

ECLLOUD12 CONCLUSIONS

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Abstract

The ECLLOUD12 workshop was held at La Biodola / Elba from 5 to 9 June 2012. This paper presents highlights and conclusions.

PARTICIPANTS & STATISTICS

In total 62 scientists participated in ECLLOUD12 (15 from United States; 15 from Switzerland; 10 from Italy; 7 from Germany; 4 from Japan; 3 from Spain; 3 from United Kingdom; 2 from France; 1 from Mexico; 1 from Portugal; 1 from Russia). They are shown on the photo in Fig. 1. The workshop featured 50 presentations, including one remote talk (by Igor Kaganovich from PPPL Princeton), 1 soccer match with theorists playing against experimentalists (a “first” at an ECLLOUD workshop), and 1 social dinner. ECLLOUD12 was characterized by working extensive discussions, continuing after dinner until late in the night. The workshop started with a fascinating review of electron-cloud effects in accelerators presented by M. Furman [1].

ECLLOUD'12



Figure 1: Photo of ECLLOUD'12 participants.

Unfortunately two key people had to cancel their participation: J.M. Jimenez, the leader of the CERN TE-VSC vacuum group, due to unforeseen complications for the preparation of the LS1 (LHC long shutdown no. 1), and D. Raboso, the manager of the High Power RF laboratory at TEC-ETM of the European Space Agency (ESA), due to “recent anomalies detected in one of our satellites.” P. Costa Pinto from CERN and B. Gimeno from the University of Valencia gratuitously delivered the corresponding ECLLOUD12 presentations [2,3] on short notice.

NEWS AND PROGRESS

Many new observations and simulations were presented including (first) measurements of electron cloud effects and their mitigation at LHC [4,5,6,7], CEsrTA [8,9,10], PETRA-3 [11] & DAPHNE [12,13] – all of which were providing many signatures, lots of data, test beds for simulations of build up / instabilities, heat load, and new diagnostics. ECLLOUD12 offered a platform for

information exchange on electron-cloud effects between all types of accelerators (e.g. high-intensity ion beams, circular hadron and lepton colliders, synchrotron light sources) and the spacecraft community.

Further significant advances were reported towards understanding the physics of surface conditioning using latest state-of-the-art surface characterization techniques [1,14,15,16 etc]. The ECLLOUD12 workshop revealed that e-cloud mitigation will be important for many upcoming large projects, such as HL-LHC (High Luminosity LHC), CERN LIU (LHC Injectors Upgrade), RHIC upgrade, Project-X, ISIS upgrade, J-PARC, RHIC upgrade, SuperKEKB, SuperB, and the ILC.

New diagnostics tools included bunch-by-bunch measurements of the synchronous phase shift at the LHC and the SPS, cryogenic measurements of electron-cloud heat load at the LHC, microwave resonance excitation at CEsr-TA, coded apertures at CEsr-TA and KEK, time-resolved shielded pick ups, e.g. at CEsr-TA, and new laboratory models, such as Gabor lenses at the University of Frankfurt [17] and another dedicated setup at BINP Novosibirsk [18].

SIMULATIONS

Concerning the agreement between simulations and measurements Jim Crittenden quoted Giovanni Rumolo highlighting that the “impressive resemblance (between simulation and measurement) suggests that our electron cloud model correctly describes the phenomenon and the rationale for the data analysis is promising”.

Powerful new codes presented at ECLLOUD12 included:

- SYNRAD3D (G. Dugan) [19] – photon tracking including surface properties & 3D geometries
- OSMOSEE (M. Belhaj) [20] – secondary emission yield including low primary energies
- PyECLLOUD (G. Iadarola and G. Rumolo) [21] – improved build up simulations: faster, better convergent
- WARP-POSINST (J.-L. Vay) [22] – combined simulations of build up, instability and emittance growth with many bunches over 100s of turns
- BI-RME/ECLLOUD (M. Mattes, E. Sorolla, F. Zimmermann) [23] – modeling the microwave/e-cloud interaction.

New codes also mean more work, e.g. the possible need of redoing for PyECLLOUD all the ECLLOUD modifications and additional features implemented at Cornell, EPFL and other laboratories.

SYNERGIES WITH SPACE COMMUNITY

Abundant topics of joint interest with the satellite / spacecraft community comprise the modelling of surface parameters: secondary emission, photoemission (e.g. the “Furman formula” is now widely used for satellites), mitigation measures (e.g. advanced coatings, magnetized surfaces,...), and simulation codes (e.g. BI-RME, FEST3D,...). E-CLOUD12 welcomed a significant number of participants from, and improved links with, the space community, e.g. the VALSPACE consortium, ESA/ESTEC, ONERA, MIT [24], EPFL LEMA, and ICMM-CSIC [25].

PUZZLES & QUESTIONS

Still many puzzles remain, e.g. on the origin of the betatron sideband signal at CEsrTA [8] (why is it different from the sidebands seen at KEKB [26] and PETRA-3 [11], the latter two presenting only an upper synchrotron sideband?), the beam-size growth in PEP-II (unexpected plane), complex incoherent effects, electron-cloud effects for electron beams (high energy photoelectrons, ϵ_{\max} (δ_{\max}^*) & R for LHC *Cu* still open, conditioning of stainless steel vs *Cu* (the same or different? if the conditioning is the same, as indicated in some of the E-CLOUD12 talks (e.g. by R. Larciprete [14]), what would be the rationale for coating the SPS stainless-steel beam pipe without coating the LHC copper beam screen?).

Open questions raised at the workshop include the following:

- Can SEY change over the time scale of seconds during the accelerator cycle? (raised by P. Lebrun in view of the FNAL MI e-cloud observations)
- Can one speed up the surface conditioning by controlled *CO* gas injection, e.g. inspired by [14]?

E-CLOUD SAFETY OF NEW MACHINES

Forecasts were made based on the present understanding and modeling. As a result with the planned or actual mitigation schemes, electron cloud should not prevent reaching the design performance of the ILC, of the LHC (if scrubbing progresses as expected) and of SuperKEKB [27]. On the other hand, electron cloud could become a problem for Project-X, the RHIC upgrade, J-PARC, and SuperB, unless appropriate countermeasures are implemented.

E-CLOUD12 FEEDBACK

Positive feedback received from E-CLOUD12 participants included the question “why only 3.5 days?” and general applause for the choice of place (with one exception).

EUCARD-ACCNET WORKSHOPS

Accelerator-science workshops so far (co-)organized in the frame of EuCARD WP4.2 AccNet-EuroLumi [28] (the successor of CARE-HHH; and precursor of EuCARD2-XBEAM) included the following 12 events (with E-CLOUD12 as the last one):

- 16-18 September 2009: EuCARD-ACCNET Workshop on LHC Crab Cavities “LHC-CC09”, organized jointly with CERN, US-LARP, DL/CI, and KEK, at CERN
- 12-13 October 2009: **AccNet EuroLumi Workshop on Anti E-Cloud Coatings that Require No Activation “AEC’09”**, CERN
- 9-10 November 2009: EuCARD-AccNet-EuroLumi mini-Workshop on Crystal Collimation, at CERN
- 17-18 December 2009: Working meeting on proton driven plasma acceleration PPA09 at CERN
- 11-12 March 2010: Workshop on Proton Driven Plasma Wake Field Acceleration, CERN
- 14-16 October 2010: HE-LHC’10, Mini-Workshop on High-Energy LHC, Malta, MCST
- 25-26 October 2010: Annual Workshop on Crystal Collimation, CERN
- 15-17 December 2010: LHC-CC10, 4th LHC Crab Cavity Workshop, CERN
- 7-8 March 2011: **CERN-GSI Electron-Cloud Workshop**, CERN
- 20-21 June 2011: Workshop on Optics Measurement, Correction & Modelling “OMCM”, CERN
- 14-15 November 2011: LHC-CC11- 5th LHC Crab Cavity Workshop, CERN
- 5-9 June 2012: **E-CLOUD’12, INFN-LNF/INFN-Pisa/LER/EuCARD-AccNet Joint workshop**, Elba

As can be seen three of these workshops were devoted to electron-cloud related topics (highlighted in bold font) and all but two of these workshops were held at CERN.

EuCARD WP4 AccNet consists of three sub work packages: WP4.1 “Coordination and management (coordinated by F. Zimmermann, CERN; W. Scandale, IN2P3, and P. Spiller, GSI); WP4.2 “EuroLumi” (coordinated by F. Zimmermann and E. Todesco, CERN), WP4.3 “RFTech” (coordinated by J.-M. De Conto, UJF Grenoble, M. Grecki, DESY, and W. Weingarten, CERN) and WP4.4. “EuroNNAc” (coordinated by R. Assmann CERN/DESY, J. Osterhoff, DESY, and H. Videay, CNRS).

WORKSHOP PROCEEDINGS

The E-CLOUD12 proceedings will represent a valuable reference. They will be published as a CERN Yellow Report. Detailed instructions for contributing to these proceedings were sent out by Giovanni Rumolo after the

workshop. In addition, ECLLOUD12 participants are encouraged to submit extended articles to an ECLLOUD12 Special Edition of the journal PRST-AB.

NEXT ECLLOUD WORKSHOP

The next ECLLOUD workshop (in 2015?) would coincide with the 50th year anniversary of the first e-cloud observation at BINP. So far ECLLOUD was held twice in Europe, twice in the US, and only once in Asia. So presumably ECLLOUD15 should be held in Asia again, e.g. at/near KEK or J-PARC (chair K. Ohmi?). Other possible venues like Novosibirsk or Mexico were also suggested.

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