

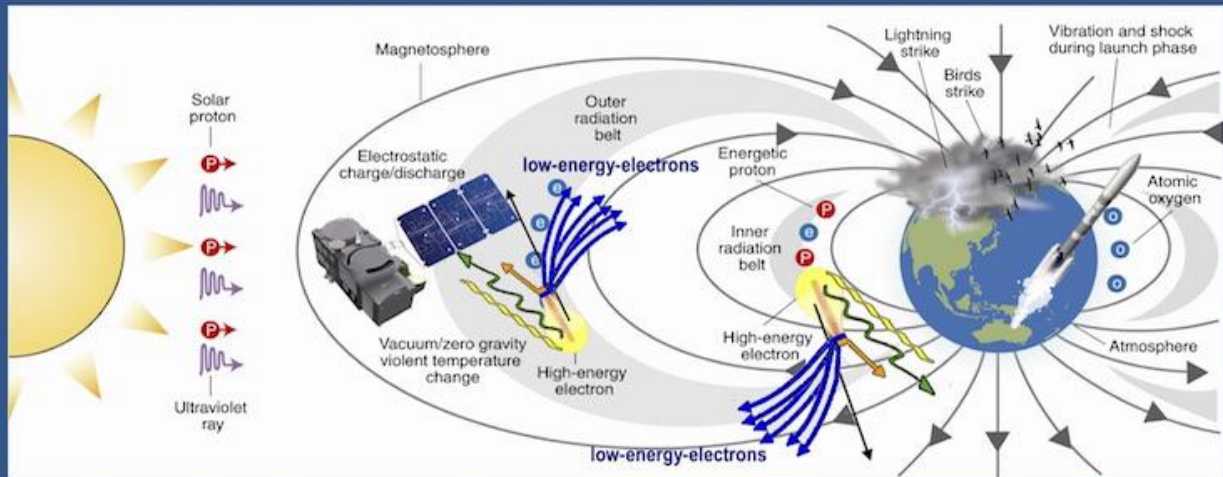
REPORT on the LEE 2022 meeting

LEE2022

A brainstorming meeting on relevance of Low Energy Electrons in aerospace

(Tuesday, November 15th 2022)

Organized by *Stefano Iacobucci & Giovanni Stefani (ISM-CNR)*



List of confirmed Speakers

Marco Angelucci INFN-LNF (Roma)

Paola Bolognesi CNR-ISM (Roma)

Andrea Liscio CNR-IMM (Roma)

Maurizio Dapor ECT*- FBK (Trento)

Piero Diego INAF- IAPS (Roma)

Stefano Nannarone CNR-IOM (Trieste)

Pierfrancesco Riccardi UNI CAL (Cosenza)

Alessandro Ruocco UNI ROMATRE (Roma)

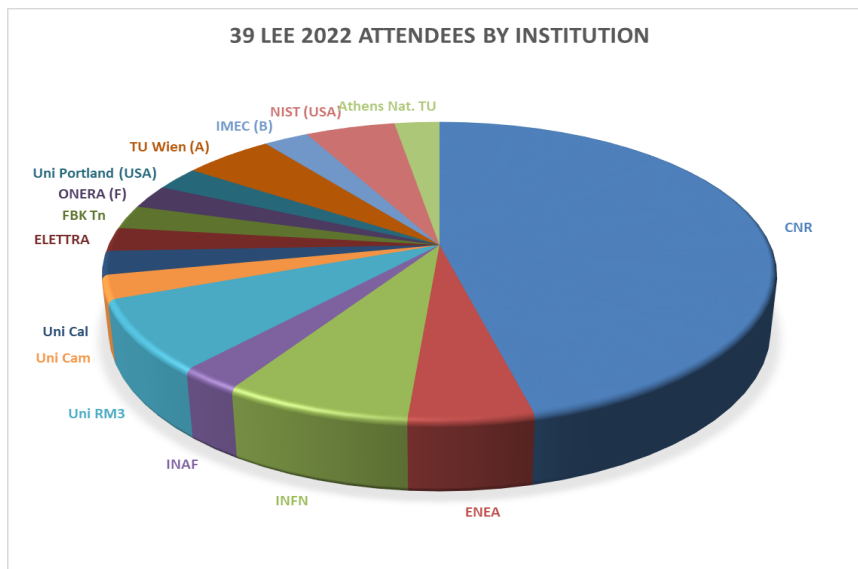
Luisa Spallino INFN-LNF (Roma)

Daniele M. Trucchi CNR-ISM (Roma)

The meeting lasts
from 9:00am to
5:00pm



The LEE 2022 brainstorming meeting on secondary (low energy) electrons (LEEs) was held in Montelibretti (Rome) Area di Ricerca Roma 1 del CNR on November 15 2022, it has been attended by 37 researchers, 17 in person and 20 on-line from 19 different institutions. The meeting aimed at being a first informal brainstorming on whatever is still to be understood on the behavior of LEEs.



Motivations

Why focus on such a niche subject? Because LEE's are ubiquitous in many different branches of nowadays technologies. The main goal of the meeting is to gather ideas on how to establish a virtuous loop of questions and answers between application and basic research always mediated by applied research.

It was chosen to focus this first meeting on aerospace, this being a vocation of Lazio's regional research, and because, as an example, in 25 years some 4500 spacecraft anomalies have been observed and traced to effects of space radiation. For instance, solar activity generates fluxes of high energy particles towards spacecrafts causing disruptive charging of the surfaces, damage of the on-board electronic devices and jeopardizing the health of the astronauts. Why should we bother with LEE's if space radiation is mostly high energy particles and radiation? Because interacting with matter all components behave as ionizing media thus producing primary electrons that further interacting with matter generate a stream of secondary electrons. It is common wisdom that a large majority of the secondary electrons are LEEs with energy between 0 and 50 eV, no matter which is the energy of the primary radiation. The secondary electrons energy distribution is the result of plural scatterings throughout the matter and to have full control of the genesis and evolution of LEEs it is needed:

- An accurate description of the individual electron collision
- A comprehensive model of the plural scattering chain
- A dependable model for qualitative and quantitative evaluation of the LEEs spectrum.

Such an accurate knowledge is needed in order to mitigate the electrostatic charging of the spacecraft surface that can easily be bad enough to generate destructive discharges in solar cells or the multipactor effects that plague the high energy accelerators ultra-high vacuum pipe or the microwave amplifiers.

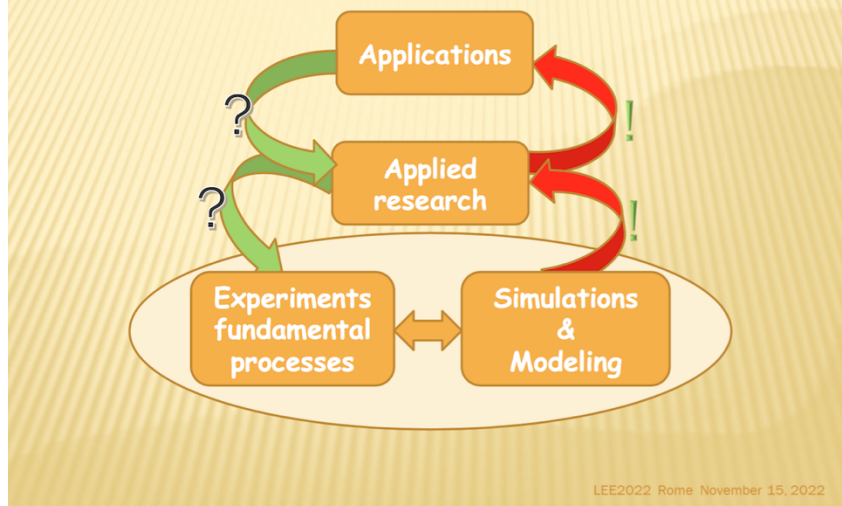
Besides charging effects, LEEs are very effective in inducing or enhancing chemical reactions, both in organic and inorganic materials, via molecular dissociations whose probability is higher just in the LEEs energy range. Indeed, it is the LEEs attachment to DNA strands that causes most of the DNA damage. A subject very relevant to astrobiology and to living matter survival strategies.

Control of secondary electrons induced reactions is likely to be a key issue in pushing the EUV lithography resolution beyond its present limits, and it is exactly to this theme that a second meeting on LEEs will be devoted early next year.

Not always the aim is to limit the LEEs production, there are cases in which it is needed to maximize it. Prototypical examples are the photomultipliers and all applications that make use of term/photoelectron emitting materials, such as the innovative photo-thermionic converters.

All these issues, and even more, have been in depth treated by the speakers and amply debated from the floor. Abstracts and presentations can be found on the web site at the link <https://lee2022.ism.cnr.it/>.

CIRCULAR ECONOMY OF LEES INFORMATION



Conclusions

In summary, the meeting aimed at establishing a “Circular Economy of Information” in which hot questions percolate down from application through applied research to fundamental research, where experiments and simulations will work hand in hand in order to feed-up answers to applied research and ultimately to application. Without false modesty, it can be said that the meeting achieved its goal.

Credits

Ending this report, it is the pleasure of the organizers to gratefully acknowledge the skillful support received from the technical staff of Area della Ricerca Roma 1 - CNR, in particular in persons of Mr. R. Occhiuto and Mr. A. Scioli, and from Dr. C. Ottaviani and A. Ippoliti of Sezione ISM Tor Vergata .

The enthusiastic scientific and financial support granted by Dr. Daniele M. Trucchi, responsabile of the Sezione ISM Montelibretti, to the organization of the meeting is also gratefully acknowledged.