

SOPHI@WEBINAR THE ADVANCED E-LEARNING PLATFORM OF THE PHOTOVOLTAIC EUROPEAN RESEARCH INFRASTRUCTURE FP7-SOPHIA PROJECT

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ABSTRACT: FP7-SOPHIA project coordinated by CEA-INES, is the European research infrastructure project which brings together 20 European PV RTD Organizations and associations like EPIA, EUREC and DerLab to strengthen and optimize the research capabilities in the field of PV technologies. The tight and frequent interaction among top-level experts of the SOPHIA consortium is essential to realize the necessary collaborative network. On the other hand the huge quantity of research areas of common interest, joint to plenty of equipment and procedures currently utilized demand combinations of disciplines and top-class scientists are not available at a single research institute. Sustaining the training programme by a more traditional in-person and on-site approach constitutes a threat given the constraints on financial budgets and time availability of the experts. To address these needs SOPHIA has developed on-line solution: SOPHi@webinar, the e-learning platform of FP7-SOPHIA project requires no more than a set of interconnected computers with suitable software and hardware.

Keywords: E-Learning, Education and Training, Dissemination, Qualification and Testing, Stability, PV Technologies

1 INTRODUCTION

The FP7-SOPHIA PhotoVoltaic European Research Infrastructure project, (<http://www.sophia-ri.eu/>) launched in Feb 2011 and 4-year duration, has received funding from the European Union's for research, technological development and demonstration under grant agreement No 262533 for the following main objectives:

- Strengthen and optimize PV research capabilities, mainly by coordinating efforts on important but precompetitive Photovoltaic topics.
- Address the issues of fragmentation and costly duplication of research toward the European scale. Relevant research infrastructures working together will avoid the useless replication of a large number of small efforts.
- Bring together the main European Photovoltaic Research Infrastructures in order to provide the scientific community with common referential to conduct efficient and coordinated research work in the field of PV technologies

FP7-SOPHIA with its free access to 48 Research Infrastructure is an unique entry point to any interested researcher, technician and professionals to interact with top-level experts and to access to many European PV research facilities not only in terms of equipment but also of expertise.

Research activities are organized in JRA-Joint Research Activities in order to improve and optimize the services provided by the research infrastructures on quicker material characterization, faster and more efficient lifetime prediction, more accurate modelling or performance prediction, etc.

Four main JRA issues are addressed by the project:

- Quicker lifetime prediction though accelerated ageing tests and improved failure analysis procedures of PV modules (JRA01)
- Greater accuracy of rated power and energy output prediction of PV modules & systems (JRA02)
- Improved Material characterization procedures on silicon material, thin films and TCOs, and organic solar cells (JRA03)
- Improvement and validation of software infrastructure for material, cell, module and system modelling (JRA04)

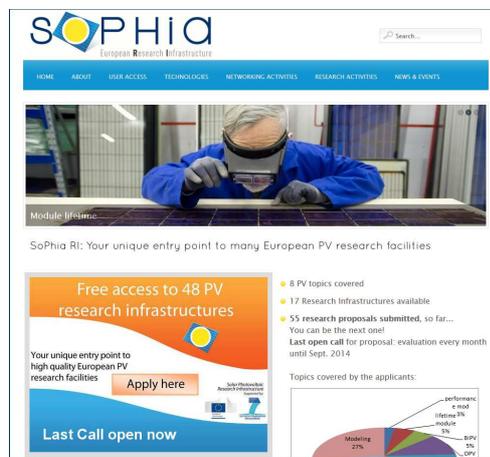


Fig. 1: FP7-SOPHIA web site <http://www.sophia-ri.eu>

Tight and frequent interaction among top-level experts is essential to realize the necessary collaborative

network frame in SOPHIA project. On the other hand the huge quantity of research areas of common interest, joint to plenty of equipment and procedures currently utilized demand combinations of disciplines and top-class scientists are not available at a single research institute. To sustain the training programme by a more traditional on-site and in-person approach constitutes a threat given the constraints on financial budgets and time availability of the experts.

To address these needs, SOPHIA has developed on-line solutions: SOPHi@webinar the e-learning platform of FP7-SOPHIA project requires no more than a set of interconnected computers with suitable software and hardware and just requiring short-hand training of speakers and participants.



Fig. 2 Sophi@webinar web site

2 WHY WEB-CONFERENCES?

Early conferencing systems required highly specialized hardware, well trained speakers and participants needed to be assisted by experienced technician utilizing sophisticated audio/mixer and video switching unit. In many cases it was also required the presence of a control room with its own audio/video assistants. .

The hardware for video conferencing (microphone, web cam) now comes as an integrated part of any computer particularly laptop. Modern web conferencing systems offer very easy access becoming a popular method of communication as Internet access, digital video capabilities and messenger environments is growing, for personal conversation, technical meeting, business training or academic lectures.

Most online web conference hosting services are all-encompassing and only require that attendees have a computer, Internet connection and right access/login information. A web conference is usually interactive, that is, participants have an opportunity to ask questions, propose comment.

2.1 Web conferences advantages

Today, the electronic conferencing requires no more than a set of interconnected computers with suitable software and hardware. Participants can connect with conferences and workshops at their convenience, regardless of their time zone and geographical location:

Time saving and reducing travel costs: this cuts down on travel costs and creates a wider audience for training individuals in academies, research organization companies. who might not be able to afford the high

inscription fees, travel and accommodation associated with going on a specialized training course. This is a great advantage also for those who, perhaps due to lack of time, would be unable to attend physical events due to their own full booked agenda. Physical meetings can take place only when strictly necessary

Fluid and improved Communication: Video conferences enhance the possibilities for all to interactively review a subject, allowing them to share efficiently ideas, documents, conclusions and concerns and propose documents and slides.

No limitation on event location: E-conferences can be realized by laptops, tablets and mobile phones and can be followed from everywhere.

Focused Involvement: Participants can focus on the topic issues of direct interest, saving time from topics in which they are not directly involved or interested.

Storage and streaming of produced output: The ability to integrate file sharing, video and presentation enhances the potential in educational field. The acquired material (i.e. audio, slides and video presentations) can be easily proposed also by webcasting all produced output even after the event , to review unclear steps of the lecture or could require extra information not available during the presentation.

2.2 Web conferences disadvantages

- There is no substitute for a face-to-face meeting when tight discussion in necessary mainly in taking decision.
- Always a very reliable, fast incoming/outcoming data link access is needed. Even with a fast connection, there might be a slight delay between responses.
- The video camera might not be able to see covered parts of the conference/meeting room at the same time. Some people might not be easy to see or listen during videoconference in “dark” video/audio areas.
- Only adequate equipment should support a high quality web conference particularly microphone audio quality is fundamental for a successful web-conference as experimented by Sophi@webinar,too.
- If the hardware breaks down for any of the participants, they cannot 'attend' the meeting. But if this happens to the chairperson(s)/ presenter(s) it is always a “catastrophic” event that irreparably undermines the event.
- To handle a consistent on line audience, the on-line and on-site organizers, chairperson and lecturers need to be adequately trained on Internet connection, access to video/microphone and projection equipment and usually two or more knowledgeable trained assistants need to run the equipment, to assist and work with event organizers/chairpersons to manage questions and discussion on line/on-site..
- There's always some kind of security risk to communication carried out online. In fact in addition to the threat of hackers or spiteful persons, there is a limited control over unwanted people who may overhear the conference. Furthermore many companies hire access to video conferences and their firewall/proxy configuration blocks incoming/out coming videoconference traffic (sometime port 80 and/or port 1935 TCP/UDP could be closed) sometime limiting access also to widely diffused teleconferencing application “Skype”.

3 FP7-SOPHIA TRAINING COURSES:

SOPHIA Internal and external courses focus on the exchange experiences and best practices, aiming to harmonize approaches and assuring that participants, particularly who are at the initial stage of their career physically participate in the work, for example in making measurements, or doing by themselves data interpretation on selected results so forth, assisted by an expert. They are also offered to experienced researchers and scientists would deepen the research and technical themes different from their own.

Participants are also requested to contribute to the interactive discussion, by giving a presentation, when applicable. In order to improve the external impact of the project, courses targeted to SOPHIA members (internal courses) are open also to interested non-SOPHIA organizations when seats are available.

For instance, we highlight among SOPHIA organized training workshop/courses:

- Sophia Workshop on PV-Module Reliability “Interactive training course on EL & DLIT characterization of PV modules” held by ECN in June 2013
- the four Sophia Workshops on PV-Module Reliability organized by FHG-ISE, FHG-IWES, JRC, CEA-INES, international
- the four Spectroradiometer and Broadband Intercomparison held from 2011 to 2014
- the two workshop on analytical tools for PV organized by HZB;
- the three summer schools ISU Energy on Solar energy, wind energy, economics of renewable energy held in Falera, Switzerland;
- The two workshop on PV Modelling infrastructure: The modeling chain (2011) and PV performance modelling 82013) organized respectively by FZ-Jülich and CEA-INES respectively
- The two BIPV Workshops –on What are the requirements of PV in buildings organized by CEA-INES in 2013 and 2014
- the “Best practices for power measurement of PV modules” held by JRC in July 2014.

Extra details can be directly found on SOPHIA web site News&Events >past events> at <http://www.sophia-ri.eu/news-events/past-events/>

On the other hand the full potential of the wide research areas of common interest of SOPHIA consortium partners, the availability of top-class scientists ready to transfer knowledge, and the combination of scientific expertise with technological capabilities offered by the utilization of SOPHIA 48 PV research infrastructures has been only partially explored by the project during its first two years of activities, mainly because the constraints on financial budgets and time availability of the experts limited the relevant potential in knowledge exchange of FP7-SOPHIA project

4 FP7-SOPHIA E-LEARNING PLATFORM: SOPHI@WEBINAR:

To address these needs in March 2013, SOPHIA has developed on-line solution: SOPHi@webinar, the e-learning platform of FP7-SOPHIA project.

Several software and service providers offer tools useful to support webconferencing (Adobe Connect,

Cisco WebEx, Citrix On-line, Microsoft Lync, Moodle, Skype, GoToMeeting, WoWza,etc)

The Sophi@webinar platform has been designed and powered by ENEA based on their corporate Adobe Connect platform. It runs on a production infrastructure consisting of two clusters servers located in Portici Data Centers running on ENEA supercomputing (fig. 3) Cresco-Centro computazionale di RicErca sui Sistemi COMplessi (nominally Computational Center for Complex Systems Research) <http://www.cresco.enea.it/>.

A third staging server is used to test patches and configuration changes. The location of the server in the DMZ-perimeter network dedicated to log-in and streaming, uses a direct connection by fiber network connected to GARR, the Italian Academic & Research Network <http://www.garr.it/>, based on high-bandwidth circuits up to 10 Gbps, using various technologies such as DWDM, SDH and MPLS. The meshed topology ensures ultra high speed connection, a high level of resilience and reliability of the network. All communications between clients and server utilize SSL certificates issued by TERENA.

ENEA is licensed "on-premise" that is, all data is stored on HW ENEA and fully managed by internal staff, to ensure the maximum security of the data. In the event of a serious HW accident, the current architecture is designed to return operational in terms of minutes



Fig. 3 ENEACRESCO Supercomputing

5 HOW DOES WORK SOPHI@WEBINAR?

Each event takes place in specific webinar virtual rooms. The URL and a room pass code are sent by email to all early registered participants.

The Sophi@webinar key roles (fig-5) are:

Presenter (*Speaker/teacher*)

researcher/scientist offering the seminar on line. A local audience can also follow lecture/presentation on site

Moderator/Host (*Chairperson(s)*)

The organizers and managers of the event. They introduce and give the floor to the speakers, they manages questions/comments to the speaker by “chat” or directly by microphone at the end of presentation

On Line Participants (*Audience/classrooms*):

the groups of students/researchers or individuals who follow the event on line.

Sophi@webinar utilize two different type of virtual rooms: events with less than 50 participants are offered by <https://connect.portici.enea.it/sophiawebinar> and events up to 250 participants or more are offered by <https://connect.portici.enea.it/sophiawebinarplenary>

Lectures are presented via microphone/web cam and slides are directly showed in high resolution on

participants laptop/desktop screen or via beamer in the audience conference room.

Participants interact with speaker and other participants via live chat (fig.4)

The duration of each webinar/speech is between 35-45 minutes, with 15-20 minutes for questions or comments.

Longer duration up to 2-3 hours can happen for short on line courses having 5-6 different lecturers.

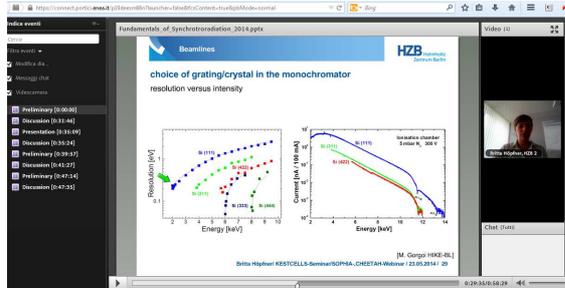


Fig. 4: Participants live interact with speakers by chat .

One or more Webcams and microphones allow the simultaneous view of the presenters/speakers, event chair

and local audience and they can offer the feeling that on-line participant is interactively joining any event. Local audience interacts with speakers as usual. As opposite on line participants interact with speakers for example during question time via "live chat".

On participant request , and in special cases, questions can be asked via microphone and web cam, particularly when participant needs of a more tight interaction with the lecturer and on line/on site audience as example to show their own slides, scientific paper or any other information can be useful to support and contribute to the collective discussion.

The reliability of e-learning platform is very high but organizers always warmly invite participants to install all their hardware (microphone, headset, loudspeaker, beamer, webcam, etc) and check their connection to avoid any problems during the speech/presentation by utilizing following link:

https://connect.portici.enea.it/common/help/en/support/meeeting_test.htm and by installing all necessary Add-ins. Adobe Connect requires the Flash Player Plugin Version 10.3 or above.



Fig. 5: Sophi@webinar web site and platform key roles (<http://uttp.enea.it/sophiawebinar>)

The typical topics offered by Sophiawebinar are indicated in fig.5 and they range from Si Technology, to OPV Organic Photovoltaics, TF Thin Film Technology, CPV Concentrated Photovoltaics, and it includes Material and Cell Characterization and Modelling, Lifetime prediction and reliability, Module and System Performance: data base and procedures, BIPV & Smart Building Integrated Photovoltaics, BOS: architectures, Safety and Conversion

Sophi@webinar also proposes online short courses organized by proposing several webinar on a common theme.

The dissemination of initiative is now assured by a well structures web portal offering any information on speakers profile, as technical/scientific content (<http://uttp.enea.it/sophiawebinar>)

When speakers agree presentations are also recorded in real time, and when they have been they are also

made available on Sophi@webinar portal. This video archive represents a relevant opportunity for European PV RTD community for any interested internal/external viewer who missed the on-line event.

Access to the past event can be assured by the menu SOPHI@Webinar > past event.

This approach has been considered to be very powerful for the dissemination of knowledge and expertise, particularly for students and younger researchers because participants following any event are invited to take part to final discussions, and have been very enthusiastic of the initiative (particularly PhD students).

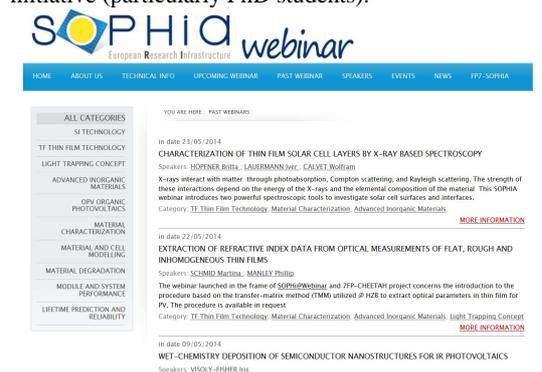
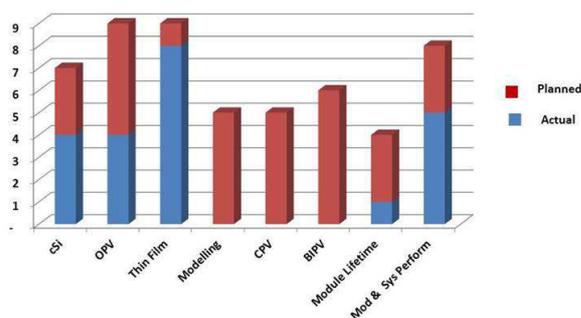


Fig. 6: SOPHI@Webinar > past event menu.. The speeches can be sorted by different criteria: by topic, by speakers or by organization

The e-learning platform is also currently proposing to any SOPHIA partner the opportunity to be directly utilized for business-to-business technical or scientific interaction of experts and scientists with teams and individual beneficiaries of host organizations to share directly among them knowledge and expertise.

Table I: summary of offered webinars as Sept 2014

- ❑ 21 webinars organized since March 2013
 - around 2-4 events/month organized
 - 30+ expected in 2014 (on cSi crystallization, CPV, OPV, modelling, BIPV, Solar radiation characterization, etc)
- ❑ 570 participants (+ >60 in live streaming)
 - Majority of non-SOPHIA members. Extra non registered access (>100)
 - Several webinars (pdf, slides, videos) are available on-line on Sophia Events pages and Sophi@webinar portal.



The platform offers also the potential for direct display and discussion of data and results, and has also the

potential to allow remote characterizations and experiments could be jointly realized and discussed by live chat/ discussion/video.

This offers a unique opportunity to Sophi@ webinar, which to the authors' knowledge never been offered by any other open source platform for e-learning.

6 CONCLUSION

Sophiawebinar has kicked-off an efficient dissemination of knowledge and technologies among SOPHIA partners through a better identification of the knowledge required among partner organizations and creation of an efficient on-line environment to promote request/supply of knowledge/expertise.

The design of an efficient Website: SOPHI@Webinar is also offering an efficient dissemination of the output of Sophiawebinar including the access to video/slides offered by the speakers.

The on-line approach to knowledge exchange is very successful because time saving and reducing travel costs and it is widely diffusing for that. It creates a wider audience for training individuals in academies, research organization companies. This is a great advantage also for those who, perhaps due to lack of time, would be unable to attend physical events.

The storage and streaming of produced output offers a very relevant opportunity to share knowledge and the ability to integrate file sharing video and presentation enhances the educational progress.

The platform offers the potential for direct display and discussion of data and results, and has also the potential to allow remote characterizations and experiments could be jointly realized and discussed.

On other hand, Web conferences cannot substitute the face-to-face meeting when it is required, as example to quickly take some decision.

So by summarizing, the web conferencing will be widely implemented during next years, particularly if the bottlenecks are continuing to prevent approach to on-line event organization, will be removed. Among them, the inadequate training and unavailability of lecturers to speak in front of camera instead than the physical presence of their interlocutors on site, as well the low quality of microphone/audio/video and LAN connection speed often met during the organization of the events, and the unavailability of trained chairperson and assistants can support locally, on site, and on-line the management of floor moved among presenters participants to set questions and open discussion, all difficulties Sophi@webinar has already experienced.

When this will be overcome the web conferencing will become the default way of communicate during workshop/conference.

Acknowledgement

A relevant initiative involving so wide number of participants having each of them a key roles, imposes that acknowledgments should be extended to a lot of involved persons and we apologize in advance if we will unintentionally forgot someone.

As first let's thanks the organizers/chairpersons and SOPHI@Webinar speakers have helped with their excellent presentations to make this initiative possible

and successful. We hope that their collaboration will also continue for the future. Among them:

Britta Höpfner, HZB (Basics of synchrotron radiation)
Iver Lauermann, HZB (X-ray photo electron spectroscopy)
Wolfram Calvet, HZB (Determination of band alignments by UV photo electron spectroscopy)
Martina Schmid, HZB (Extraction of refractive index data from optical measurements of flat, rough and inhomogeneous thin films) & Phillip Manley (Presentation of hands-on examples)
Iris Visoly-Fisher, BGU (Wet-chemistry deposition of semiconductor nanostructures for IR photovoltaics)
Suren Gevorgyan, DTU (Challenges in testing OPV lifetime)
Giorgio Bardizza, JRC (Ageing tests of OPV devices at ESTI: facing issues and criticalities)
Tony Sample, JRC (Existing PV Measurement and Type Approval Standards and OPV Devices)
Jens Mertens, CEA-INES (Advanced Module Characterisation Based On I/V Measurements),
Gianluca Coletti, ECN (Impurities in Si and their impact on solar cell performance)
Gaute Stokkan (Dislocations in multicrystalline silicon)
Martin Schubert, FHG-ISE (Defect Imaging in Silicon Wafers)
Ounsi El Daif, IMEC (From nanoscale to gigawatt: nanopatterned thin crystalline silicon solar cells) ,
Jürgen Hüpkens, FZ-Jülich (Transparent ZnO contacts for silicon thin film solar cells)
Harald Müllejans , JRC (Uncertainty of Pmax calibration of PV modules)
Jörg Kirchhof (Uncertainty Estimation of I-V-Curve Measurement Devices)
Vincent Helmbrecht, DerLab (PV Energy Yield Uncertainty Estimations using the propagation of uncertainty method)
Wendelin Sprenger, FHG-ISE (Calculation of the uncertainty of a PV electricity yield simulation)
Ralph Gottschalg, LU-CREST (Uncertainties in the outdoor performance assessment of PV modules – the importance of the experimental design) and last but not least ENEA colleagues Vera La Ferrara (Introduction to FIB-Focussed Ion Beam) and Giuseppe Nenna (TCO and ARC Nanopatterning by FIB) because by showing all their enthusiasm they were the pioneers in this initiative by offering the first webinar

Obviously we also thank all webinar participants that have reacted with enthusiasm and interest to our initiative. Without them it would have been a pleasant dinner without tablemates.

We acknowledge the technical staff of ENEA has consistently supported both the development and the use of applications and David Casaburi for the realization of the very useful and well structured website and Maria Giovanna Gaglione and Giuseppe Cipolletta (ENEA) for their always present support. We also thank Stéphanie Ruguet Chappuis and Maud Bossard (ALMA CG) for their very useful comments and suggestion supported during 2013-2014 period the improvement of Sophi@webinar e-learning platform.

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REFERENCES

- [1.] Sophi@webinar Web portal
<http://uttp.enea.it/sophiawebinar>
- [2.] FP7-SOPHiA web site
<http://www.sophia-ri.eu>

- [3.] Private communications within SOPHIA Consortium and with ALMA CG Consultant
- [4.] 7EO.2.1 Strengthening and Optimising PV Research Capabilities in Europe:outcomes of the Sophia Project (this conference proceedings)
- [5.] E-learning Platforms in Higher Education. Case Study, D. Bentaa,, G. Bologaa, I. Dzitaca, b, , Procedia Computer Science, Volume 31, 2014, Pages 1170-117
- [6.] What drives a successful e-Learning? Pei-Chen Suna, et others Computers & Education Volume 50, Issue 4, May 2008, Pages 1183–1202