

Open Hardware at CERN

an initiative for changing the way we work

- Introduction
- Why Open Hardware
- Open Hardware at CERN
- Conclusions

LHC Particle Accelerator

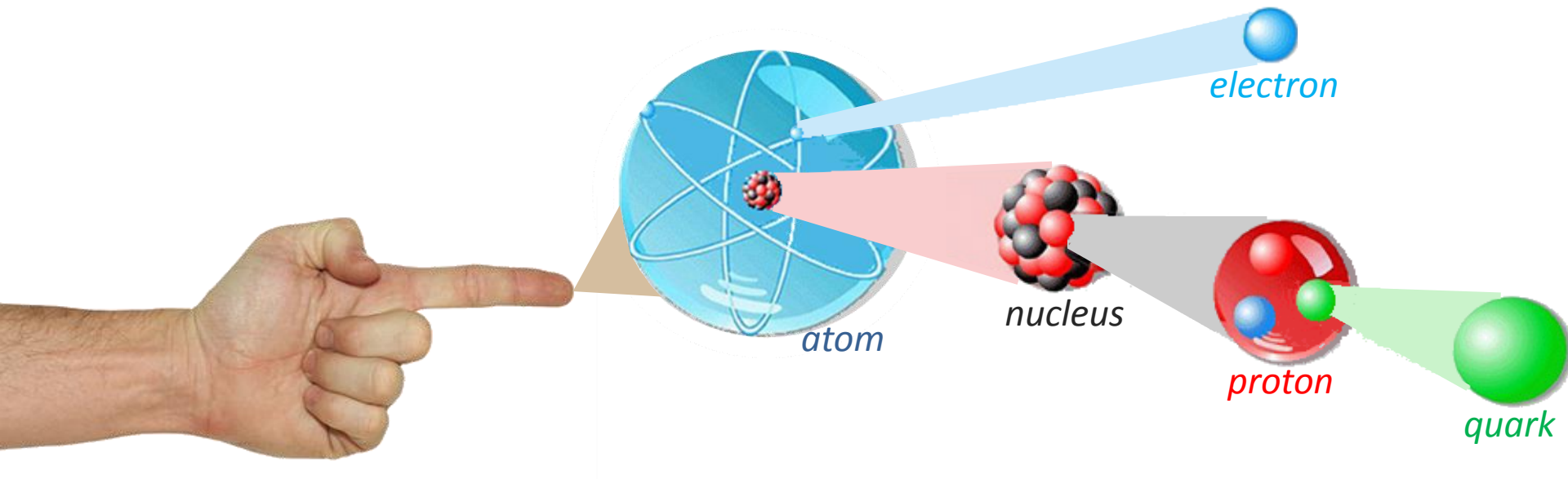
Studying the finest constituents of matter

Outline

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- Why Open Hardware
- Open Hardware at CERN
- Conclusions

LHC Particle Accelerator

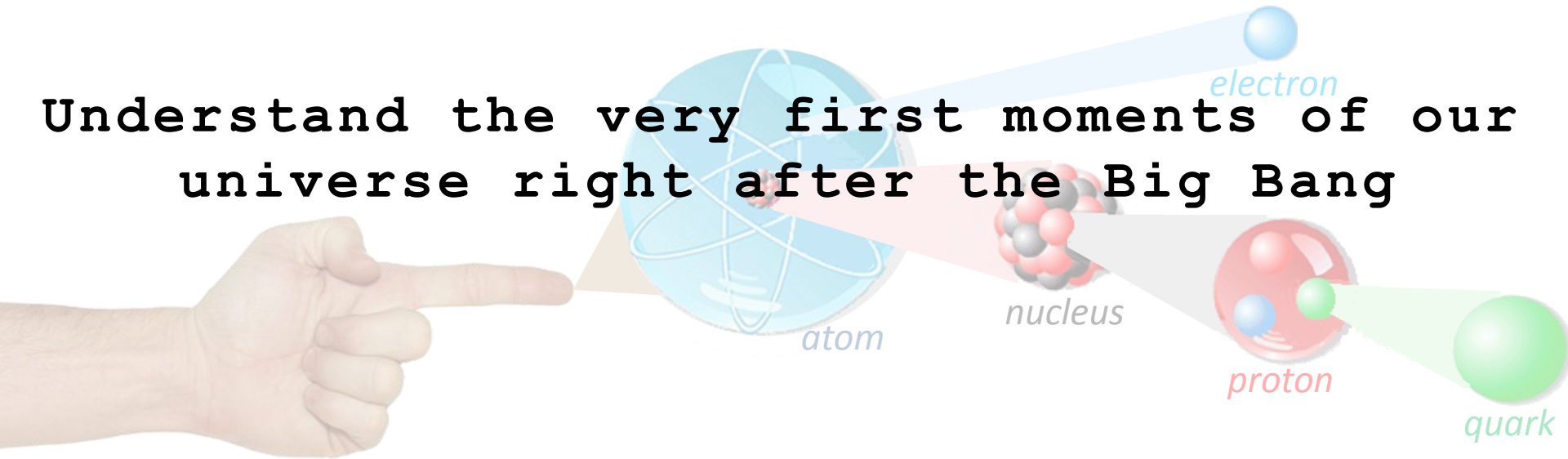
Studying the finest constituents of matter



LHC Particle Accelerator

Studying the finest constituents of matter

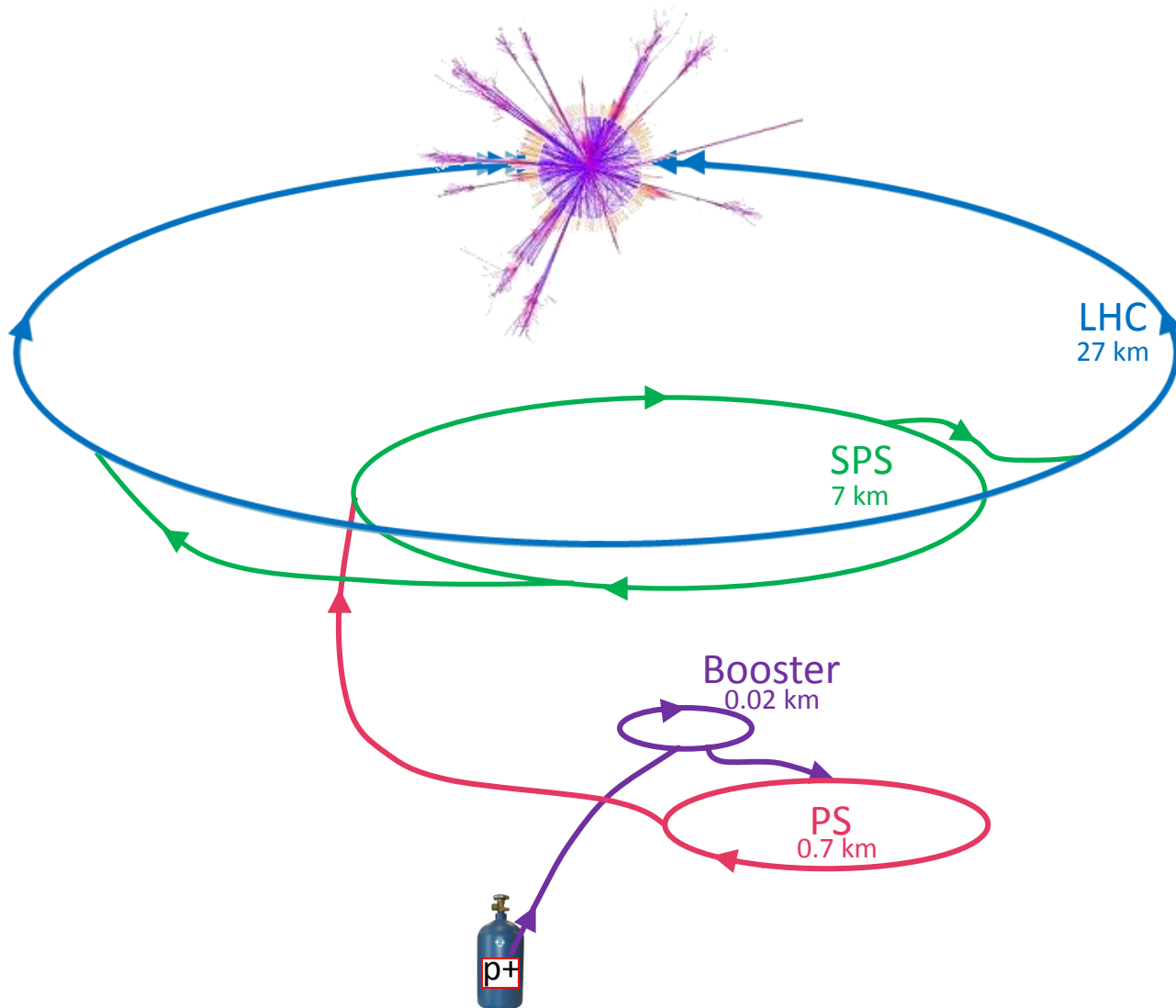
Understand the very first moments of our universe right after the Big Bang



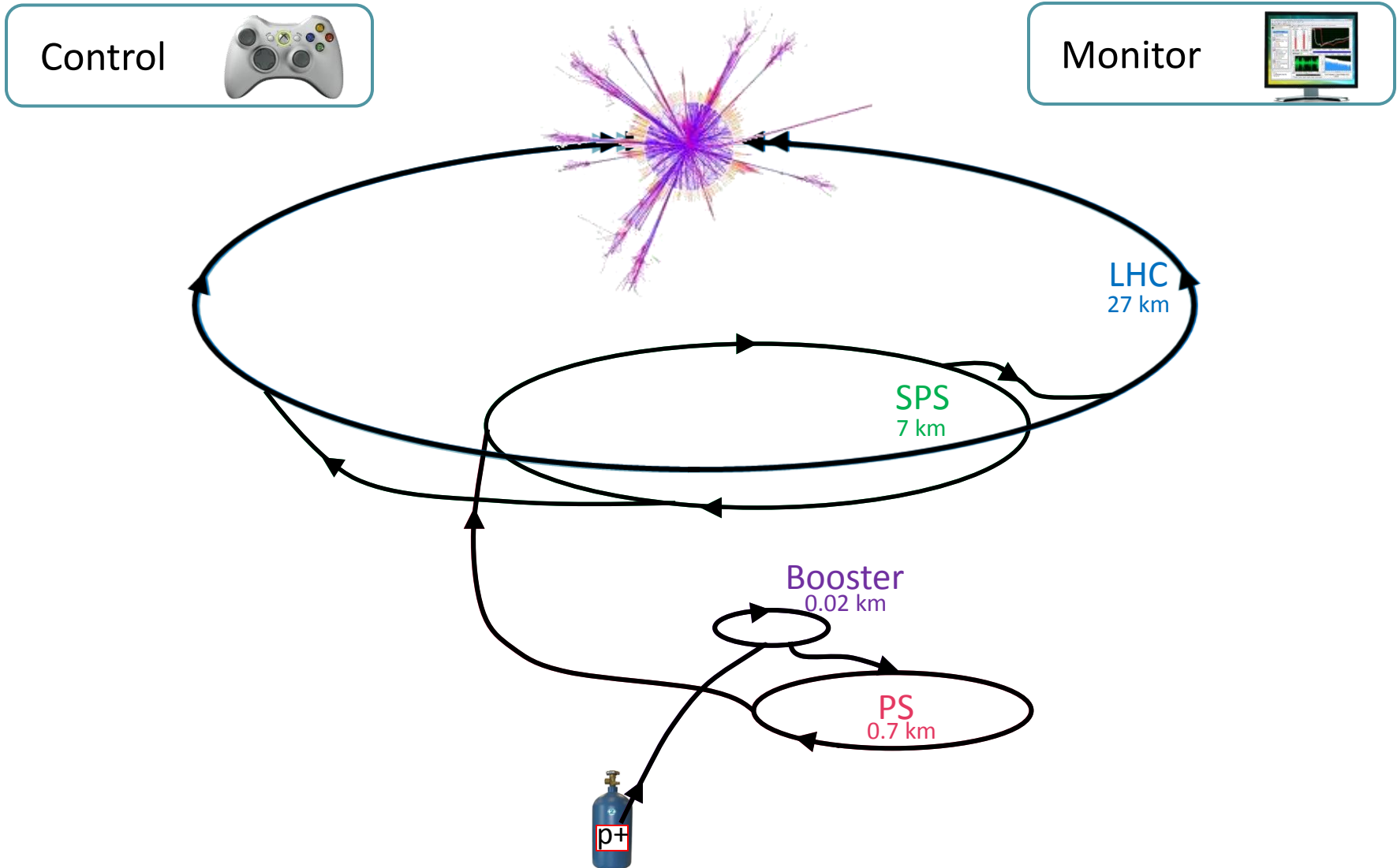
LHC Particle Accelerator

A complex machine
Studying the finest constituents of matter

A complex machine

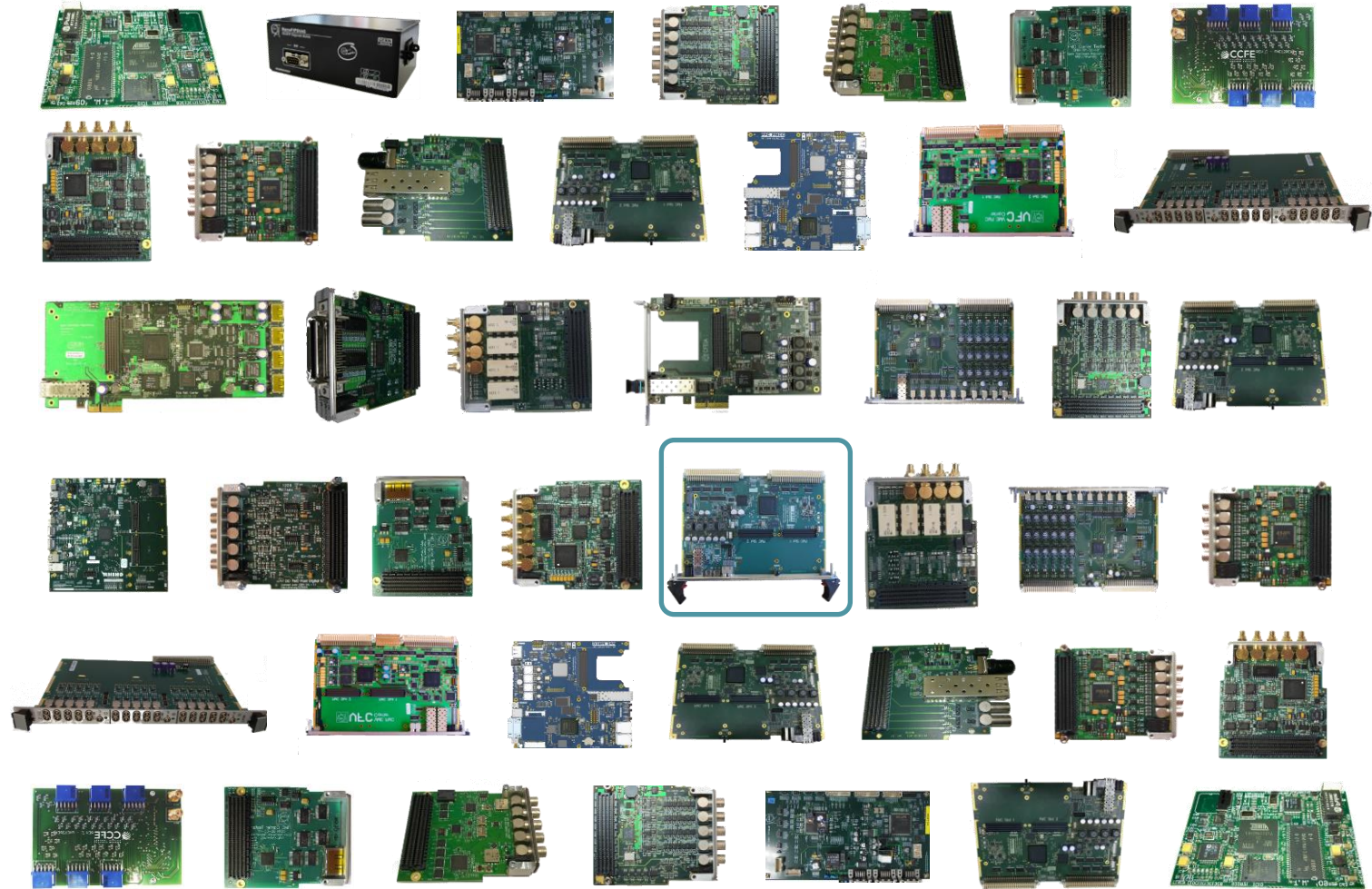


A complex machine

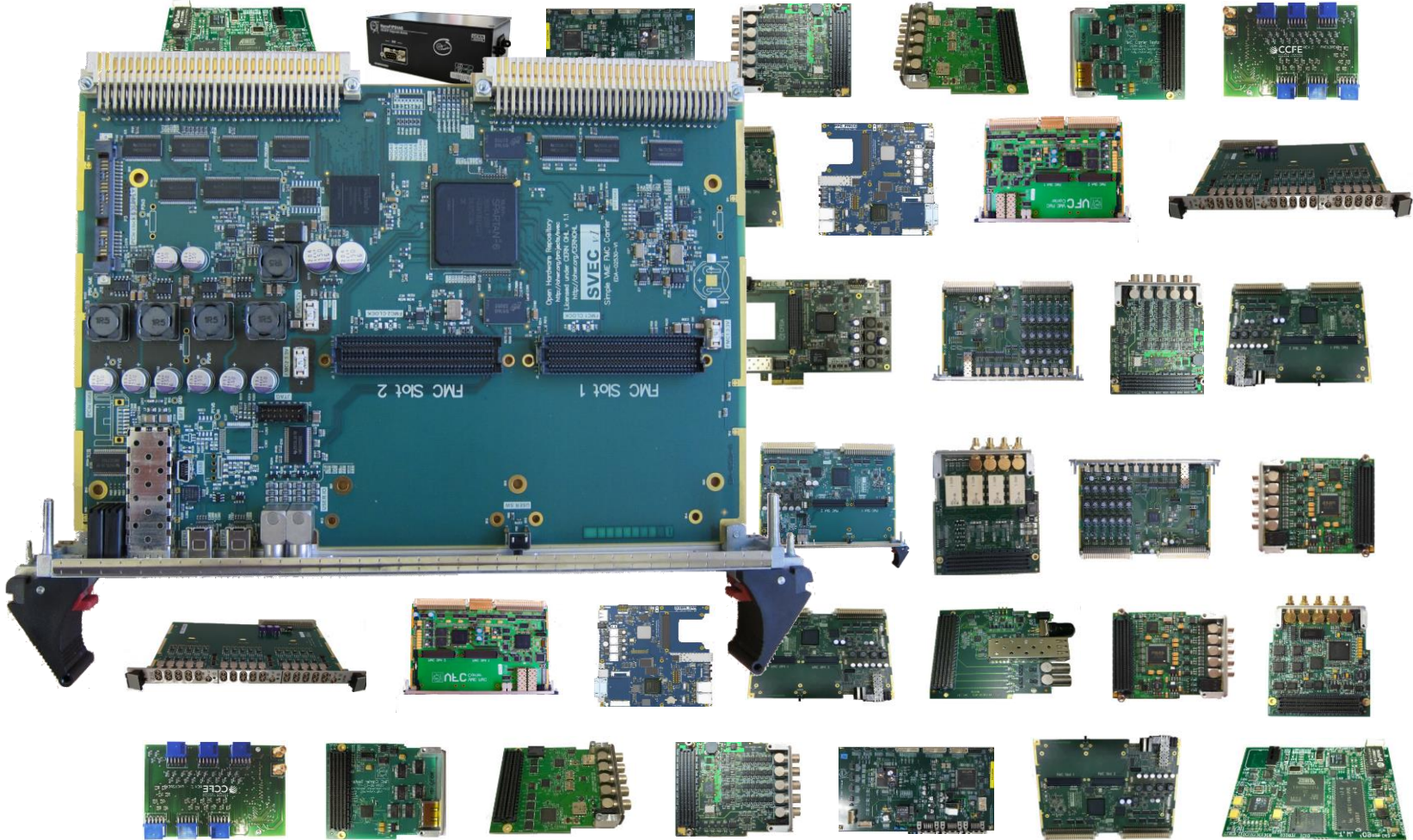


Beam Control systems and designs

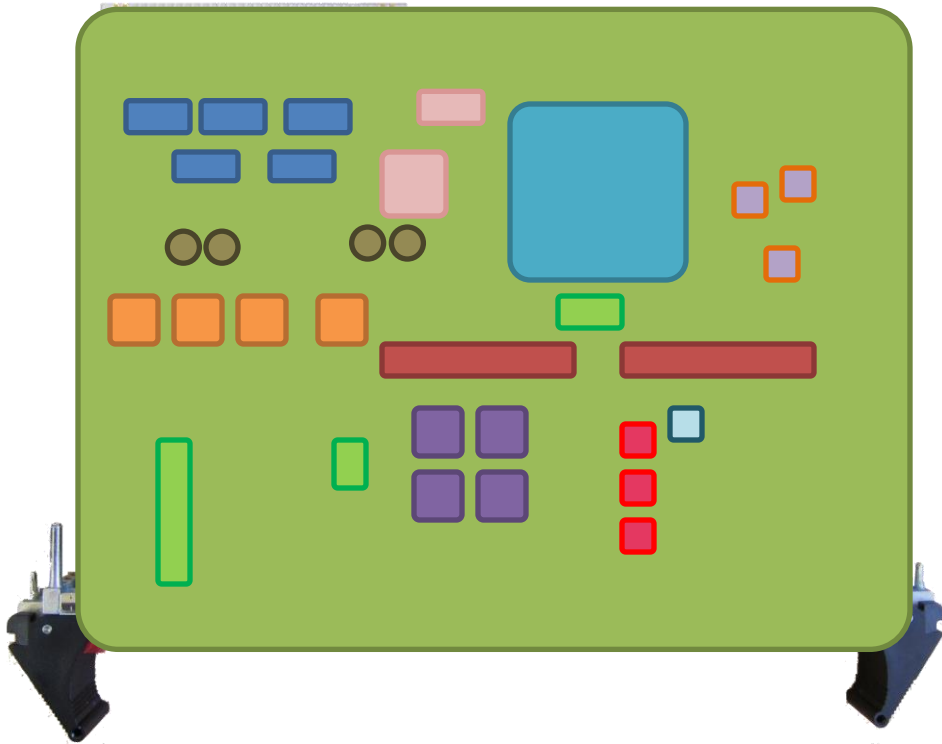
Beam Controls: Hundreds of designs



Beamer front panel design



Electronic Design Dependencies

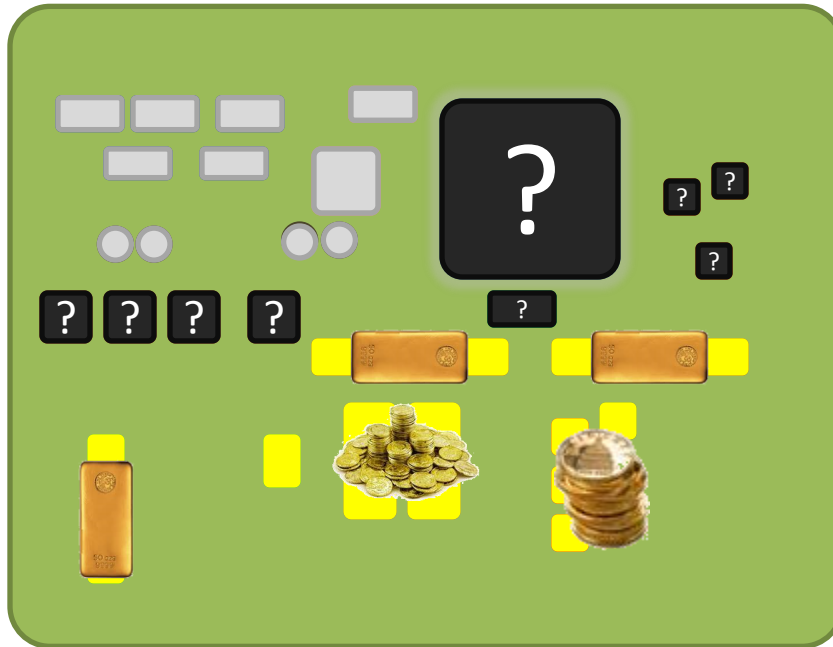


○ Components

○ IP cores

○ Tools

Electronic Design Dependencies



○ Components

○ IP cores

○ Tools

⇒ Obsolete

⇒ Expensive

⇒ Bugs



Open Hardware Electronic Design Dependencies

Open Hardware

The 5 commandments



Open Hardware

The 5 commandments

Outline

Why Open Hardware

Creative Abundance

○ Skillful people

○ Similar needs

Avoid duplication of effort | Build upon | Better designs



⇒ Obsolete

⇒ Bugs

⇒ Expensive

Why Open Hardware

Why Open Hardware

In practice

- Design Reuse



- Well established standards



- Peer Review

“Given enough eyeballs all bugs are shallow”

Linus Law



- Rigorous design process

- Dissemination of knowledge



Why Open Hardware

Why Open Hardware

Companies and the Open Hardware

- Similar to FOSS: Support



- Manufacturing



- Healthier relations with companies

- Select upon Testing quality | Guarantee | Support



Why Open Hardware

Companies and the Open Hardware		
	Commercial	Non-commercial
Open	Best of both worlds	Whole support burden falls on developers
Proprietary	Vendor lock-in	Dedicated non-reusable projects

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- **Open Hardware at CERN**
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Following the FOSS principles Outline

Following the FOSS principles



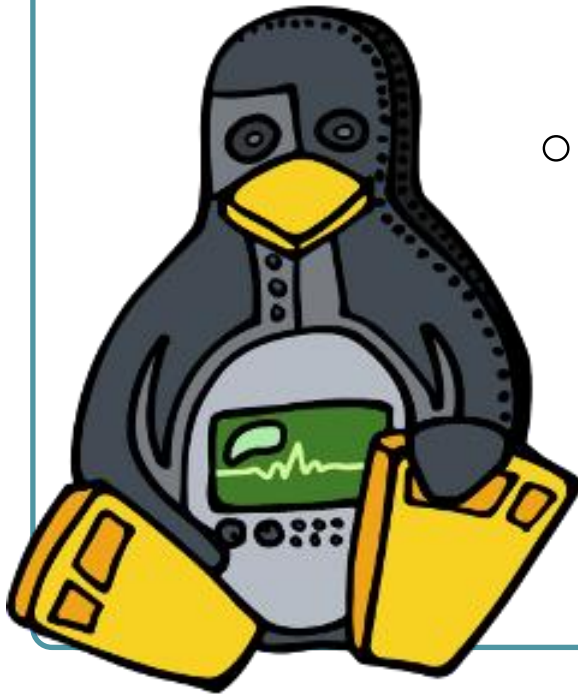
Following the FOSS principles



Følgebrev i høj retning af FCS Separations tilførs

Open Hardware Repository

www.ohwr.org



- Publishes everything needed to
 - Review
 - Modify
 - Manufacture

Open Hardware Repository

www.ohwr.org

- Fully open access
- Built using FOSS

Open Hardware Repository

www.ohwr.org



HOME PROJECTS LICENSES COMPANIES

CERNFIP


OVERVIEW WIKI ACTIVITY ISSUES NEWS DOCUMENTS REPOSITORY

OVERVIEW



WorldFIP is a deterministic rad-tol fieldbus used at CERN's LHC for a variety of control systems.

Cryogenics, Power Converters, Beam Instrumentation and other critical systems are using WorldFIP for the exchange of data between their sensors and actuators and the control and supervision level.

With  **Alstom** phasing out WorldFIP support in 2009, it was decided to **insource** this technology at CERN.

The insourcing project has started with



, a rad-tol FPGA that acts as an agent in the communication over the WorldFIP fieldbus.

Open Hardware Repository

www.ohwr.org


- 120 active projects
 - 70 initiated by CERN | 50 outside
 - 80 hardware designs | 40 IP blocks
- 165 active developers
 - 12 companies
 - 10 research centers



OVERVIEW

OVERVIEW



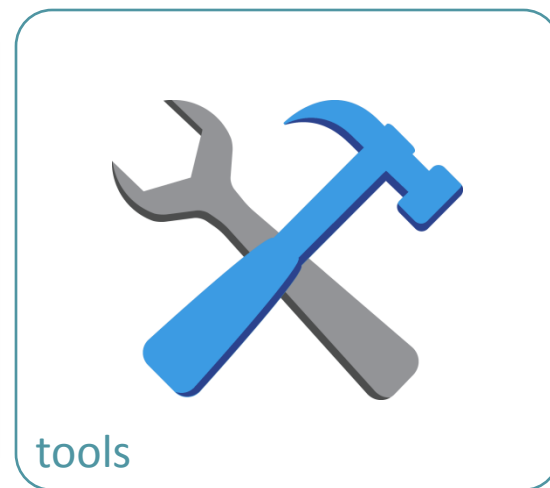
WorldFIP is a
Cryogenics, Po
supervision lev
With  **Alstom**

The insourcing



control and

Open Hardware Repository



Open Hardware License

Open Hardware License

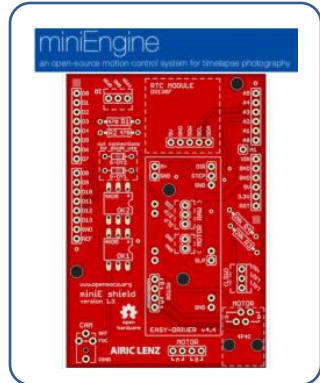
CERN OHL



- Developed by CERN Knowledge Transfer
- Defines conditions for using | modifying a design
- Persistent license
- Clear, easy to read
- Makes it easier to work with others

Open Hardware License

Under CERN OHL



Sufficiency Lab presents: Worm Farm



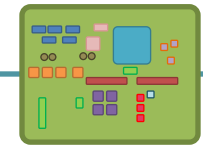
Open Hardware Toolsense



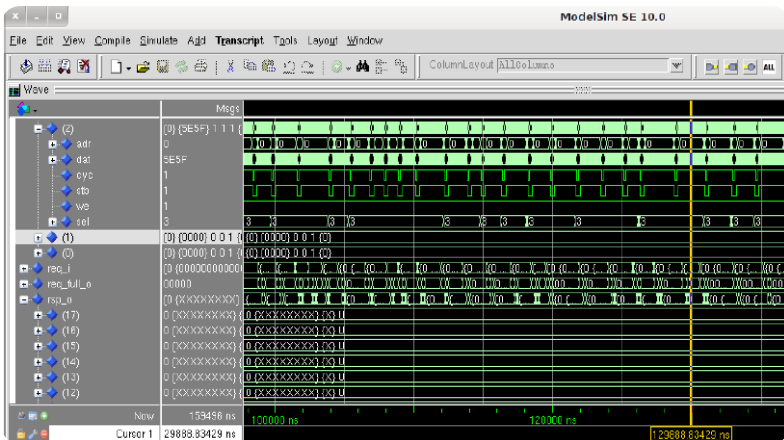
Hardware Tools

Hardware Tools

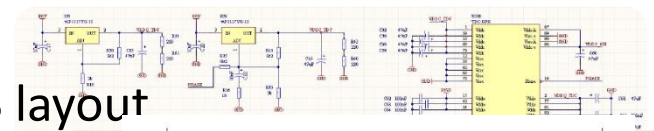
FPGA



- HDL simulator



- Schematics entry

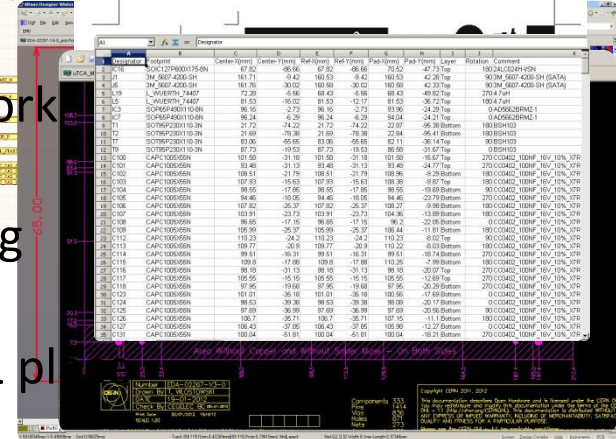


- PCB layout

- Art work

- Drilling

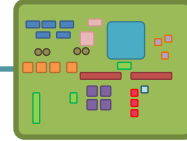
- Pick & pl



Hardware Tools

FPGA

- HDL simulator



- Schematics entry
- PCB layout
- Art work
- Drilling
- Pick & place

Efforts on Open Hardware Tools

FPGA

- HDL simulator



Icarus Verilog



- Schematics entry
- PCB layout
- Art work
- Drilling
- Pick & place

KiCad EDA Software Suite

Efforts On Open Source Storage Tools

The White Rabbit Case 

One Success Story

The White Rabbit Case

- CERN needs



Operation coordinated with sub-ns accuracy

One Success Story

The White Rabbit Case

- CERN needs
- Based on well established standards



Operation coordinated with sub-ns accuracy

One Success Story

The White Rabbit Case

- CERN needs
- Based on well established standards
- Institutes & Companies building upon
- Peer Review

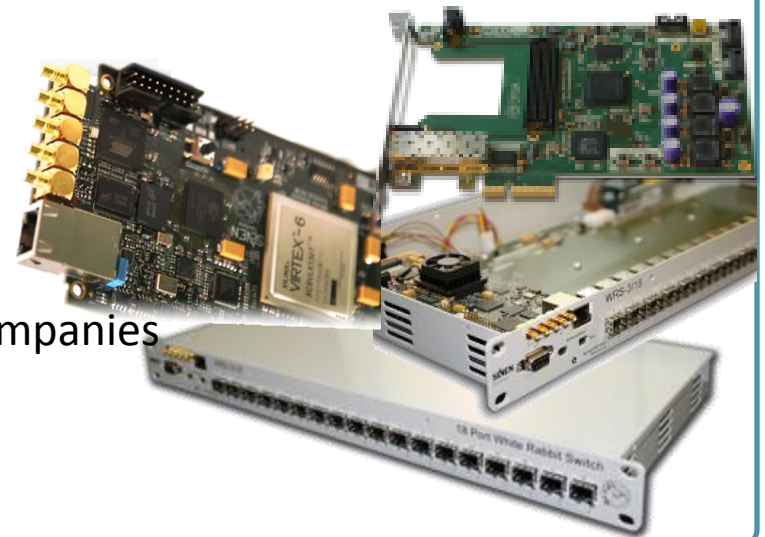


One Success Story

The White Rabbit Case

- CERN needs
- Based on well established standards
- Institutes & Companies building upon
- Peer Review
- Different products available by several companies
- IEEE standardization 

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00001100100011011101101000  
1000001110011011001011101  
101101110110010101110100001  
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11101001100101011010001110  
10001000001100010110010001  
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A Win-Win Situation

Companies

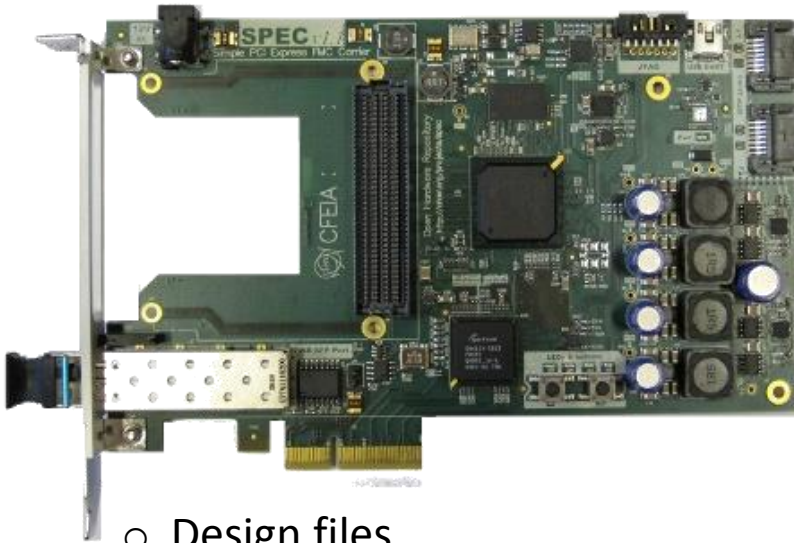
- Negligible upfront costs | Easy entry into market
- Manufacturing | Guarantee | Support

Institutes

- Better designs
- Avoid vendor lock-in
- Fun :-)

Open Hardware Repository

www.ohwr.org



- Design files
- Documentation
- Production tests
- Device Drivers

