

- History, from LHC Electronics Workshop to TWEPP
- TWEPP-07 workshop facts
- Executive Summary
- Conclusions

Francois Vasey  
on behalf of the TWEPP-07 scientific committee

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# Previous Workshops

- 1995 Lisbon Portugal
- 1996 Balaton Hungary
- 1997 London UK
- 1998 Rome Italy
- 1999 Snowmass USA
- 2000 Cracow Poland
- 2001 Stockholm Sweden
- 2002 Colmar France
- 2003 Amsterdam Holland
- 2004 Boston USA
- 2005 Heidelberg Germany
- 2006 Valencia Spain
- 2007 Prague Czech Republic

Electronics for LHC Experiments



Electronics for LHC and future Experiments



Electronics for Particle Physics



# Creation of TWEPP

- In its meetings of 30/11/2006, the LECC committee deliberated on the future of the workshop.
  - The electronics workshop is a rather unique forum, covering electronics for particle physics and clearly responding to the needs of a broad community
  - Regular attendance since many years
  - Its scope, though open to non-LHC applications, could be more visibly extended, covering particle physics facilities beyond LHC (ILC, CLIC, SLHC, neutrino physics, fixed target applications, etc)
- In order to reflect the broadened scope of its mandate, the new Workshop Scientific Committee was made independent of the LHC Electronics Coordinating Committee (LECC) and the workshop was renamed TWEPP

# TWEPP-07 Scientific program committee

- J. Christiansen, CERN
- Z Doležal, Charles Univ. Prague
- P. Farthouat, CERN
- F. Formenti, CERN
- G. Hall, Imperial College London
- M. Letheren, CERN
- L. Linssen, CERN
- A. Marchioro, CERN
- J. Nash, CERN
- P. O'Connor, BNL
- E. Petrolo, INFN Rome
- S. Quinton, RAL
- V. Radeka, BNL
- W. Smith, Wisconsin
- C. de la Taille, LAL Orsay
- F. Vasey, CERN
- T. Wijnands, CERN
- M. Winter, IRES Strasbourg
- R. Yarema, FNAL

Presently 19 members:

1 chair of scientific committee

1 chair of local organizing committee

4 LHC electronics coordinators

1 representative accelerator, CERN

1 representative of CERN-PH management

11 experts covering a wide span of expertise, PP experiments, and geographical areas

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# TWEPP-07 local organization

- Prague, Czech Republic, 3-7 September 2007
  - Organisers
    - Charles University
    - Czech Technical University
    - Nuclear Physics Institute (ASCR)
    - Institute of Physics (ASCR)
  - Chair of local organizers
    - Zdenek Dolezal (Charles University)



**TWEPP-07**  
**Topical Workshop on Electronics for Particle Physics**  
 Former LECC Workshop

Prague, Czech Republic / 3-7 September 2007

The workshop will cover all aspects of electronics for particle physics experiments and accelerator instrumentation of general interest to users. It addresses and expands the scope of the former workshop on electronics for LHC and future experiments (LECC). LHC experiments will receive a focus of the meeting but a strong emphasis on R&D for future accelerators will be established, such as ELHC, CLIC, ILC, muonics facilities as well as other particle and astroparticle physics experiments.

**Deadline for abstracts 30 April '07**

Workshop topics	Scientific organisation	Local organisation
<ul style="list-style-type: none"> <li>➤ Instrumentation for Particle Detection, Triggering and Acquisition Systems</li> <li>➤ Electronics for Accelerator and Beam Instrumentation</li> <li>➤ Camera Analogues and Digital Cameras</li> <li>➤ Applications of Programmable Digital Logic</li> <li>➤ Digital-to-Analog Data Transfer and Control</li> <li>➤ Packaging and Interconnection Technologies</li> <li>➤ Real-time and High-speed Data Acquisition and Systems</li> <li>➤ Production, Testing and Reliability</li> <li>➤ Power Management and Conversion</li> <li>➤ Grounding, Shielding and Cooling</li> <li>➤ Design Tools and Methods</li> </ul>	<ul style="list-style-type: none"> <li>B. Basso, CERN, CH</li> <li>J. Christmann, CERN</li> <li>Z. Dolezal, Charles University</li> <li>P. Ferraz, CERN</li> <li>F. Garbino, CERN</li> <li>G. Hall, Imperial College</li> <li>R. Lefebvre, CERN</li> <li>J. Llorens, CERN</li> <li>A. Lusignea, CERN</li> <li>J. Maier, CERN</li> <li>P.OT. Carrara, INFN</li> <li>B. Stenlund, INFN, Torino</li> <li>S. Galassi, INFN</li> <li>M. Goulet, INFN</li> <li>W. Smith, Wisconsin</li> <li>C. de la Torre, INFN</li> <li>T. Williams, CERN</li> <li>M. Zolotarev, INFN</li> <li>P. Zeman, INFN</li> </ul>	<ul style="list-style-type: none"> <li>Z. Dolezal, CHU</li> <li>J. Filip, CHU</li> <li>M. Sedláček, CHU</li> <li>V. Vokac, CHU</li> <li>V. Vokac, CHU</li> </ul>

**For information**  
[twepp07@cern.ch](mailto:twepp07@cern.ch)  
<http://www.particle.ch/TWEPP07>

CERN, European Organization for Nuclear Research  
 Châtenay-Malvern, France  
 Robert Rutherford Institute (RRI) in Brno (ASCR)

# TWEPP-07 Finances

- As usual the Workshop was self-financing
- We are very grateful for support from
  - The local institutes
  - CERN
    - Poster, call for abstracts, booklet
    - Indico and printed proceedings
  - Industrial exhibitors
    - FOTON sro
    - Wiener Plein and Baus GmbH
    - Springer Verlag (EPJ)

} Sandra Claude



# TWEPP-07 Statistics

- 161 participants
  - 89 contributed presentations (61 oral 28 poster)
  - 9 invited talks
  - Topical day on detector power supply and distribution
  - Two working group meetings on Electronics and Optoelectronics
  - Optional tutorial on robust ASIC designs for hostile environments *NEW*
- 
- Online access to all presented material
    - <http://indico.cern.ch/event/11994>
  - Printed Proceedings
    - [CERN-2007-007](#)
  - Executive Summary written by session chairs *NEW*
    - <http://indico.cern.ch/getFile.py/access?contribId=123&resId=2&materialId=paper&confId=11994>

2006

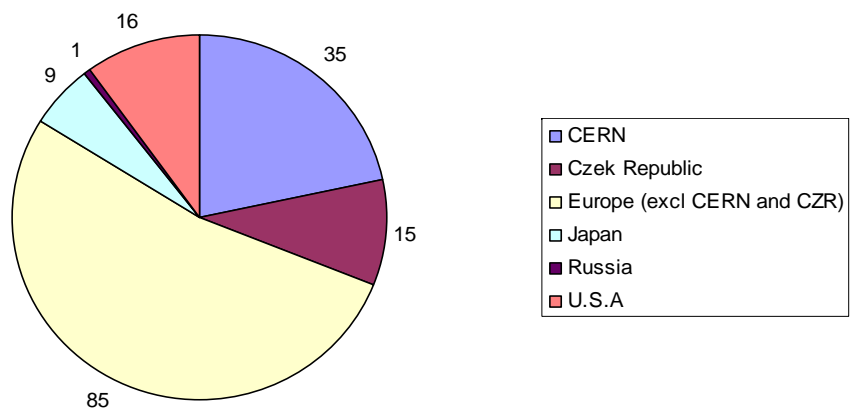
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106 (62+44)

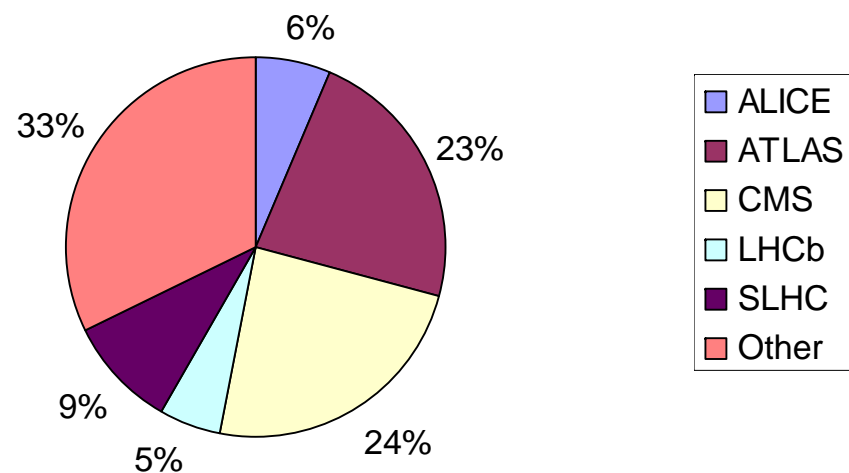
11

# ORIGINS

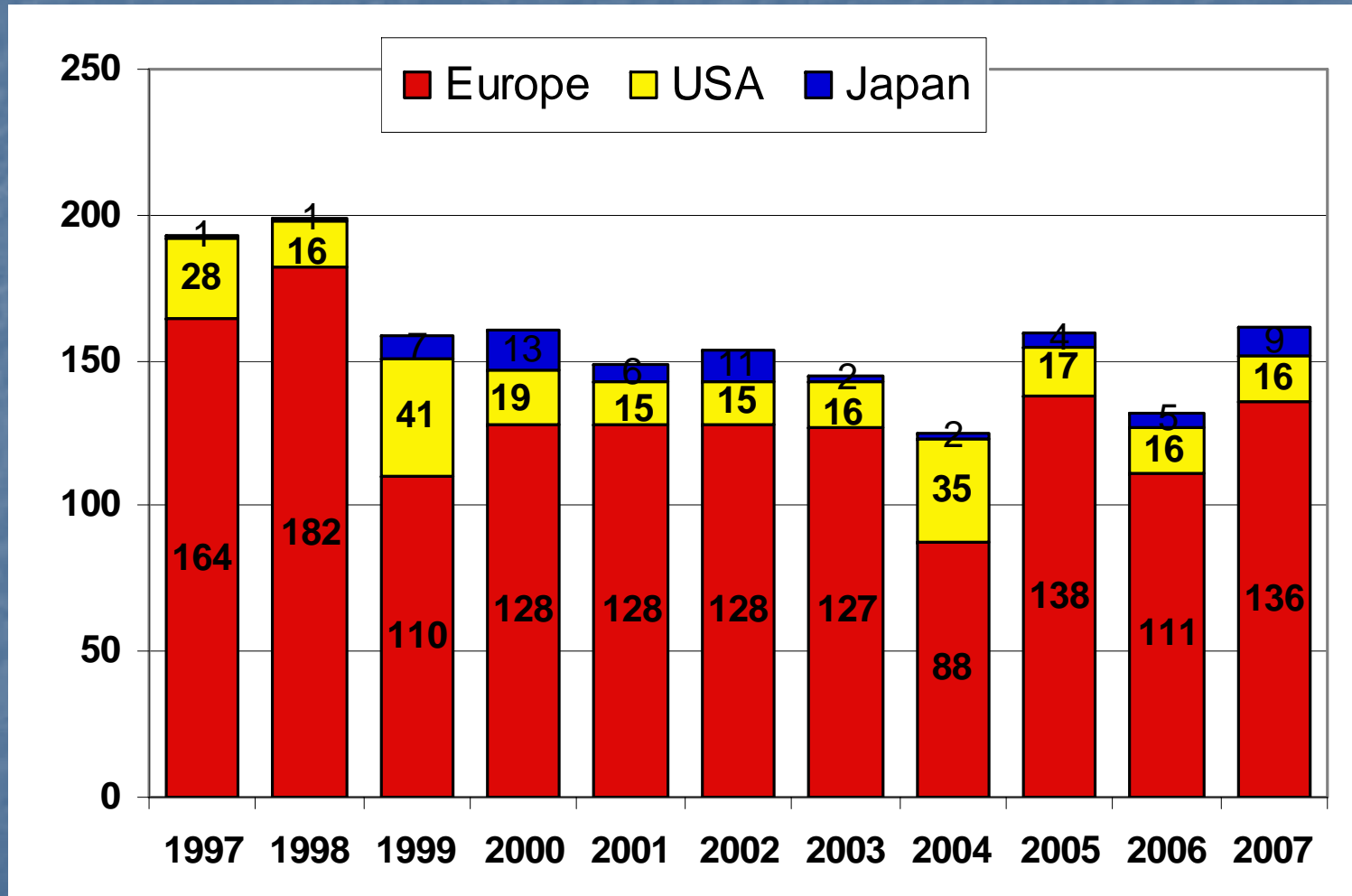
Participants origin



Experiment



# Historical Perspective





- History, from LHC Electronics Workshop to TWEPP
- TWEPP-07 workshop facts
- **Executive Summary**
  - <http://indico.cern.ch/getFile.py/access?contribId=123&resId=2&materialId=paper&confId=11994>
- Conclusions

# TWEPP-07 Session Layout

	Session A	Session B
Monday	Plenary	
Tuesday	Plenary	
	Systems, Instal. and Commis. Optoelectronics	Trigger
Wednesday	Plenary	
	Systems, Instal. and Commis.	ASICs
Thursday	Topical: Power supply and distribution Posters	
Friday	Plenary	
	Systems, Instal. and Commis.	Systems, Instal. and Commis.
	Tutorial: Robust ASIC designs for hostile environments	

# Summary a: Systems, Installation and Commissioning

	Session A	Session B
Monday	Plenary	
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# Summary a: Systems, Installation and Commissioning

- 25 Contributions
- Significant progress reported
  - Many sub-detectors in final commissioning phase with cosmics
  - Electronic systems with all related firmware and software perform in general according to expectations
  - A major effort from the collaborations
- Practical difficulties have been encountered
  - Services for FE electronics (power, cooling, cables,...) } 2007 Topical day
  - Mains power distribution, cooling of racks and crates } 2005 Topical day
  - Reliability of high density kapton hybrids and cables
- Extensive R&D work for ILC and first plans to prepare for SLHC were presented
  - Pixel detectors integrated with electronics (MAPS, DEPFET, SOI)
  - Low power front-ends and inter-connection schemes
  - ...

# Summary b: ASICs

	Session A	Session B
Monday	Plenary	
Tuesday	Plenary	
	Systems, Instal. and Commis. Optoelectronics	Trigger
Wednesday	Plenary	
	Systems, Instal. and Commis.	ASICs
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# Summary b: ASICs

## ■ 13 Contributions

### ■ Technologies

- 0.35 $\mu\text{m}$  and 0.25 $\mu\text{m}$ , very robust technology node
- 0.13 $\mu\text{m}$ , excellent performance and density
- SiGe for high voltage or large dynamic range applications
- ...
- The use of a common technology base would allow sharing of building blocks and reduction of qualification effort

### ■ Applications

- Silicon and gas tracking detectors
- ILC: very low power ASICs for pixels, trackers and calorimeters
- ADC
- High bandwidth data transfer for readout, control and timing (GBT)
- ...
- Increasing complexity of ASICs (systems on chips) requires more and more expertise from larger and larger teams
- Extensive discussions on appropriate system architectures required



# Summary b: ASICs

- Microelectronics User's Group (chaired by A. Marchioro)
- 130nm and 90nm foundry services available to the community via CERN
  - Users urged to plan in advance for the submission of designs for common MPW runs in early 2008
- Design kit facilitating assembly of digital and mixed signal chips available to community
  - Number of institutes expected to rise as new SLHC and ILC designs are about to start

# Summary c: Trigger

	Session A	Session B
Monday	Plenary	
Tuesday	Plenary	
	Systems, Instal. and Commis. Optoelectronics	Trigger
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	Systems, Instal. and Commis.	ASICs
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# Summary c: Trigger

- 11 Contributions
- Impressive progress in commissioning the trigger electronics for LHC experiments
  - growing confidence that these systems will deliver to specifications
- Manufacturing problems with the high density circuit boards largely overcome
- Commissioning has highlighted issues illustrating the need to work with the real infrastructure as early as possible in the testing process
  - cooling problems
  - power supply oscillations
- LHC trigger systems include many large boards with several FPGAs
  - large burden for support of firmware and diagnostic software for the lifetime of these systems
  - A number of designers have identified that designs would have been easier if costly advanced FPGAs had been used at the prototype stage



# Summary d: Optoelectronics

	Session A	Session B
Monday	Plenary	
Tuesday	Plenary	
	Systems, Instal. and Commis. <b>Optoelectronics</b>	Trigger
Wednesday	Plenary	
	Systems, Instal. and Commis.	ASICs
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# Summary d: Optoelectronics

## ■ 4 Contributions

- Optoelectronics used in nearly all sub-detectors with high quality
  - Dark channel count in ‰ range
- Sophisticated optical link quality control tools used on wide scale during integration
- Potential of the technology for future detectors being investigated
  - Further R&D required to address open issues (rad resistance in particular) and converge on a few technologies deserving full qualification
  - The use of standardized optical links is generally considered an attractive prospect
- Joint ATLAS-CMS Working Group on Optoelectronics for SLHC (chaired by C. Issever and F. Vasey)

Progress reports from 3 subgroups:

- Lessons learned and to be learned from LHC
- Optical System Irradiation Guidelines
- Optical link Evaluation Criteria and Test Procedures
- Joint plans and proposals being drafted for versatile optical link development, reference test system and common irradiation tests

# Summary e: Topical day

	Session A	Session B
Monday	Plenary	
Tuesday	Plenary	
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Wednesday	Plenary	
	Systems, Instal. and Commis.	ASICs
Thursday	<b>Topical: Power supply and distribution</b> Posters	
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# Summary e: Topical day

## Power supply and distribution

- 10 Contributions

- Depending on the technical requirement, either custom solutions or commercial systems have been selected at LHC

- Custom components: production and installation now largely completed
- Commercial components: construction and qualification required more time than anticipated and production is currently still on-going

- In general, the overall efficiency of present LHC power distribution systems is low, with large power dissipation in long cables and often with sizeable power supply inefficiencies

For future detectors:

- Power pulsing techniques (ILC has low duty cycle)
- Serial powering
- Local radiation tolerant DC-DC converters and regulators

# Summary e: Topical day

## Power supply and distribution

Summary of the discussion session (chaired by L. Linssen)

- Power management is a complex, multidisciplinary engineering issue
- Too often, the design of a specific power supply is tackled in relative isolation from the conception of the overall power management of the detector
- In the future, an **engineering office** will be needed from the early stages of detector design to coordinate power supply, management and distribution. Such a task cannot be left to the electronics coordinator alone.
- **R&D** must be launched to investigate and compare **different powering schemes** and confirm availability of **front-end voltage regulators**.
- Procurement of **COTS** power supplies needs to be coordinated to ensure that the cheapest and most reliable solution is chosen.
- A **working group** should be set up to discuss a coordinated approach to the power management and distribution for large experiments.

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# Conclusions

- Electronics is an enabling technology for PP
  - Trend: increased complexity speed and density
  - Challenge: maintain system quality, reliability, and low power
- Installation and commissioning of electronic systems for LHC
  - Making significant progress thanks to huge effort
  - Issues with services and their scalability being actively addressed
  - Problems at the local level affect the global installation schedule
- The TWEPP workshop brings together:
  - different teams
  - different experiments
  - different stages of development

Disseminating knowledge and know-how eventually improves quality and reliability of the systems built
- Significant quantity of contributions looking beyond LHC
  - 9% SLHC, 33% ILC and others
  - Several joint working groups exploring common approaches
  - New technologies being validated

New reviewing mechanisms ?