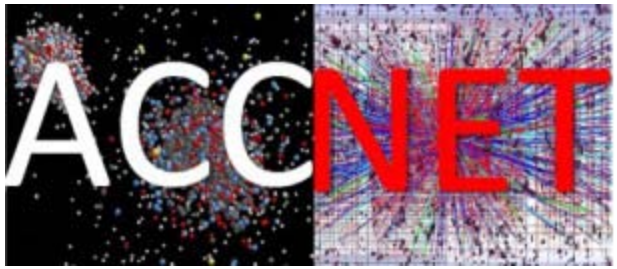
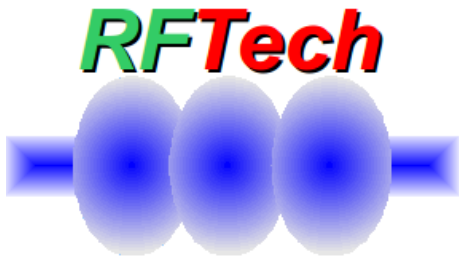
Summary of
LLRF 2011 Workshop

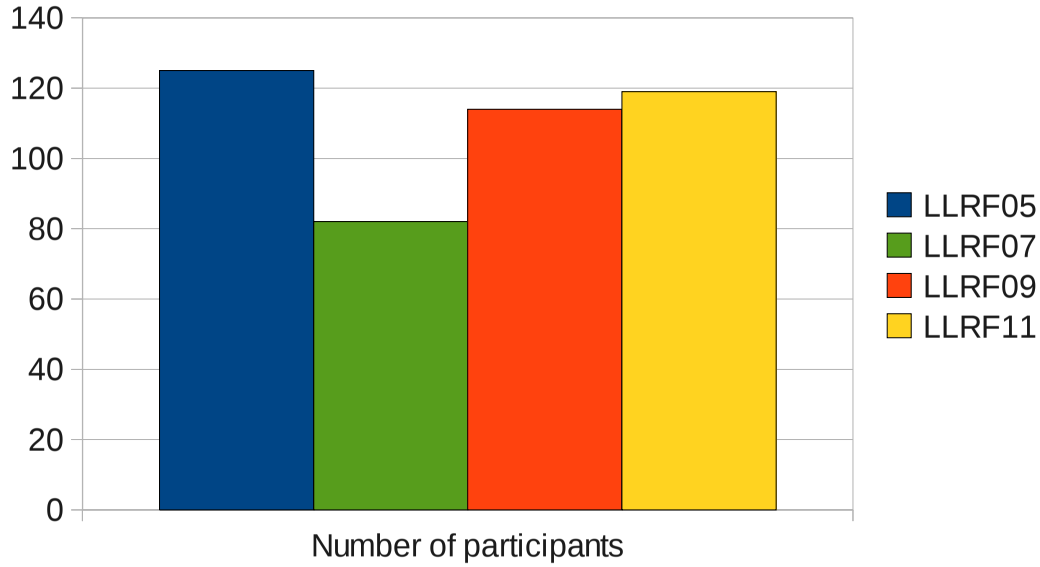
M.Grecki





LLRF Workshop

- Started in 2001 (Jefferson Lab)
- Continued in 2005 (CERN), 2007 (Knoxville), 2009 (Tsukuba) and 2011 (Hamburg)
- The goals of the LLRF Workshops are to bring together people working on LLRF control systems worldwide to share the experiences, to present the status of the work, to discuss recent technical developments, and to seek solutions to the technical problems



WORKSHOP ON LOW-LEVEL RF CONTROLS FOR SUPERCONDUCTING CAVITIES

Jefferson Lab
Newport News, Virginia, USA

April 25 - 27, 2001

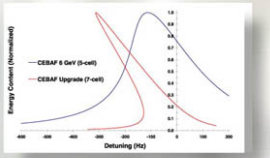
http://www.jlab.org/LLRF
email: llrf@jlab.org

The Workshop will explore the present state and future directions of Low-Level RF (LLRF) control systems for superconducting cavities, investigate in-depth common design issues, such as algorithms and implementation, and attempt to initiate collaborative efforts among institutions.

Topics to be discussed include:

- Control of SRF Cavity Field and Resonance Frequency in the Presence of:
  - High Gradient
  - High or Moderate Q_L
  - Heavy or Negligible Beam Loading
  - Pulsed or CW (RF/Beam)
  - One Klystron/One Cavity or One Klystron/Multiple Cavities
  - Relativistic or Non-relativistic Particle Acceleration
- Analog vs. Digital Systems: Directions, Limitations
- Feedback and Feedforward Techniques
- Design and Development Tools
- Operability Issues

Specific applications of interest include CEBAF Upgrade, SNS/NSP (JAERD, RIA, TESLA, Energy Recovery Linacs (ERLs) and ERL-based FELs.



Workshop Organizers: Curt Hovater (hovater@jlab.org) and Lia Merminga (merminga@jlab.org)
Workshop Administrator: Sherry Thomas; Tel. (757) 269-7078; Fax. (757) 269-7638; email: llrf@jlab.org

Workshop on Low Level RF

Sophisticated Low Level RF systems are needed in modern particle accelerators to deal with the characteristics of state-of-the-art RF accelerating structures and their power sources, and to meet unprecedented levels of performance. The goal of the LLRF05 workshop is to share experience between linac and synchrotron projects (SNS, J-PARC, ILC, LHC etc.) and to discuss the best engineering practice.

This four-day workshop will be the 15th in the series of mini-workshops under the auspices of the ICFA Beam Dynamics Panel, and specifically will be the second in a series on low-level RF techniques, initiated at Jefferson Lab, USA, in 2001.

Scientific Programme Committee

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B. Chase (FNAL)
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R. Garoby (CERN)
C. Hovater (JLab)
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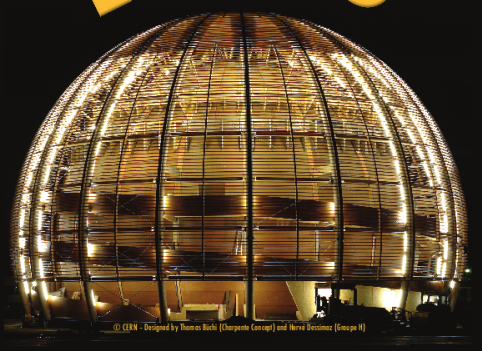
LLRF05



CERN, Geneva, 10–13 October 2005

http://www.cern.ch/LLRF05

ICFA

OCTOBER 22-25, 2007

LLRF07

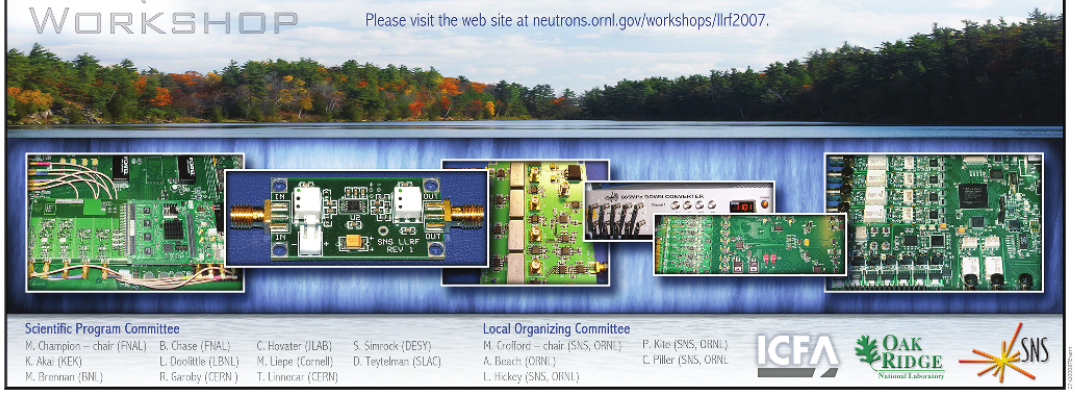
KNOXVILLE, TENNESSEE

2007 LOW-LEVEL RADIO FREQUENCY WORKSHOP

Low-level RF control systems are essential for producing high-quality particle beams. Although their fundamental purpose is field regulation in RF cavities, they also serve as the primary interface between the operations team and the RF system as a whole, and interface with numerous technical subsystems. Therefore, despite their complex nature, they must be easily operated by non-experts, and they must be robust and reliable. Most modern LLRF control systems are implemented digitally, which provides for functional and performance modifications through code development. The goals of the LLRF07 Workshop are to bring together people working on LLRF control systems worldwide to share our experiences, to present the status of our work, to discuss recent technical developments, and to seek solutions to technical problems.

This four-day workshop will be the third in a series of LLRF workshops; the first was held at Jefferson Lab in 2001 and the second was held at CERN in 2005.

Please visit the web site at neutrons.ornl.gov/workshops/llrf2007.



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A. Beach (ORNL)
L. Hickey (SNS, ORNL)
P. Kite (SNS, ORNL)
C. Piller (SNS, ORNL)

ICFA OAK RIDGE National Laboratory SNS

LLRF09

2009 Low-Level Radio Frequency Workshop

KEK, Tsukuba
October 19-22, 2009

http://www-conf.kek.jp/llrf09
For info, please contact: llrf09@ml.post.kek.jp

Sophisticated Low-Level RF systems are essential to control RF structures and their power sources in modern particle accelerators for producing high-quality beams. The goals of the LLRF09 workshop are to share our experiences, to present the status of our work, and to discuss recent developments and future prospects in this field. This four-day workshop will be the fourth in a series on low-level RF techniques, initiated at Jefferson Lab in 2001, and followed at CERN in 2005 and at SNS in 2007.

Scientific Program Committee

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E. Ciapala (CERN)
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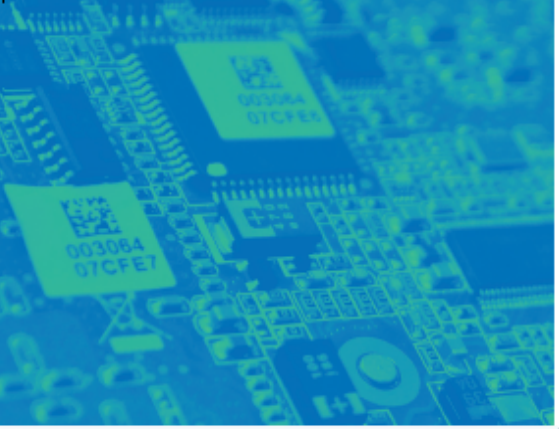
Y. Hayashi (KEK)
T. Kobayashi (JAEA)
T. Matsumoto (KEK)
T. Miura (KEK)
Y. Nagashio (KEK)



LLRF 2011

17 - 20 October 2011, DESY, Hamburg

2011 Low-Level Radio Frequency Workshop

Sophisticated Low-Level RF systems are essential to control RF structures and their power sources in modern particle accelerators for producing high-quality beams. The goals of the LLRF2011 workshop are to share our experiences, to present the status of our work, and to discuss recent developments and future prospects in this field.
This four-day workshop will be fifth in a series on low-level RF techniques, initiated at Jefferson Lab in 2001, followed at CERN in 2005, at SNS in 2007, and at KEK in 2009.

For further information please, visit the workshop website:
http://llrf2011.desy.de/

contact:
llrf2011@desy.de

Scientific Programme Committee

Kazunori Akai (KEK)
Brian Chase (FNAL)
Mark Crofford (ORNL)
Larry Doolittle (LBL)
Mariusz Grecki (DESY)
Wolfgang Hofle (CERN)
Curt Hovater (Jefferson Lab)
Matthias Liepe (Cornell)
Shinichiro Michizono (KEK)
Stefan Simrock (ITER)
Kevin Smith (BNL)
Dmitry Teytelman (Dimtel, Inc.)

Local Organising Team

Gohar Ayvazyan
Hannah Gerth
Mariusz Grecki
Matthias Kreuzeder
Izabela Malka
Swaantje Mette
Britta Niemann

Advertising

EuCARD webpage:

EuCARD >> News >> Events >> Past events

2008 | 2009 | 2010 | 2011

2011

Date	Title	Location	Keywords
16-18 November	**HiLumi LHC / LARP** joint collaboration meeting	CERN, Switzerland	Meeting; **WP7-HFM**
14-15 November	**LHC-CC11** on LHC Crab Cavities	CERN, Switzerland	Workshop; **WP4-AccNet**
7-9 November	**NNN11**: The 12th International Workshop on Next generation Nucleon Decay and Neutrino Detectors	Zurich, Switzerland	Workshop; **WP3-NEu2012**
6-17 November	**Sixth International Accelerator School for Linear Colliders**	Pacific Grove, California, USA	School; **WP9-NCLinac**; **WP10-SRF**
17-20 October	**LLRF-2011** Workshop (co-sponsored by **RFTech**)	**DESY**, Germany	Workshop; **WP4-RFTech**
16-21 October	**ERL 2011** - ICFA Advanced Beam Dynamics Workshop on Energy Recovery Linacs	KEK, Tsukuba, Japan	Workshop; **WP4-AccNet**; **WP9-NCLinac**; **WP10-SRF**

ACCNET webpage:

Past ACCNET workshops and meetings:

17-21 October 2011	LLRF-2011 Workshop, DESY
21-23 September 2011	MulCoPim'11, Valencia - *NEW!*
20-21 June 2011	Workshop on Optics Measurement, Correction & Modelling "OMCM", CERN
16-18 June 2011	MIXDES2011, Gliwice
6-8 June 2011	Workshop on Linac Operation with Long Bunch Trains, DESY

LLRF2011
17/20 OCTOBER 2011
DESY HAMBURG
GERMANY

CONTACT
llrf2011(at)desy.de

OR

Mariusz Grecki (Programme)
Phone: +49 40 8998 5489

Matthias Kreuzeder (Organisation)
Phone: +49 40 8998 4130

Izabela Malka (Organisation)
Phone: +49 40 8998 4290

PARTNER

EuCARD

ACCNET

RFTech

Topics covered

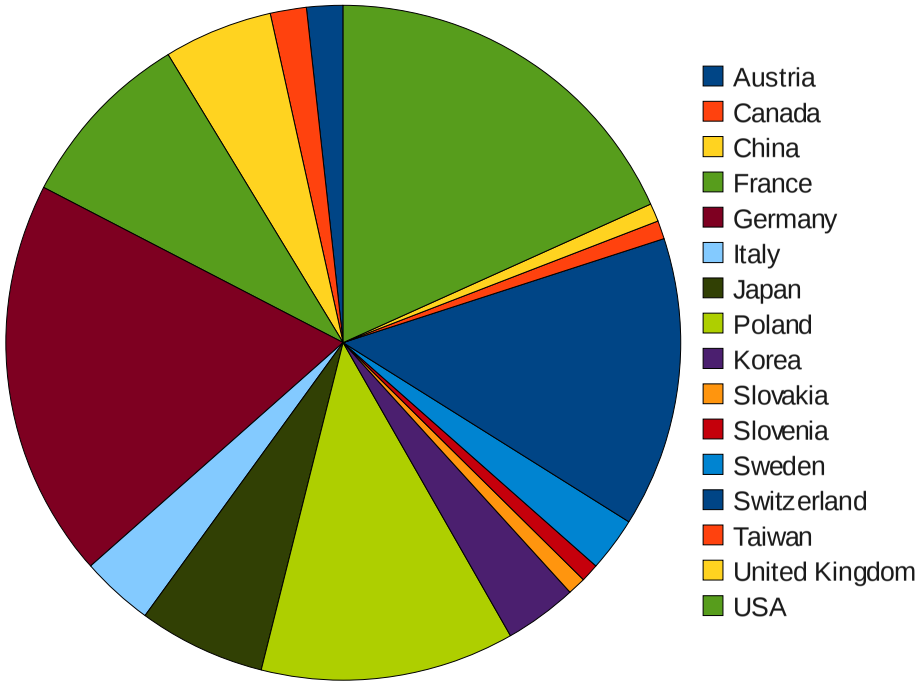
- Reviews of the low-level RF system at various laboratories
- Fast and/or digital low-level RF control for pulsed and CW operation
- Applications of the digital signal processing at accelerator
- Software development
- LLRF systems (requirements, performance reached, modeling)

Working grups

- Hardware developments (RF analogue and digital techniques)
- Software development and Operational experience
- Systems (including timing, frequency reference distribution, modeling)

LLRF-2011 Workshop numbers

- 119+ participants from 16 countries
- 44 talks in 11 sessions (plenary)
  - 6 lab-talks (DESY, KEK, JLAB, FNAL, CERN, Cornell)
  - 10 invited
  - 4 tutorials
  - 1 industry talk (LT)
  - 1 welcome talk
  - 22 contributed talks (7 hardware, 7 software, 8 systems)
- Poster session with 49 posters
- Exhibition with 9 industrial companies



Exhibition

- 9 industrial partners:
  - GLOBES ELEKTRONIK GmbH & Co KG
  - PowerBridge Computer Vertriebs GmbH
  - Struck Innovative Systeme GmbH
  - Telemeter Electronic GmbH
  - Teledyne Electronics and Communications
  - RUPPtronik
  - Dimtel
  - Rohde und Schwarz
- 5 minutes plenary presentation and 3.5hours visits to the booths (combined with poster session)

GLOBES ELEKTRONIK GmbH & Co KG

powerBridge Computer Vertriebs GmbH

Struck Innovative Systeme GmbH

Telemeter Electronic GmbH

Teledyne Electronics and Communications

Teledyne Electronics and Communications

RUPPtronik

dimtel

Rohde und Schwarz

High Speed Direct Sampling Analog to Digital Converters

Oblique answers to a number of hypothetical questions that I presume would be of interest to a certain percentage of those involved in particle physics

Derek Redmayne, Linear Technology

Financial infos

- Conference fee 250-300€, Industry participation 500€
- Total income ~30k€
- Incomes covered the expenses as planned
- Conference rooms provided by DESY (no charge)
- Money spent on social program, conference materials, cofee breaks, students support
- Few attendants were supported from EU projects (RFTech)

Scientific program

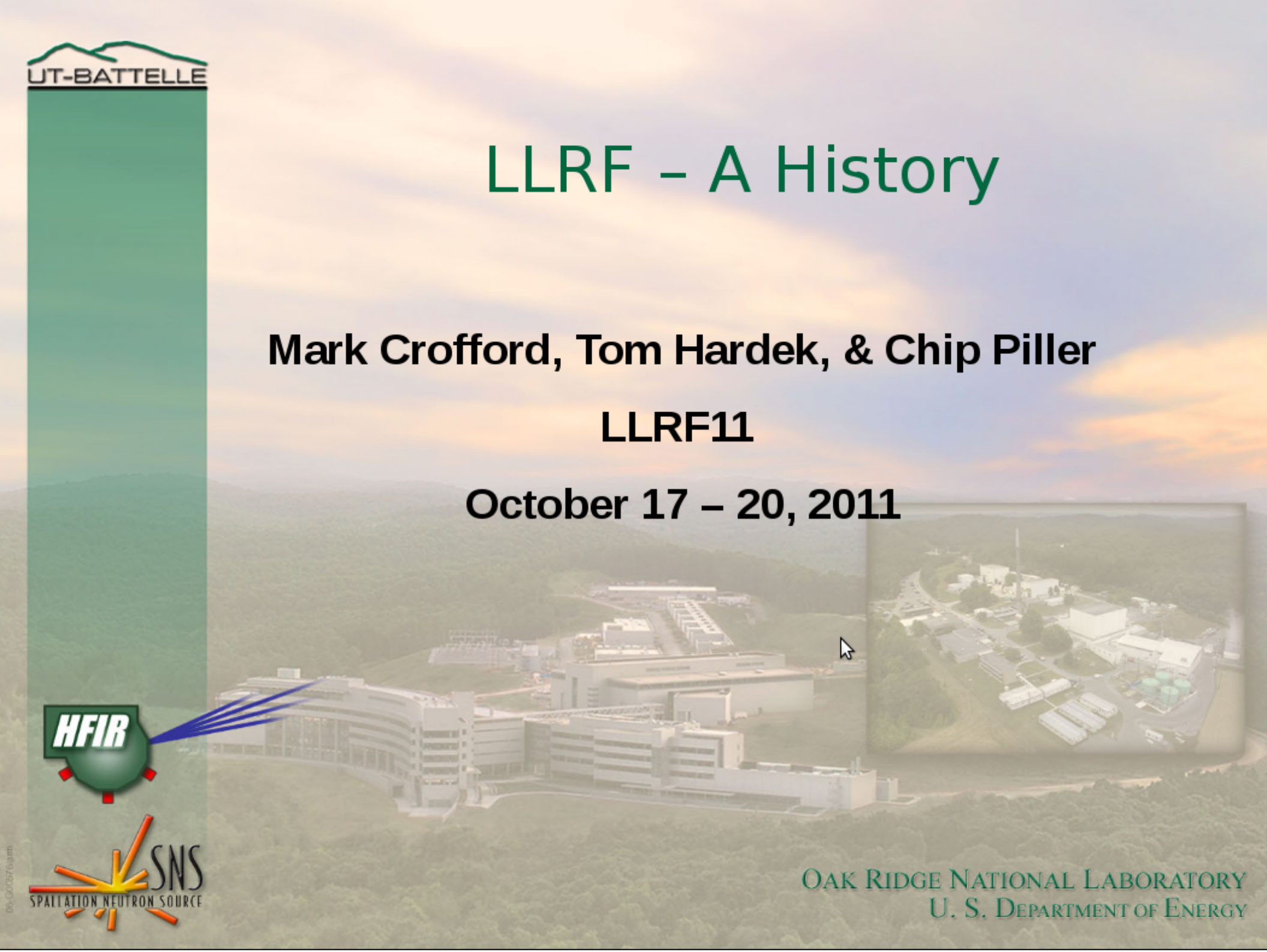
- 3 workgroups
  - Hardware (7 oral + 21 posters)
  - Software (7 oral + 11 posters)
  - Systems (8 oral + 19 posters)
- 4 tutorials
  - Control System Fundamentals
  - Receiver Fundamentals
  - FPGA Programming
  - Embedded system development
- Visit to DESY facilities (FLASH and PETRA)

LLRF – A History

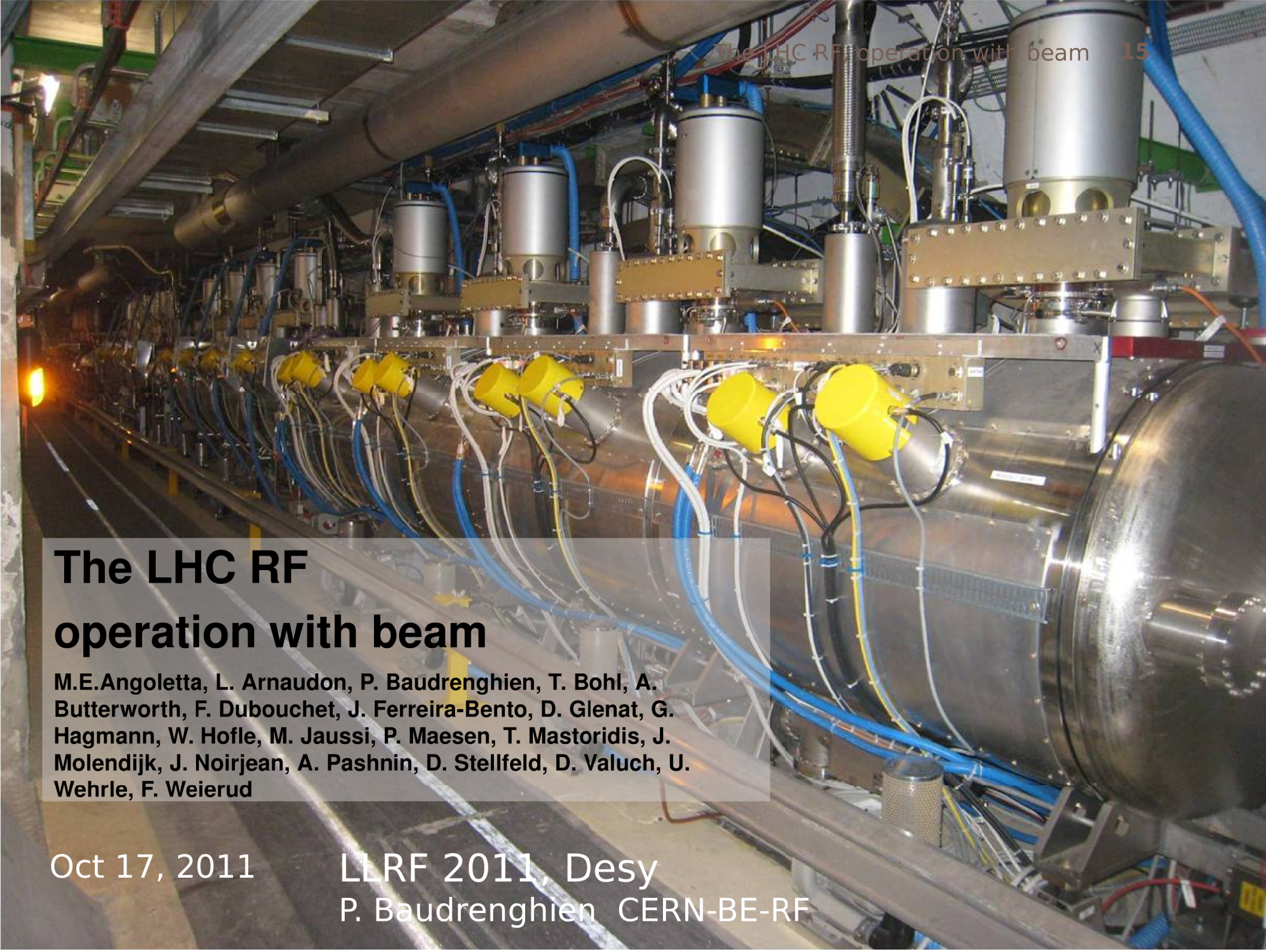
Mark Crofford, Tom Hardek, & Chip Piller

LLRF11

October 17 – 20, 2011



OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY



The LHC RF operation with beam

M.E.Angoletta, L. Arnaudon, P. Baudrenghien, T. Bohl, A. Butterworth, F. Dubouchet, J. Ferreira-Bento, D. Glenat, G. Hagmann, W. Hofle, M. Jaussi, P. Maesen, T. Mastoridis, J. Molendijk, J. Noirjean, A. Pashnin, D. Stellfeld, D. Valuch, U. Wehrle, F. Weierud

Oct 17, 2011

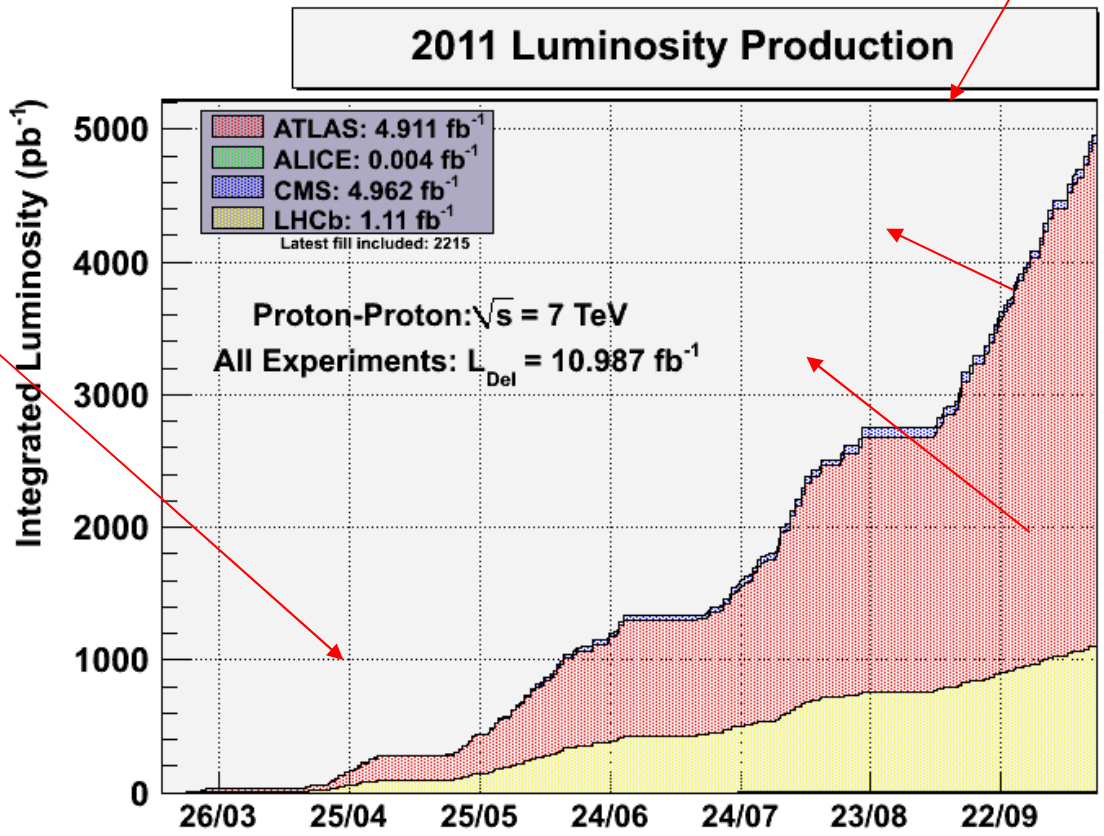
LLRF 2011, Desy

P. Baudrenghien CERN-BE-RF

Integrated luminosity

Further increase in bunch intensity from the injectors comes with transverse emittance increase

Every 6 wks we have a 5-days MD block followed by a 5-days technical stop and re-starting



Cruising at 0.1 fb-1 per fill, one good fill every ~30 hours...

Maximum nbr bunches (50 ns spacing) reached (1380)

By the end of the month (when we will revert to Pb-Pb physics), the LHC will have accumulated more than 5 fb-1 integrated luminosity in both CMS and ATLAS. The target for 2011 was 1 fb-1. To-day each fill produces ~ 0.1 fb-1

LLRF System Performance at S1-Global in KEK

Takako Miura (KEK)

Summary

S1-Global successfully completed operation in February, 2011.

Various diagnostics such as on-line quench pulse detector, dynamic detuning monitor were also implemented.

The digital FB system using cPCI or TCA are adopted for vector-sum field regulation.

The vector-sum performance satisfied the ILC requirements.

Circulator-less system operated in good stability and
QL diagnostics worked well even in the large reflection condition.

Following operations are planned in future

Beam Operation will start at STF in KEK.

- Quantum beam project will start from Jan.2012. (10 mA, 40 MeV)
- STF-2 project will start from April 2013. (8.7mA, 273 MeV)

LLRF Systems for Next Generation Light Sources

Tom Powers

LLRF Workshop 2011

18 October 2011

? ? ? Conclusion? ? ?

I hope that I have given you something to think about with respect to the requirements for LLRF used in the next generation light sources as well as some topics for further discussion during this workshop.

RF Synchronization System Plans for the European XFEL

LLRF 2011

DESY, Hamburg, 18.10.2011

Krzysztof Czuba
ISE/WUT
On behalf of DESY LLRF and ISE teams

European XFEL

Summary

- System in advanced conceptual design stage
- User requirements collected, main problems identified and solutions confirmed by experiments and device characterization
- MO concept established. New version of hardware under development. System prototype to be demonstrated in spring 2012
- Drift and RF loss problem in distribution line to be overcome: reflectometer under development, cables characterized and selected, active power amplifier compensation circuit under development
- Characterized drifts of many basic components of the distribution chain (selected power splitters, directional couplers, switches)
- Open issues:
  - Phase coherent integration of optical and RF distribution
  - 7/8” or thicker cable for long distance distribution
  - Redundant phase stable amplifier
  - Drifts over the RF Backplane

1.3 GHz Phase Averaging Reference Line

Ed Cullerton, Brian Chase

Fermilab, Batavia, IL

10/18/2001

Conclusions

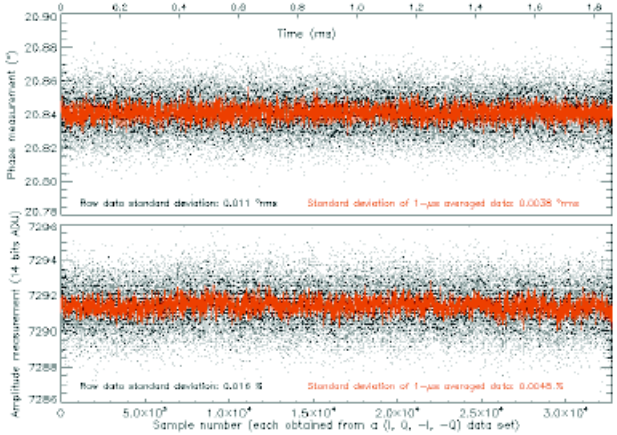
- A promising design has been proposed and analyzed for the 1.3 GHz reference line for the Fermilab SRF Beam Test Facility.
- Simulations and the scaled lab model have been shown to have good phase stability over a broad temperature range.

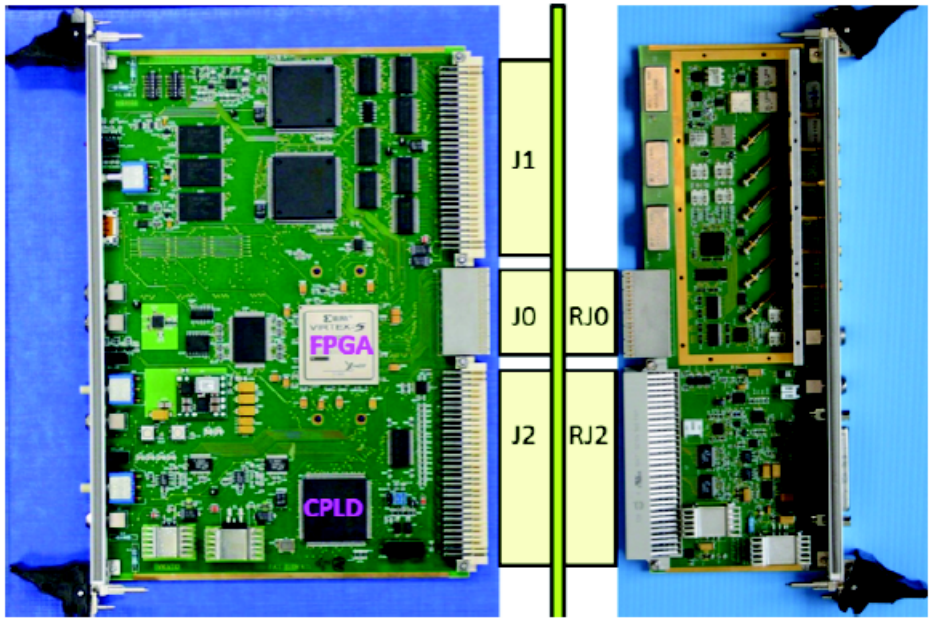
A method for removal of the measurement noise caused by clock jitter in RF digital demodulation techniques.

Philippe GALDEMARD

C.E.A. / Saclay, DSM / Irfu / SIS

e-mail: Galdemard@cea.fr



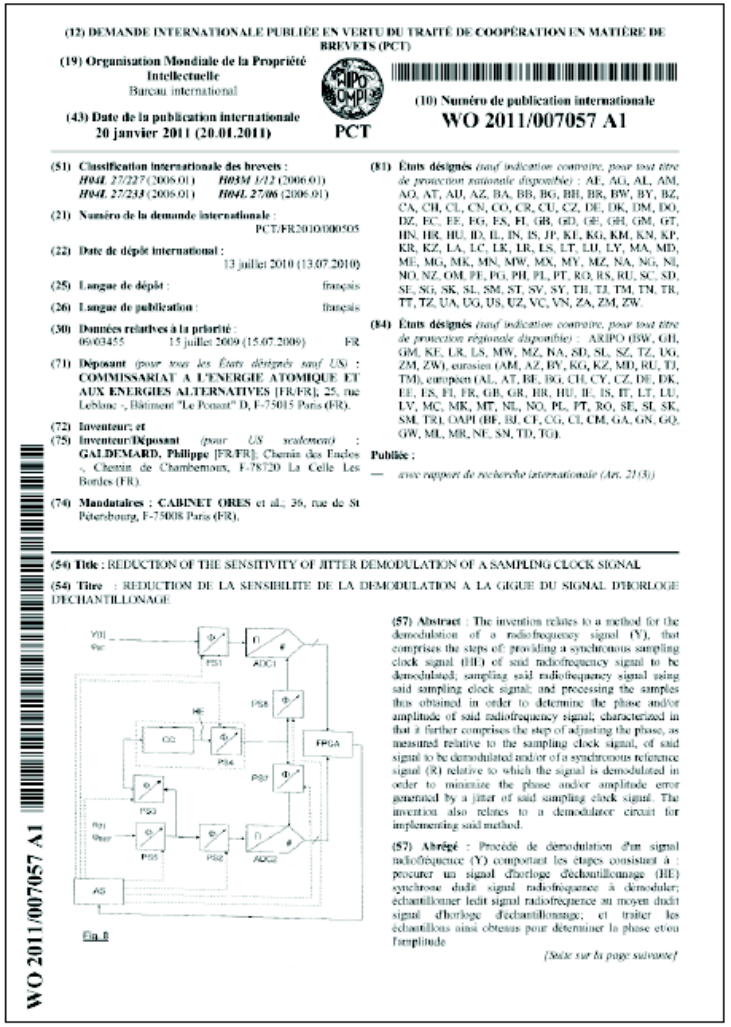


Spiral-2 LLRF VME-64X boards

Conclusions

1. Even if you do not have a good clock to sample the RF, you can do as well as with a good clock !
2. If you have a poor clock and if you are clever you can probably do better than using a good clock without care.
3. If you have a “good” clock, you probably can still improve things !

- All extra details available in the WO2011/007057A1 publication
- Example : operation still works with the reference and the RF at different frequencies : measurement noise minimized on the quantity $(\varphi_{RF} - \frac{f_{RF}}{f_{REF}}\varphi_{REF})$



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(43) Date de la publication internationale
20 janvier 2011 (20.01.2011)

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09/03455 15 juillet 2009 (15.07.2009) FR

(71) Déposant (*pour tous les États désignés sauf US*) : COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES [FR/FR]; 25, rue Leblanc -, Bâtiment "Le Ponant" D, F-75015 Paris (FR).

(72) Inventeur; et

(75) Inventeur/Déposant (*pour US seulement*) : GALDEMARD, Philippe [FR/FR]; Chemin des Eudes -, Chemin de Chambemoux, F-78720 La Celle Les Bordes (FR).

(74) Mandataires : CABINET ORES et al.; 36, rue de St Pétersbourg, F-75008 Paris (FR).

(81) États désignés (*sauf indication contraire, pour tout titre de protection nationale disponible*) : AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) États désignés (*sauf indication contraire, pour tout titre de protection régionale disponible*) : ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasien (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), européen (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Publiée :
— *avec rapport de recherche internationale (Art. 21(3))*

(54) Title : REDUCTION OF THE SENSITIVITY OF JITTER DEMODULATION OF A SAMPLING CLOCK SIGNAL

(54) Titre : REDUCTION DE LA SENSIBILITE DE LA DEMODULATION A LA GIGUE DU SIGNAL D'HORLOGE D'ECHANTILLONAGE

Fig. 8

(57) Abstract : The invention relates to a method for the demodulation of a radiofrequency signal (Y), that comprises the steps of: providing a synchronous sampling clock signal (HE) of said radiofrequency signal to be demodulated; sampling said radiofrequency signal using said sampling clock signal; and processing the samples thus obtained in order to determine the phase and/or amplitude of said radiofrequency signal; characterized in that it further comprises the step of adjusting the phase, as measured relative to the sampling clock signal, of said signal to be demodulated and/or of a synchronous reference signal (R) relative to which the signal is demodulated in order to minimize the phase and/or amplitude error generated by a jitter of said sampling clock signal. The invention also relates to a demodulator circuit for implementing said method.

(57) Abrégé : Procédé de démodulation d'un signal radiofréquence (Y) comportant les étapes consistant à : procurer un signal d'horloge d'échantillonnage (HE) synchrone dudit signal radiofréquence à démoduler; échantillonner ledit signal radiofréquence au moyen dudit signal d'horloge d'échantillonnage; et traiter les échantillons ainsi obtenus pour déterminer la phase et/ou l'amplitude

(Suite sur la page suivante)

WO 2011/007057 A1

Prototype Performance of Digital LLRF Control System for the SuperKEKB

~ KEKB LLRF Team ~

Tetsuya Kobayashi, Kazunori Akai, Kiyokazu Ebihara,

Atsushi Kabe, Kota Nakanishi, Michiru Nishiwaki, Jun-ichi Odagiri,

~ Mitsubishi Electric TOKKI System Corp. ~

Hisakuni Deguchi, , Kazutaka Harumatsu, Kazutaka Hayashi,

Masatsugu Ryoshi, , Jun-ichi Nishio,

Summary

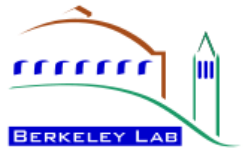
- Prototype of the digital LLRF system for the SuperKEKB was developed, and Its performance was evaluated.
- Very good stability of 0.03% in amplitude and 0.02 deg. in phase is obtained in FB control.
- But, temperature dependency is not negligible: the temperature coefficients are 0.6%/deg. C in amplitude and 0.3 deg. /deg. C in phase.

Future Issues

- In order to reduce the temperature dependency, some countermeasures will be implemented.
- Tuner Control function in the FPGA is now under implementation. Its control performance should be evaluated soon.
- For very high current beam, beam loading compensation and detuning control should be verified.

LLRF Firmware of FERMI@ELETTRA

Larry Doolittle



Lawrence Berkeley National Laboratory

Low Level RF Workshop, Hamburg 2011

Representing:
LBNL: Gang Huang, Alessandro Ratti, John Byrd, Carlos Serrano,
Matt Stettler; Sincrotrone Trieste: Federico Gelmetti,
Massimo Milloch, Angela Salom, Alessandro Fabris;
TSR Engineering: Tony Rohlev

System is in place and in use with beam
Production hardware is in testing now

Successful Gatware development requires

- clear concept of architecture and resource utilization
- simulations that represent reality, ideally pass/fail
- early connection to software

Vielen Dank!

Social program

- Guided Hamburg tour
- Welcome party
- Lunch combined with poster session/industrial exhibition
- Workshop diner

Participants

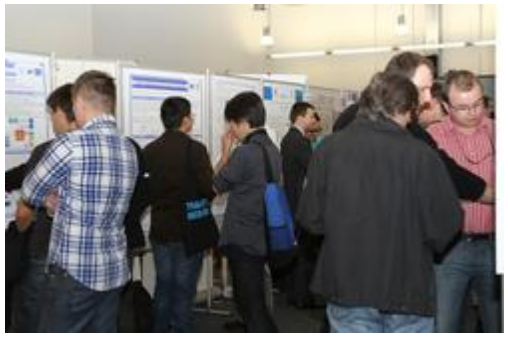
Impressions
















Participant's impressions after LLRF Workshop

… Please, let me tell you first of all that the workshop was very well organized and most of all, very, very interesting. This is the fourth time I have attended this kind of workshop and in my opinion this has been the most interesting one, because there were many different talks about several topics and I have learnt many things from other people. Really, I think the scientific program was very well done....

Future plans

- LLRF Workshop 2013 – October 2013 (related to ICALEPCS Conference), probably in San Francisko Area (Lake Tahoe proposed), LNBL & SLAC (Larry Doolittle)
- Workshop proceedings are beeing discussed. Since there is some interest probably the proceedings from selected presentations will appear.

Thank you for attention

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You are invited to LLRF 2013