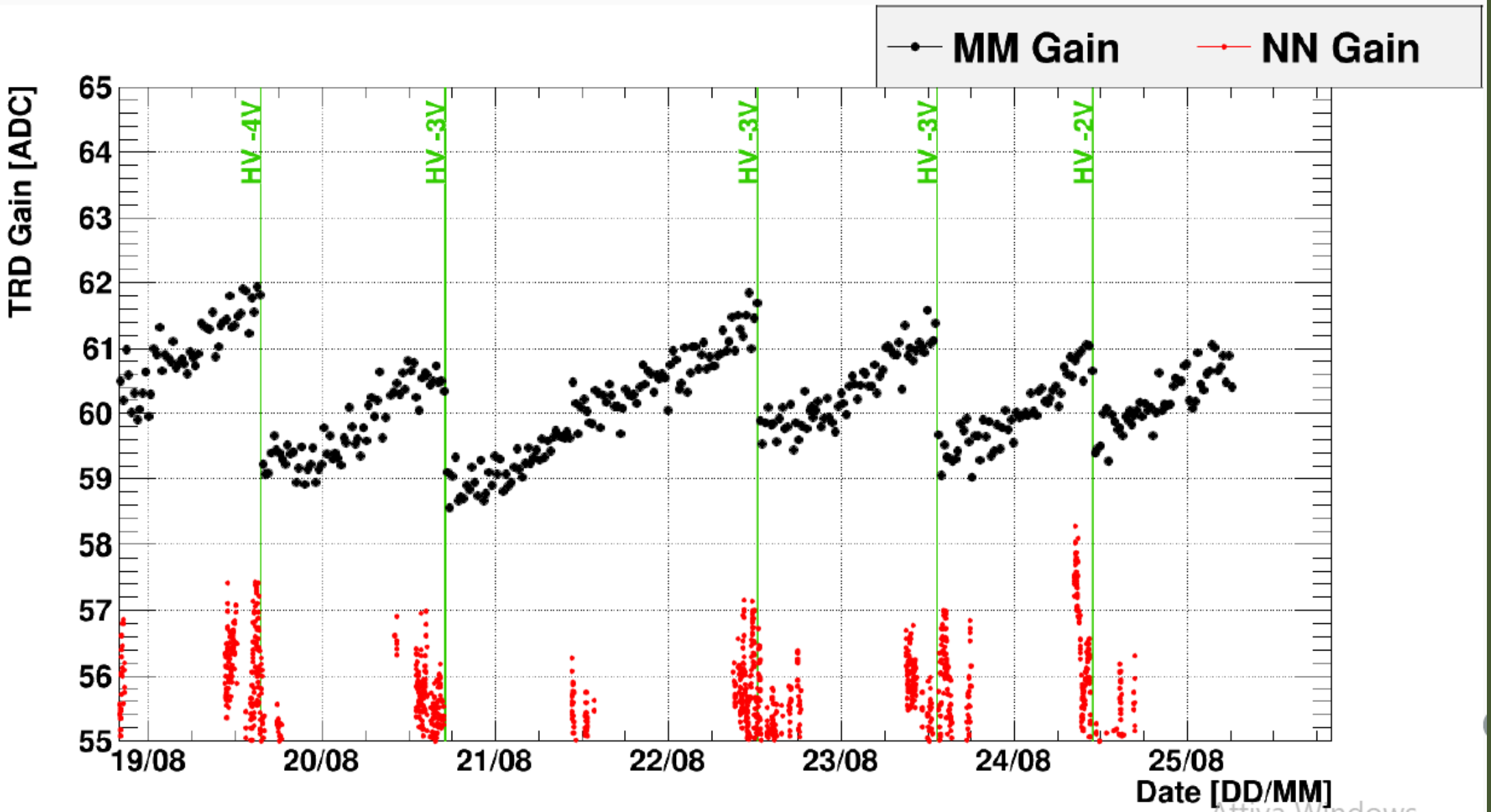




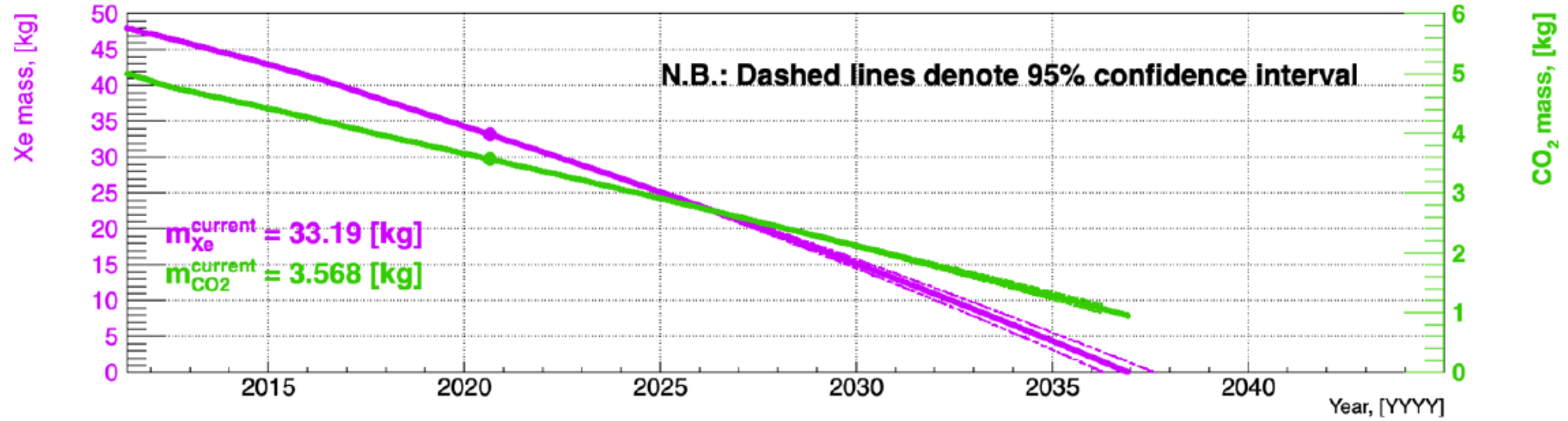
Gas composition, last year

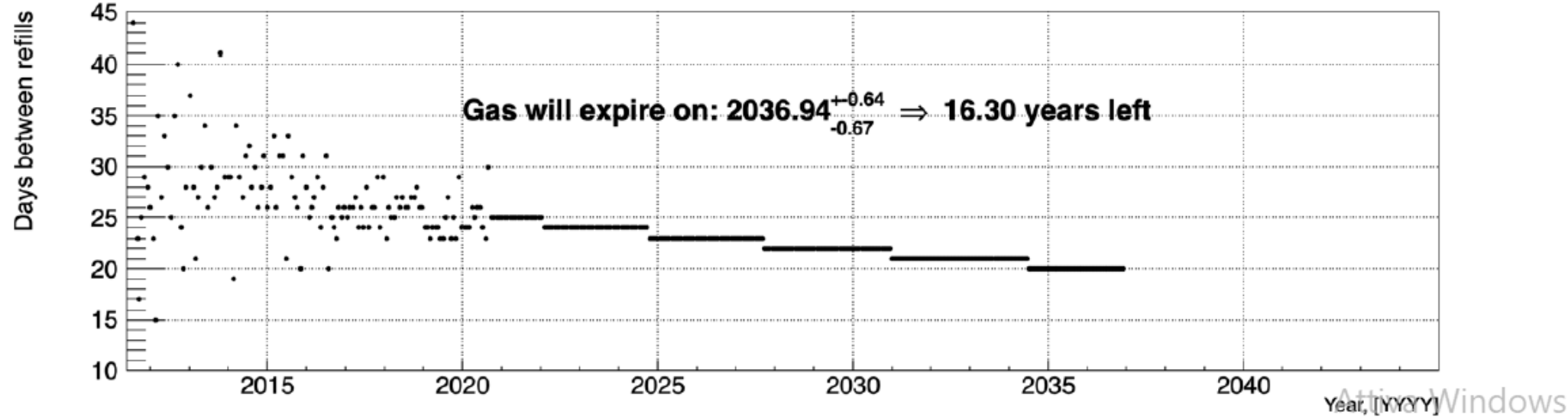


Gas Gain over last week (MM and NN monitors)

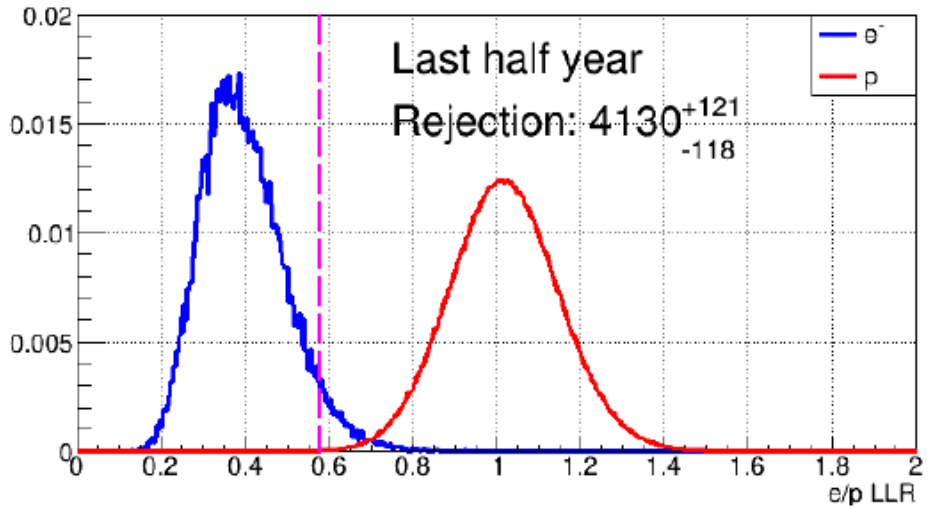


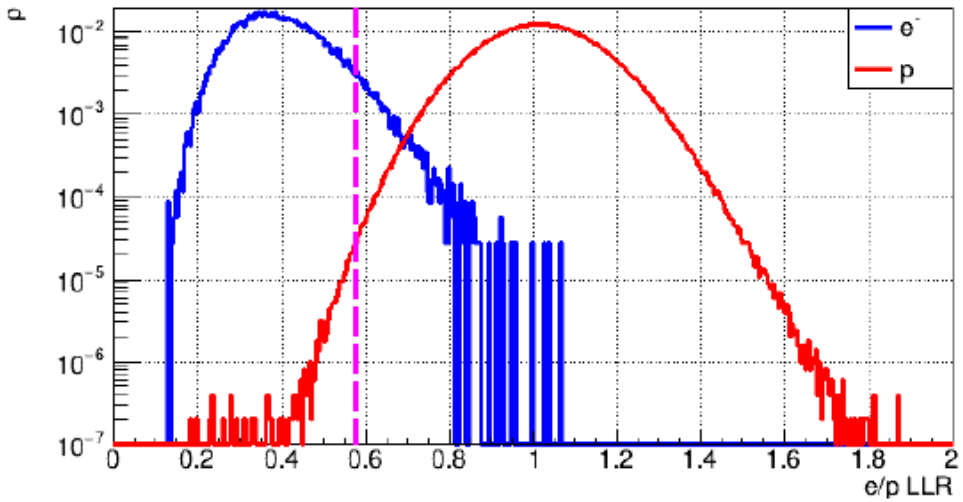
Gas masses and days between refills vs. time, linear fit

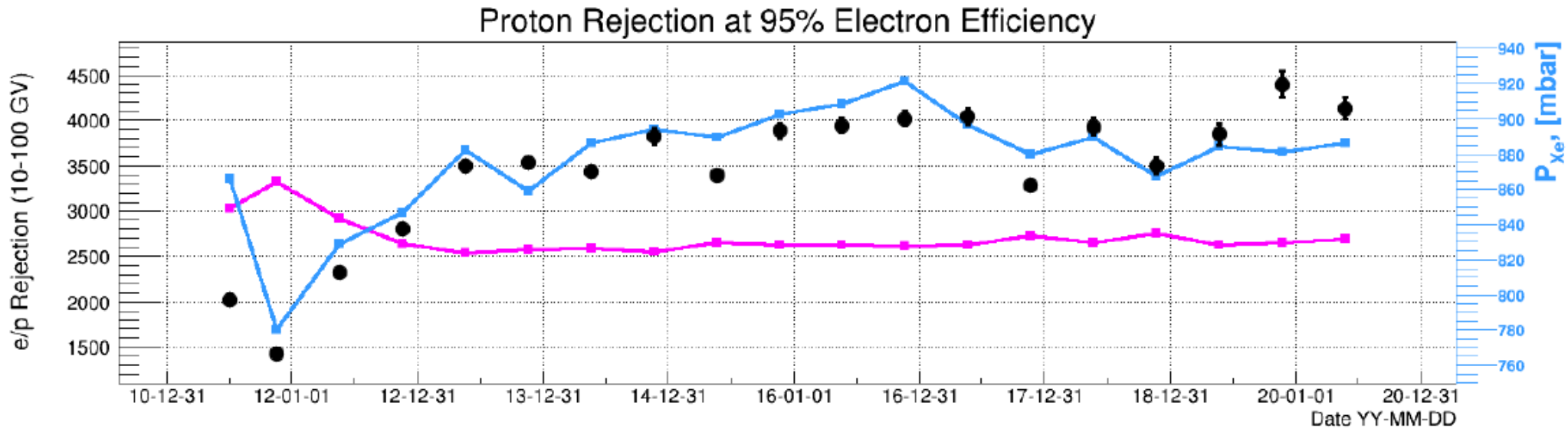




Proton/Electron Rejection







Dal 2017 il gruppo AMS-Roma ha iniziato un'attività di ricerca nel campo della radiobiologia in ambiente spazio, per lo studio delle possibili applicazioni dei dati raccolti da AMS (in particolare protoni) nell'ambito della all'attività di ricerca in radiobiologia dello spazio. Le attività sono svolte in collaborazione con i ricercatori della Fisica Sanitaria del Policlinico Universitario S. Orsola di Bologna.

Il servizio di fisica del policlinico Sant'Orsola ha già effettuato studi in vitro per la caratterizzazione dell'effetto della radioterapia e dell'ibernazione come strategia per ridurre gli effetti secondari dell'esposizione alle radiazioni dei tessuti sani.

L'attività di ricerca riguarda lo studio delle possibili sinergie fra i dati raccolti da AMS-02 e quelli clinici dopo radioterapia per una maggiore comprensione della relazione dose-effetto sugli astronauti.

AMS2 ROMA

— Internal Note

— Presentazioni e documentazione Interna

— SCK-CEN Space Summer School 2019

— *Alessandro Bartoloni* 2019/02/15 09:20

INFN WIKI

SPRB-2019/2020

SIF 2019

ESA Topical Team su SPRB

Pomeriggio Tematico in Sezione dedicato alla SPRB

Overview on SPRB

Un esempio di «GCR sensitivity analysis» - Slaba2014[3]

Radiation Type	Energy WR (ICRP 60)
x-rays, gamma rays, beta particles, muons	1
neutrons (< 1 MeV)	$2.5 + 18.2.0e^{-[\ln(2E)]2/6}$
neutrons (1 - 50 MeV)	$5.0 + 17.0e^{-[\ln(2E)]2/6}$
neutrons (> 50 MeV)	$2.5 + 3.25e^{-[\ln(0.04E)]2/6}$
protons, charged pions	2
alpha particles, nuclear fission products, heavy nuclei	20

- Environmental GCR model : BON2010 [4]
- ICRP 60 Radiation Quality Factors
- ICRP 103 for Tissue Weights
- "FAX": Female Adult voXel phantom[5]
- Transport Code : HZETRN-π/EM[6]

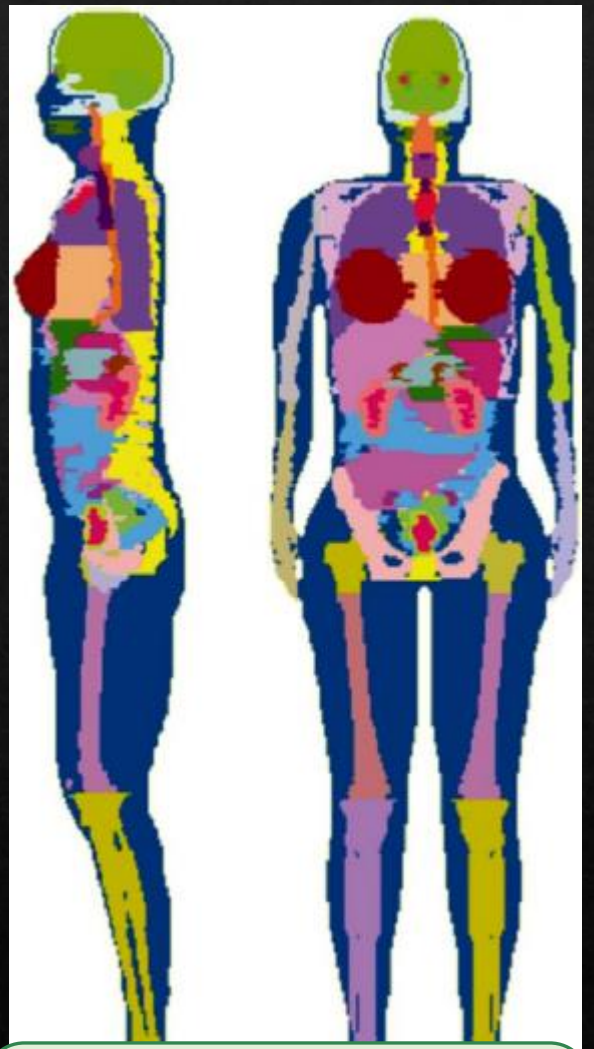


Table 1: Tissue weighting factors according to ICRP 103 (ICRP 2007)

Tissue	Tissue weighting factor wT	ΣwT
Bone-marrow (red), colon, lung, stomach, breast, remaining tissues(*)	0.12	0.72
Gonads	0.08	0.08
Bladder, oesophagus, liver, thyroid	0.04	0.16
Bone surface, brain, salivary glands, skin	0.01	0.04
	Total	**1.00**

(*) Remaining tissues: Adrenals, extrathoracic region, gall bladder, heart, kidneys, lymphatic nodes, muscle, oral mucosa, pancreas, prostate (♂), small intestine, spleen, thymus, uterus/cervix (♀).

"The Badhwar-O'Neill galactic cosmic ray (GCR) model has been revised to model all balloon and satellite GCR measurements since 1955. This includes the newer 1997-2010 Advanced Composition Explorer (ACE) measurements and spans six solar cycles.

....

The GCR spectrum is needed by radiation health physicists for astronauts exposures on deep space missions"

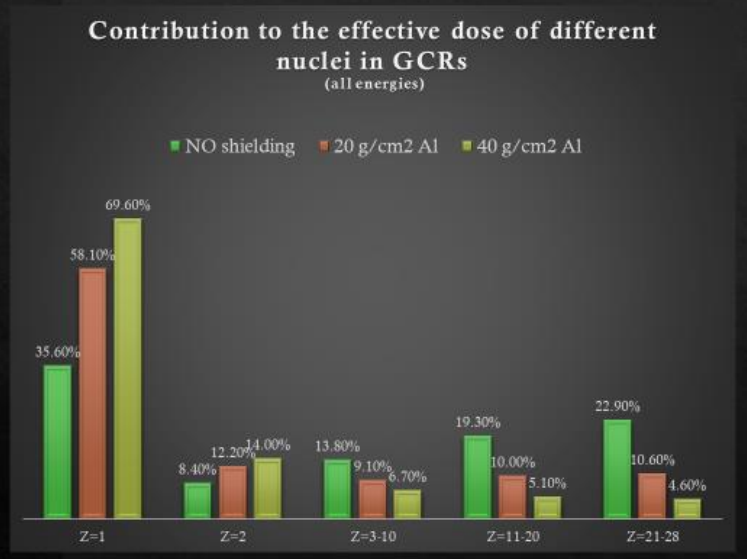
FAX model built using 151 CT images recorded from a female patient, corresponding to indication in ICRP 89

SIF 2019

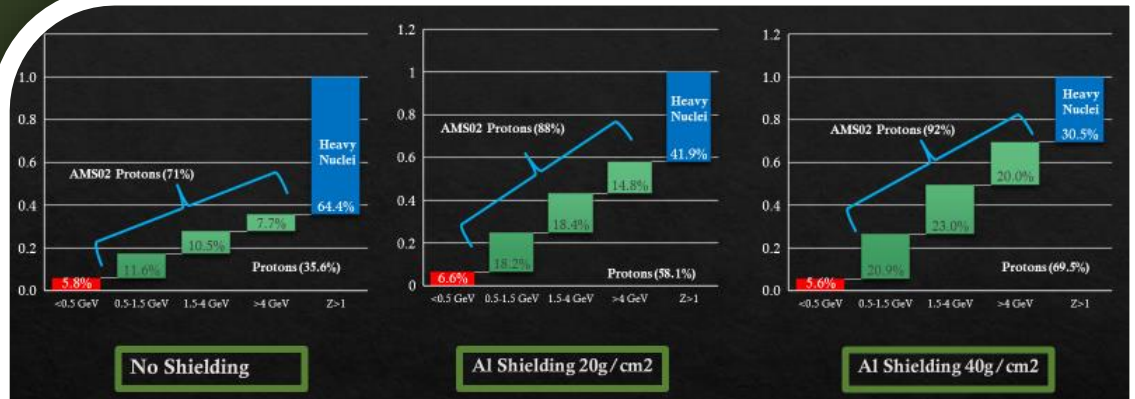
AMS02 is able to measure 100% of the particles and heavy ions of interest

As the thickness of the protective shielding increases (in the Aluminum study) the heavier ions are stopped and the contribution of the lighter ones becomes prevalent.

Protons contribute for 50% of the effective dose



Dati elaborati da (Slaba2014)



AMS02 measures the flux and properties of most protons that contribute to the effective dose

Dati elaborati da (Slaba2014)

AMS02 measures the flux and properties of most GCRs charged particles that contribute to the effective dose

- AMS02 is able to measure all the components of GCRs, and other phenomena (SPE,..) that can be harmful to human health in its space exploration activities.
- The energy range covered by AMS02 allows to measure a large part of the contribution of RI to the effective dose is the measures can be used to improve the effect dose models and therefore the different aspects of the risk assessment process of the effects of Useful to optimize future space missions.

Space Radiobiology
and
Precision Galactic Cosmic Ray Measurements

on how the AMS02 experiment on the International Space Station can help the radiation health hazard assessment in exploratory space missions

Lunedì 4 novembre 2019

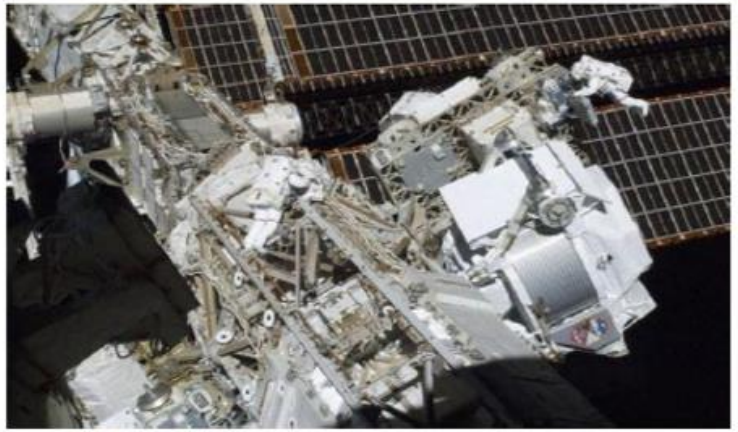
Dipartimento di Fisica – Aula Conversi

14:30-14:45
Introduzione
A. Bartoloni – INFN Roma

14:45-15:35
High precision measurements of charged cosmic rays in space with the Alpha Magnetic Spectrometer.
M. Paniccia, Università di Ginevra

15:35-16:20
ESA Human Spaceflight Radiation Research Programme activities.
L. Surdo, European Space Agency

16:20-17:05
Shielding design for long duration human exploratory space missions : issues and future perspective.
M. Giraudo, Thales Alenia Space

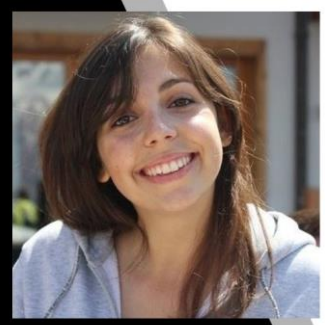


AMS-02

https://agenda.infn.it/event/20462/

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
Département de physique nucléaire et corpusculaire

esa
European Space Agency
Agence spatiale européenne



ThalesAlenia Space
a Thales / Leonardo company

INFN
Istituto Nazionale di Fisica Nucleare

SAPIENZA
Università di Roma

Pomeriggio Tematico:

Space Radiobiology
and
Precision Galactic Cosmic Ray Measurements

on how the AMS02 experiment on the International Space Station can help the radiation health hazard assessment in exploratory space missions

A. Bartoloni, G. Cavoto

In the last two decades many experiment was built and deployed in space to produce a complete inventory of charged particles and nuclei in cosmic-ray (CR). The physics goals are the study of CR properties, indirect search of Dark Matter and direct search of primordial antimatter. By now precise measurements of CR components exist in the energy region from few KeV to hundreds of TeV.

Such precision measurements can be used also to evaluate the health hazard of astronauts due to the exposure to ionizing radiation in exploratory space missions and are of interest for the space scientist (physicists, biologist, engineers, …) working on space radiation and health.

These seminars are addressed to a broad audience of researchers and students of different discipline.

- We shall start with a detailed description of the AMS02 experiment installed since 2011 on the International Space Station, to which construction took part also a group of INFN Roma and Sapienza University people. AMS02 has collected up to now more than 146 billion CR events and its measurements has changed the current understanding of CR components.
- We shall then discuss the present and future research activities done by European Space Agency (ESA) for the radiation health hazard assessment in exploratory space missions.
- Finally, the problem related to space ionizing radiation in design and build a space infrastructure will be presented, with particular attention to shielding solutions for manned lunar/mars missions.

ESA Topical Team

→ THE EUROPEAN SPACE AGENCY

Topical Team opportunity

ESA has a long history of supporting so-called Topical Teams to enhance European collaboration and focus on research. Topical Teams, depending on their subject, include experts from European universities, research entities and industries who together formulate succinct and relevant proposals for comprehensive research. Support to new Topical Teams in the “Science in the Space Environment (SciSpacE)” programme will continue and expanded to multidisciplinary research to increase international collaboration.

Download the information package in PDF format.

Proposal template for a
"ESA Topical Team"

Title of the proposed Topical Team

Synergy between medical applications of ionizing radiation and Space Radiobiology
Acronym (SPRB-TT)

Coordinator *(First, middle, and last name; institution; position; mailing address, eMail address, phone number):*

Lidia Strigari,
Polyclinic St. Orsola Malpighi - University Hospital,

Members *(First and last name, institution, position, mailing address, eMail address phone number):*

Manuel Bardiès
Centre de Recherches en Cancérologie de Toulouse, (France)

Alessandro Bartoloni
Italian Institute of Nuclear Physics (INFN) Roma – c/o Università La Sapienza

Glenn Flux
Royal Marsden Hospital & Institute of Cancer Research · London (UK)

Alessio Giuseppe Morganti
Polyclinic St. Orsola Malpighi - University Hospital,
via Massarenti 9, 40138, Bologna (Italy);

Katarina Sjögreen Gleisner
Lund University – Lund (Sweden)

Anna Tesei
Laboratorio Bioscienze IRST, Meldola (Italia)

1. Proposal Abstract (not exceeding 200 words)

The project will address the topic of space radiobiology by the comparison of possible effects on the health of astronauts from particles and dangerous charged nuclei with the radiobiology experience in the clinical field where ionizing radiation is used for therapy and diagnosis.

In the coming years a new era for human space exploration is on the agenda of all space agencies, with the main objective of exploring and colonizing the Moon and Mars. These deep space missions will expose the astronauts to levels of radiation not experienced by humans since the Apollo missions in the 1970s. The assessment of the risk from exposure to ionizing radiation will be the basis for designing manned missions and building of spaceships, infrastructures and personal equipment that will protect astronauts during their space tasks.

The team will be composed of scientists with experience in the field of space research (life sciences, astro-particles, systems engineering) and with experience in medical clinics (radiotherapy, nuclear medicine, radiobiology, medical physics). The interdisciplinary character of the team will create a synergy between the different research approaches, leading to innovative points of view and to the emergence of new research directions and definitions of new objectives and experimental guidelines in this sector.

ESA Topical Team

Da: esa-tt@esa.int
Inviato: venerdì 31 gennaio 2020 16:55
Cc: esa-tt@esa.int; Daniele.Mangini@esa.int; Leonardo.Surdo@esa.int; Elena.Ruckh@esa.int; Nicol.Caplin@esa.int
Oggetto: Invite to the Topical Team Workshop - 1st and 2nd April 2020 - TheNetherlands

Dear Topical Team Coordinator/Member,

With this email we would like to officially invite you to participate and contribute to the Topical Teams (TT) workshop organised by ESA in Noordwijk (NL) on 1-2 April 2020.
We are glad to let you know that the community of Topical Teams (TT) has shown quite some interest in this event.

Objectives of the workshop are:

- exchange and collaboration among Topical Teams
- research recommendations to ESA

On the first day, each TT representative will be invited to give a 5 minutes pitch (Presentation Template attached hereafter), summarising the objectives, status and outlook of each TT.
Given the time constraints and the number of presentations expected, we would kindly invite you to strictly adhere to the 5 minute time limit.

Further discussions will take place on the second day, when a panel discussion will be organised with the goal to promote scientific exchange and collaboration among Topical Teams to foster and further enable science and research for human and robotics space exploration.
Where cross-fertilisation areas are identified among two or more TTs, their representatives will then be encouraged to further discuss possibilities and strategies in dedicated splinter sessions which can take place following the panel discussion.

In order to arrange the final workshop agenda, we would need to get the following information:

- Names and affiliations of max two representatives from your Topical Team planning to attend the workshop. Please confirm your attendance not later than Friday 10th of February 2020
- Please send us your 5 minutes presentation not later than Monday 16th of March 2020 in order to facilitate the collection of all presentations and the organization of the workshop

A detailed agenda will be distributed after the participation confirmation deadline.

Thank you in advance for your contribution to ESA's Human and Robotic Exploration Programmes. Please get in touch if you have any questions.

Best regards,
the TT Workshop Organization Committee

Rinviato al 2021

Overview

"Dose-Effects Models for space radiobiology: an overview"[1]

N. Study Reference	Model	Particles	Dose range/threshold or LET	Experimental Validation
4	Eye flashes	Light Nuclei (He,..)	LET> 5 – 10 keV/μm	Yes
7	Chromosomal aberrations	Not Identified	5 - 150 mGy	Yes
7	Cataract Risk	Not Identified	8mSv	Yes
2	CNS Risk	Not Identified	100-200 mGy	No
1	Mucositis	Heavy Nuclei (C, ..)	-	No
3	Cardiovascular disease (CVD)	Not identified	1000 mGy	In japan atomic bomb survivors
6	Cancer	Not identified	<100 mGy	Yes

We carried out a review of the dose effect patterns derived from the biological effects observed as a result of space missions.

Many of the effects occur at doses of hundreds of mGy and are typical doses of diagnostic investigations so a synergy between knowledge arising from clinical trials and those of Space Radiobiology is desirable to increase the robustness and prediction of current models.

- **Invited review submitted to EJMP-Physica Medica**

Dose-Effects Models for space radiobiology: an overview

Lidia Strigari[1], Silvia Strolin[1], Alessio Giuseppe Morganti[2], Emiliano Loi[1] and Alessandro Bartoloni[3]

1 Department of Medical Physics, S.Orsola Malpighi University Hospital, Bologna, Italy.
2 Department of Radiotherapy, S.Orsola Malpighi University Hospital, Bologna, Italy.
3 INFN Sezione di Roma and CERN

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Abstract

Space radiobiology is an interdisciplinary science that examines the biological effects of ionizing radiation on humans involved in aerospace missions. One of the relevant topics of space radiobiology is represented by the dose effect models. Their knowledge is crucial to optimize radioprotection strategies (e.g. spaceship and lunar space stationshielding, lunar/Mars village design,...), the risk assessment of the health hazard related to human space exploration and to reduce the damages potentially induced to astronauts from galactic cosmic radiation.

Dose-effects models are used to describe the observed damages to normal tissues or the induction of secondary tumors during and after space flights and are developed for the various dose ranges and radiation qualities characterizing the actual and the forecast space missions (International Space Station, solar system exploration,...).

These strategies require an accurate characterization of the space radiation quality, the conduction on Earth of radiobiological studies in vitro and in vivo and the reinforce of the actual knowledge using dose-effect relationship developed at doses typical of diagnostic or radiotherapy exposure.Novel researches in the field are of paramount importance to reduce damages to astronauts from cosmic radiation before Beyond Low Earth Orbit (BLEO) exploration in the next future.

The manuscript aims at providing an overview of the publisheddose-effect relationships to inspire future researches, improve the model prediction capability and reduce their uncertainty levels in this fascinating and developing field.

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