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Author: Mrs. Giulia Bazzano
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy

Dr. Marco Sabatini
Sapienza University of Rome, Italy
Dr. Fabio Cardelli
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mr. Fabio Fortini
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mr. Paolo Nenzi
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mr. Luigi Picardi
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Dr. Luca Piersanti
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mrs. Concetta Ronsivalle
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mr. Vincenzo Surrenti
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mr. Emiliano Trinca
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Mrs. Monia Vadrucci
ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Prof. Giovanni B. Palmerini
Sapienza University of Rome, Italy

RADIATION TESTING FOR SPACE APPLICATIONS AT ENEA FRASCATI 35 MEV PROTON LINEAR ACCELERATOR

Abstract

Small satellite space missions are an important asset and their relevance is increasing in recent years, not only for educational purposes, but also as technological demonstrators, and for realizing constellations of a huge number of nanosatellites for communication and internet providers. This kind of missions, usually targeted to short operational life, would greatly benefit from the use of commercial components (COTS). Of course, resistance to the space environment of COTS should be first tested on ground, from vibration, thermal and radiation point of view. This latter one is the main topic of this research. We present the set-up and performances of the TOP-IMPLART accelerator as a proton source for radiation testing of space components. The TOP-IMPLART proton accelerator is a pulsed fully linear machine aimed at active intensity modulated proton therapy with a final energy of 150 MeV under development at ENEA Frascati Research Centre. Presently the machine offers a beam extraction point on the horizontal line at 35 MeV, with a current up to 50 A in a 3 s long pulse and maximum repetition frequency of 50 Hz. An in-air irradiation set-up 1.8 m downstream the accelerator exit window is available with an effective beam energy of about 31 MeV, beam spot of 30 mm FWHM and intensity repeatability within 5This research aims at demonstrating the possibility to use an accelerator with these characteristics for testing a commercial 9-axis integrated MEMS inertial navigation system (accelerometer, gyroscope, magnetometer). These devices could be used for example as sensors for attitude determination in University Cubesat missions. Irradiation with high energy proton beams allow simultaneous exploration of total dose, displacement damage and some single-event effect of such components. The results of experimental tests aimed to define an operational procedure are reported: the irradiation set-up is described in detail and the characterization of radiation effect on the component is reported highlighting the consequence of the device performance degradation in terms of the overall navigation system accuracy. These results are considered a first step towards the use of the TOP-IMPLART linear accelerator as a meaningful alternative to traditional cyclotron for testing not only cheap COTS devices, but also proper space qualified items.