

# Risks what we encounter in the space

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Everybody knows that we are exposed to cosmic rays in the space. Ordinary risks brought by galactic cosmic rays are almost constant wherever we are. However, energetic particles of solar origin brings with much higher risks. Considering that, JAXA calculated dose values allowed for astronauts. However, they say that they are not in a position to publish the data now. Even if very thick shielding will work ineffectively to prevent from the solar flare particles.

In ordinary condition, dose rate in the space is 1mSv/day. It can attain more in the case of solar flare, and sometimes reach to about 15mSv/day. Although such values sound tremendously large for people of radiation protection circle, but also can sound as tremendously small if one see it from biologists' eyes. But recently biological study has got success to lower the research dose, and now the both circles are standing closer.

First of all, we have to know that oxygen is the most harmful being. It cut DNA threads indirectly. About 70% of the cutting is done through this mechanism, though remaining 30% are left for direct cutting. In expressing the biological effect, secondary electrons are the most important. Number of secondary electrons, born in the interactions with incident particles and matter, is proportional to square of atomic number of bombard matter. Therefore, roles of heavy ions will be larger than expected. In effect, Fe ion ( $Z=26$ ) will be most important among heavy ions. It makes reason why biologists prefer accelerators in which Fe ions can be used.

Accelerator in LBNL, which could produce 2GeV particle, is shut down now. After that, many biologists flock together around synchrotron in BNL (AGS), which can produce 1GeV Fe ions exclusively, and another machine of BNL (NSRL) which can produce up to 10GeV Au ions as well as Fe ions. It urges Germany to construct similar machine, which can also produce 10GeV particles. Riken-Ring Cyclotron (135MeV) and NIRS-HIMAC (800MeV) also charmed scientists. All those machines are designed for various purposes, but are outstanding in biological field in particular.

Then, from where 'effects' are observed when solar flare occurs? On the ground surface, wherever people live, the effect will be very small considering that more than 99% Japanese are living below 400 m altitude, and no apparent damages are found. The situation will not be changed if we consider Mexico. On the other hand, airplanes are now one of the major tools of public transportation. However, to find out any apparent risk, about 500 thousand samples will be necessary. Currently, however, only thousands of each sample is obtainable. In other word, risk of active sun will be also small and becomes visible only if such large number of samples are collected. It equals to one time chest scanning of CT (computerized tomography), at most. Only risks in space voyage will bring large doses, which is worth studying more in age of tight budget.