

*Power Working Group*

# *Summary*

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# Introduction

- Most recent session at TWEPP11
- TWEPP11 participant comments in the direction of:
  - Rather an extension of conference than a working group session
  - Should be less presentations and more discussion
  - Basic rules
    - A few slides for poster introduction
    - A few more slides for subject introduction
  - Presentations intended as a source of inspiration for the discussion
    - Description of the issues, solutions, etc.

# Introduction 2

- The Power working group was started to explore different power scheme options for e.g. LHC Stage 2 tracker upgrades
  - While these detectors are not yet built one can say that powering options have been explored
    - Serial Power with linear shunt regulator in each node
    - Parallel power through DCDC converters

# Serial Power and DCDC

- Peter Phillips gave an introduction to his poster
  - “A Serially Powered ATLAS Strip Tracker Stavelet with Improved Referencing Connections”
- Background including a direct comparison between the two schemes
  - DCDC scheme appear solid but more material
  - Serial scheme appear possible but still learning; potential (or probable) benefit of less material

# Pulsed Power Schemes

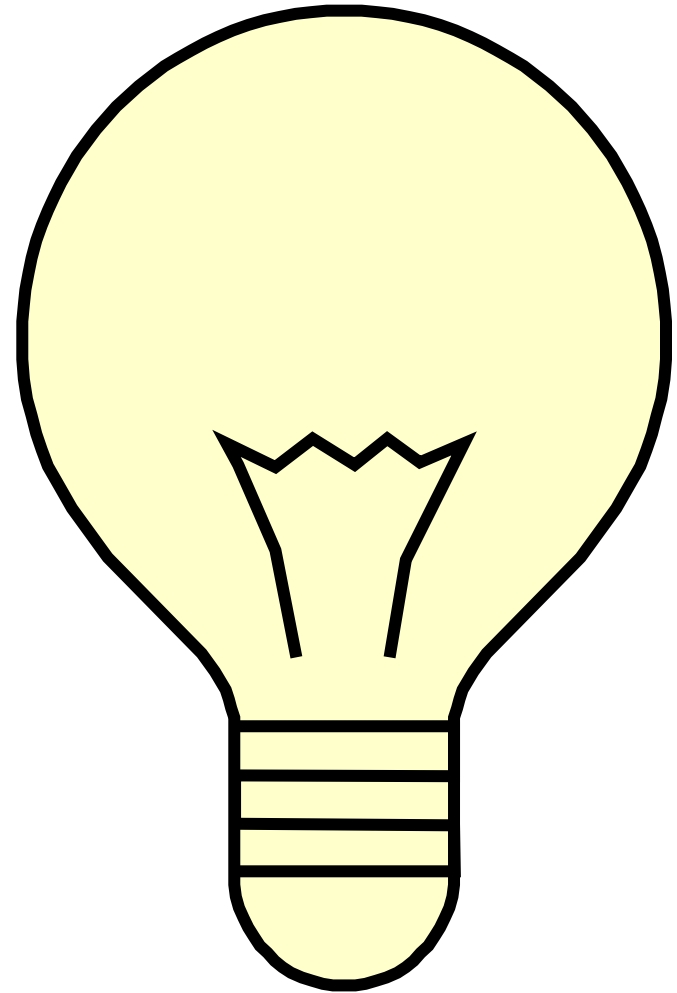
- The future may involve building detectors for which neither of DCDC or serial power schemes are suitable or sufficient
- Agenda
  - Pulsed Power introduction
    - Christophe de la Taille, LAL
  - Pulsed Power system issues
    - Peter Goettlicher, DESY
  - Power pulsing schemes for vertex detectors at CLIC
    - Poster introduction by Cristian Fuentes, CERN

# Pulsed Power

- The idea is not new...

# Pulsed Power

- You turn off the light when you leave the room



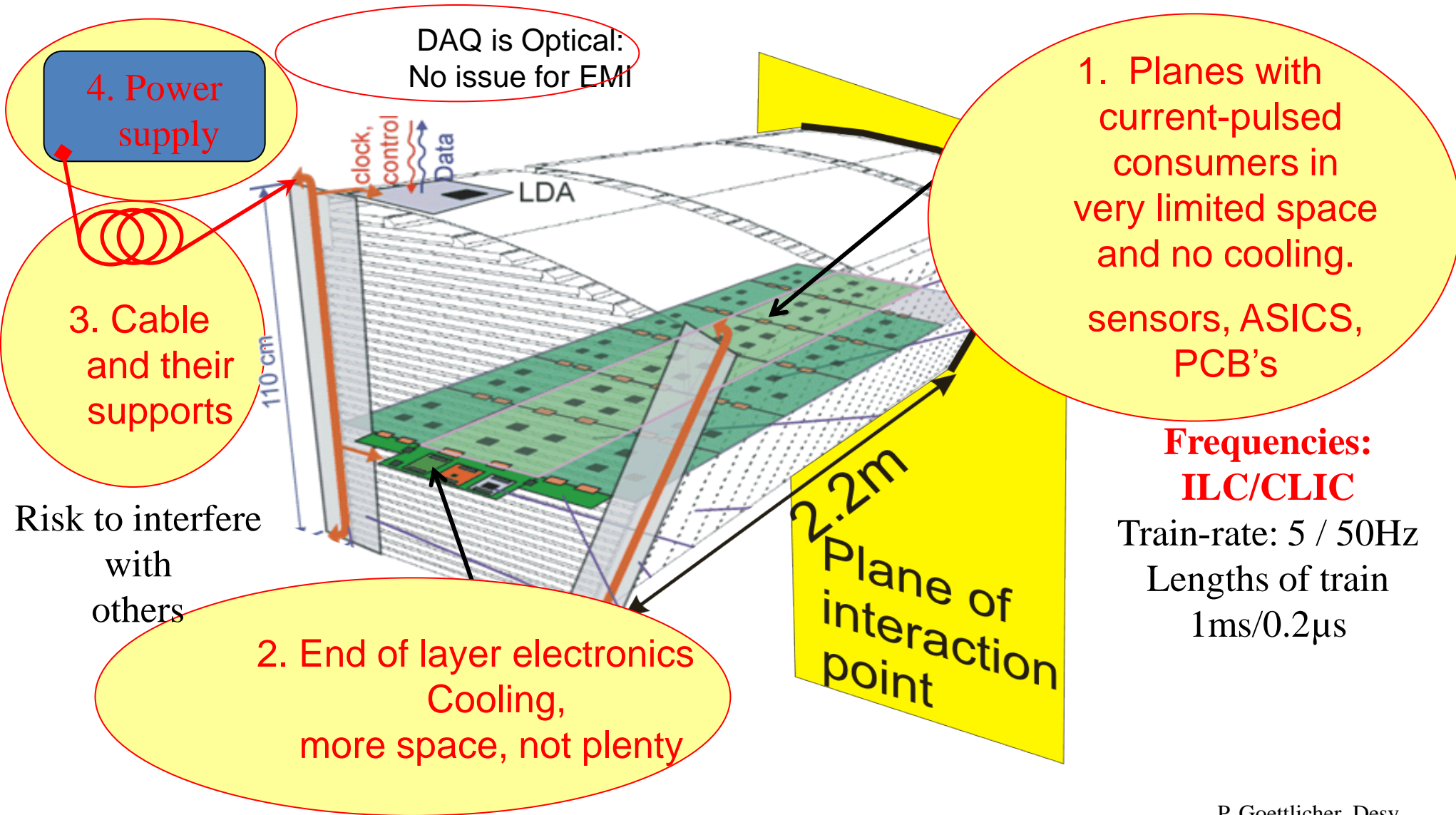
# Pulsed Power

- You do not leave your car idling 24/7 either...





# To give an Idea of the Vision...



P. Goettlicher, Desy

# Power issues

- Before power pulsing, minimize power !!
  - Do not overdesign (noise, linearity, speed...)
  - Minimize data transfer (zero suppress)
  - Minimize digital currents :  $C \, dV/dt$
  - Very different from LHC habits (and old habits die hard...)
- Power pulsing gives an additionnal factor up to 200
  - Any permanent bias should be extremely small
  - Avoid floating nodes, especially on digital inputs...
- R&D on power pulsing started early in ILC community
  - All detectors assume it (vertex, TPC, calorimeters...)
  - Calorimeters put emphasis early on this issue in CALICE

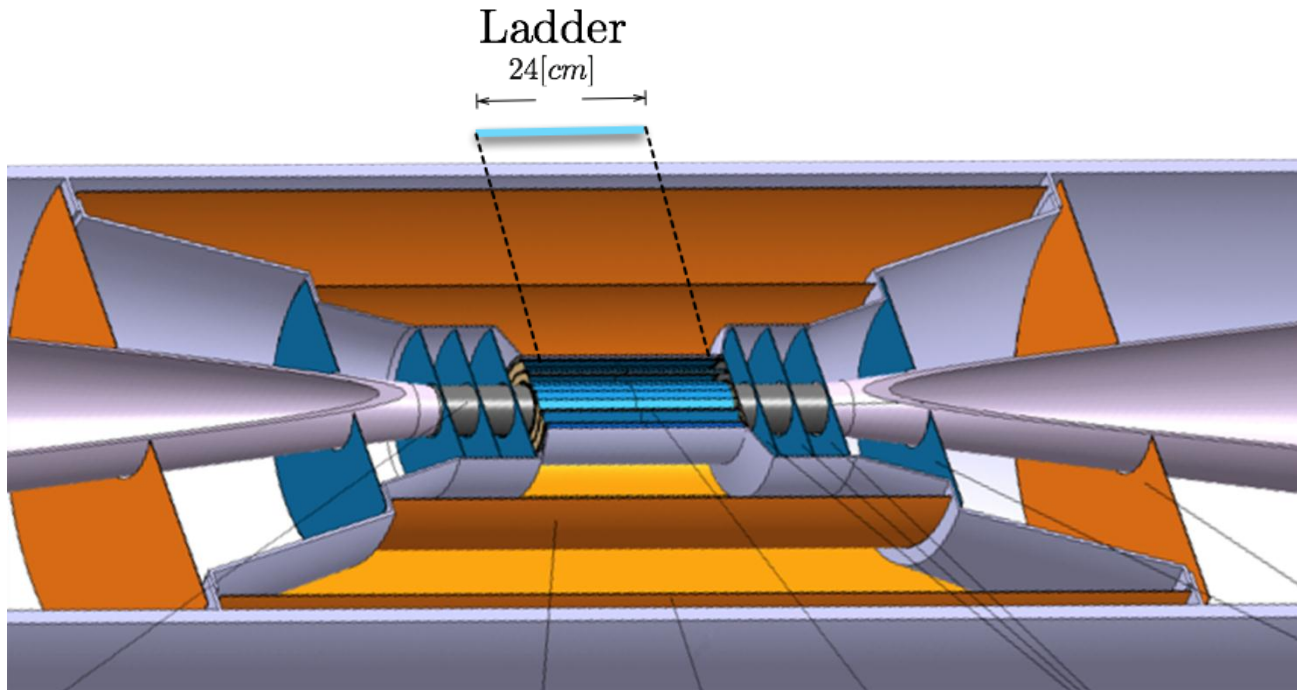
C. De la Taille, LAL

# Pulsed Power Introduction

- Christophe and Peter introduced PP work performed within Calice
  - Full M3 HCAL detector prototype
  - In test beam
  - 10% duty cycle PP with good performance
    - By necessity; higher duty cycle would cause overheat
    - 0.5% goal for ILC but conflict of interest (or priority); physicists prefer to tweak detector performance rather than validate pulsed power scheme

# More Pulsed Power

- Cristian introduced poster describing work on powering a CLICPIX detector



# Constraints

- Restricted material budget
  - No Cooling as we know it from e.g. LHC experiments
    - $< 50\text{mW/cm}^2$  average allowing air cooling
  - To give an idea: flex cable with two 8u Cu layers exhaust the material budget for services
- $> 4\text{T}$  B field
- Etc.

# Conclusion

- Development of DCDC and serial power schemes for the LHC stage 2 trackers continue
  - CMS has selected base line scheme
  - ATLAS will have to select a baseline scheme at some point
- Studies of powering schemes for ILC/CLIC detectors are ongoing
  - Important since the day either of these machines come on the table one need to demonstrate feasibility for both machine and experiments

# Future

- It was felt that the discussion was useful and we propose to re-convene next year during TWEPP and upon event perhaps during the year as well
- It would obviously be most effective if the TWEPP power session would take place before the working group meeting