



OPEN SOURCE HARDWARE AT CERN

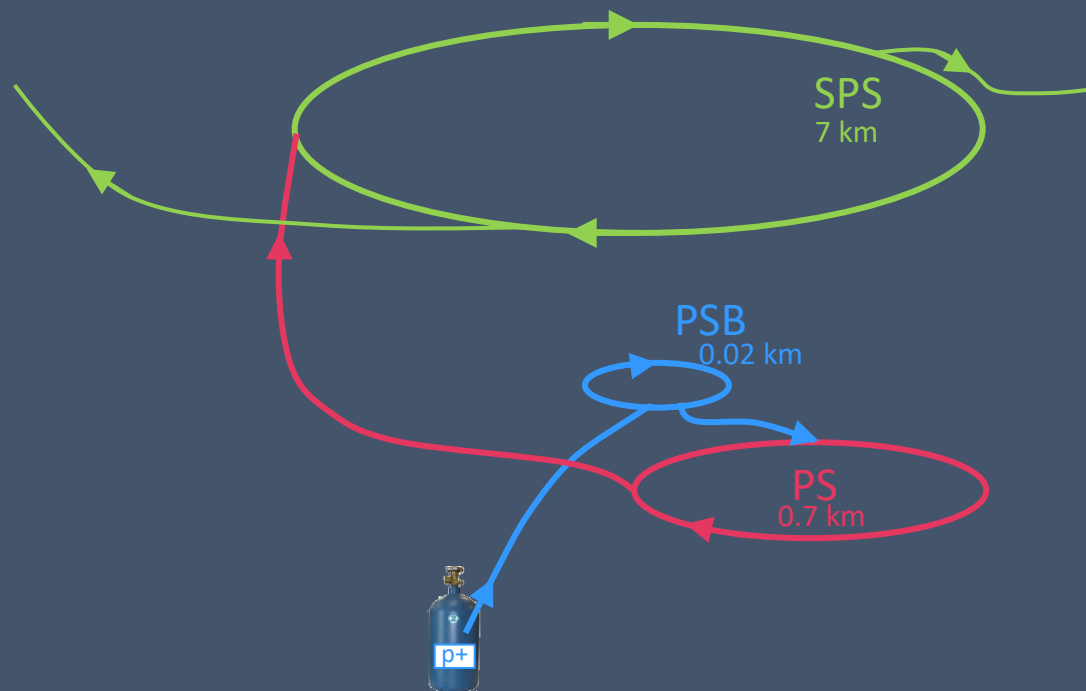
EVA GOUSIOU | 22 NOV 2023



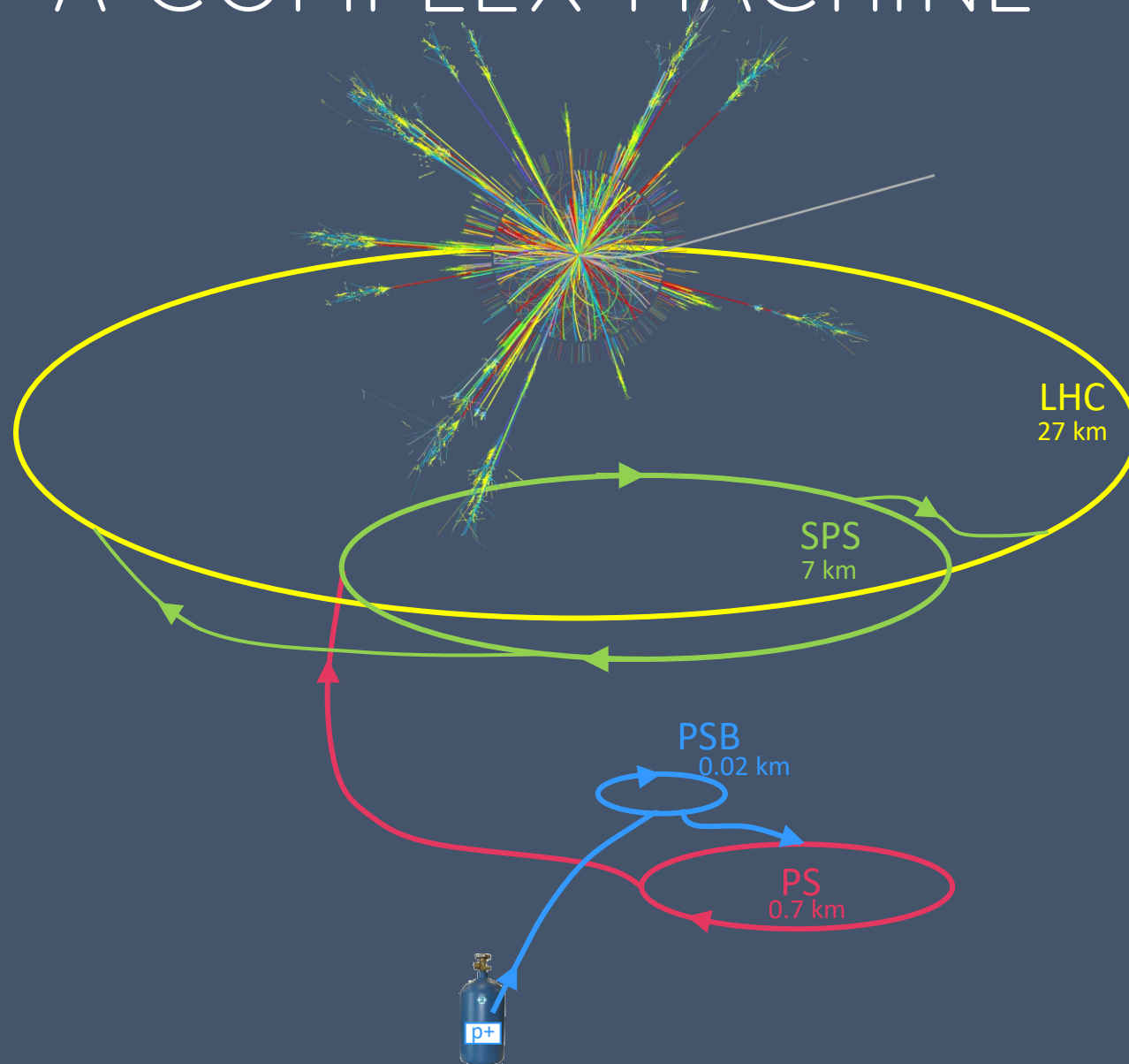
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A COMPLEX MACHINE



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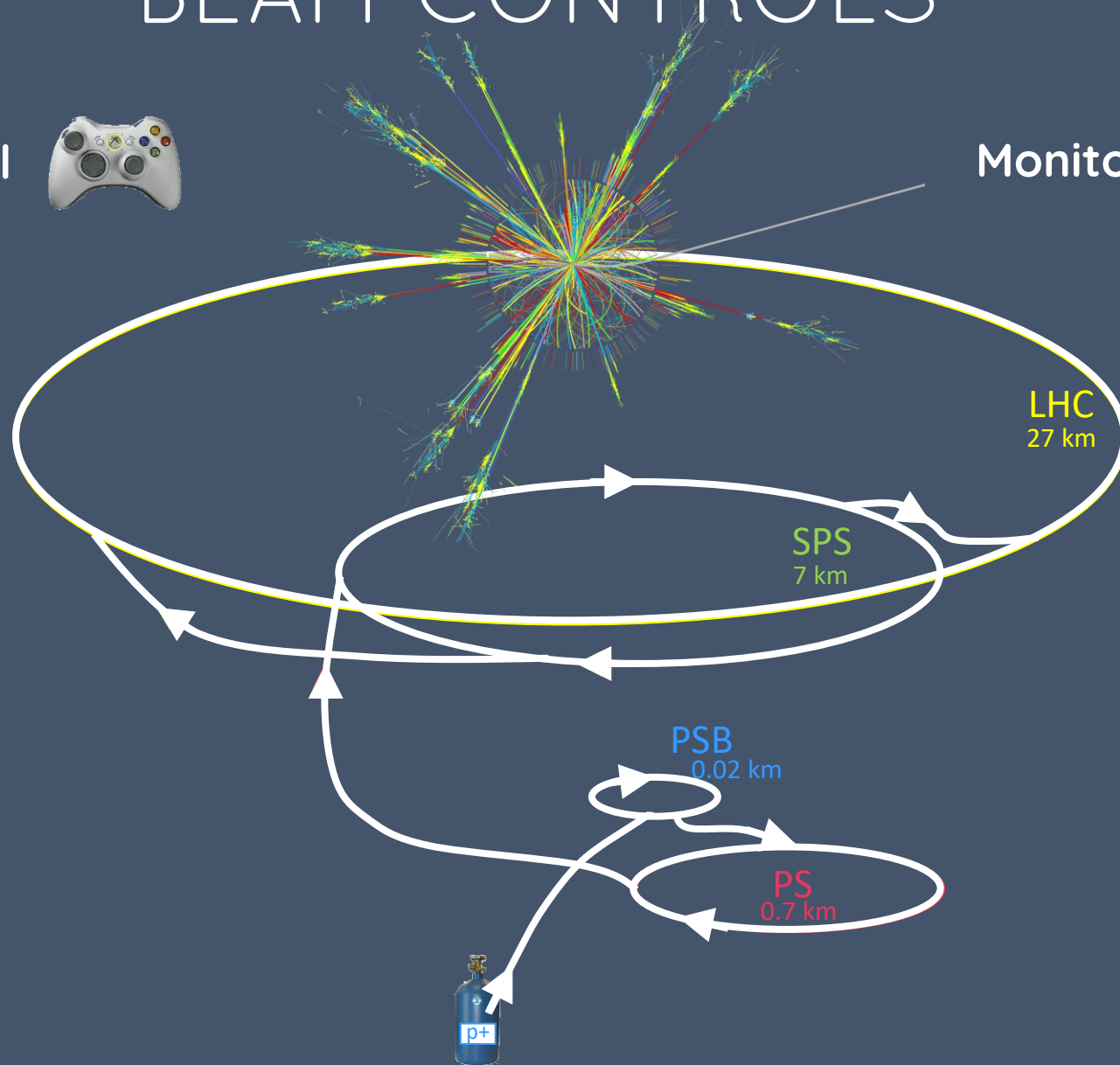
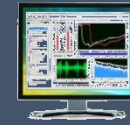


BEAM CONTROLS

Control

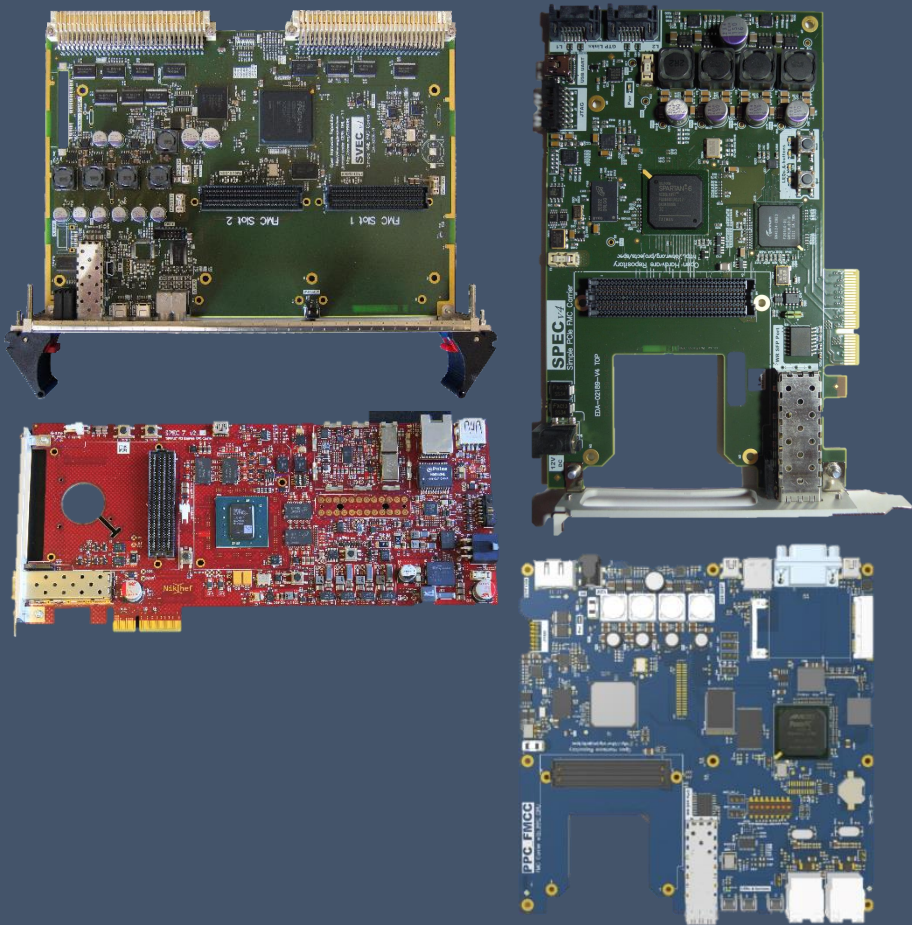


Monitor



OUR MISSION

Carriers



Mezzanines



White Rabbit

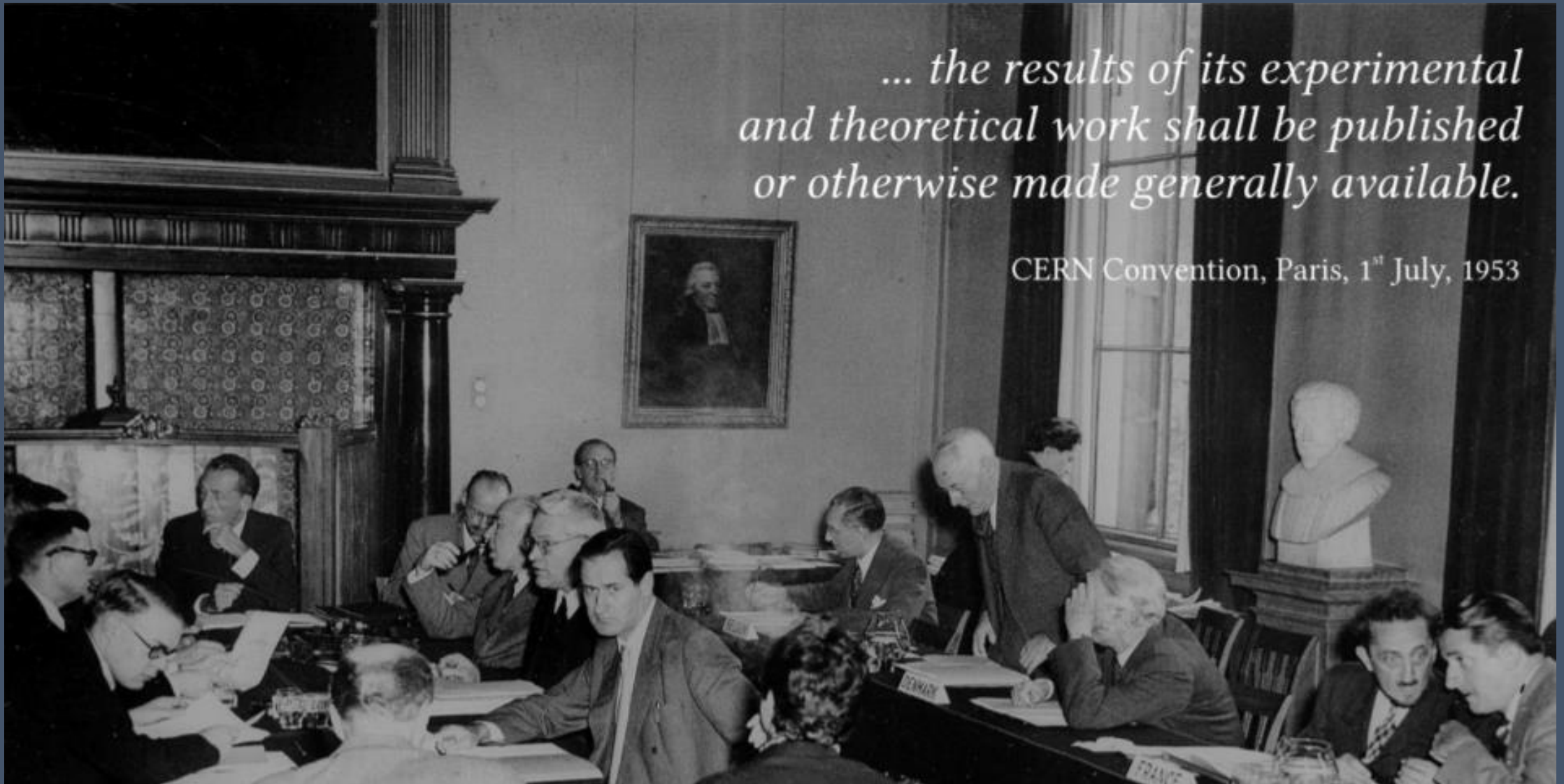


- ★ Dozens of designs
- ★ Modular & Generic
- ★ Use of standards
- ★ Industry Collabs
- ★ 10y operation

OUR MISSION

*... the results of its experimental
and theoretical work shall be published
or otherwise made generally available.*

CERN Convention, Paris, 1st July, 1953



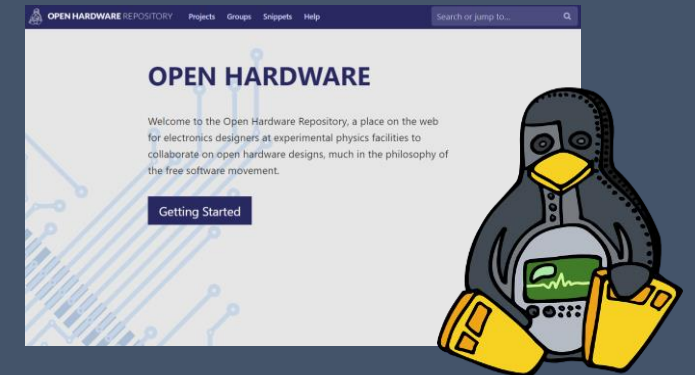
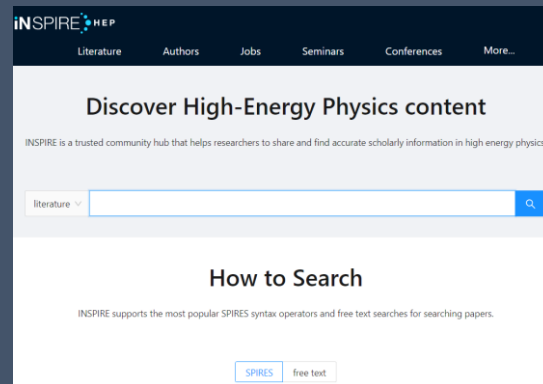
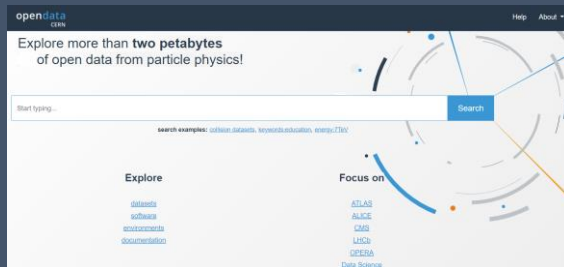
OUR MISSION

Open Data

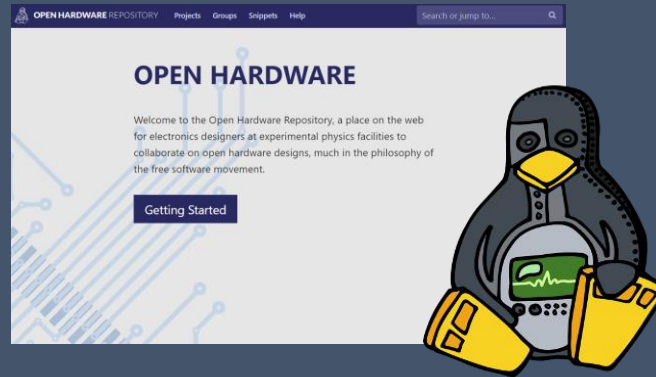
Open Access

Free Open Source
Software

Open Hardware



WHAT - WHY - HOW



👍 Study

👍 Modify

👍 Distribute

👍 Make & Sell

♥ No Vendor Lock-in

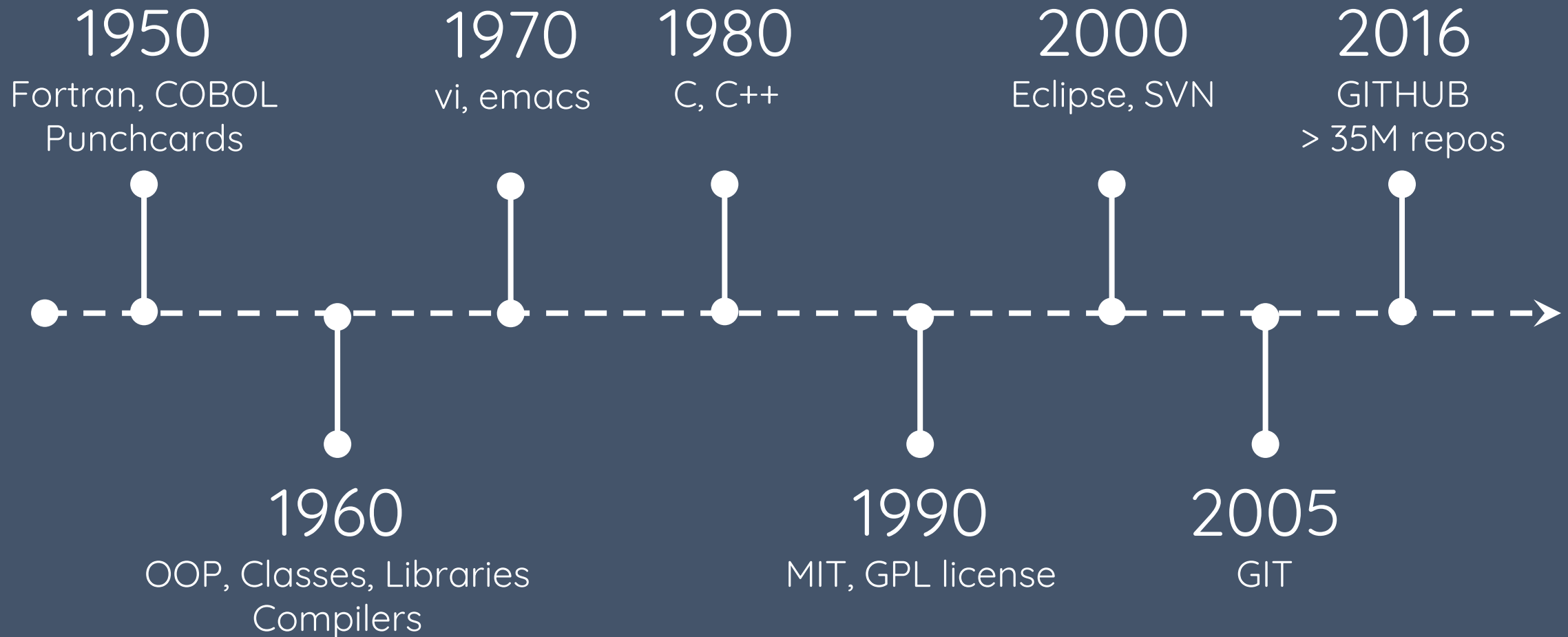
♥ More Contributors

♥ Higher Quality

♥ Our Mission

Inspired by SW

BRIEF HISTORY OF THE SW MILESTONES



FOLLOWING THE FOSS PRINCIPLES

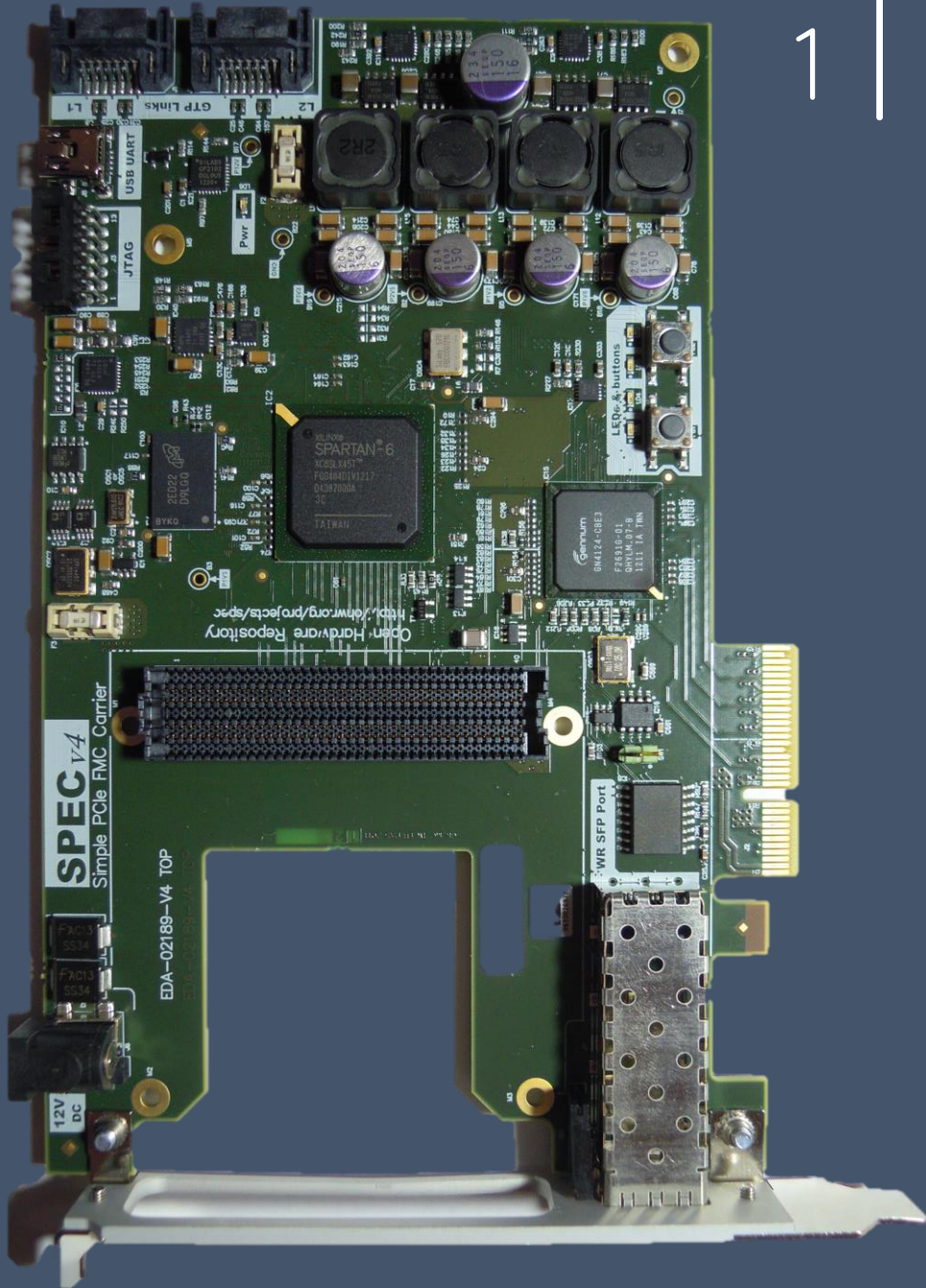


- 1 | Host
- 2 | License
- 3 | Tools

FOLLOWING THE FOSS PRINCIPLES

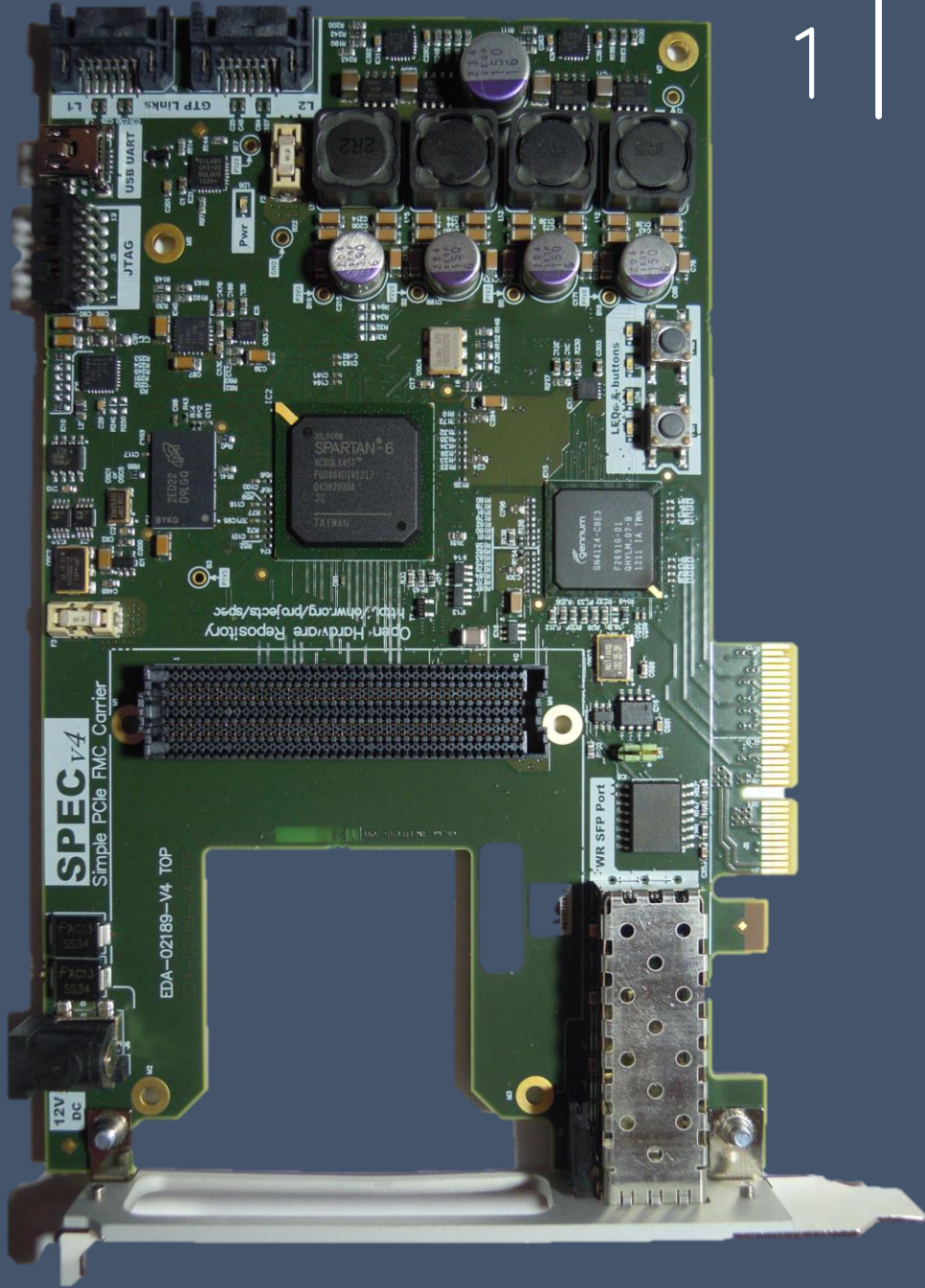


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1 | OHWR.ORG

- ★ Hardware, Firmware Software
- ★ Design choices
- ★ Document everything
- ★ Issues tracking and detected bugs
- ★ Mailing list discussions



1 | OHWR.ORG

- ★ Produced Units > 1000
- ★ Users outside CERN > 100
- ★ Spinoffs > 9

COMMERCIAL VS OPEN

	Commercial	Non-commercial
Open	Winning combination Best of both worlds	Whole support burden falls on developers. Not scalable.
Proprietary	Vendor lock-in.	Dedicated, non-reusable projects

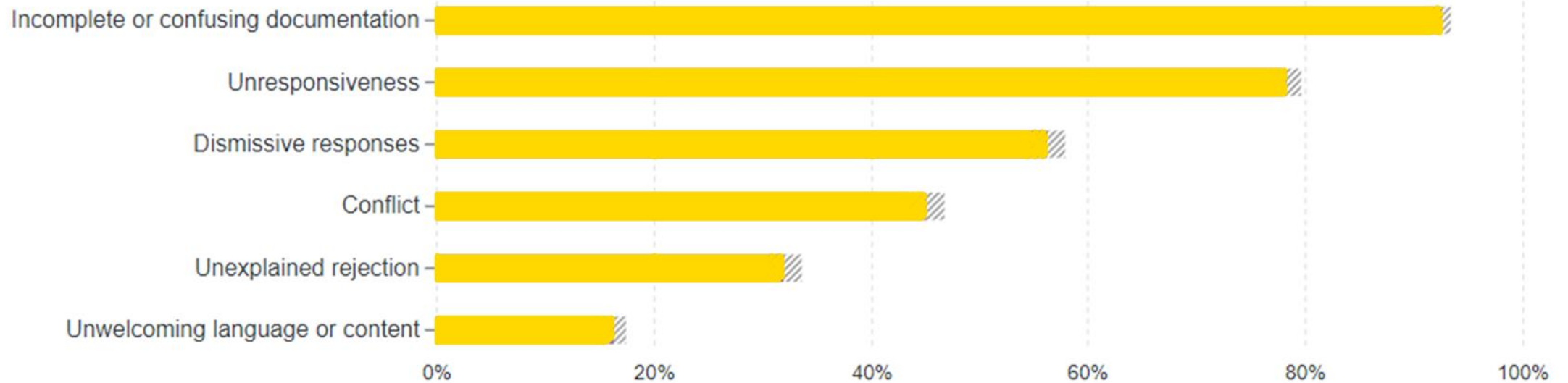
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COMMERCIAL VS OPEN

NON-COMMERCIAL OPEN-SOURCE

Fig1. - Problems encountered in open source

Source: opensourcesurvey.org



	Commercial	Non-commercial
Open	Winning combination Best of both worlds	Whole support burden falls on developers. Not scalable.
Proprietary	Vendor lock-in.	Dedicated, non-reusable projects

COMMERCIAL VS OPEN

Fig5. - What open source users value in software

Source: opensourcesurvey.org



FOLLOWING THE FOSS PRINCIPLES

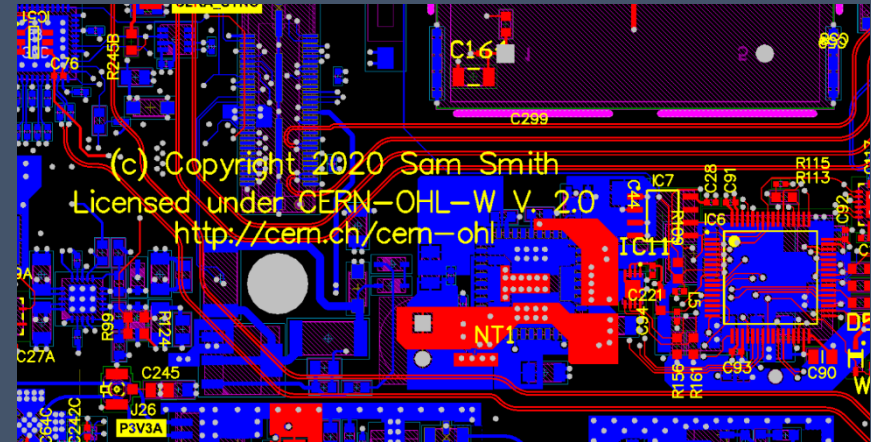


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2 | CERN OPEN HARDWARE LICENCE V2

<https://ohwr.org/cernohl>

- ★ CERN-OHL-S: Strongly-reciprocal
- ★ CERN-OHL-W: Weakly-reciprocal
- ★ CERN-OHL-P: Permissive



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(https://ohwr.org/cern_ohl_s_v2.txt).

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Source location: https://example_url

As per CERN-OHL-S v2 section 4, should You produce hardware based on this source, You must where practicable maintain the Source Location visible on the external case of the Gizmo or other products you make using this source.

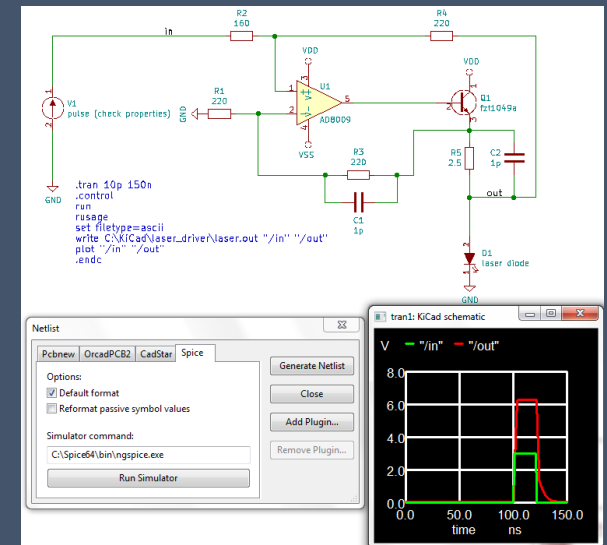
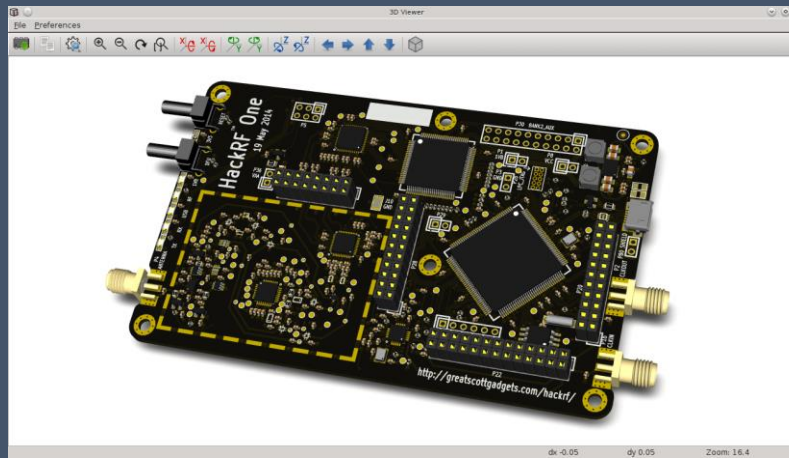
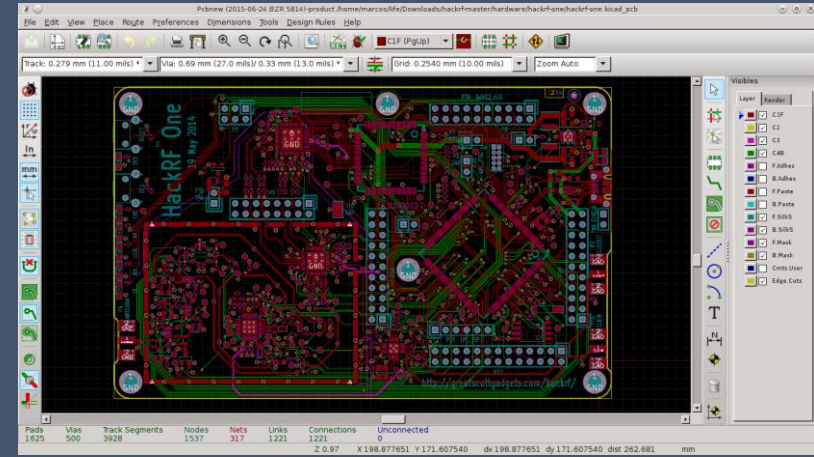
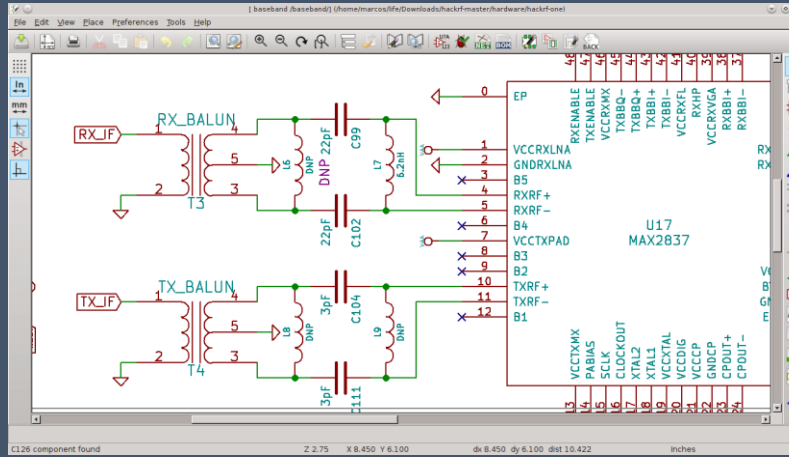
FOLLOWING THE FOSS PRINCIPLES



- 1 | Host
- 2 | License
- 3 | Tools

3 | TOOLS

I. Hardware

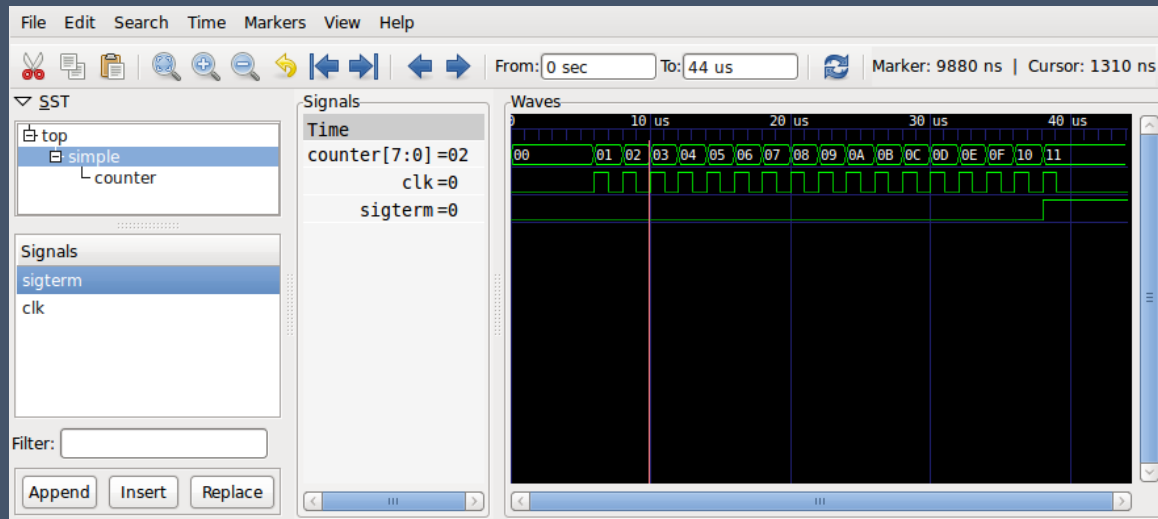


3 | TOOLS

II. Gateware, Firmware

★ Simulators: GHDL

★ Dev Flow: HDLmake | Cheby



1. Memory map summary

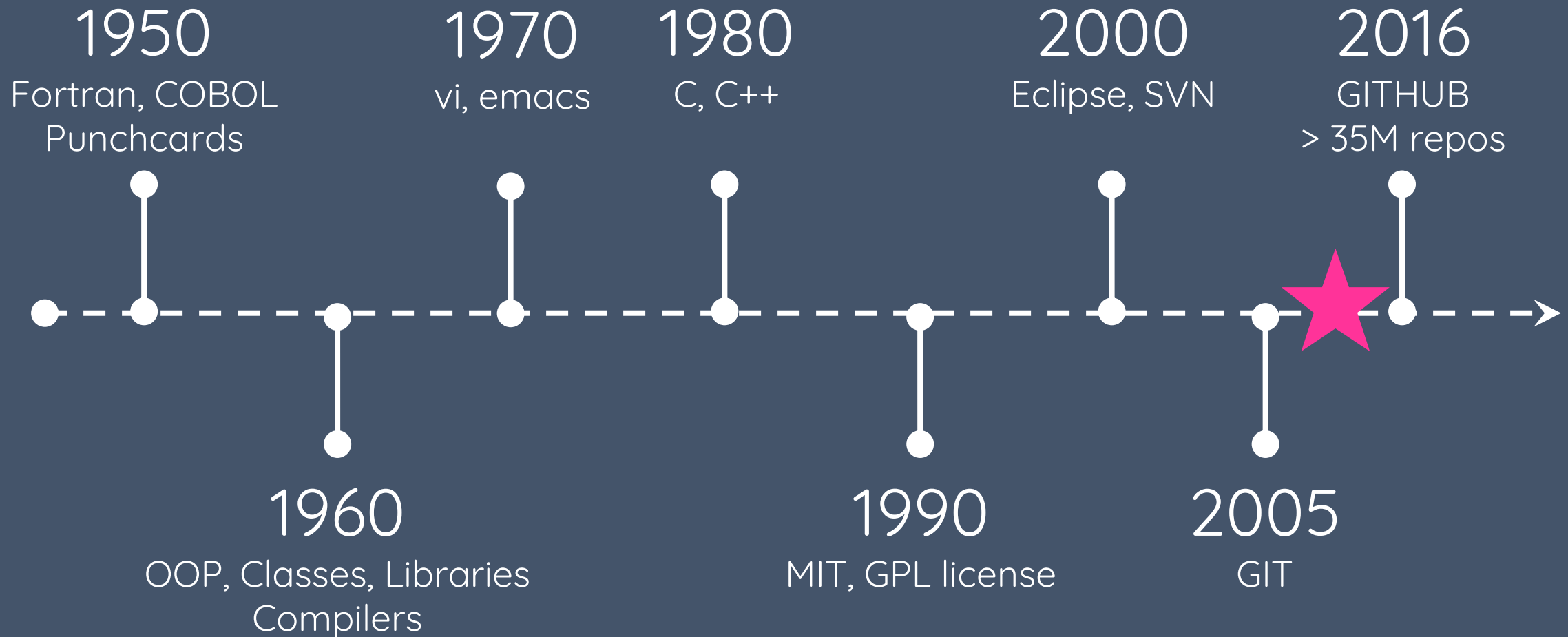
H/W Address	Type	Name	HDL prefix	C prefix
0x0000	REG	reg0	reg0	reg0
0x0004	REG	reg1	reg1	reg1
0x0008	REG	reg2	reg2	reg2
0x0010-0x001f	BLOCK	block1	block1	block1
0x0010	REG	block1.b1reg0	block1_b1reg0	block1.b1reg0
0x0014	REG	block1.b1reg1	block1_b1reg1	block1.b1reg1
0x0018	REG	block1.b1reg2	block1_b1reg2	block1.b1reg2
0x0020-0x002f	SUBMAP	sub1	sub1	sub1

3 | TOOLS

The Future

- ★ Libraries (circuits, sub-assemblies) for HW
- ★ Version Control for HW
- ★ Debug at the module level
- ★ Integrated environment with all tools in one place
- ★ Mixed Language Simulator

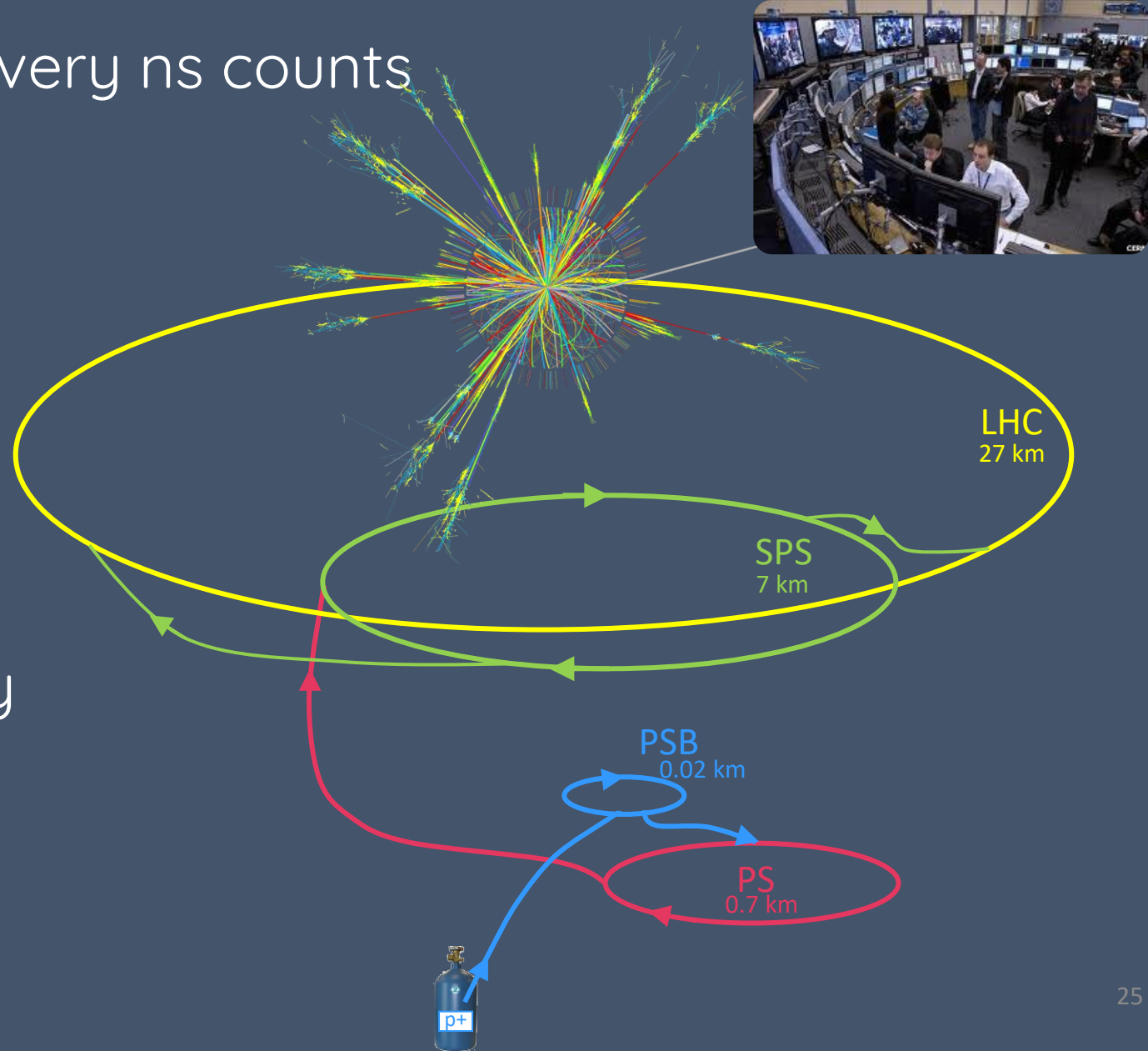
BRIEF HISTORY OF THE SW MILESTONES



OHWR.ORG: A SUCCESS STORY

When every ns counts

- ★ CERN needs
- ★ Based on Open standards
- ★ Institutes & Companies
- ★ High Quality product
- ★ Open & Available in industry
- ★ IEEE standard-extension
- ★ WR collaboration



YOUR CONTRIBUTION

★ ohwr.org

★ kicad.org

★ zenodo.org