A path through the trigger - from physics to software engineering

Louis Henry
2nd COMCHA workshop, A Coruna, 03/10/2024

EPFL

Looking back over a career

- **2013-2016:** Ph.D. at LPNHE Paris in LHCb
  - Quasi-pure data analysis:

2017-2019: postdoctoral position at IFIC Valencia (LHCb)

2019-2021: postdoctoral position at Universita di Milano (LHCb)

  - Lots of data analysis still:
    - Amplitude analysis of prompt-produced $\Lambda_c \rightarrow pK\pi$
    - Convener of the "Production and Properties" sub-WG
  - Detector work:
    - Decoding of the SciFi
    - Convener of the SciFi Software & Simulation
  - Tracking developments:
    - Hybrid seeding on CPUs

- **2021-2023:** senior research fellow at CERN (LHCb)
  - Continuing to work on detector and tracking
  - Physics work starts to be way less data analysis and more prospective: long-lived particles

- **Since 2023**: Scientist at EPFL (LHCb)
  - Recipient of a grant for prospective physics work.

The point of looking back

- Important to realise what profile one is building.
  - Tasks can be very synergetic…
  - … but then constrain you into one profile.
- In my case, I became closer and closer to a software developer for physics, both in terms of CV and skills, but also in terms of taste.
- So what does it mean for positions?
  - Little teaching experience, fewer analyses, no large responsibilities in physics groups.
- Does not mean there are no positions either!
  - Software can be a highly visible task;
  - Some dedicated positions are also opened from time to time.

The eScience center

- The eScience center is an organism of the Dutch government that sends research software engineers (RSEs) in team for dedicated projects funded by the Netherlands or the EU.

- Profiles are similar to mine: researchers that ended up specialising more and more into software.

- Somewhat of a position similar to academia research:
  - Conferences;
  - You will still (try to) write papers;
  - Still beholden to funding;

PySE: Software for extracting sources from radio images

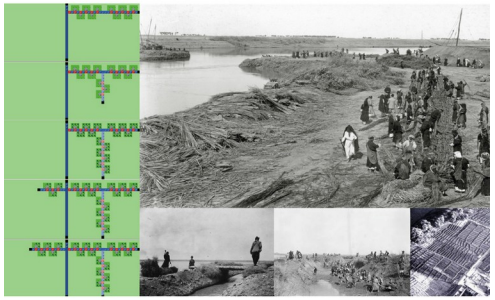
D. Carbone [a b], H. Garsden [c], H. Spreeuw [d], J.D. Swinbank [e], A.J. van der Horst [f], A. Rowlinson [a g], J.W. Broderick [g], E. Rol [h i], C. Law [j], G. Molenaar [a], R.A.M.J. Wijers [a]

- But also very different:
  - At least in my case, will help having a clearer set of duties;
  - Permanent contract after 2 years;
  - And also…

Variety!

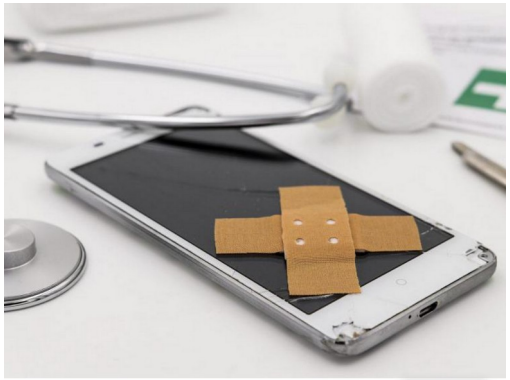
Urban-M4

Urban Morphology for Microscale Meteorological Modelling



MESS

Modelling Emerging Societal Systems in Mesopotamia



CARRIER

Coronary artery disease: risk estimations and interventions for prevention and Early detection

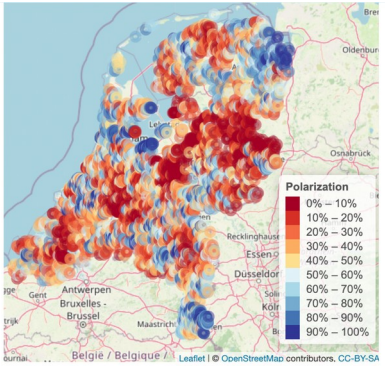
ESiWACE3

Centre of Excellence in Simulation of Weather and Climate in Europe

Jan 2023 - Dec 2025

Decoding Raphael

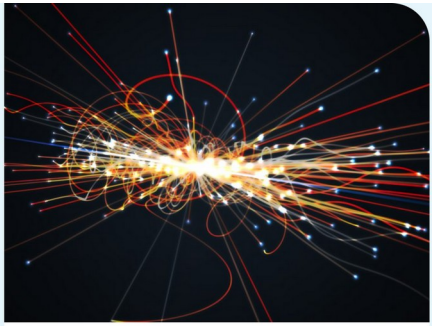
Computational Study of the Production and Reproduction of Italian Renaissance Paintings



Political Polarisation and Residential Segregation

ROOFIT

Optimized parallel calculation of complex likelihood fits of LHC data



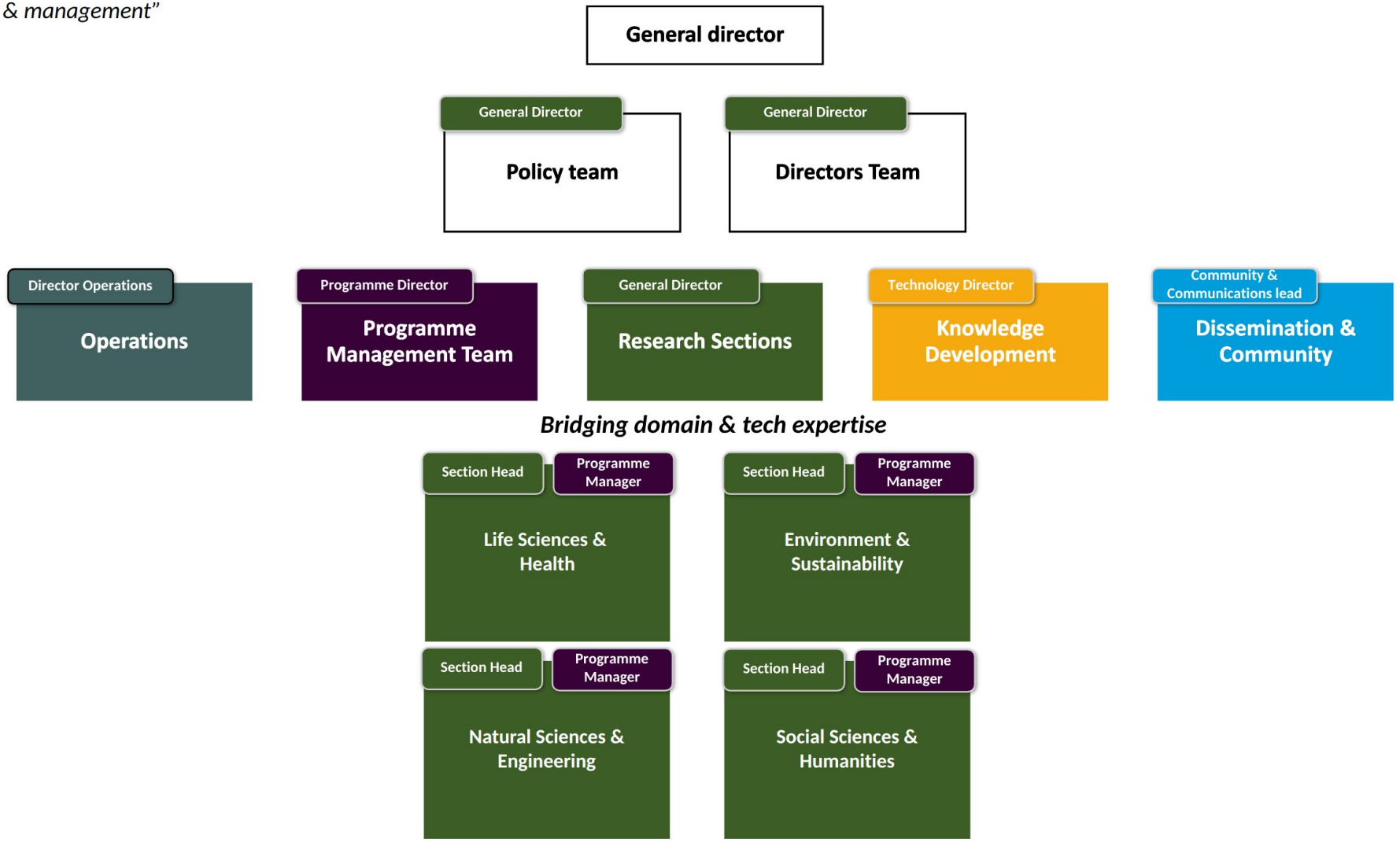
GAHTIe

High-throughput GPU computing for New Physics searches with electrons in LHCb

Oct 2021 - Sept 2024

The structure of the eScience center

"People & management"

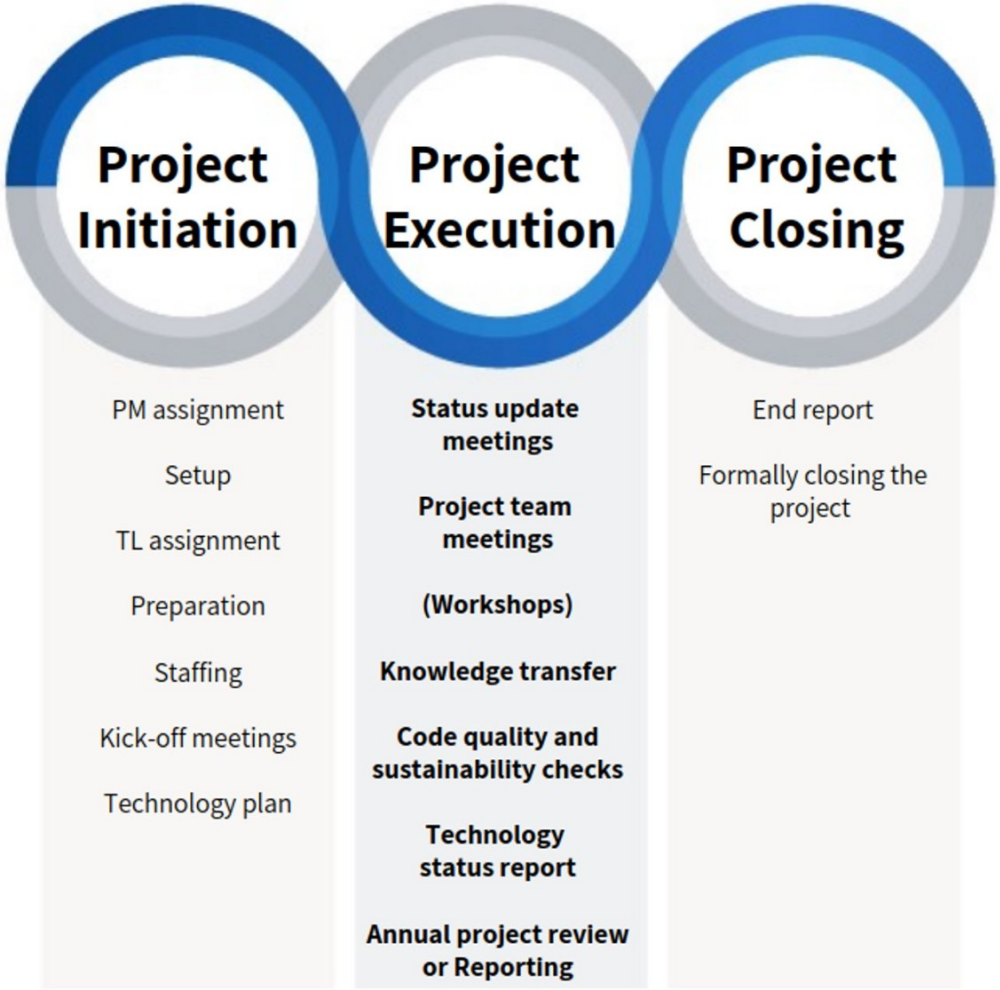


Projects in numbers

- 310 projects, including 219 finished ones.
  - 87 in social sciences;
  - 73 in life sciences;
  - 109 in physics and engineering.
- Partners from different countries, some public some private.
  - Barcelona supercomputing center is a partner in 5 projects.
- Where do these projects come from?
  - Bulk: our own calls, science-oriented (OEC) or sustainability-oriented (SSC)
  - European projects (Horizon Europe, ERC) as partners or subcontractors
  - Some national funding where we are eligible as partners
  - Internal funding: knowledge development
  - External projects as contractor

Life cycle of a project

- Every 12 months review meeting with RSE's, applicant, PM, tech lead and possibly other stakeholders.
  - Monitoring of the scientific & technical progress.
  - Optimize purpose, improve performance of the project.
  - Reinforce visibility and monitor project impact.
  - Update of Software Management Plan (SMP) and Data Management Plan (DMP)



- Many of our projects include (at least 1) workshop as deliverable.

- 3-months after the end of the project, submission of the Final Report:
  - Project objectives are justified.
  - Software, posters, presentations and scientific papers are listed.

GPU projects

- Adapting algorithms to GPUs is a large part of current projects (~10%).

RECRUIT

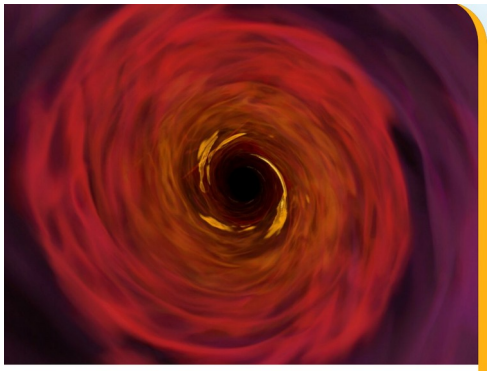
Reducing Energy Consumption in Radio-astronomical and Ultrasound Imaging Tools

DEEPDIP

Discovering deep physics models with differentiable programming

COMPAS

A Computational Answer to the Soaring MRI demand



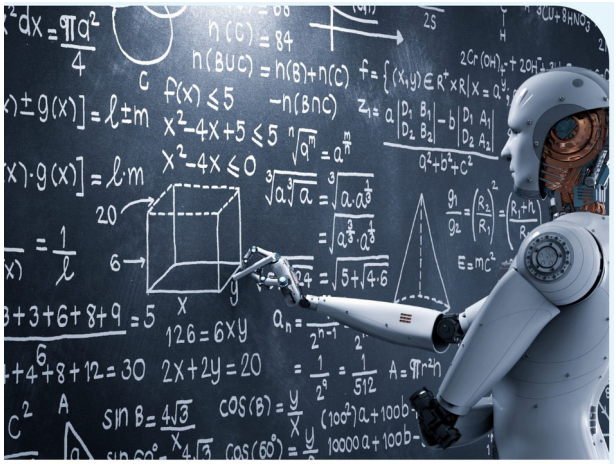
AGILE

Astrophysics on GPUs for InterdiscipLinary Exascience challenges

- Some experiments are looking to diversify from NVIDIA → need to write not just in CUDA but in more portable code.
  - ArXiV:2407.11488: Bringing Auto-tuning to HIP: Analysis of Tuning Impact and Difficulty on AMD and Nvidia GPUs
  - Wrote a pretty accessible guide on Optimization Techniques for GPU Programming.

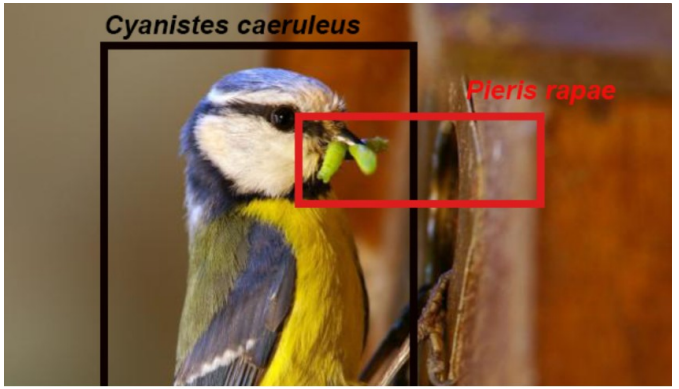
Multivariate analyses

- MVAs are ubiquitous in physics, but not just.
  - The eScience mission means that some collaborations or fields that had little access to MVAs can ask for expert help.
  - In the meantime, being able to focus on the technical aspects can help more established fields to hone their tools.



DIANNA - Deep Insight and Neural Networks Analysis

Explainable AI tool for scientists



ARISE

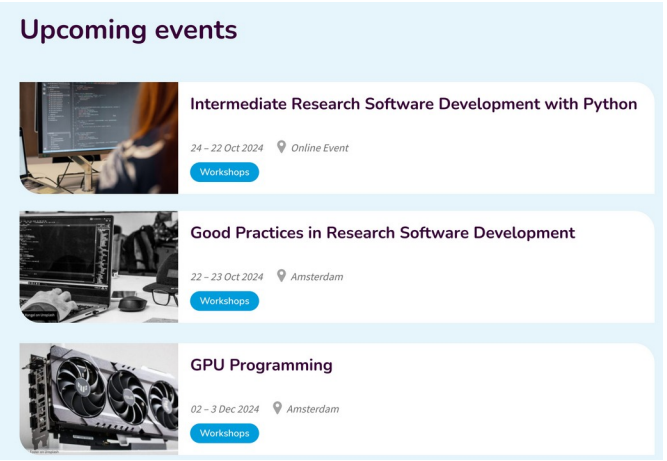
Authoritative and Rapid Identification System for Essential biodiversity information

What Works When for Whom?

Advancing therapy change process research

The other missions of the center

- **Teaching:** the center organises courses and workshops (visible here).
  - Important that code standards get disseminated, also because it helps delivering better projects.
  - Fellowship programme here.



- **Coordination and promotion**:
  - Chairs the Plan-E, whose mission is to develop eScience centers in Europe.
    - Don't know much about the status, in-person plenaries have not resumed after COVID.
  - Supports the Netherlands Research Software Engineers (NL-RSE);
  - Part of the Research Software Alliance (ReSA);
  - Part of The Carpentries, an international organization that teaches foundational coding and open science skills to researchers worldwide.

- **Promotes standards** for the community.
  - Authorship and credit are huge challenges → we also have a funding agency and need to show papers.
  - FAIRSECO: An Extensible Framework for Impact Measurement of Research Software.

Research takes many forms

- Research software engineer positions offer an interesting alternative for profiles that became more technical with time.
  - Most importantly: I realised I simply preferred the technical aspect of things.
  - It is not exactly “research-minus-academia” since there is still a need for funding calls, papers, metrics… but I should be able to say more in a year or so!

- The eScience Center fills a much-needed niche in Dutch research.
  - Even large LHC collaborations can have trouble filling their software needs, so picture smaller ones.

- Part of a wider European effort to address software challenges in a coherent manner.