Can high energy particle detectors be used for improving risk models in space radiobiology?

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In the last two decades many experiments were 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.
PAMELA (Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics) launched in June 2006, attached to the Russian RESURS-DK1, took data for ten years until 2016. Its sensitivity gave the possibility to measure particles and nuclei up to Z=6 in the energy range up to hundreds of Giga Electron Volts.

<table>
<thead>
<tr>
<th>Particle</th>
<th>Energy Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiproton flux</td>
<td>80 MeV – 190 GeV</td>
</tr>
<tr>
<td>Positron flux</td>
<td>50 MeV – 270 GeV</td>
</tr>
<tr>
<td>Electron flux</td>
<td>up to 400 GeV</td>
</tr>
<tr>
<td>Proton flux</td>
<td>up to 700 GeV</td>
</tr>
<tr>
<td>Electron/positron flux</td>
<td>up to 2 TeV</td>
</tr>
<tr>
<td>Light nuclei (up to Z=6)</td>
<td>up to 200 GeV/n</td>
</tr>
<tr>
<td>Light isotopes (D, 3He)</td>
<td>up to 1 GeV/n</td>
</tr>
</tbody>
</table>
AMS02 (Alpha Magnetic Spectrometer) is installed from May 2011 on the International Space Station and will continue to operate throughout the lifetime of the ISS (2028).

In the last years the AMS collected more than 166 billions cosmic rays events and the AMS collaboration produced new measurements of unprecedented precision of charged particle fluxes that compose the Cosmic rays up to high Z nuclei.

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Ionizing radiation exposures is one of the main concern for astronaut’s health involved in exploratory missions to the Moon and Mars due to the high doses of radiation expected during the flight and on the surface.

The radiation health hazard assessments in exploratory space missions requires the evaluation of the dose effects models in order to quantify the expected damage in the forecast astronaut’s exposition scenario.

To complete this task the charged particle data taken by the high energy particle experiments can be useful to increase knowledge in many part of the risk assessment phases.
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To address such problems a research collaboration on SPace RadioBiology (SPRB) is active since the 2017 between the INFN Roma-Sapienza AMS group and the Medical Physics Department of Policlinico S.Orsola in Bologna (Italy).

The aim is to 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 the ionizing radiations are used for therapy and diagnosis.

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(A.Bartoloni¹, S.Stroli², L.Strigari²)
If you are interested to collaborate on the SPRB with our research group please contact alessandro.bartoloni@roma1.infn.it

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