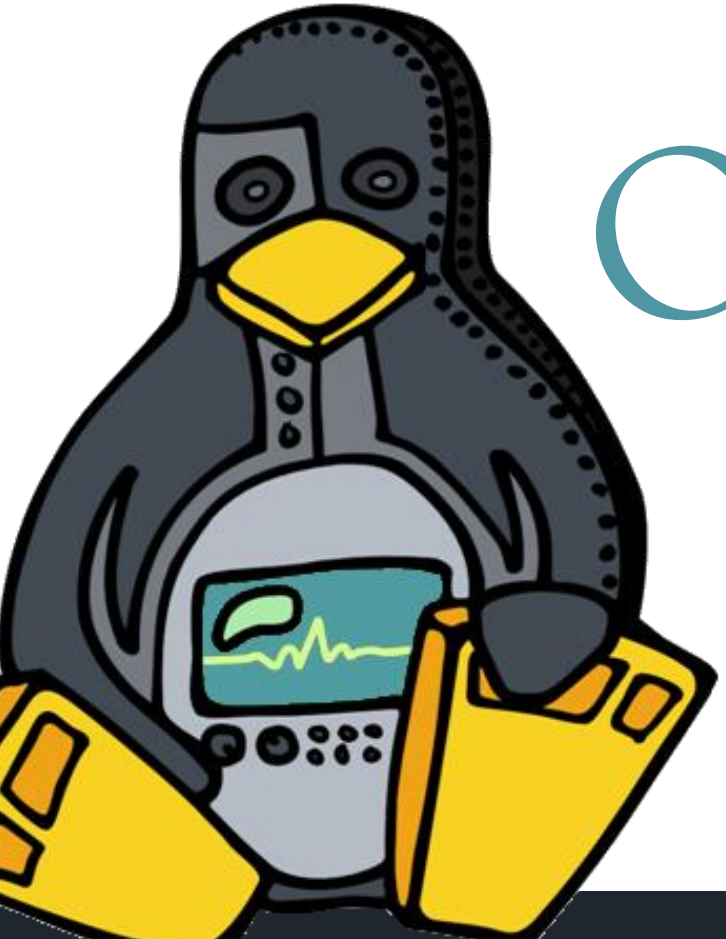

Open Hardware at CERN

an initiative for changing the way we work

Outline

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

Outline

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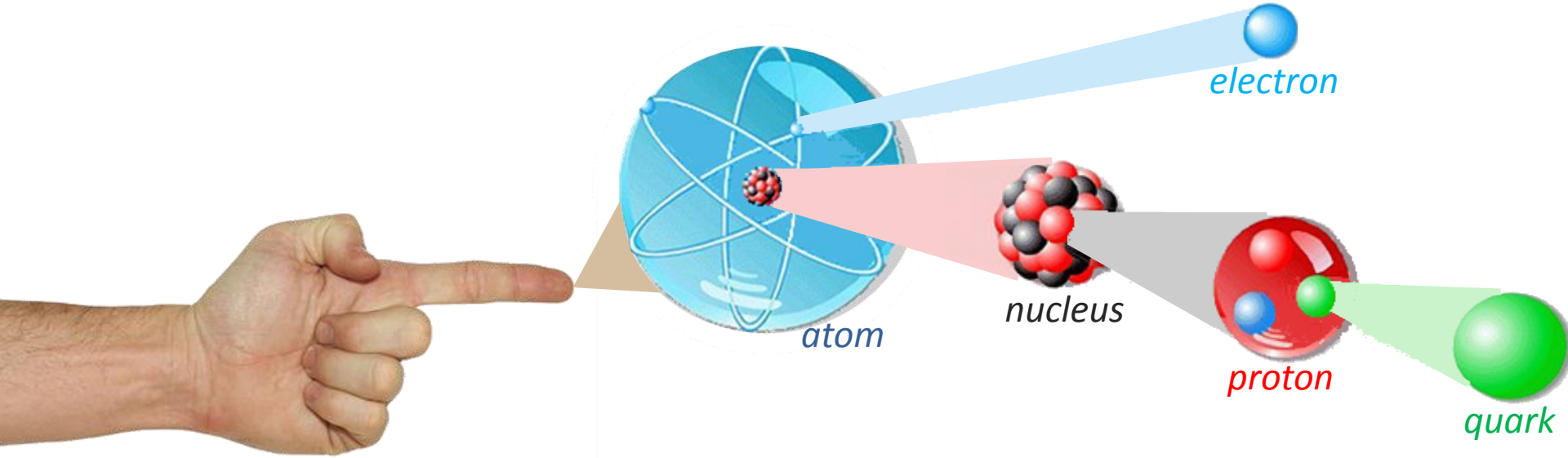
LHC Particle Accelerator

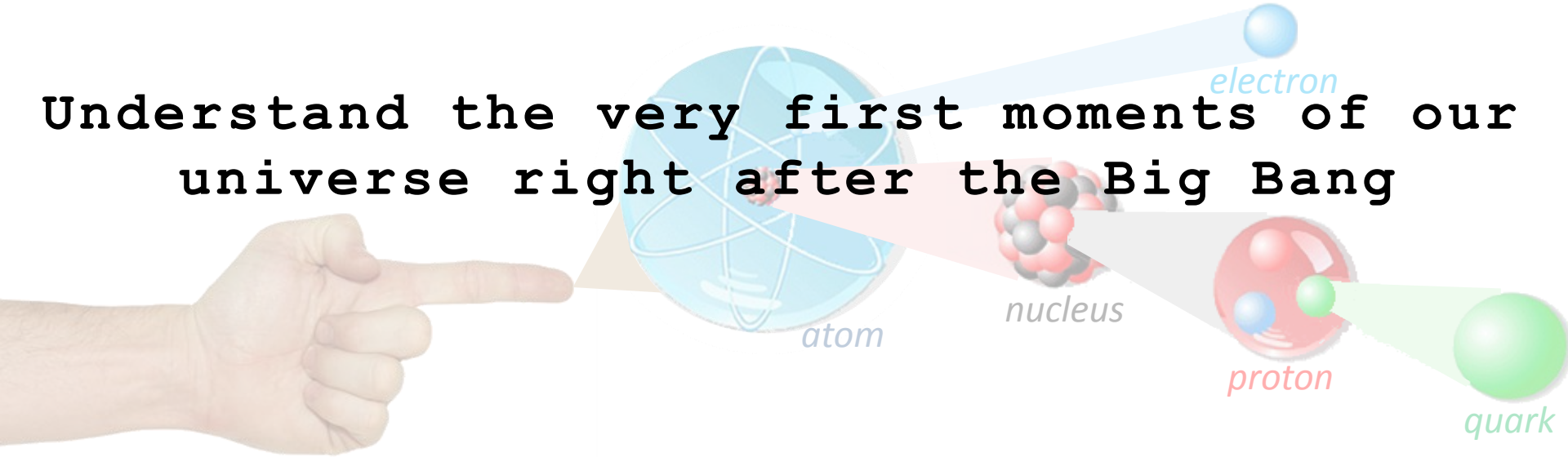
Studying the finest constituents of matter



LHC Particle Accelerator

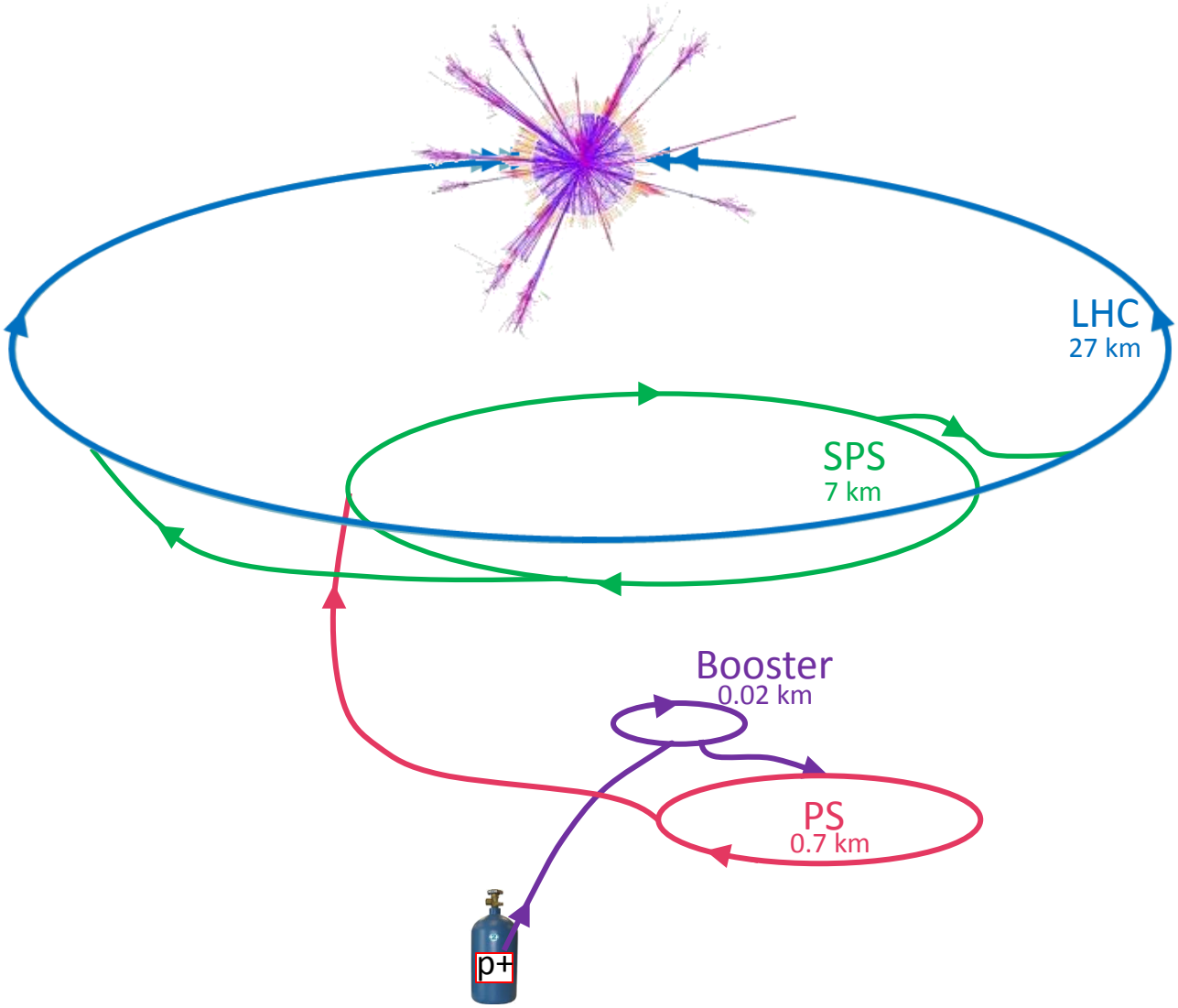
Studying the finest constituents of matter

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



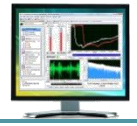
LHC Particle Accelerator
A complex machine
Studying the finest constituents of matter

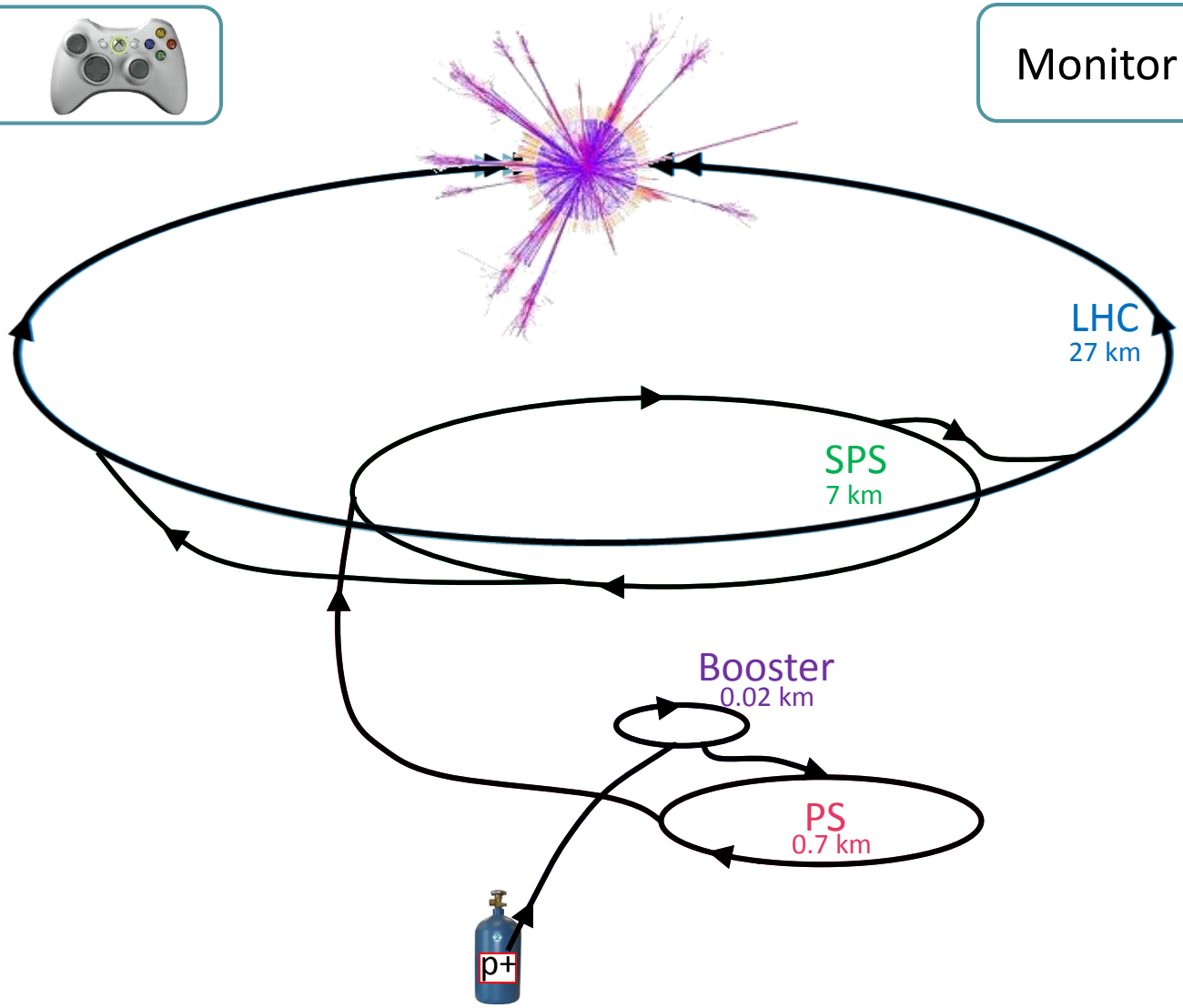
A complex machine



A complex machine

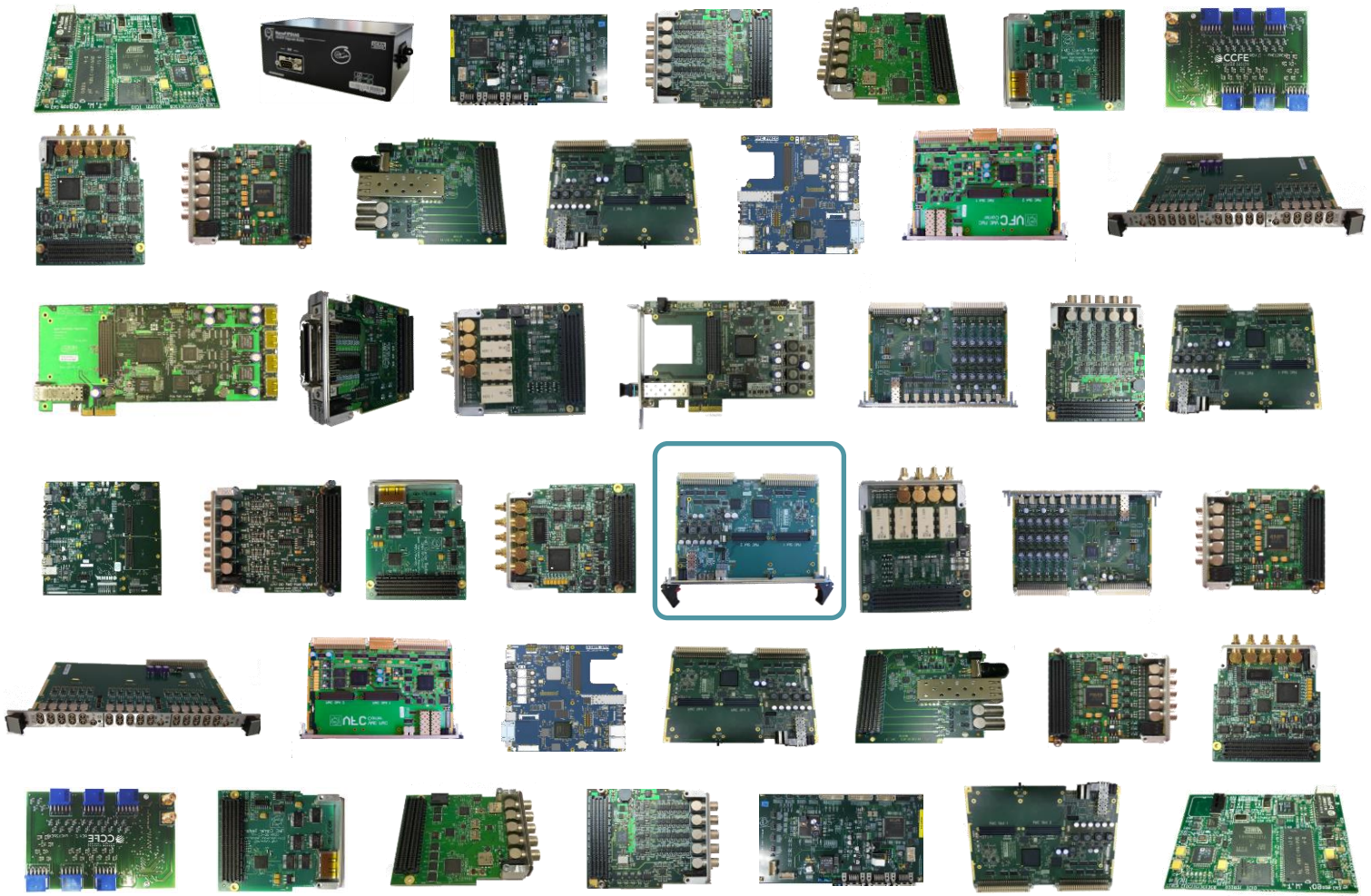
Control

Monitor 

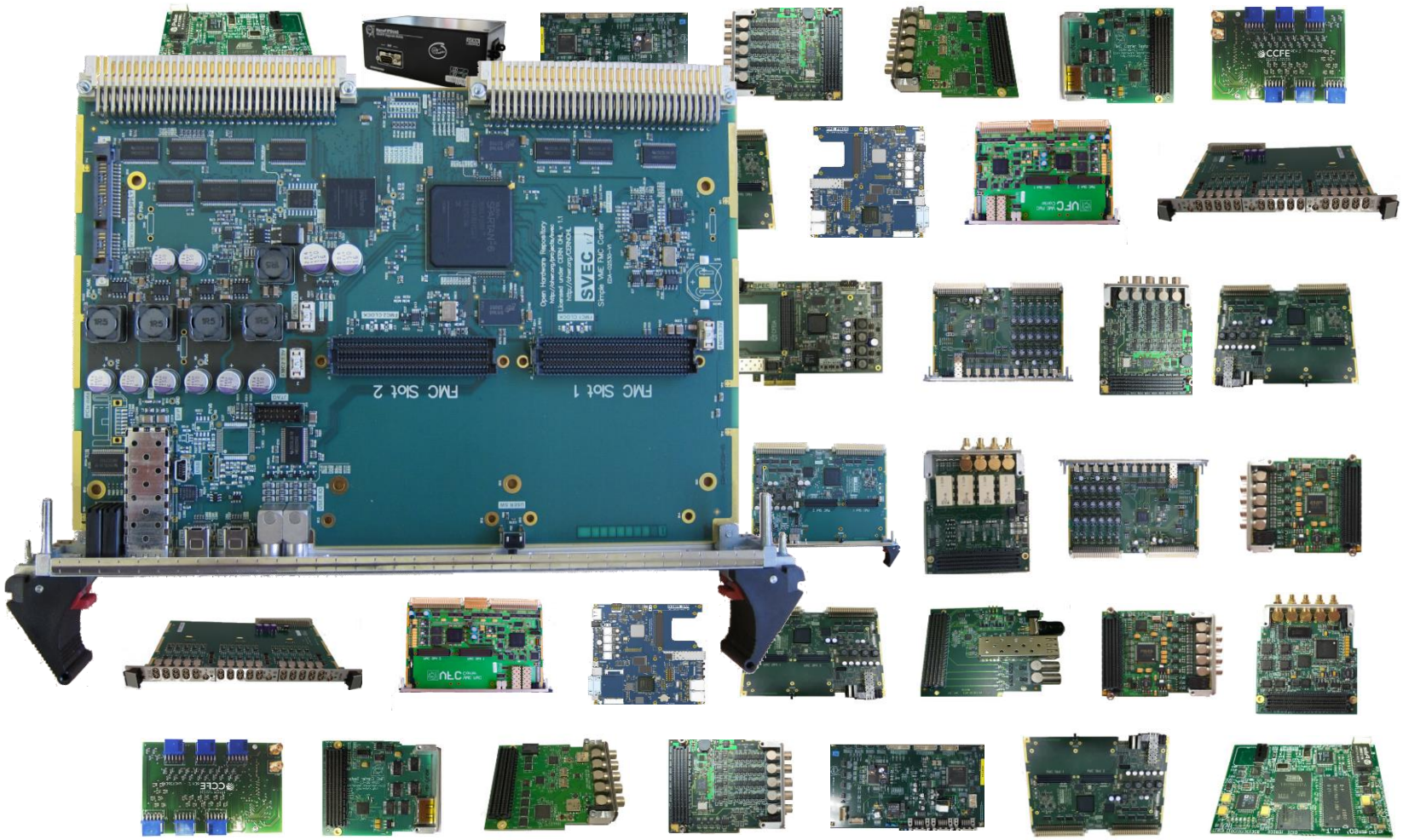


Beam Coupling Impedance of designs

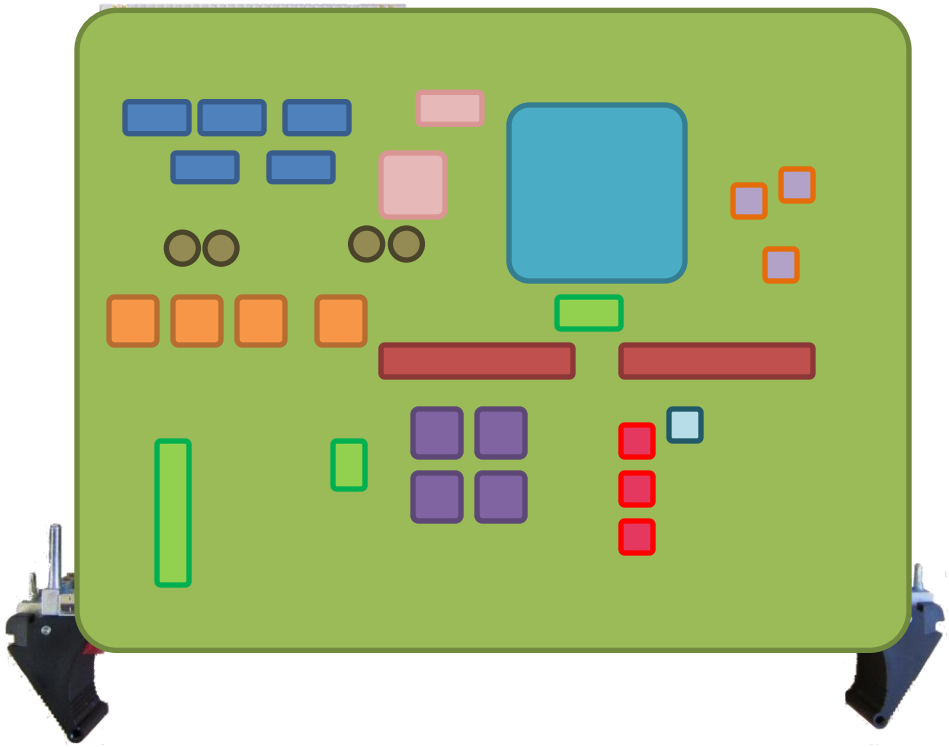
Beam Controls: Hundreds of designs



Electronic Design Depends of designs

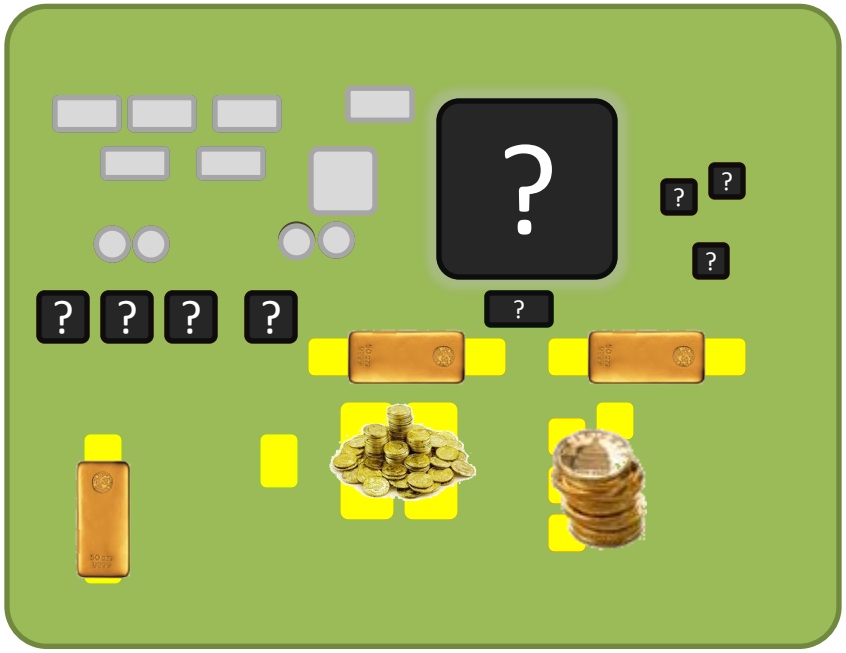


Electronic Design Dependencies



- 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

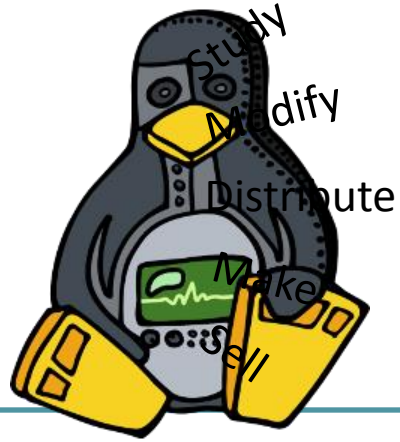
Outline

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

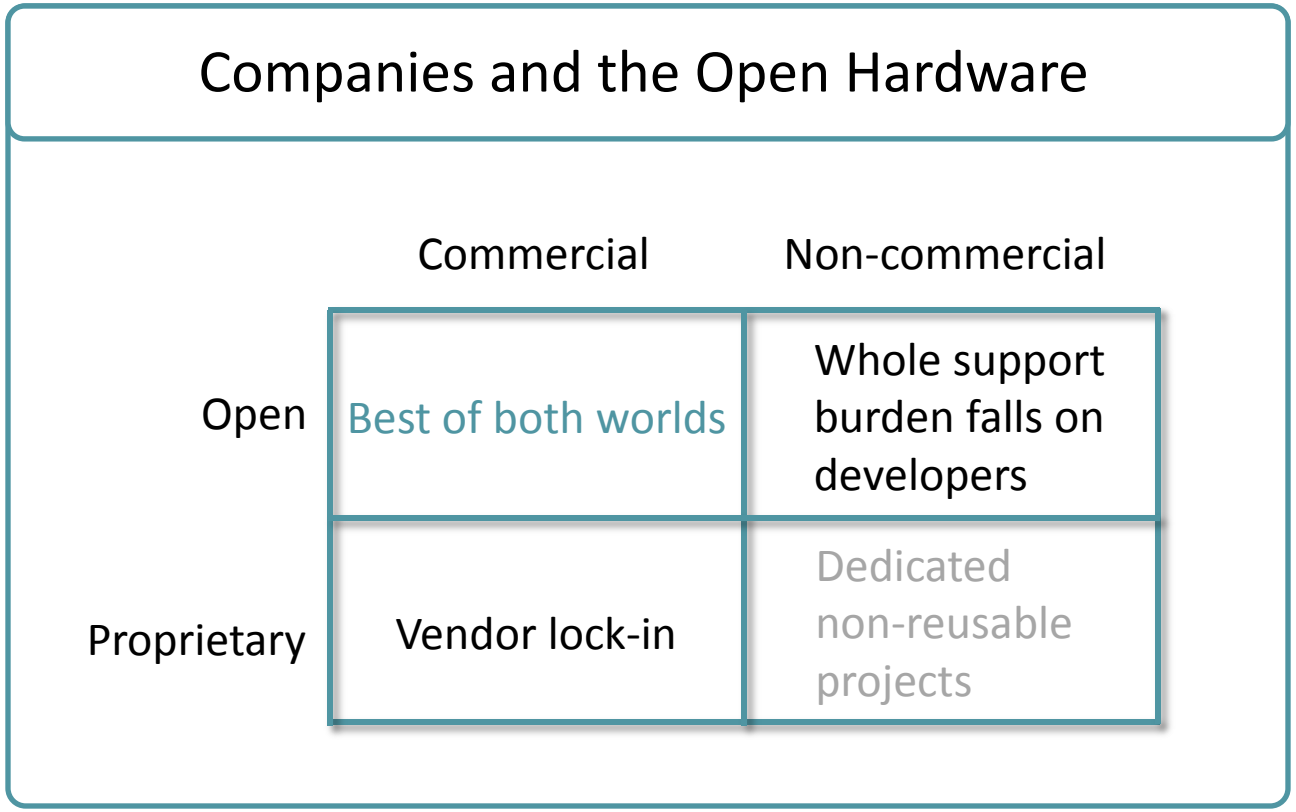
- Similar to FOSS: Support

- Manufacturing

- Healthier relations with companies
  - Select upon Testing quality | Guarantee | Support

igalia

Why Open Hardware



Outline

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Following the FOSS principles Outline

Following the FOSS principles

site

license

tools

Following the FOSS principles

site

license

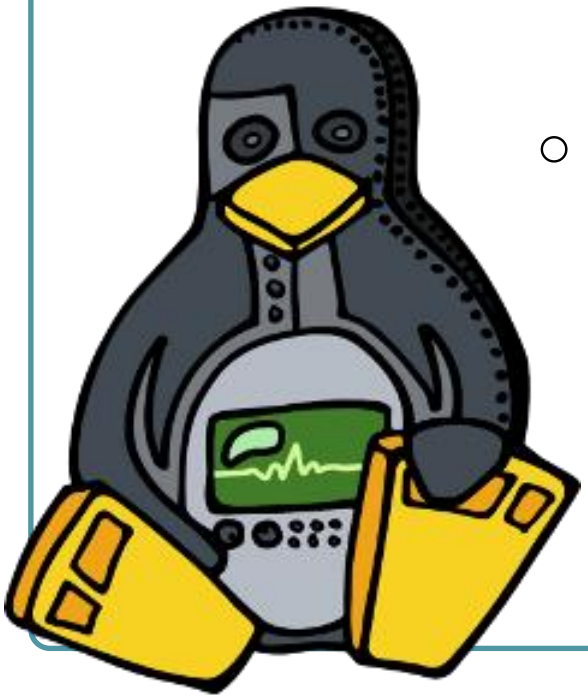
tools

Following the FOSS principles

Following the FOSS principles

Open Hardware Repository

www.ohwr.org



- Publishes everything needed to
  - Review
  - Modify
  - Manufacture

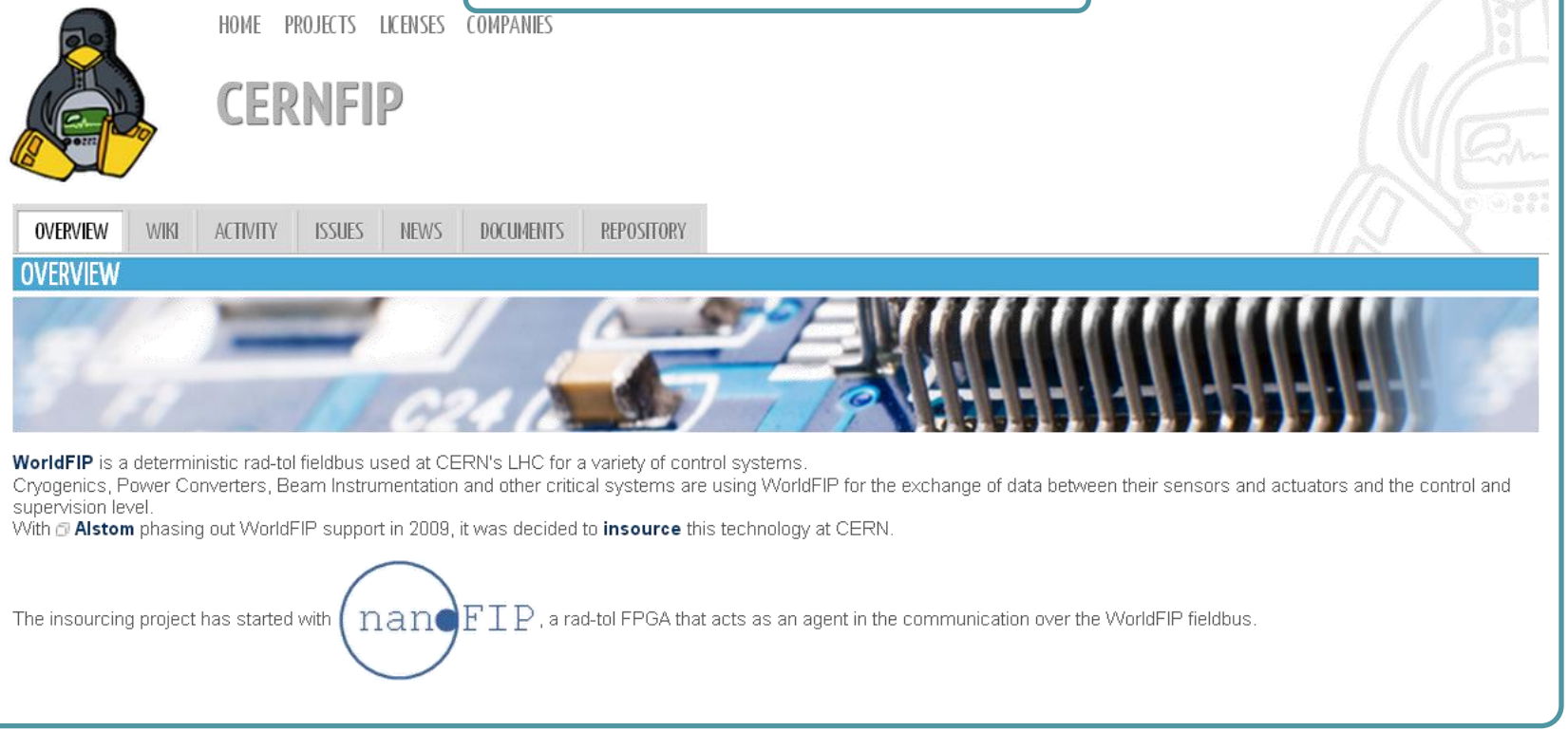
Open Hardware Repository

www.ohwr.org

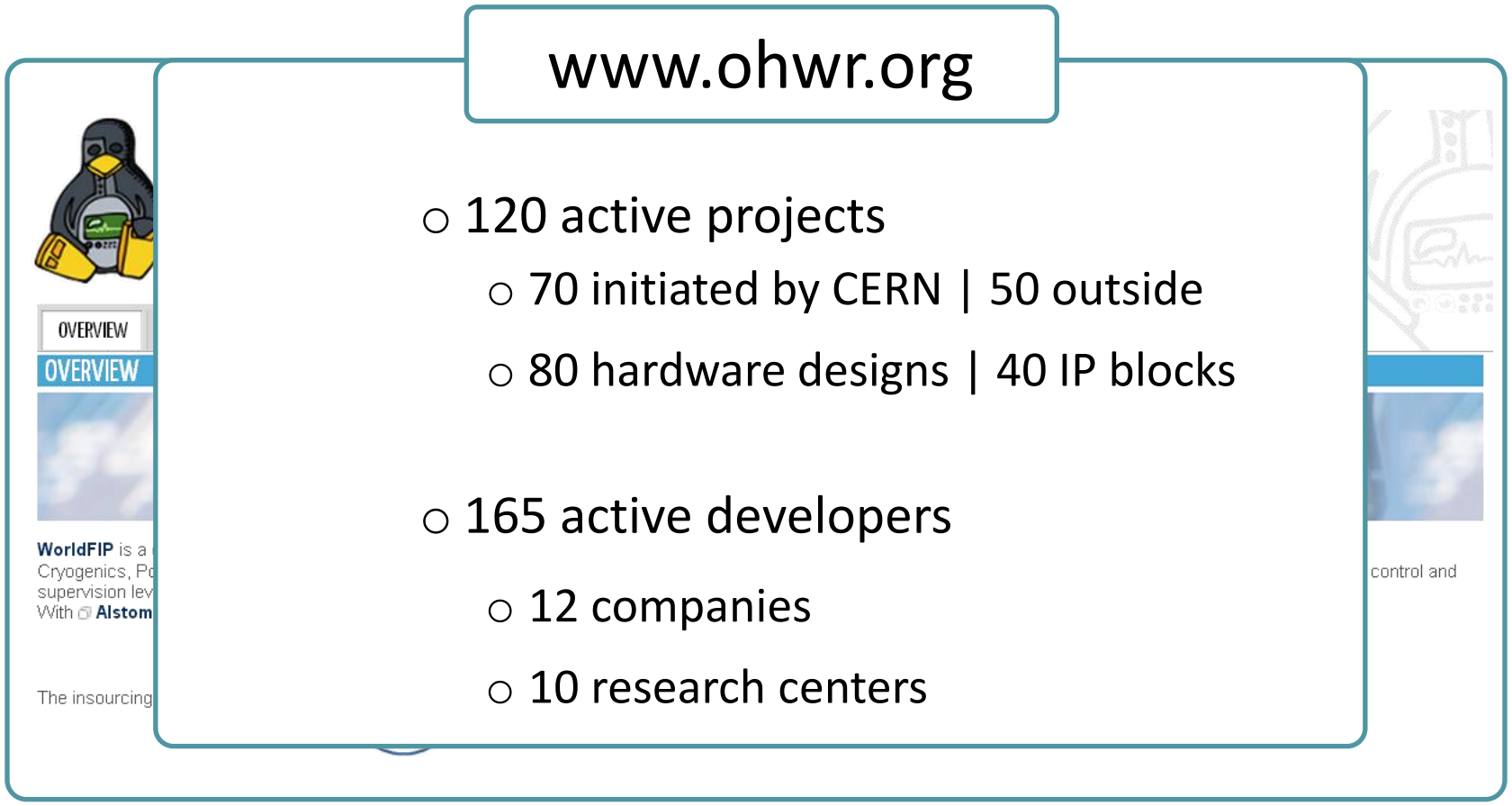
- Fully open access
- Built using FOSS

Open Hardware Repository

www.ohwr.org



Open Hardware Repository



Open Hardware Repository

site

license

tools

Open Hardware License

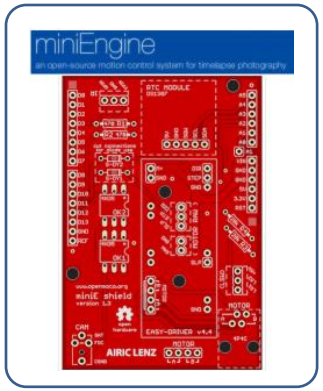
Open Hardware License

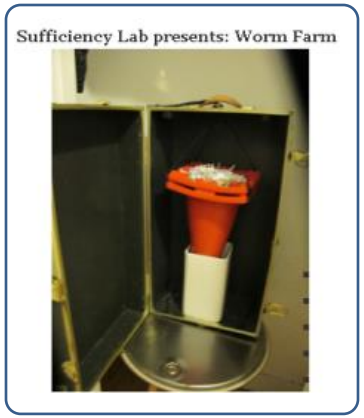
CERN OHL

- 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





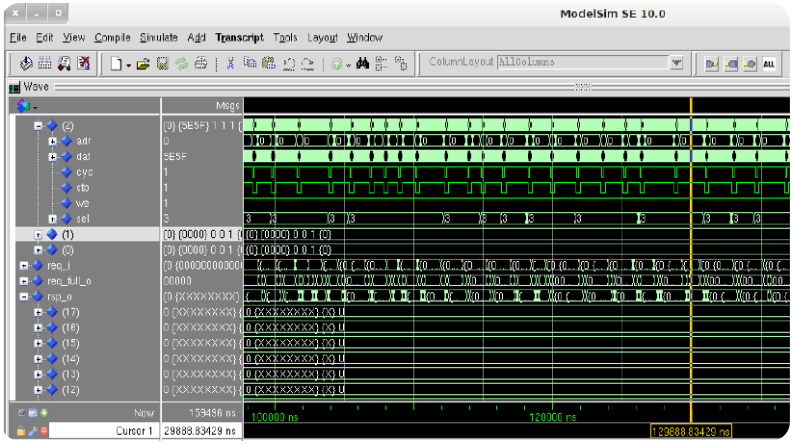
OpenHardware License

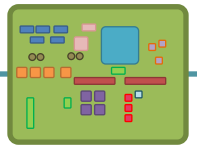
Hardware Tools

Hardware Tools

FPGA

- HDL simulator



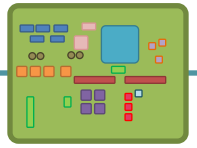


- Schematics entry
- PCB layout
- Art work
- Drilling
- Pick & pl

Hardware Tools

FPGA

- HDL simulator



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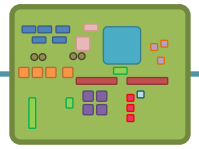
Efforts on Open Hardware Tools

FPGA

- HDL simulator

Icarus Verilog



- Schematics entry
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- Art work
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- Pick & place

KiCad EDA Software Suite

Efforts One Quarter Software 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

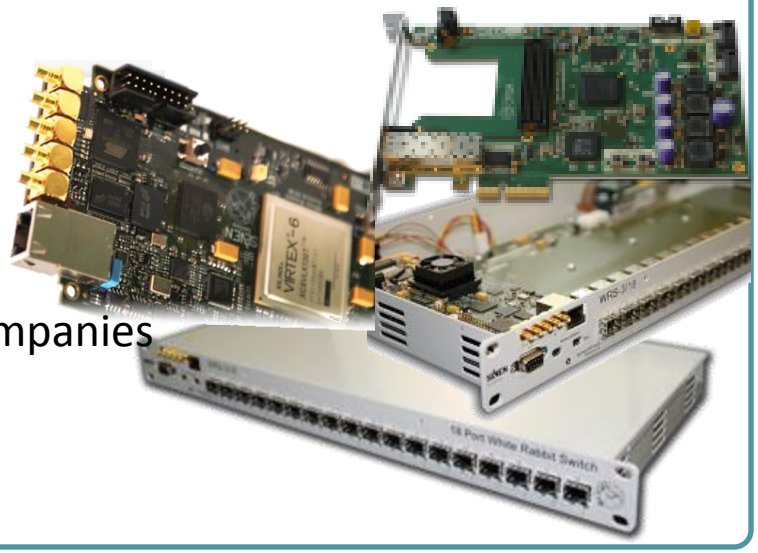
The White Rabbit Case

- 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



One Success Story

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A Win-Win Situation

Outline

A Win-Win Situation

Companies

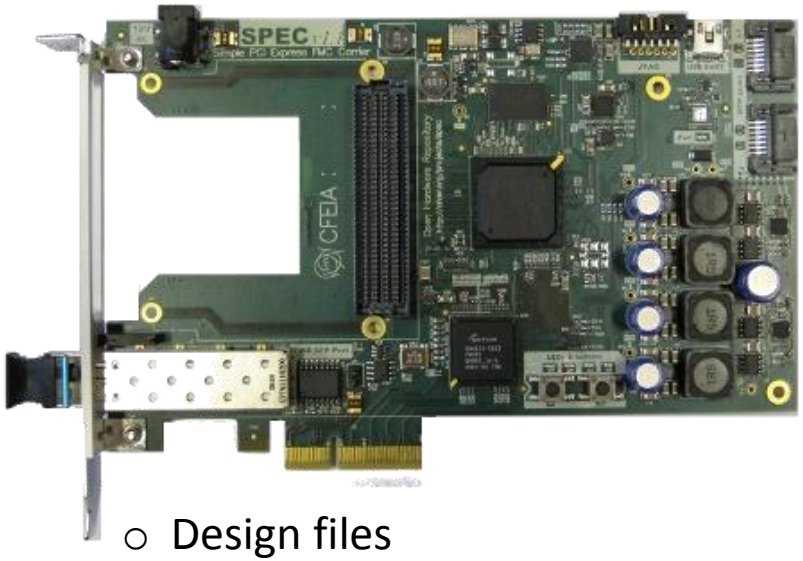
- Negligible upfront costs | Easy entry into market
- Manufacturing | Guarantee | Support

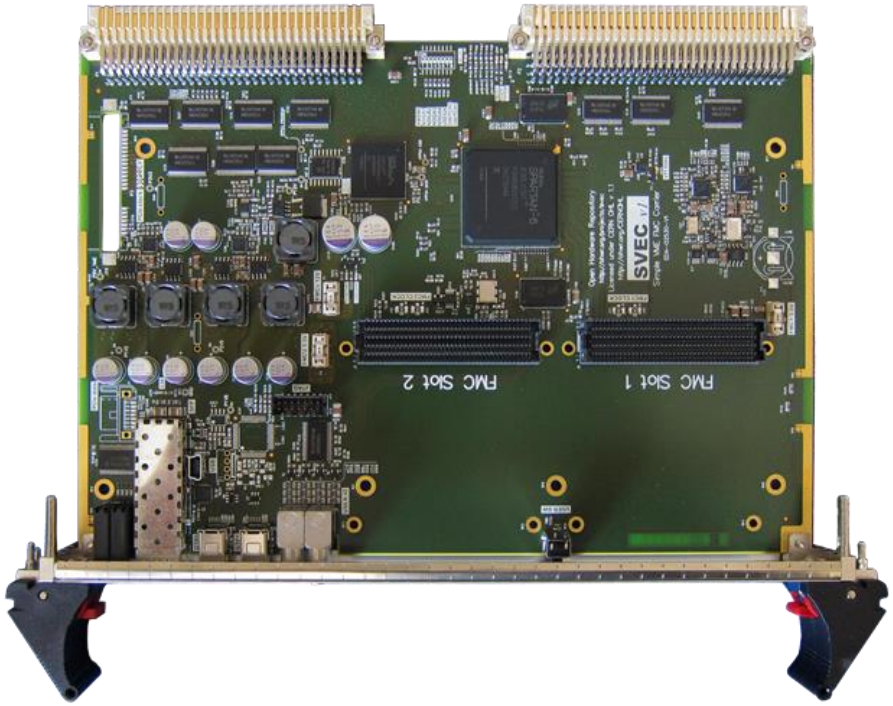
Institutes

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

Open Hardware Repository

www.ohwr.org





- Design files
- Documentation
- Production tests
- Device Drivers