

H2020 EPICEA PUBLIC WORKSHOP 13 JUNE 2019





ELECTROMAGNETIC PLATFORM FOR LIGHTWEIGHT
INTEGRATION/INSTALLATION OF ELECTRICAL
SYSTEMS IN COMPOSITE ELECTRICAL AIRCRAFT

WP4.1 COLLECTION OF COSMIC RADIATIONS

OFFICE NATIONAL
D'ETUDES ET DE
RECHERCHES
AEROSPATIALES
(ONERA)

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SOLAR STORM



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CONTRIBUTION ONBOARD TOOL

- | | |
|--|-----------------|
| ▪ Supply of the aircraft Global 7500 FTV3 | Bombardier |
| ▪ Supply of detectors | BTI |
| ▪ Supply of calculator | Star-Navigation |
| ▪ Supply of the S.W for data analysis | Isonéo |
| ▪ Supply of EFB | CMC Electronics |
| ▪ Analysis of the data from the Isonéo S.W | Bombardier |



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3

CONTRIBUTIONS ON GROUND

- | | |
|---------------------------------------|--|
| ▪ Neutrons laboratory | TRIUMF Vancouver (ETS's subcontractor) |
| ▪ Analysis of CR on metal/composite | ETS |
| ▪ Analysis of CR on components | ETS |
| ▪ Analysis of documentation available | Isonéo |
| ▪ Analysis of Fault Tree Simulation | POLY |



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4

COLLECT OF COSMIC RADIATIONS STEP 1

- The step 1 was installed in the Global 7500 code FTV3 in December 2017, after several months delay due to the availability of the aircraft.
- The first flight started in January 2018.
- The step 1 is now flying since more than one year.
- After each flight campaign, the data recorded during the flight are analysed by Bombardier.
- The analyse covers: Following the energy received by the sensors in light pulses, the student analyses the equivalent in term of Protons, Neutrons, Electrons, Gamma, as the sensor doesn't give directly these details.
- The purpose to use 3 different sensors is to know the difference of radiations received, in the cabin, the cockpit and the avionic bay.



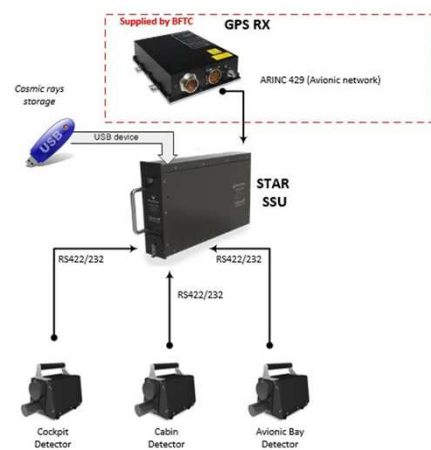
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STEP 1

FTV 3



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STEP 2

- Step 2 uses only 2 sensors instead of 3 on step 1, but add to the step 1:
 - One Electronic Flight Bag from CMC Electronics.
- EFB collects the radiations level, with correlation between the position of the aircraft and the level of radiations received.
- If EFB receives the information of a too high radiation flux, (in real time), the pilot can reduce the altitude of the aircraft in a safer altitude.
- The step 2 is dedicated to be installed on the Aircraft Global 7000-6, with the capability to fly all over the World, which is not the case of the FTV3, limited to the US territory, as a certification aircraft.



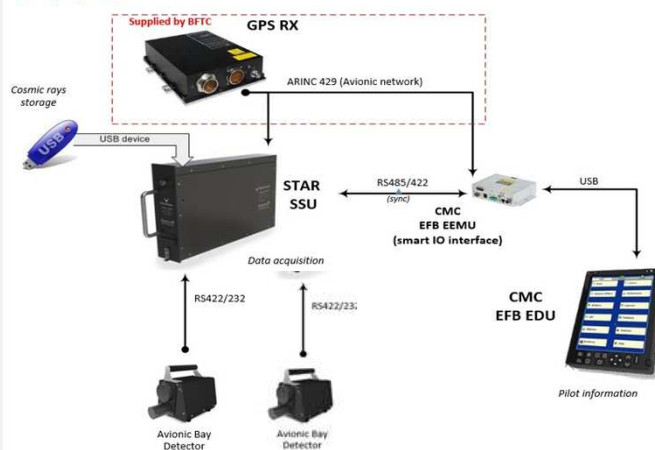
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STEP 2

FTV 6



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SOLAR ENERGY



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WHAT IS A COSMIC RADIATION ?

Primary Particles

- Protons (86%)
- Alpha particles (13%)
- Electrons (1%)

Neutral Primary Particles

- Photons
- Gamma ray
- Neutrinos (each person receives each second a dose of 65 B per cm²)



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RADIATIONS LEVEL ACCORDING TO THE ALTITUDE



The radiation level increases with the altitude.



A person leaving in the mountains, like the tibetans, receives more radiations than the persons leaving near the ocean.



This is the same situation for a person who skies, or with activities in the mountains.



However, there are also areas in the world where the radiations are higher at the same altitude.



This is the case for Brasil, India, China and of course the Poles, where the level of radiations can be 20 times the level or radiation in N .America America or Europe.

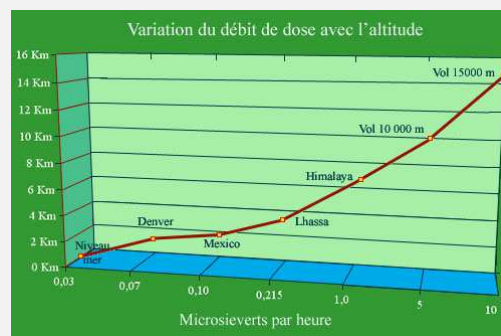


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DOSE RECEIVED ACCORDING TO THE ALTITUDE



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CONSEQUENCES OF THE ALTITUDE

Consequences of the radiations at the Sea level

- Radiations at the sea level: 0.001mSv/h
- Altitude 10,000 meters: 0.005mSv/h
- Altitude 18,000 meters: 0.12 mSv/h

Consequences of radiations received on the Poles

- Polar flight: x 3
- Polar flight with very strong solar explosion: x 30

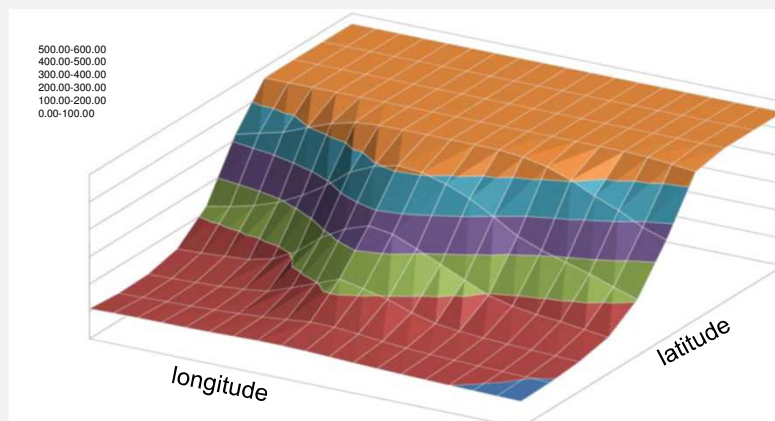


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NEUTRONS FLUX (CM²\S) AT THE ALTITUDE (40,000FT), LONGITUDE AND LATITUDE

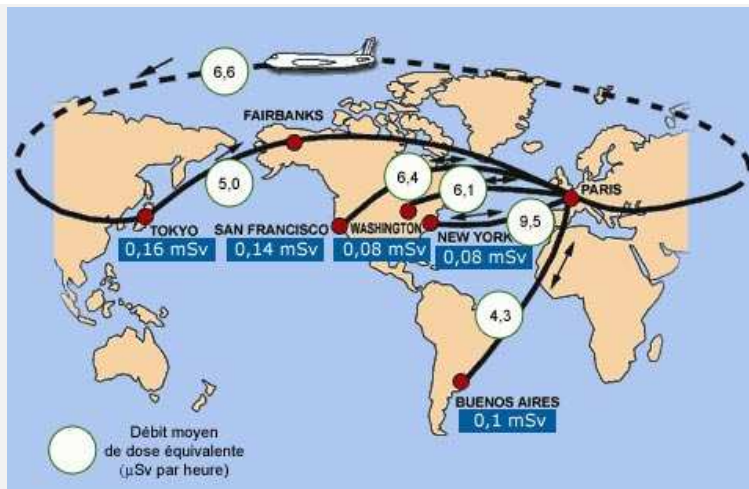


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FLIGHT EXPOSURE

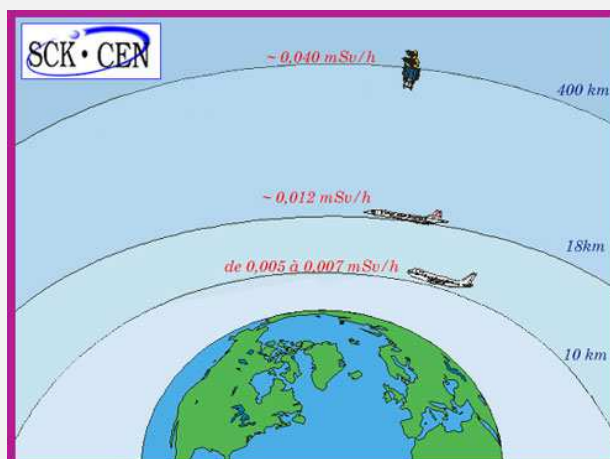


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POLAR FLIGHT



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IF YOU WANT TO KNOW THE QUANTITY OF RADIATION YOU WILL RECEIVE ON A FLIGHT

- The US NOAA follows permanently the level of the solar activity.
- If you want to know the quantity of radiation you will receive during your next flight, you can contact:

www.sec.noaa.gov

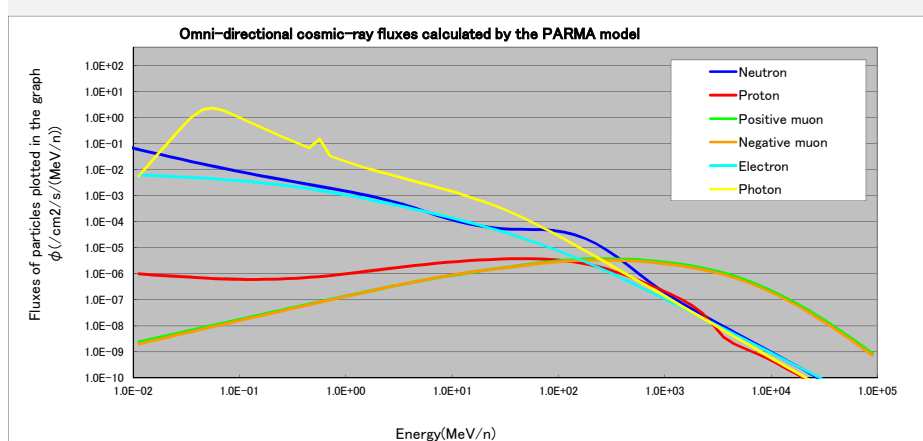


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ANALYSIS OF COSMIC RADIATION DATA



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EXAMPLE OF ENERGY BY CHANNEL OF THE BTI SENSOR

- The BTI sensor has 1024 channels
- Each channel is equivalent to a level of energy
- Ex: Channel 50 = 0,08 MeVee (electrons)
- Channel 200 = 1,74 MeVee
- Channel 800 = 9,42 MeVee
- Channel 1000 = 11,98 MeVee

Formula of conversion: (Channel-64) x 0,0128

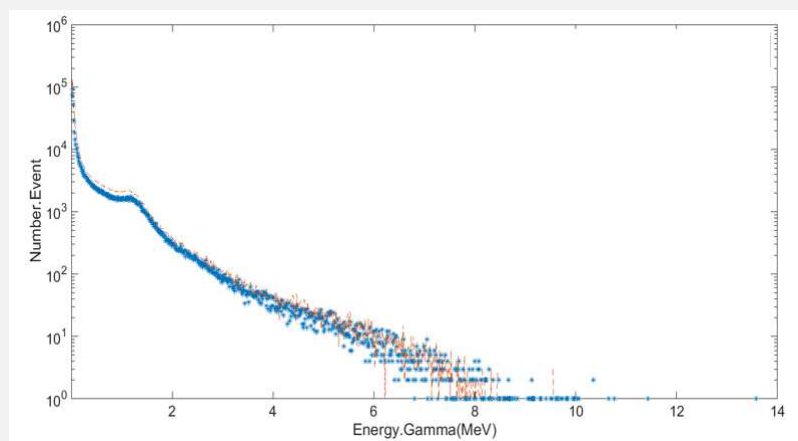


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NUMBER OF EVENTS

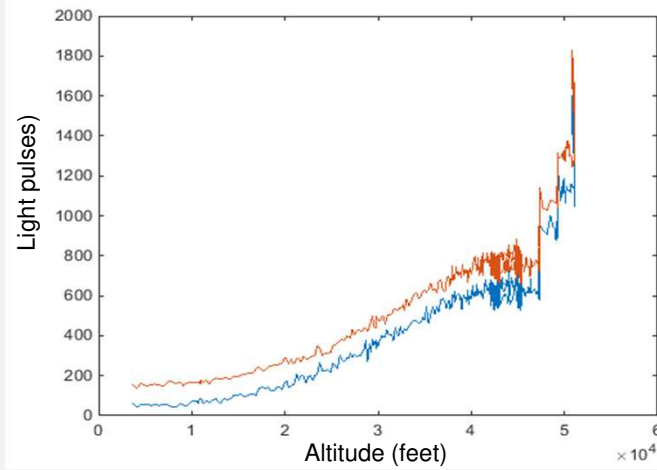


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EVOLUTION OF THE LIGHT PULSE OF THE NEUTRONS (BLUE) AND GAMMA (RED), ACCORDING TO THE ALTITUDE (FT)

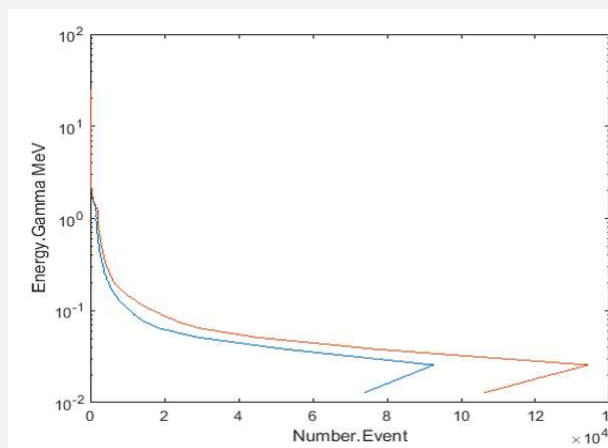


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GAMMA ENERGY



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THANK YOU FOR YOUR ATTENTION! ANY QUESTION?



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 13 June 2019 EPICEA Public Workshop 24