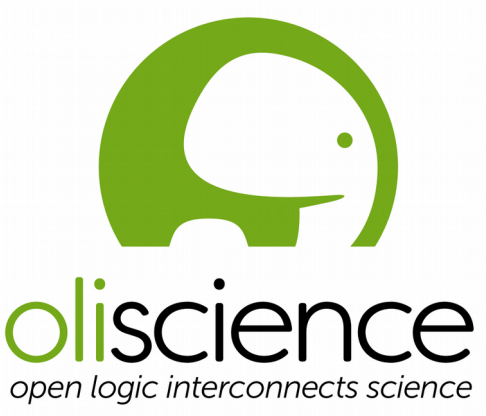


FPGA as a multidisciplinary tool for scientific research and industry

a practical example

Andrea Borga
digital design engineer and co-founder

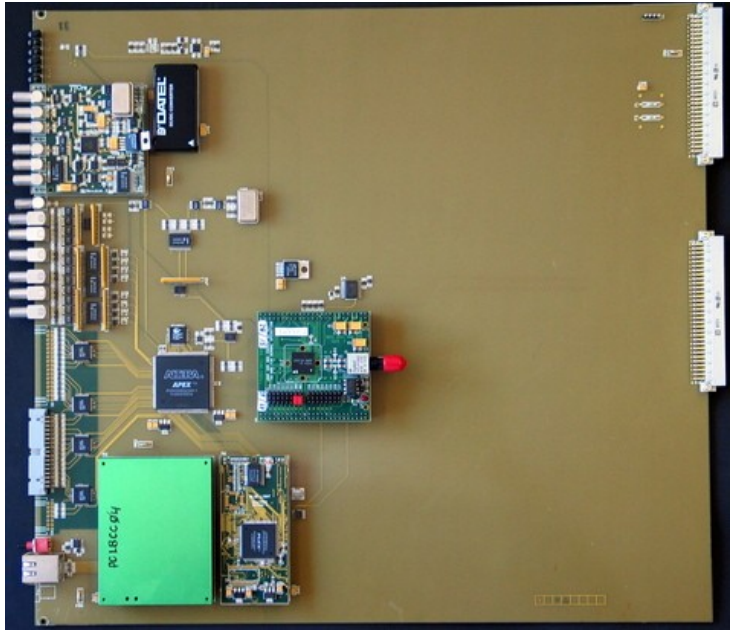
oliscience
open logic interconnects science

Outlook

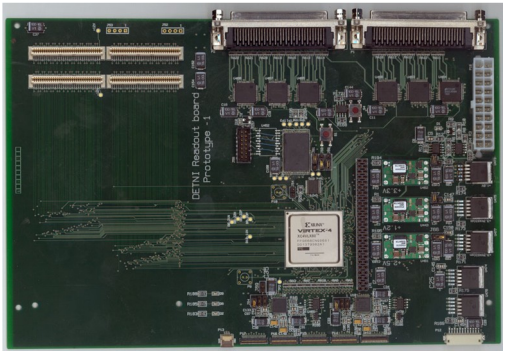
- About myself
- Setting the scene: FPGA
- Nikhef and its activities
- Sharing development efforts
- Technology challenge forecast
- Open Source initiatives at CERN
- Oliscience in a nutshell
- OpenCores
- Closing thoughts

This is me

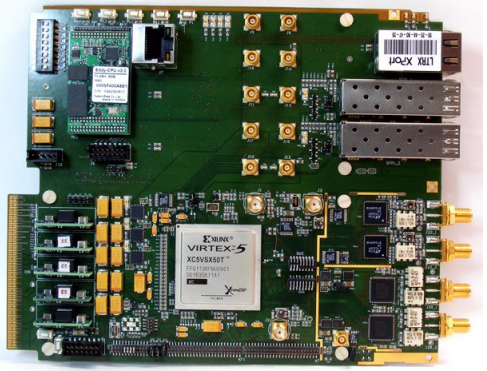
- Digital Designer (aka “the FPGA guy”) specialized in DAQ



CERN – LHCb (2004)



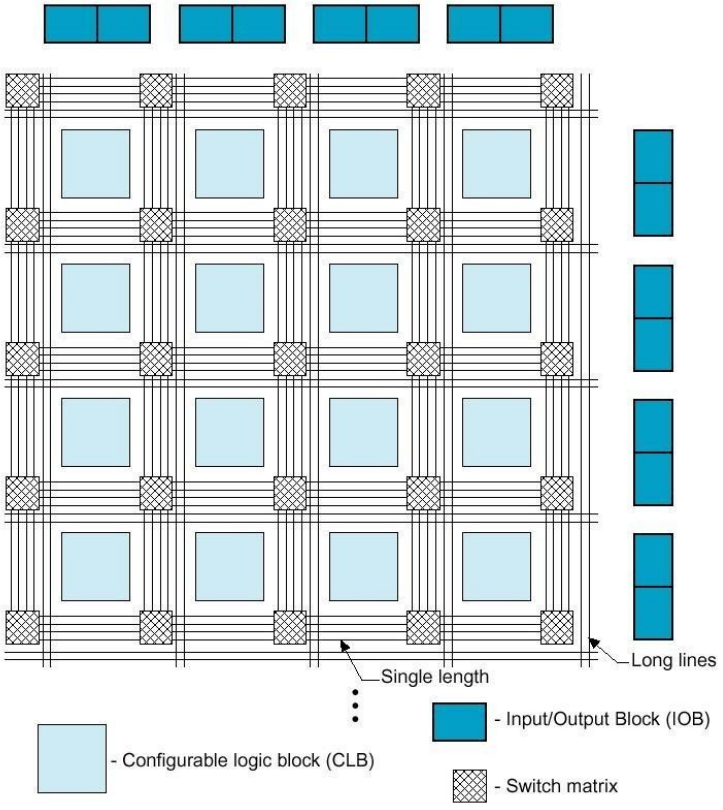
FZ-Juelich – DETNI (2007)

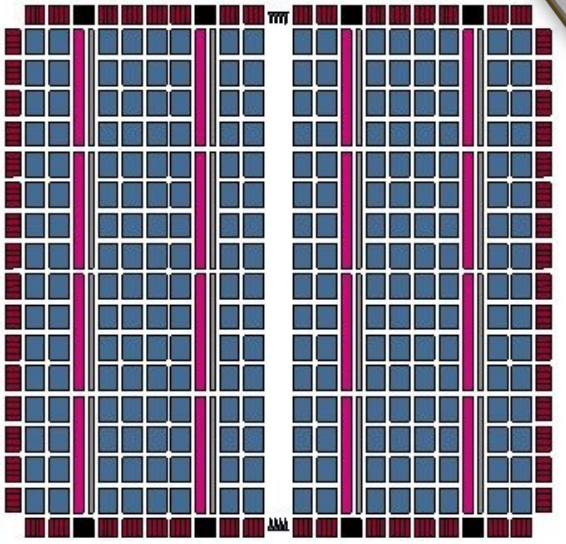


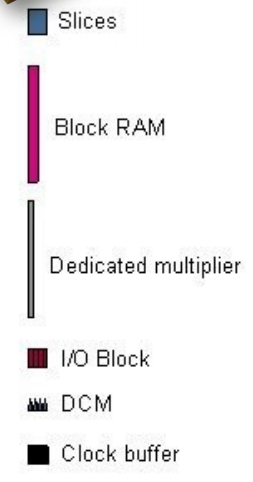
Elettra – FERMI@Elettra (2011)

Nikhef – ATLAS (today)

FPGA… nothing else!







http://www.xilinx.com
http://www.altera.com

Filling enormous FPGA

oliscience
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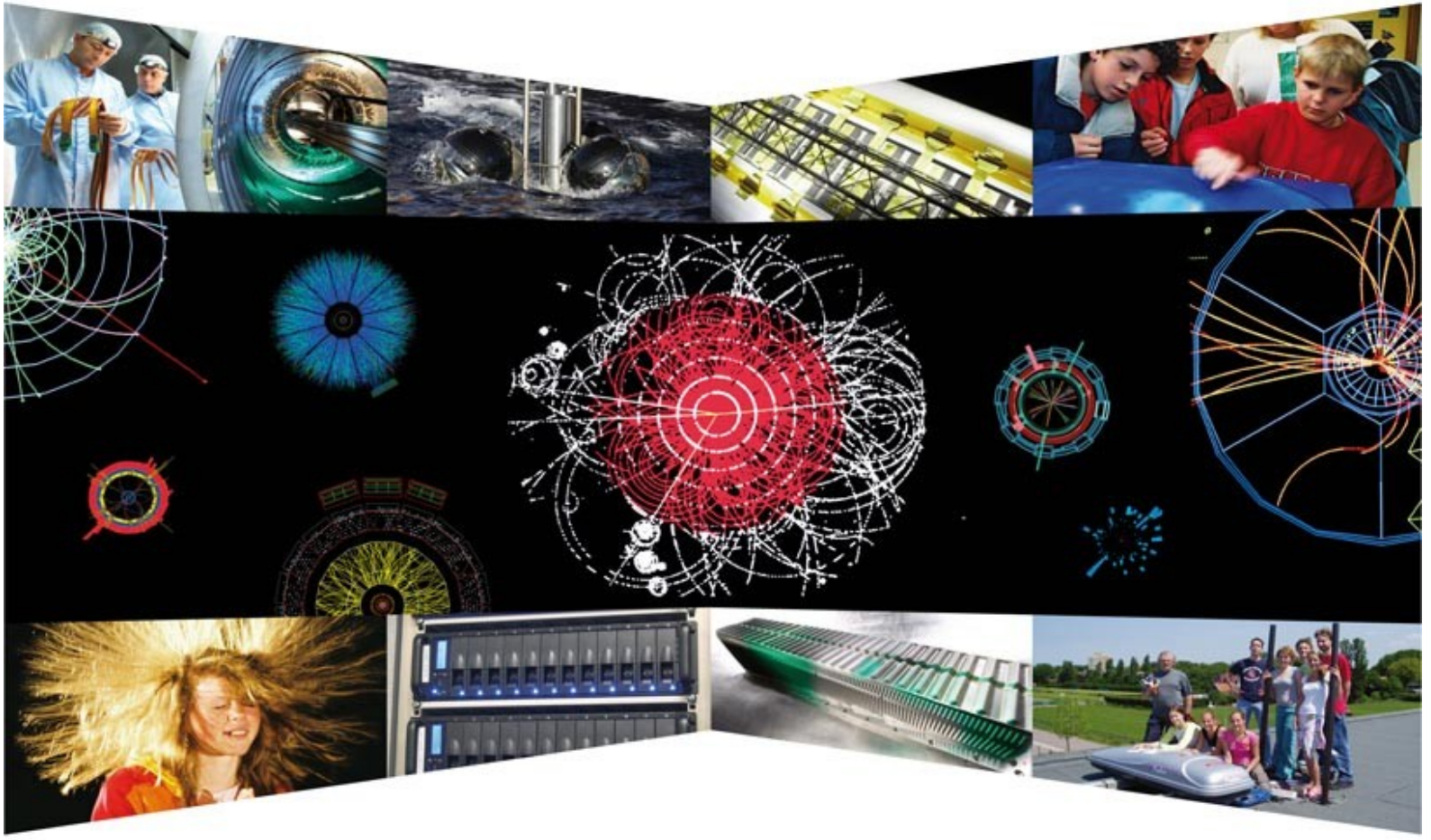
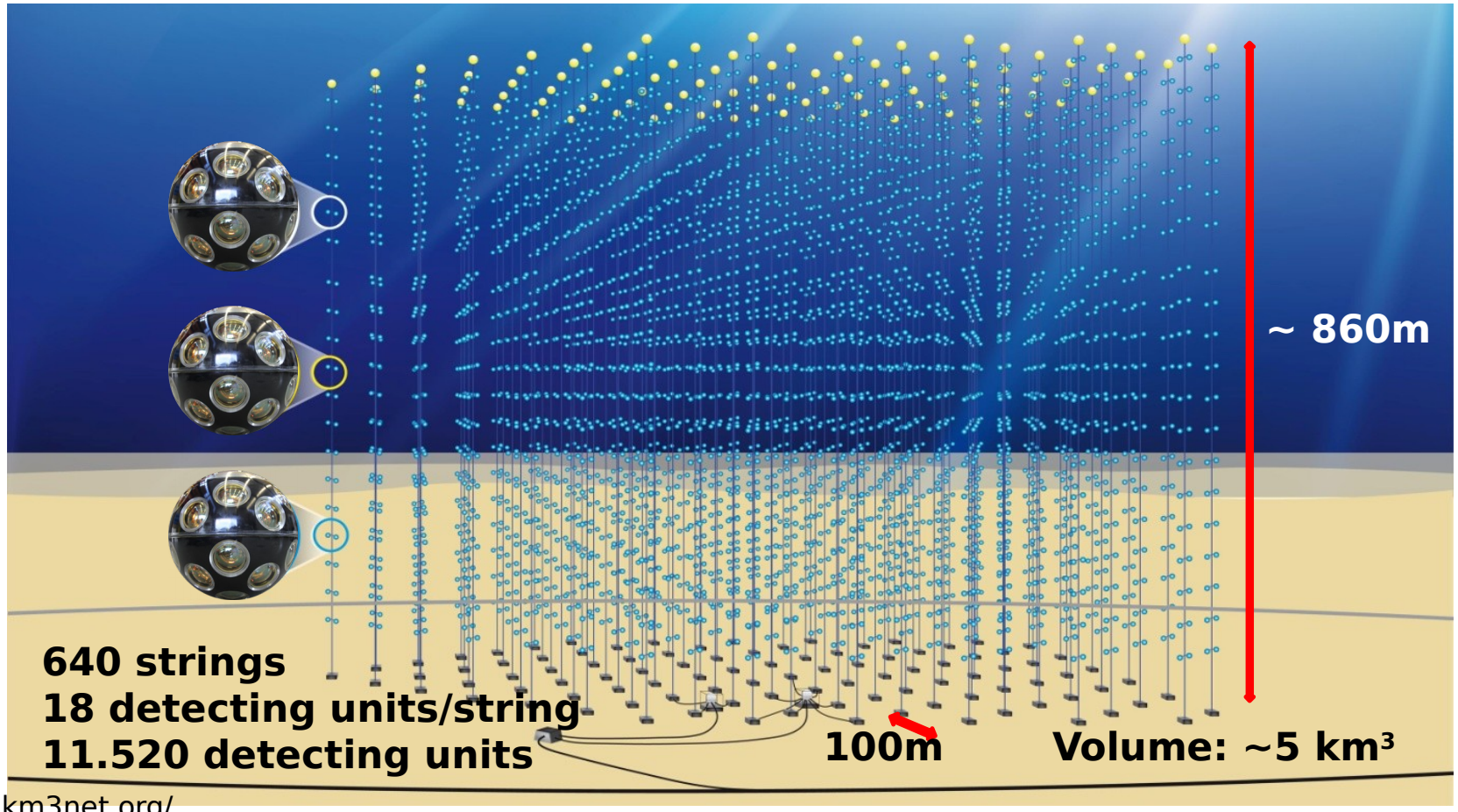
About Nikhef



Astroparticle physics

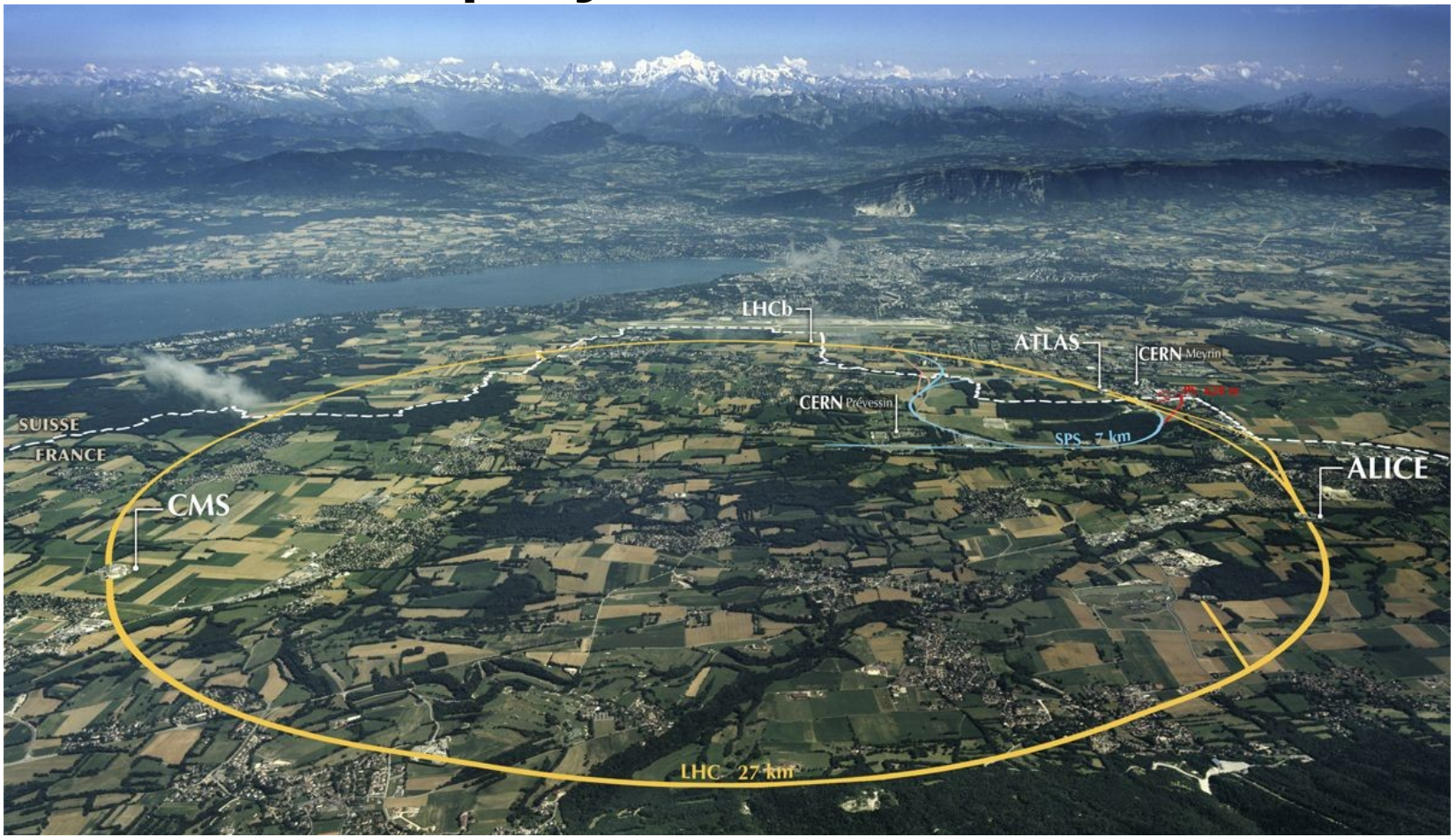
P.C. Budassi, "Observable universe on a log scale" (2016)

Astroparticle physics: Km3Net



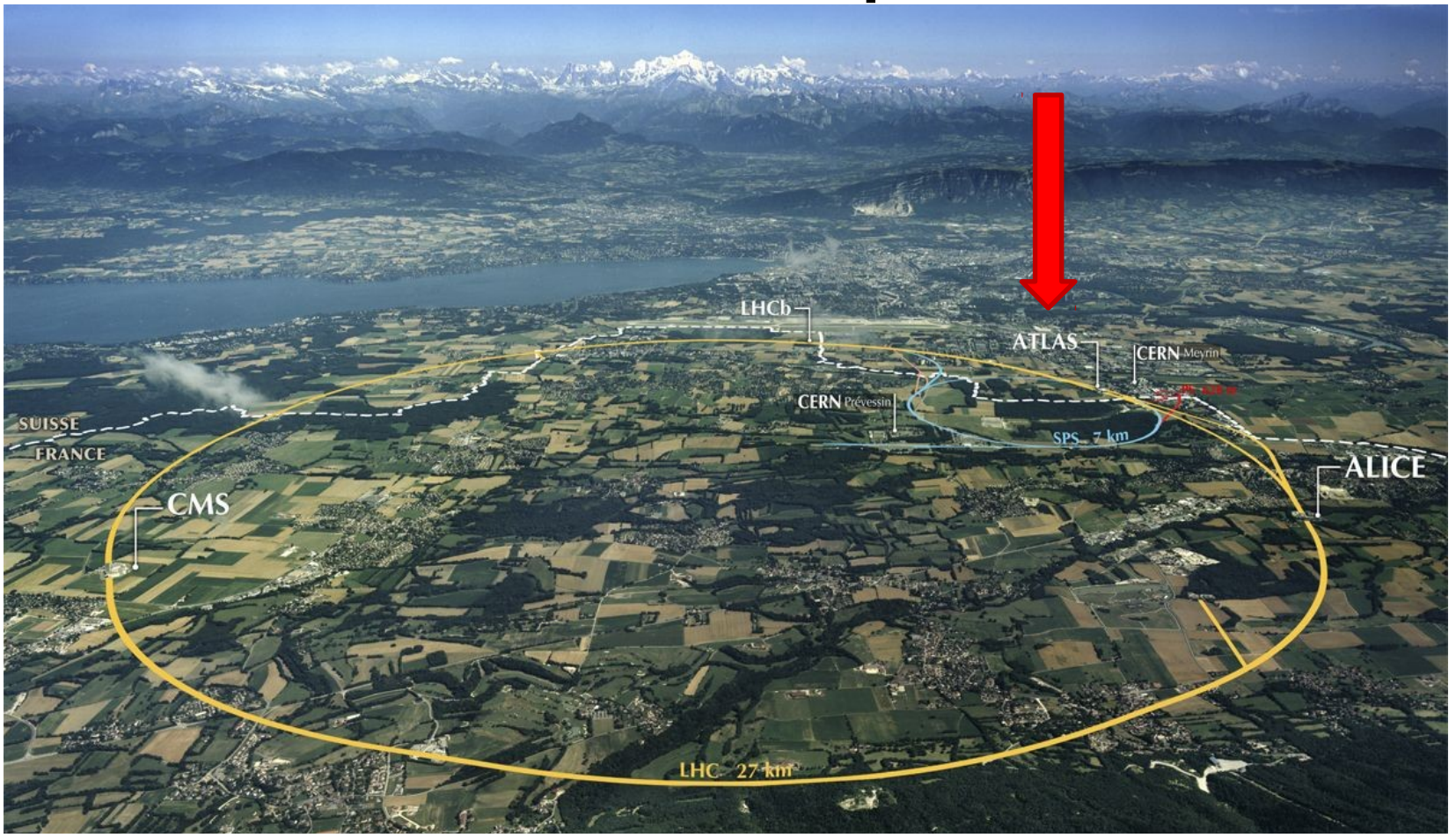
https://www.km3net.org/

Accelerator physics: CERN LHC

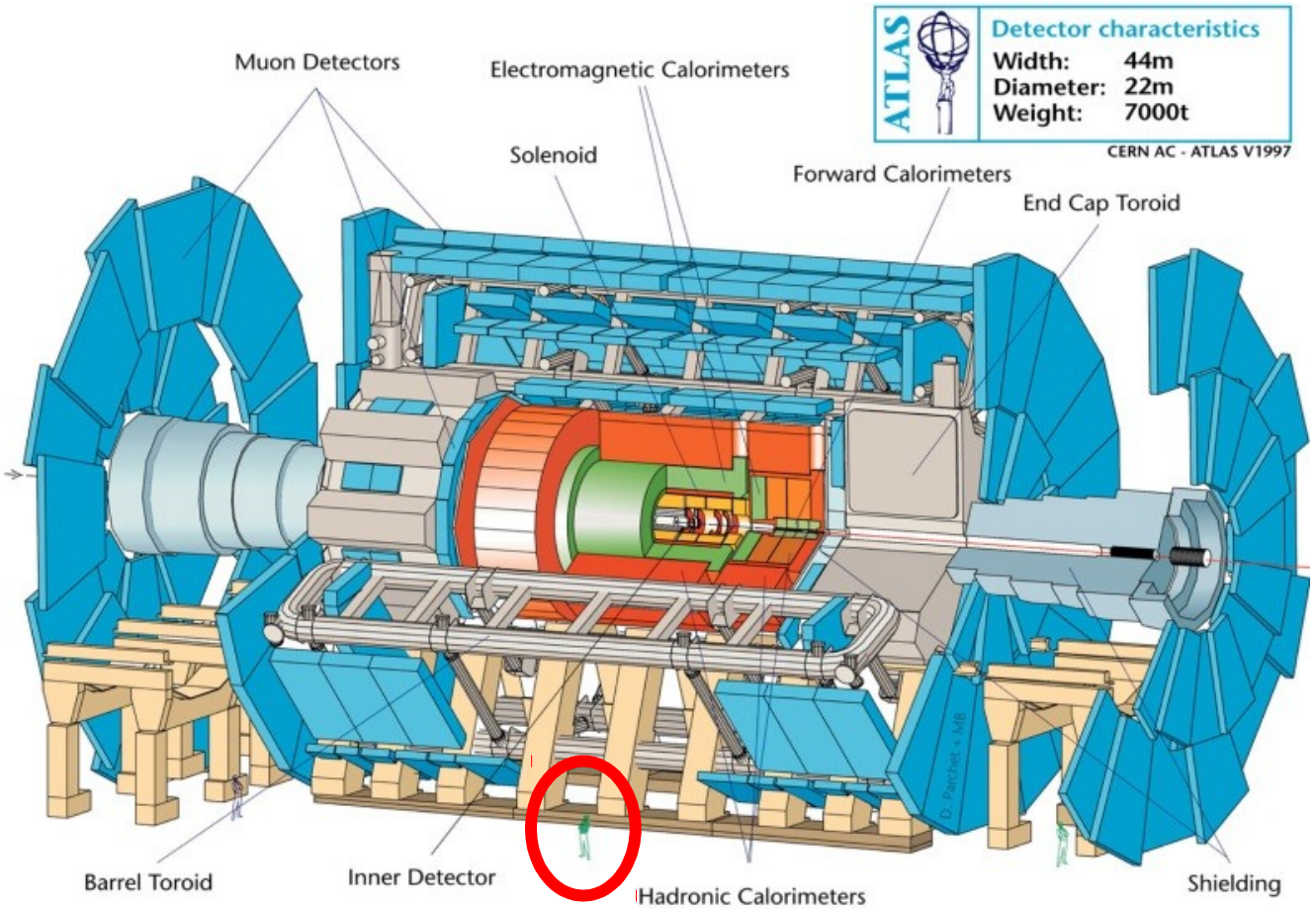


http://www.cern.ch

CERN ATLAS Experiment

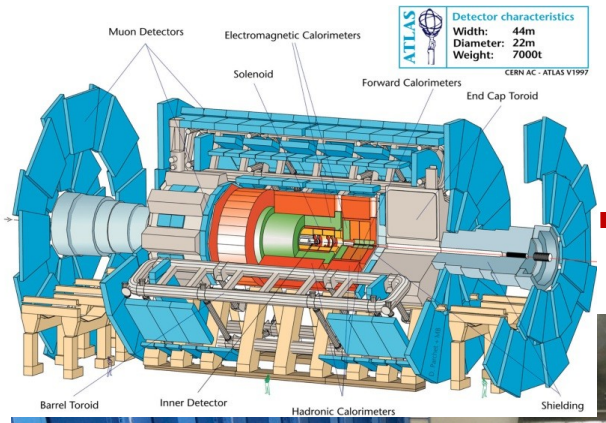


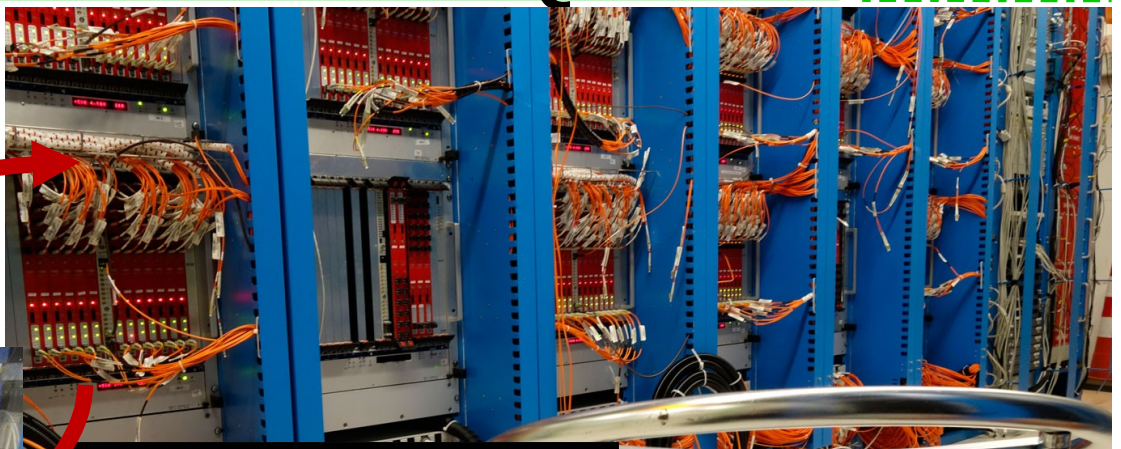
CERN ATLAS detector

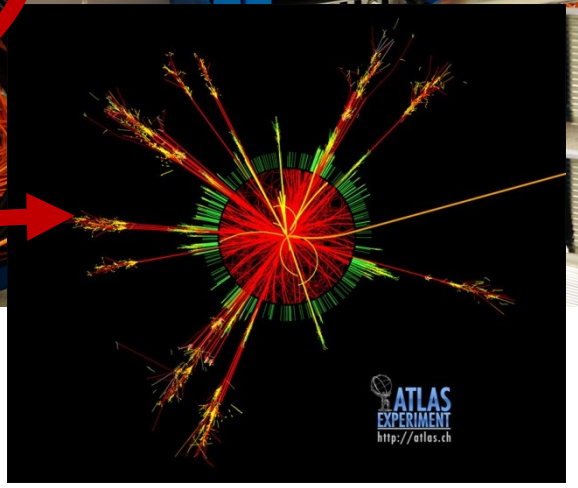


http://atlas.cern

CERN ATLAS DAQ





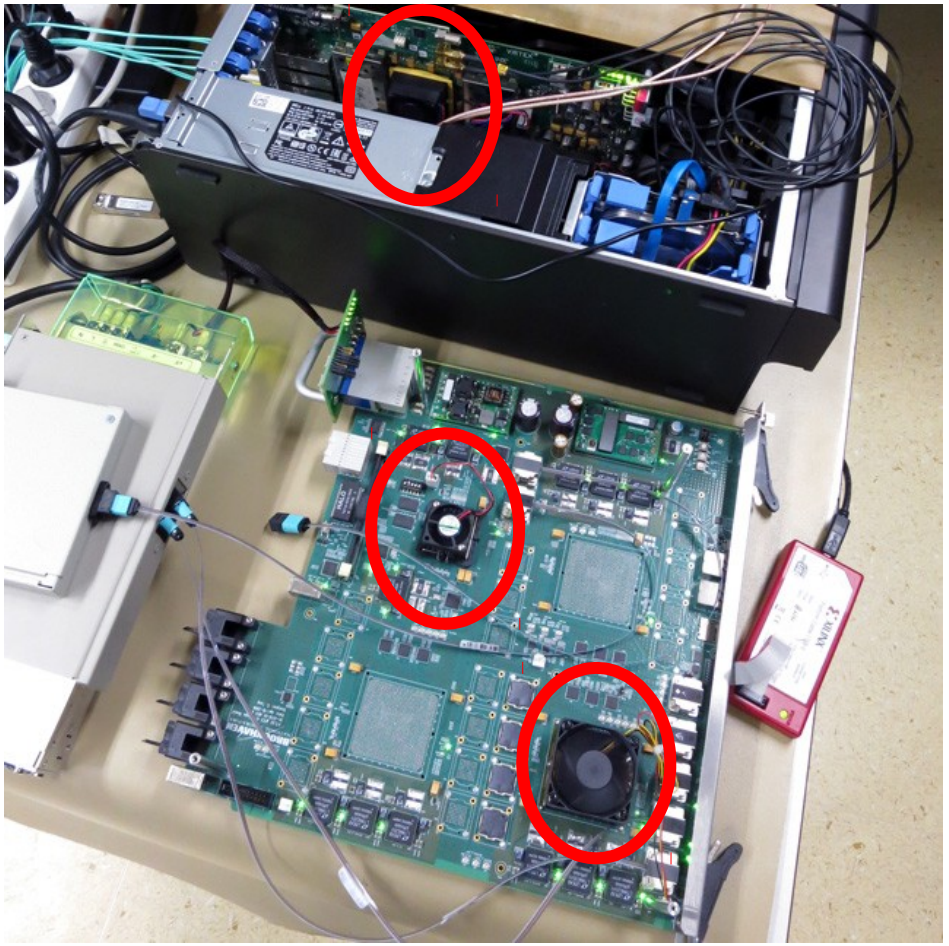


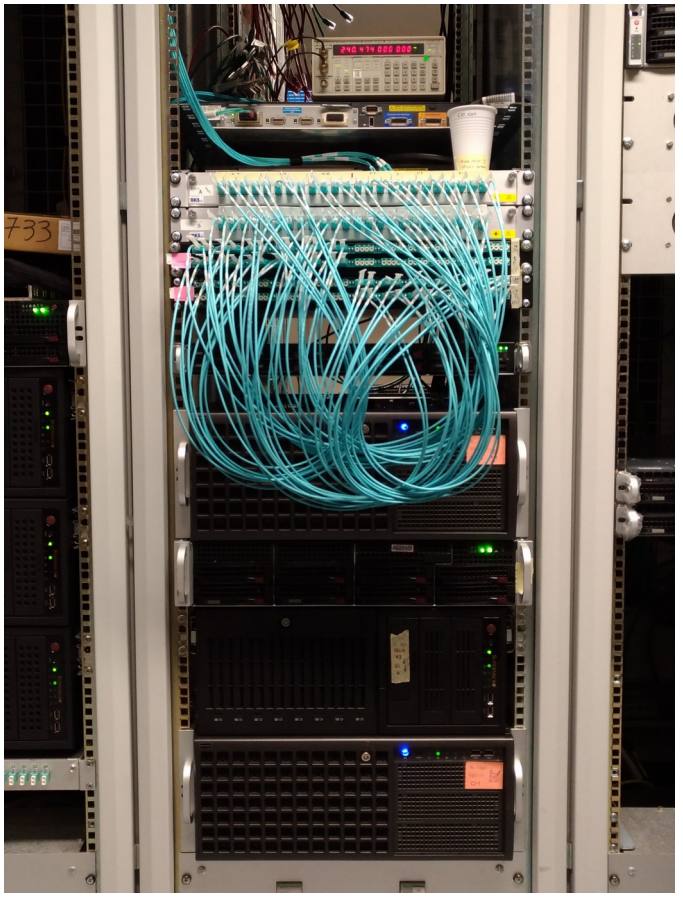
The need for rad-hard devices

- Large experimental physics facilities make use of rad-hard devices (including FPGA) in the following areas:
  - Detector FrontEnds
  - Particle accelerator complexes

- Mostly custom ASICs or Microsemi FPGA
- **This topic not covered in details today...**

FPGA in DAQ systems





https://atlas-project-felix.web.cern.ch/

At the heart of the matter

Wupper: PCIe DMA Engine for Xilinx FPGAs :: Overview

Overview | Hardware details | Software details | Doxygen | News | Downloads | Bugtracker

Edit pages | Add a block | Define block order | Help

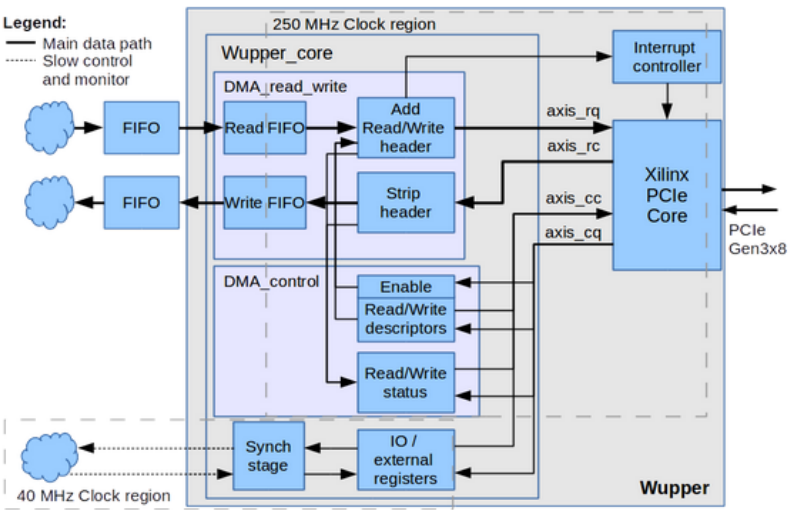
Details

Name: virtex7_pcie_dma
Created: Dec 18, 2014
Updated: Apr 7, 2018
SVN Updated: Feb 14, 2018
SVN: Browse
Latest version: download (might take a bit to start...)
Statistics: View
Bugs: 7 reported / 6 solved

★ Unstar | 8 you like it: star it!

Other project properties EDIT

Category:System controller
Language:VHDL
Development status:Mature
Additional info:FPGA proven, Specification done
WishBone compliant: No
WishBone version: n/a
License: LGPL



Project maintainers

- Borga, Andrea
- Blankers, Roel
- Schreuder, Frans
- Kharraz, Oussama
- Add maintainer

Partner team

Nikhef

nikhef@opencores.org

SpaceWire anyone?

- Browsing OpenCores only...
- https://opencores.org/projects/spacewire_light
- https://opencores.org/projects/spacewire
- https://opencores.org/projects/socwire

- How many more available “out there”?

FPGA upcoming challenges

- complexity is exponentially growing
- **trust in quality of open source products screams for verification**

  →would you put IP Core “xyz” in space?
- **open standard reference design to compare against?**

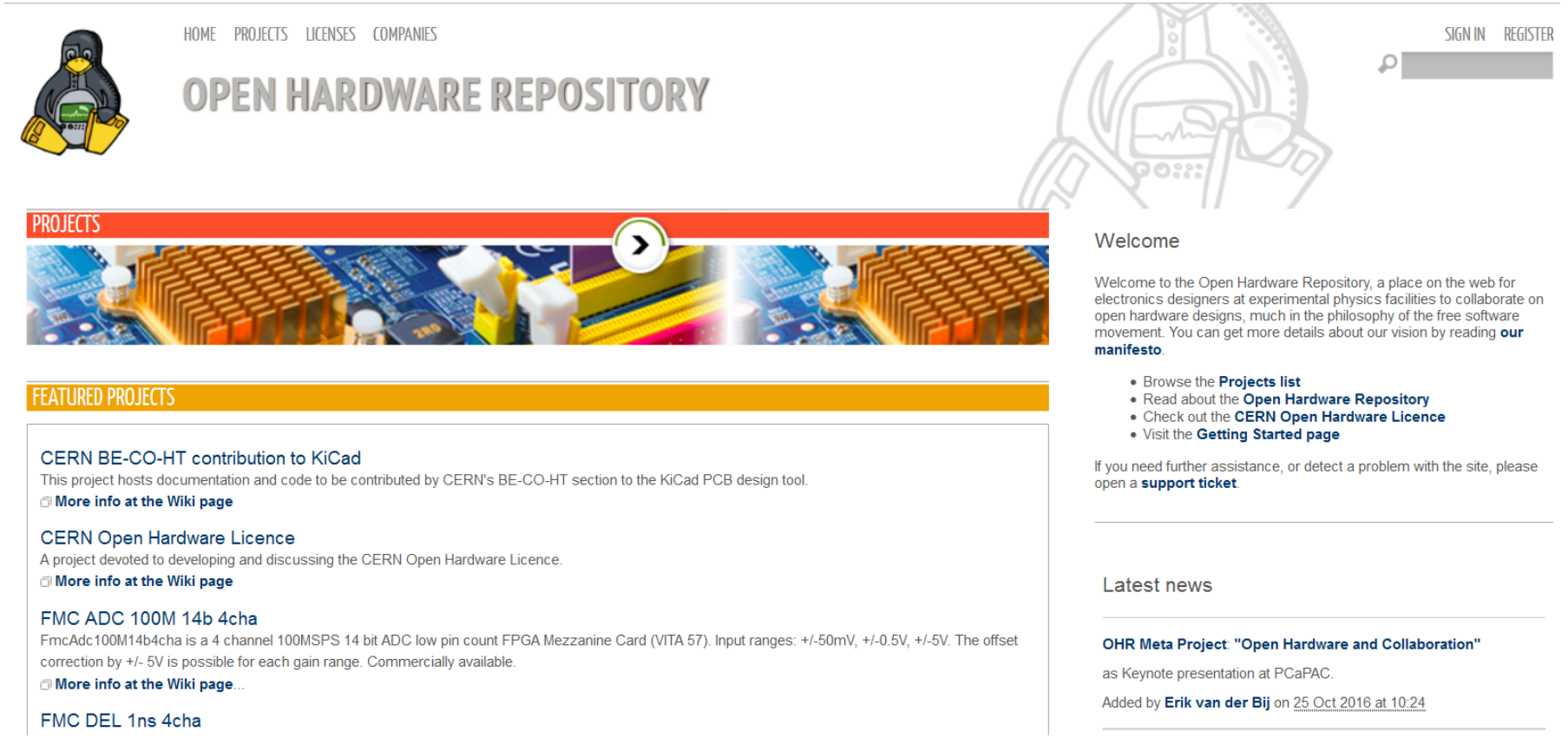
Share is the name game

Share… why?

- Get the job done
- Avoid duplication effort
- Seeding of ideas
- Free peer review
- *Sharing in the genes of scientific collaboration*
- A lot of testing done by third parties **(verification)**
- Promote common/good practices **(standardization)**
- Sharing often comes bidirectional

CERN efforts

CERN efforts



http://www.ohwr.org

CERN efforts

HOME PROJECTS LICENSES COMPANIES SIGN IN REGISTER

CERN OPEN HARDWARE LICENCE

OVERVIEW WIKI ACTIVITY MAILING LIST NEWS DOCUMENTS

History

Wiki

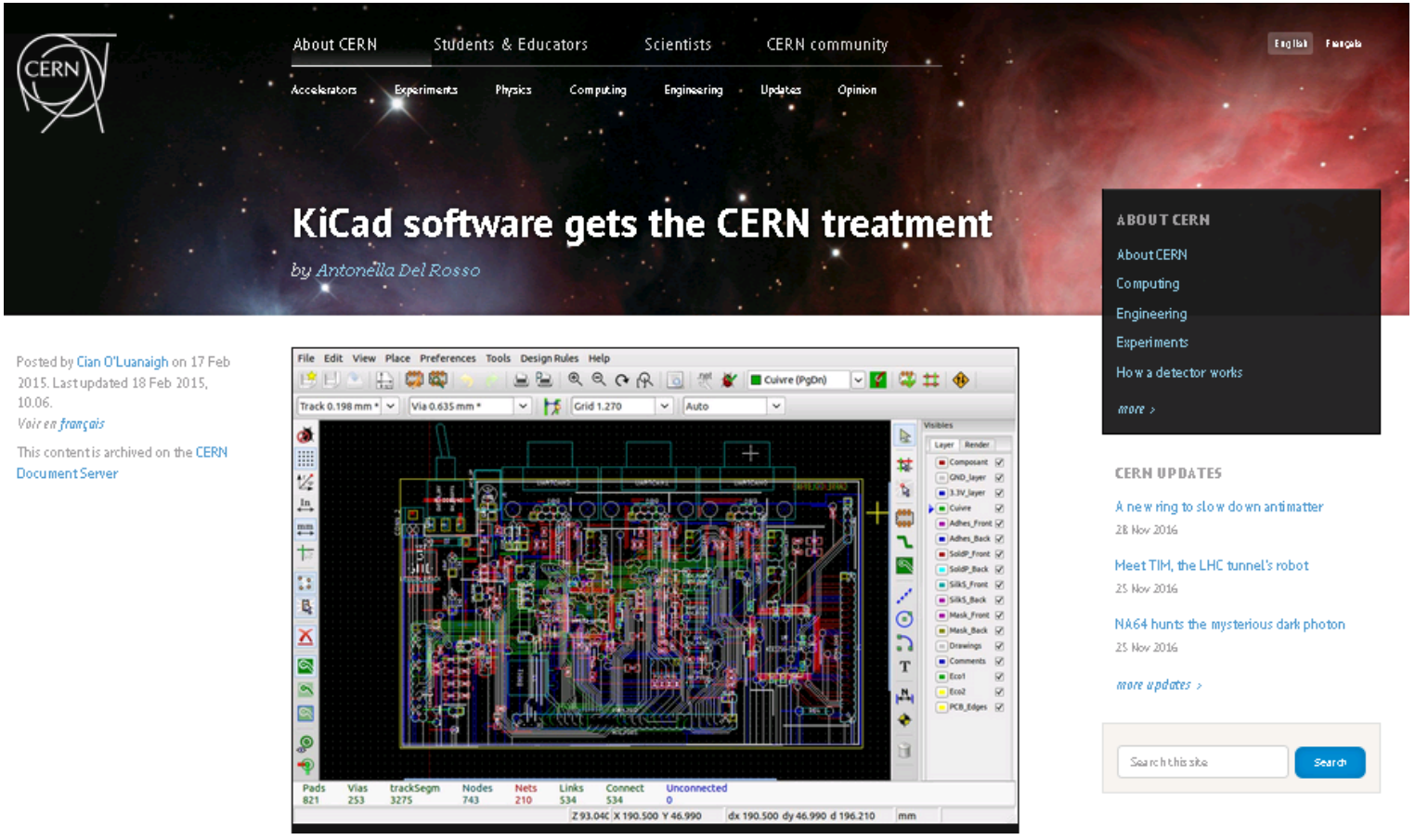
Start page
Index by title
Index by date

CERN Open Hardware Licence - Introduction

Myriam Ayass, legal adviser of the Knowledge and Technology Transfer Group at CERN and author of the CERN OHL:

> *In the spirit of knowledge sharing and dissemination, the CERN Open Hardware Licence (CERN OHL) governs the use, copying, modification and distribution of hardware design documentation, and the manufacture and distribution of products.*
>
> *The CERN–OHL is to hardware what the General Public Licence (GPL) is to software. It defines the conditions under which a licensee will be able to use or modify the licensed material. The concept of 'open-source hardware' or 'open hardware' is not yet as well known or widespread as the free software or open-source software concept. However, it shares the same principles:* ***anyone should be able to see the source (the design documentation in case of hardware), study it, modify it and share it.***
>
> *In addition, if modifications are made and distributed, it must be under the same licence conditions – this is the 'persistent' nature of the licence, which ensures that the whole community will continue benefiting from improvements, in the sense that everyone will in turn be able to make modifications to these improvements.*

CERN efforts



oliscience

open logic interconnects science

Oliscience team

- Alberto Alberton: (sales and marketing)
  - → experienced entrepreneur
  - → angel investor in oliscience
- Leo Davoli: (legal and operations)
  - → professional lawyer
  - → angel investor in oliscience
- Andrea Borga: (CEO and CTO)
  - → seasoned digital design engineer
  - → passionate technologist
  - → open source enthusiast
  - → the geek!

About Oliscience

- Originating from the CERN-BIC at Nikhef

Nikhef

- Coached at Amsterdam Centre for Entrepreneurship

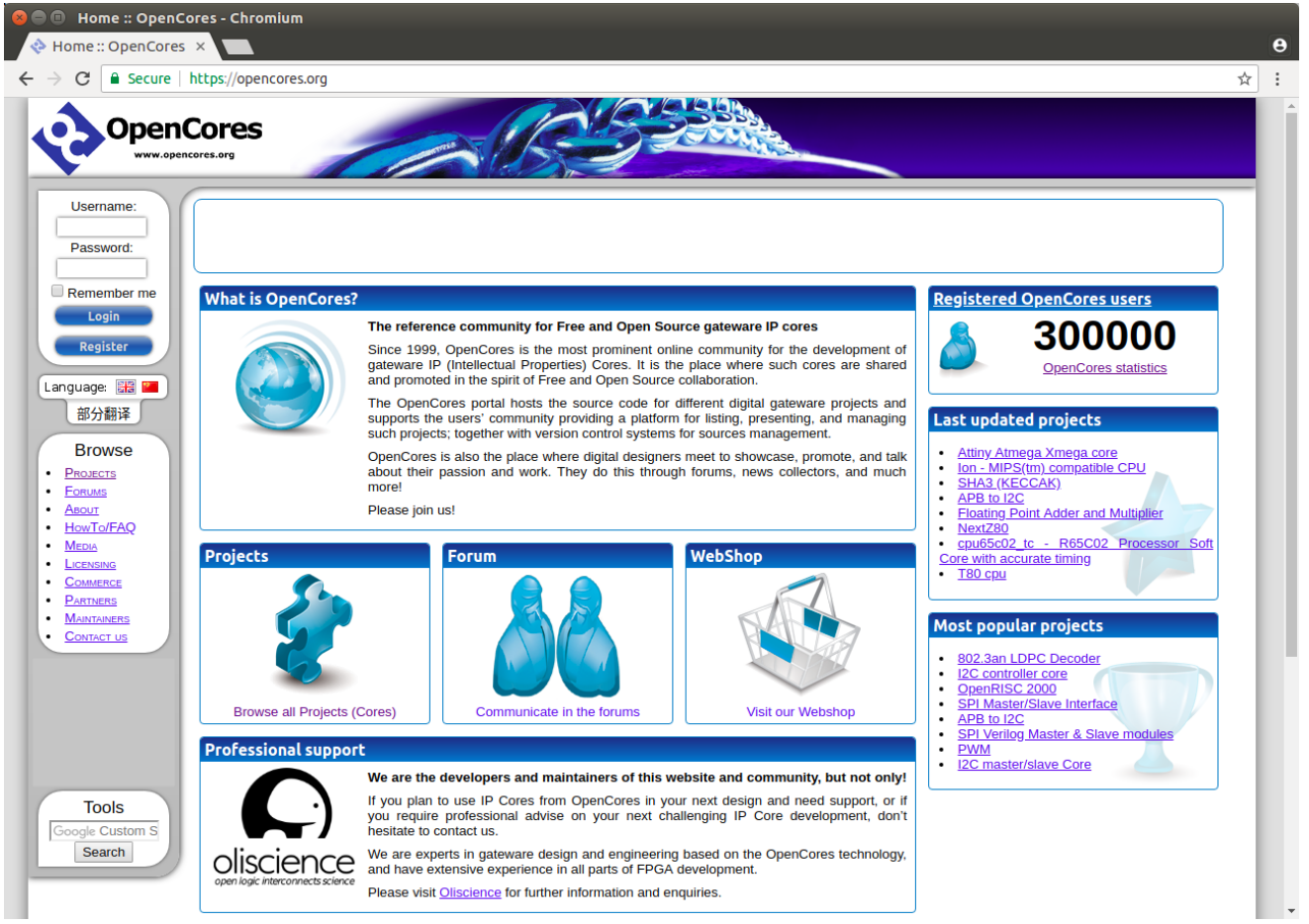
ACE

- Based at the Amsterdam Science Park

Oliscience in a nutshell

- Core business: FPGA technology
- Providing consultancy services
- Innovating in the field of FPGA technology
- Driving the OpenCores.org platform: portal for the exchange of open source IP

The “good old” OpenCores.org



OpenCores.org in numbers

- Made in Europe!
- Funded in 1999
- Frequented by >300.000 professionals
- Generating ~500.000 views per month
- **Acquired by Oliscience in 2017**
- Steadily increasing activity [up 30% from acquisition]
- Still strong identity, established trademark, consistent community, very specialized

OpenCores.org purpose

- OpenCores brings together Digital Design Engineers
- access to specialized developers
  → OpenCores offers precious insights
  → OpenCores pushes the frontier of possibilities
- **make FPGA and gateware more accessible**
- **push!** ensure that the best IP blocks are used and let them be improved further by the community
- **pull!** encourage more people to add their IP cores

Oliscience goals

- **Stimulate** the community
- **Offer** an “impact metrics” to asses performance
- **Motivate** designers to contribute
- **Offer** a forum for like-minds to meet
- **Promote** best-in-class design practices
- **Provide consultancy services via the portal in the field of gateware design and support**

A call to action to partners

<u>we</u> develop, drive and promote the large OpenCores community

consisting of:

- Research institutions
- Universities
- High-tech corporates

<u>you</u> access resources on our portal and contribute fostering common practices

OpenCores → to the next level

- Grow community and increase content
  - → many micro processors architectures
  - → virtually all standard peripherals
  - → a lot of general infrastructure cores
- Increase content **quality and trust**
  - → verification, *verification*, verification!
  - → standardize methodologies and benchmarks
  - → have credited institutions help the process

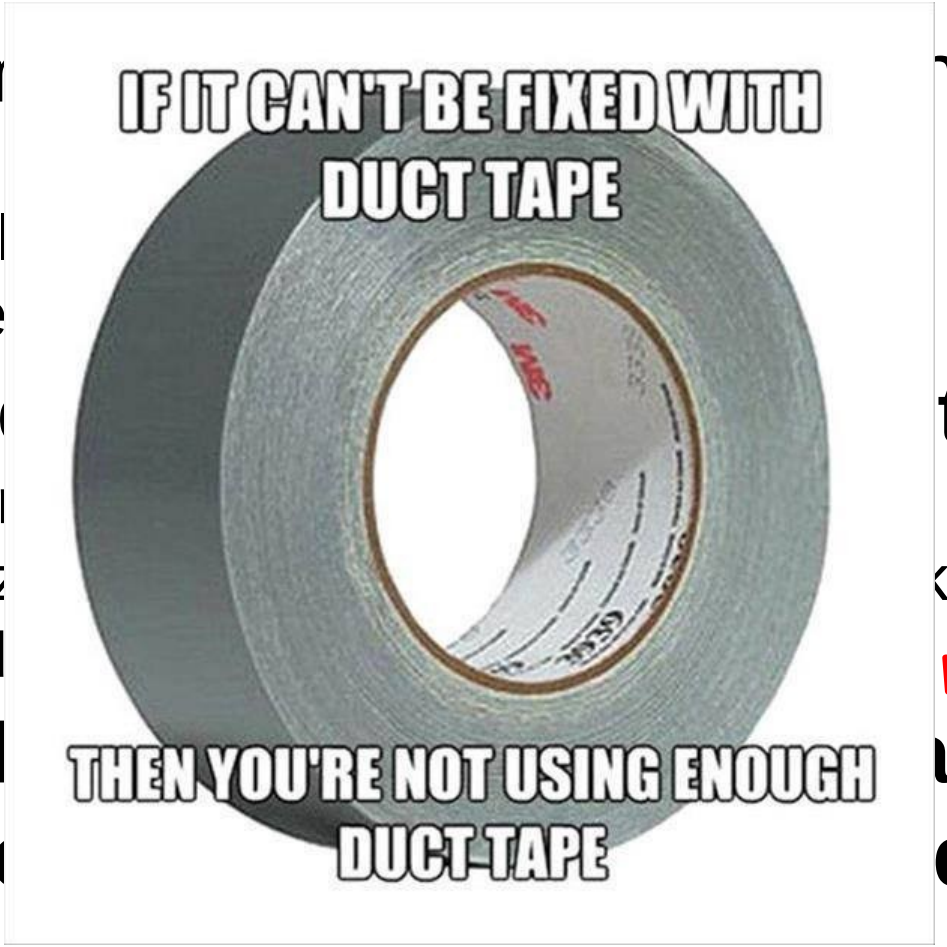
be the reference market place where new ideas are exchanged and advanced

OpenCores → to the next level

- Grow con ntent
  - → many mic
  - → virtually al
  - → a lot of ge
- Increase t
  - → verificatio
  - → standardiz ks
  - → have cred

be t ce where

new i d advanced

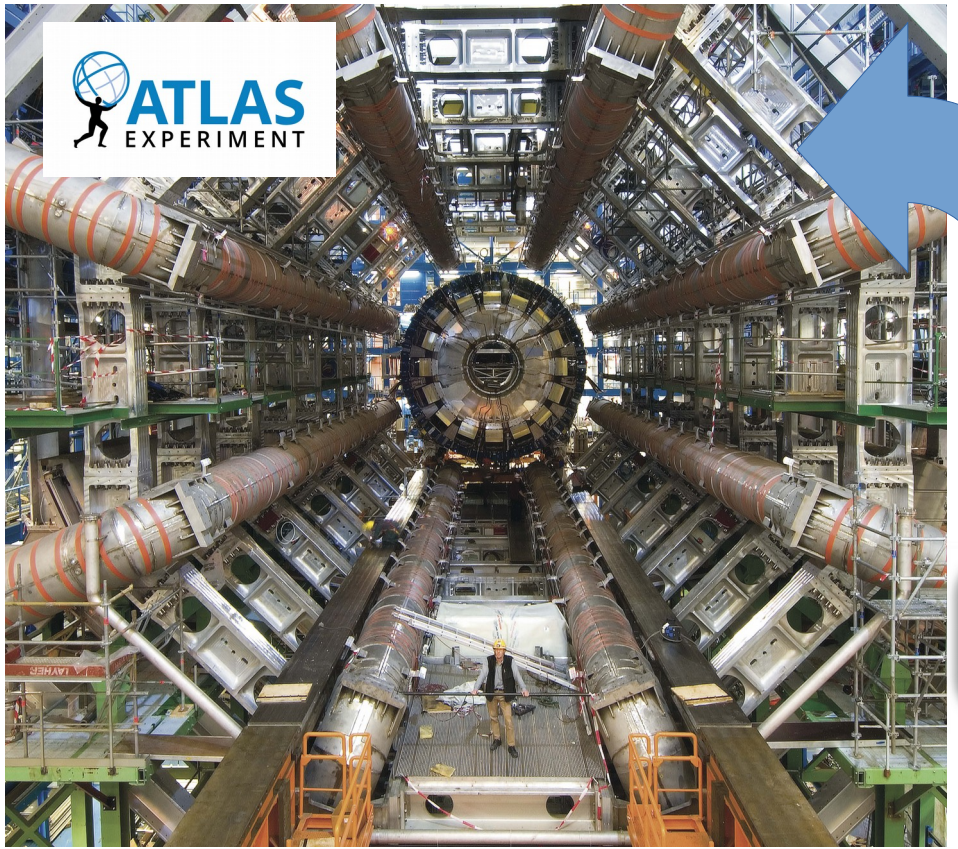


Premium partner

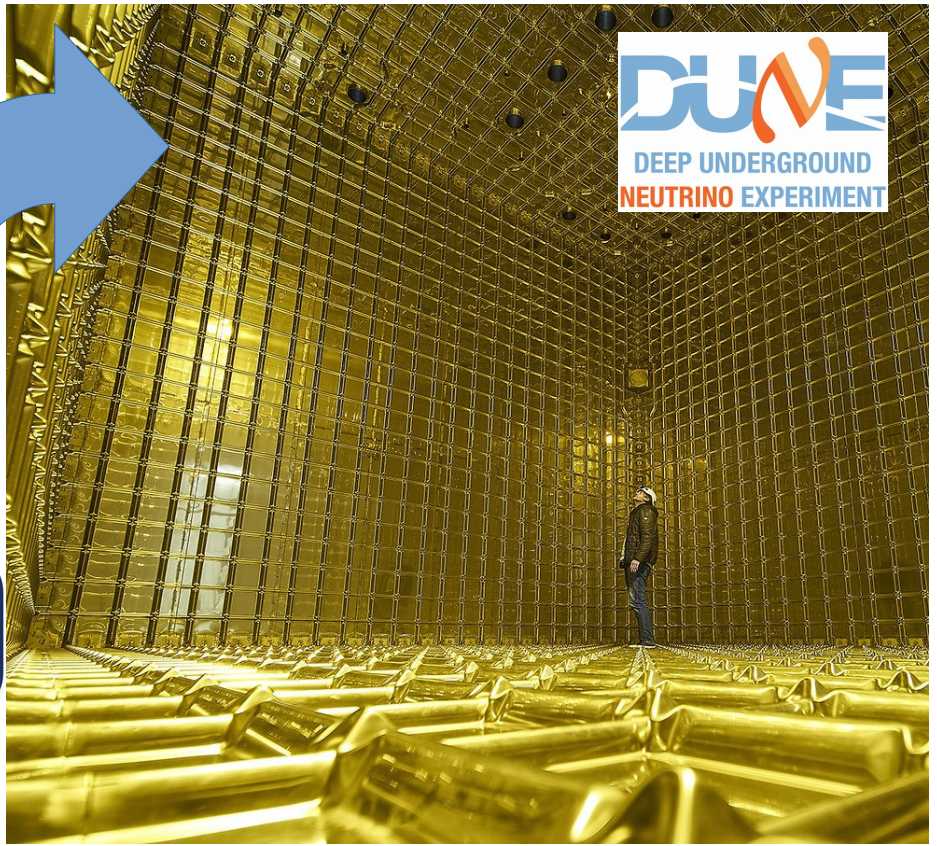
ASTRON
Netherlands Institute for Radio Astronomy

"[…] **We are working on the opposite extremes of physics, but we are using the same technology**. This collaboration allows us to share ideas and reuse FPGA designs, which will help to speed-up the process of engineering the tools for science."- *Daniel Van der Schuur*

Consultancy customer

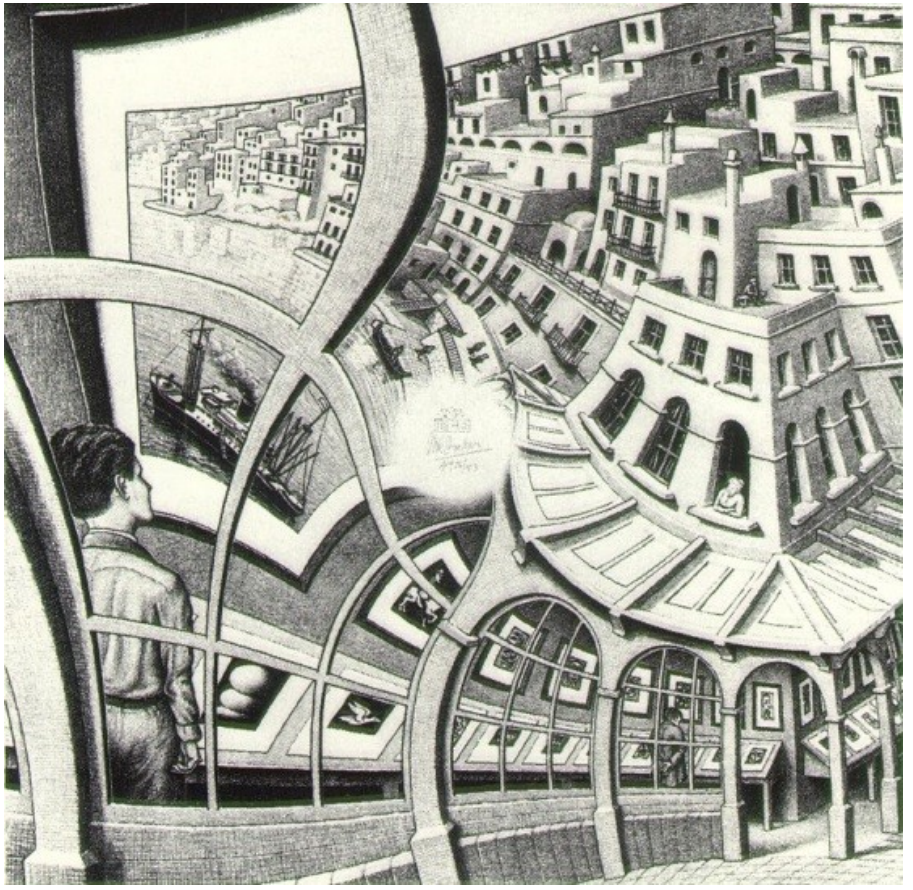


FPGA



Think different future perspectives

- Overturn common belief
  → open ≠ “cheap”
  → look for changes
- Embrace and engage
  → look for alliances
- Cross-contaminate
  → dare to share



M.C. Escher, "Prentententoonstelling" (1956)

Thank you

+

www.opencores.org

www.oliscience.nl

LinkedIn: https://www.linkedin.com/company/oliscience/

Twitter: @Oliscience101