

# TRAINING

# RADIATION EFFECTS



- ☐ Space environment
- ☐ Components
- ☐ Materials
- ☐ FASTRAD® / OMERE software

We can adapt the program to your needs : In your company using your equipment or in our premises, for one or multiple days.

## FOR WHAT

- To understand and manage calculations related to radiation effects on components, systems and materials.
- To react proactively and integrate solutions during the design phase.
- To analyse accurately the performance of your system in harsh environment.
- To understand your clients' specifications related to the qualification of their systems.

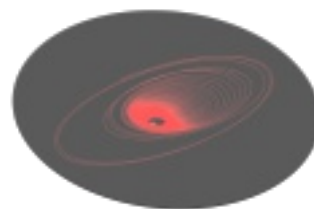


## FOR WHOM

- OEMs / System designers and manufacturers
- Satellite Integrators
- Space Agencies
- Component Manufacturers

And in general, all professionals in the space domain concerned by radiation effects.

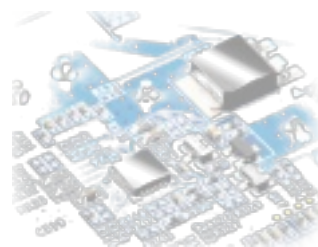
➡ Space radiation environment and introduction to OMERE



➡ Introduction to dose calculation and shielding optimisation with FASTRAD®



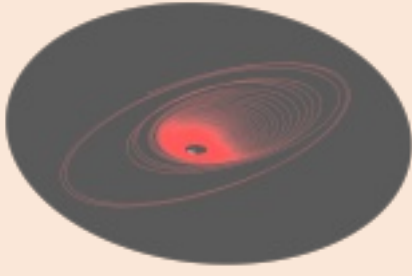
➡ Radiation effects on electronic components



➡ Radiation effects on materials



# *Space Radiation Environment and Introduction to OMERE*



Taking into account radiation effects on space systems first implies the determination of precise environmental constraints. During space missions, satellites are exposed to an environment dense in charged particles from different sources (radiation belts, sun, cosmic rays).

The OMERE software - developed by TRAD with the support of the French Space Agency, the 'CNES' - allows to quickly estimate the space radiation environment for any kind of mission.

The engineer can then define this environment in terms of Dose (TID), Displacement Damage (TNID) and Single Event Effects (SEE) with the calculation methodologies recognised by the space community and available in the OMERE freeware.

## ***TRAINING SCHEDULE :***

- ⊙ Radiation sources in the space environment
- ⊙ Engineering models and standards
- ⊙ Environment calculation
- ⊙ Dose depth curve calculation
- ⊙ SEE rate calculation
- ⊙ Practical exercises using OMERE



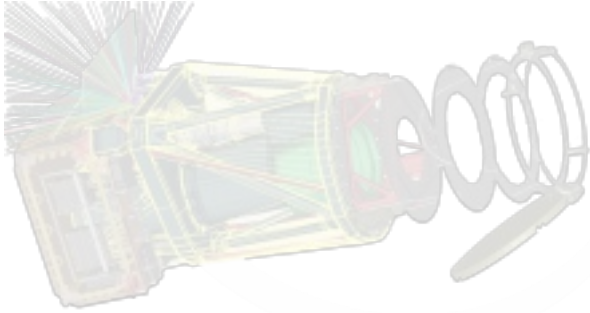
## ***PARTICIPANT PROFILE (Engineer level or equivalent) :***

- ⊙ Quality assurance
- ⊙ System engineering
- ⊙ Component / Material Engineering
- ⊙ Equipment design and embedded instruments
- ⊙ Research and development
- ⊙ Project managers

*Non-exhaustive list , we adapt the training content according to your knowledge and needs.*

# ***All about FASTRAD®***

## ***For FASTRAD® beginners***



The accurate estimation of the dose received in orbit by electronic components requires the consideration of the system 3D geometry.

By providing a robust user-friendly interface combined with effective and recognised calculation methods, FASTRAD® is the tool used by radiation engineers to assess the deposited dose on equipments and instruments.

This training provides the opportunity to discover all features and applications of the software. The hands-on training allows participants to assess the practical value of such a tool.

***Save time and become autonomous in the shielding design !***

### ***TRAINING SCHEDULE :***

- ◎ Review of software features
- ◎ CAD tool and STEP import
- ◎ Material property management
- ◎ Dose calculation by sector analysis
- ◎ Radiation shielding calculation
- ◎ Hands-on exercises :
  - Modeling of an electronic equipment
  - Use of the component package database
  - Application using a spacecraft platform
  - Shielding definition



*Different training levels are available:  
FASTRAD beginner, intermediate or advanced.*

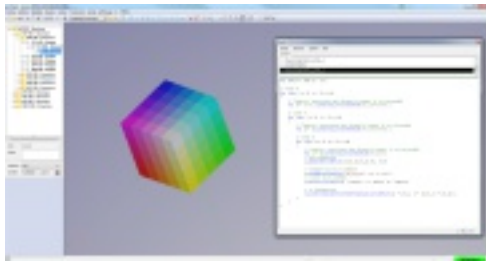
*The program will be defined according to your knowledge and your needs.*

### ***PARTICIPANT PROFILE (Engineer level or equivalent) :***

- ◎ Quality assurance
- ◎ Systems Engineering
- ◎ Equipment Design and Embedded Instruments
- ◎ Research and Development

⇒ Note: It is recommended to have some basic knowledge on space radiation environment

# ***FASTRAD® scripting module***



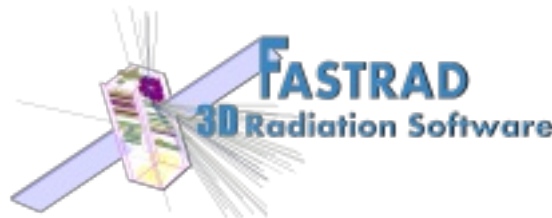
FASTRAD® is constantly evolving with new features as the **scripting module**. TRAD developed a training dedicated to this specific capability, to learn how to write your scripts by yourself.

## ***TRAINING CONTENT:***

- © FASTRAD script language description (classes, functions, variables, loops, ...)
- © FASTRAD modelling operations with scripts (operations on the hierarchy of a model, parameterized shape definitions, materials operations, ...)
- © FASTRAD calculation operations with scripts (iterative calculations, design optimizations, creation of a customized output files, ...)
- © Script Interface creation



⇒ A background in code development (C++, VBA, JavaScript, Python, etc.) is necessary to participate in this training



## ***FASTRAD® Advanced***

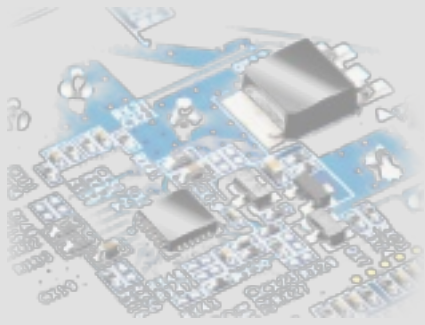
### ***TRAINING CONTENT:***

This training is dedicated to people who are already FASTRAD users and who want to enhance their skills on specific tasks or modules – advanced modelling, Monte Carlo calculation, shielding optimisation, etc.





# *Characterisation of radiation effects on electronic components*



Radiation qualification of embedded electronic equipment requires a good knowledge of :

- types of radiation effects on electronics
- sensitivities related to component technology
- procedures of experimental characterisation (radiation tests)

The purpose of this training is to provide engineers with tools and methods necessary to carry out all stages of radiation qualification for components. This training will address both the microscopic aspects of radiation effects on materials, as well as the "system" aspects with the components' electrical parameters drift and its impact on systems. European specifications with regards to qualification will also be presented.

## ***TRAINING SCHEDULE :***



### **1. Single Events**

- ⊙ Physical phenomena and SEE types
- ⊙ SET treatment
- ⊙ Experimental characterisation

### **2. Dose and displacement damage**

- ⊙ Effects related to specific technologies
- ⊙ Dose depth curve calculation with OMERE
- ⊙ Dose rate calculations with OMERE

## ***PARTICIPANT PROFILE (Engineer level or equivalent) :***

- ⊙ Quality assurance
- ⊙ Systems Engineering
- ⊙ Component / Reliability Engineer
- ⊙ Equipment Design and Embedded Instruments
- ⊙ Research and Development

*Non-exhaustive list , we adapt the training content according to your knowledge and your needs.*

⇒ **Note** : This training requires a good understanding of the space radiation space environment and the OMERE software. The 'Space radiation Environment and Introduction to OMERE' session is highly recommended before this training.

# *Characterisation of radiation effects on materials*



Taking into account radiation effects on materials is a distinct subject in the field of Radiation Hardening Assurance (RHA). Compared to electronic component aspects (see our training « Characterization of radiation effects on electronic components »), determining dose levels in orbit and the reproduction of these constraints on earth requires a methodology and experimental means adapted to this problem.

These points are discussed in detail during the training to enable engineers to understand the physical mechanisms of material degradation and to identify key parameters for their characterisation.

## ***TRAINING SCHEDULE :***

### **1. Space radiation environment applied to materials**

### **2. Effects on materials**

- ⊙ Particle-matter interaction
- ⊙ Effects depending on material types

### **3. Implementing radiation tests**

- ⊙ Experimental test sequence calculation
- ⊙ Characterisation means

## ***PARTICIPANT PROFILE (Engineer level or equivalent) :***

- ⊙ Quality assurance
- ⊙ Materials Engineer
- ⊙ Equipment Design and Embedded Instruments
- ⊙ Research and Development

*Non-exhaustive list, we adapt the training content according on your knowledge and your needs*

⇒ **Note:** This training is usually combined with 'the characterisation of radiation effects on electronic components' session.

***Participant (s):***

Forename :

Surname :

Email :

Phone :

Company and function(s) :

***Training desired :***

Space Radiation Environment and Introduction to OMERE

Introduction to dose calculation and shielding optimisation with FASTRAD®:

Beginner and intermediate levels

Advanced level

Characterisation of radiation effects on electronic components

Characterisation of radiation effects on materials

***Location of training :***

TRAD

In my company

***Dates requested:***

***Other request :***

TRAD certified training organization under the number: 73-31-04810-31