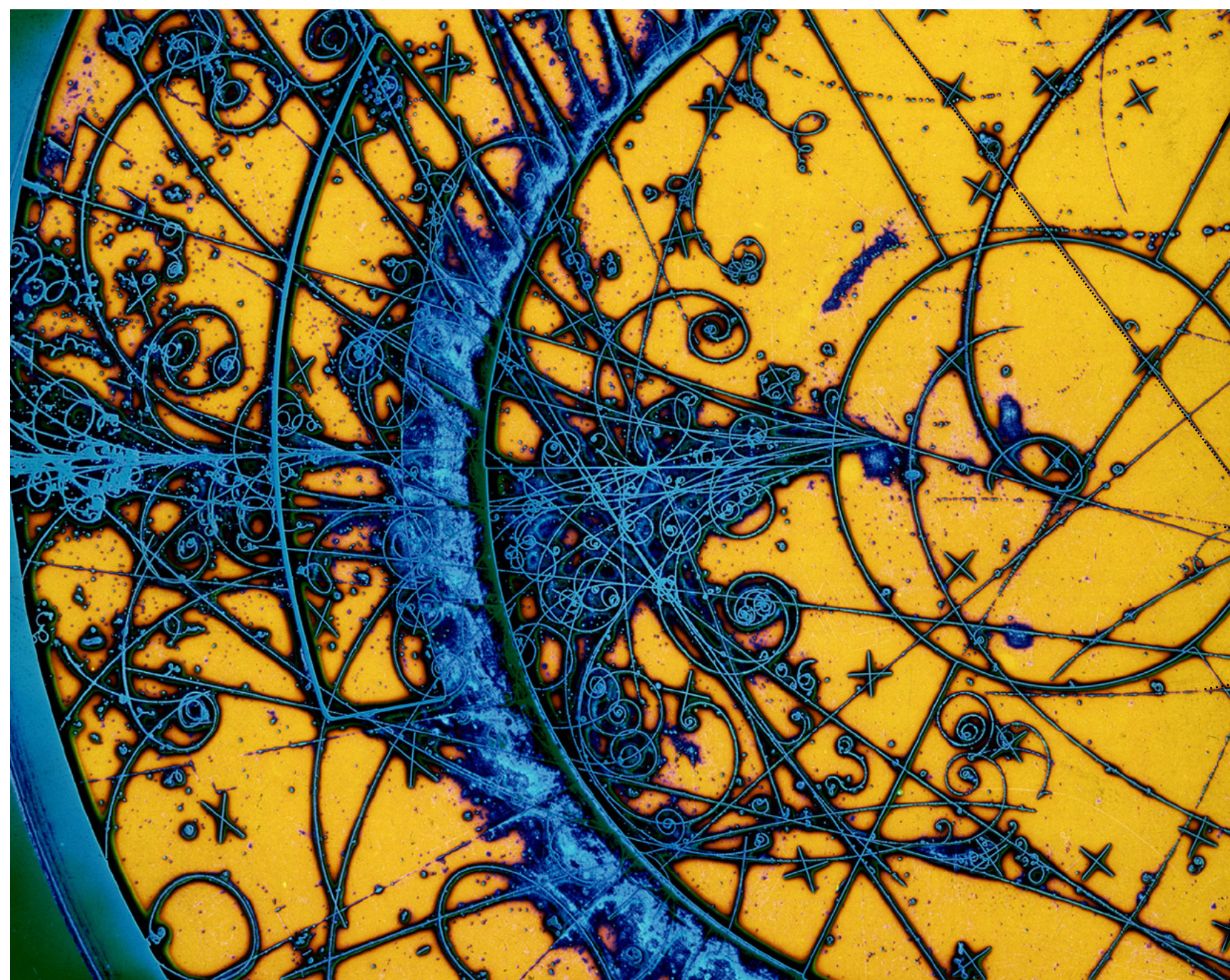


Learning to discover: Advanced Pattern Recognition



Introduction



A. Salzburger (CERN)

@SaltyBurger

► **Learning** to **Discover** - a series of three workshops:

1 15-26 Jul 2019: Real time analysis workshop

2 14-25 Oct 2019: Advanced Pattern recognition ←

Organisation committee: Andreas Salzburger (CERN), David Rousseau (LAL Orsay), Jean-Roch Vlimant (Caltech), Cherifa Sabrina Amrouche (University of Geneva), Cecile Germain (Université Paris-Sud), Slava Voloshynovskiy (University of Geneva), Marco Rovere (CERN), Marc Schoenauer (INRIA Saclay), Paolo Calafiura (LBNL) & [Sabrina Soccad \(Institut Pascal\)](#)

3 20-31 Jul 2020: Learning to Discover

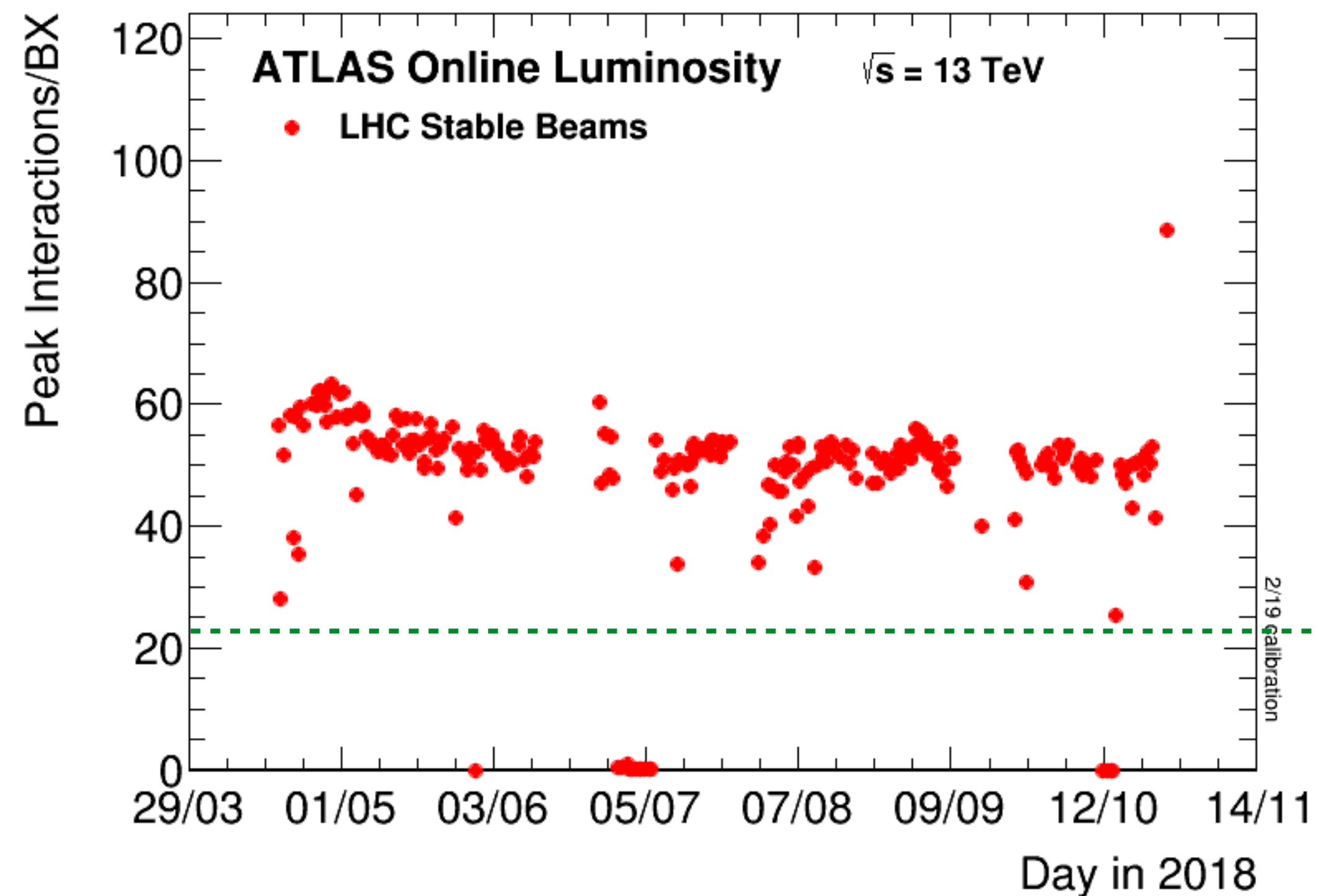


And a big THANK YOU

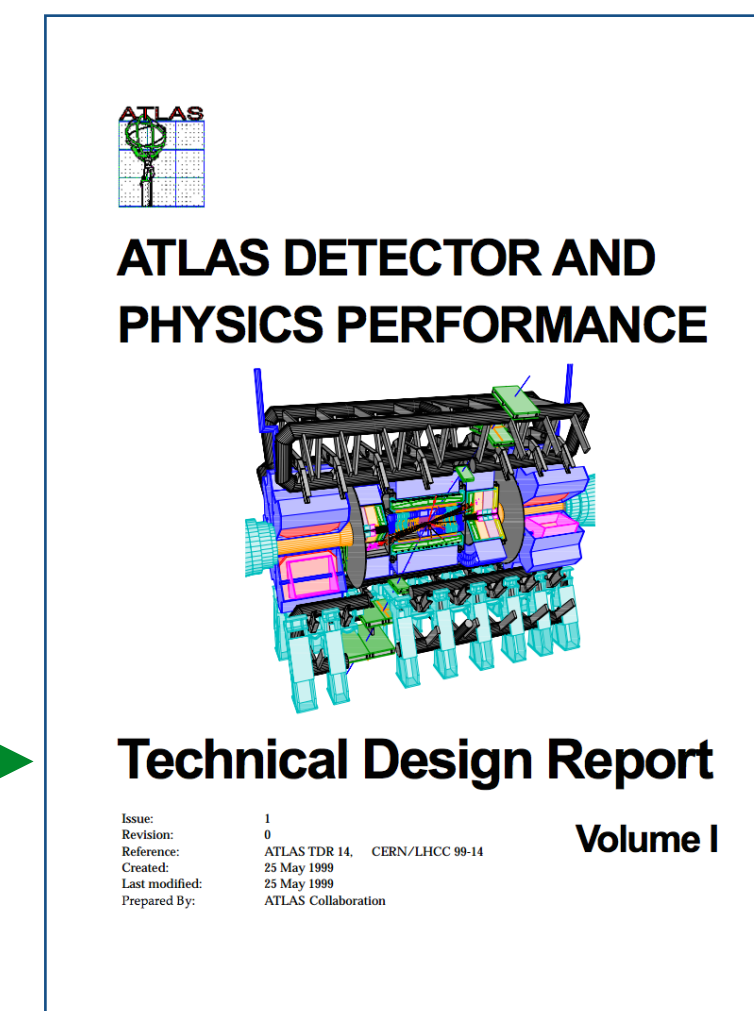
- ▶ To the submitters of the *Learning to Discover* proposal
 - The initiators can be found [[here](#)]
- ▶ To the **INSTITUT PASCAL** for accepting this proposal
 - And of course for the stunning location & excellent local organisation
- ▶ To you for participating
 - And I hope for participating not attending



- ▶ LHC Run-1 / Run-2 was a great success
 - (Accelerator,) Detectors and reconstruction software exceeded all expectations



That's what we designed the detector and software for

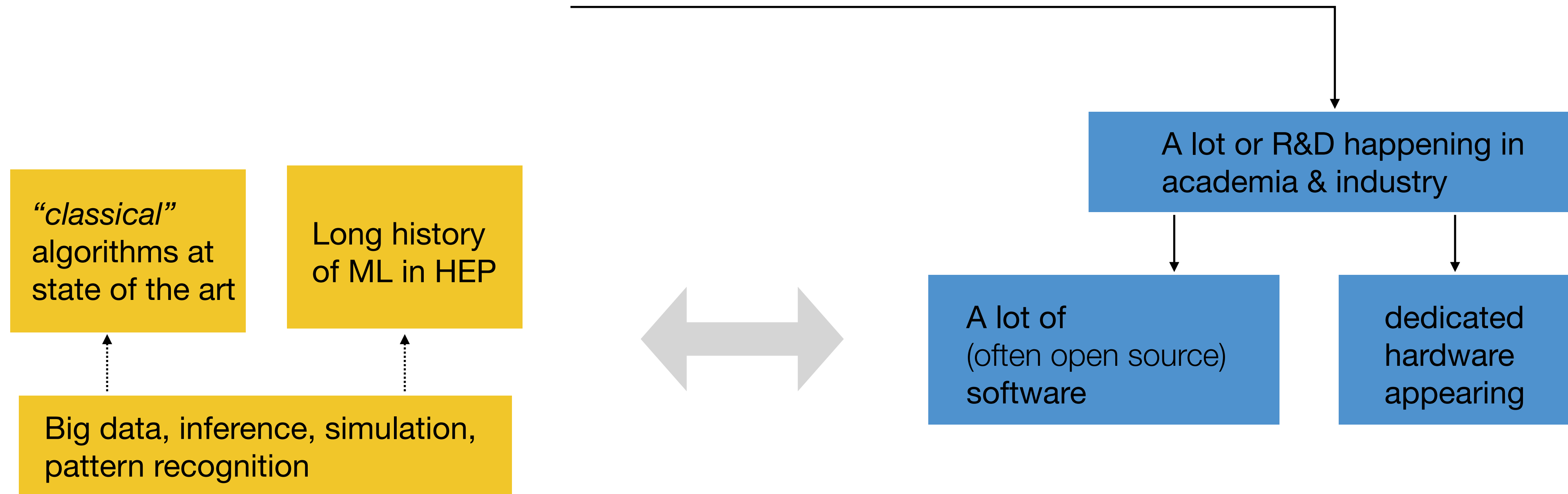


- ▶ Run-4 will be a paradigm shift for LHC experiments
 - Pile-up of $\langle\mu\rangle\sim 200$ (HL-LHC) is an order of magnitude higher than LHC design values
 - New detectors (that incorporate timing)
 - Continuous readout & real time analysis **1**
 - New computing landscape (post “*Moore’s law*” era: GPUs, HPCs)
 - Are we entering the post C++ era as well?
 - New (algorithmic) approaches
 - Machine Learning
 - Virtual reality & the way we look at things?
 - Quantum Computing?

- ▶ Machine learning is not new to HEP at all
 - ML is more than *just* deep learning
 - We might have used different labels, but ML has been in HEP since its rise
 - Clustering
 - Graph networks
 - Also first deep learning applications appeared rather early
- ▶ Fair to say: ML is growing and with it its potential (for us)



- ▶ Machine learning is a vastly fast growing field



- ▶ HEP problems are extremely complex to solve

- ▶ Machine learning has great potential to be further exploited
 - In analysis, inference, simulation
 - Certainly also in pattern recognition & reconstruction
 - Worth to look outside our little corner what is going on:

The screenshot displays three Kaggle challenge cards. The top card is the 'Higgs Boson Machine Learning Challenge' with a prize of \$13,000. Below it is the 'TrackML Particle Tracking Challenge' with a \$25,000 prize, described as 'High Energy Physics particle tracking in CERN detectors'. The bottom card is the 'TrackML Throughput Phase', organized by VictorEstrade, with a \$15,000 reward. A timeline at the bottom shows the 'Current' phase (Final) from Nov. 5, 2018, to Nov. 5, 2018, 11:59 p.m. UTC, with 'Previous' (Development) and 'End' (Competition Ends) phases also listed.

Phase	Status	Start	End
Previous	Development	Sept. 3, 2018, midnight UTC	
Current	Final	Nov. 5, 2018, 11:59 p.m. UTC	Nov. 5, 2018, 11:59 p.m. UTC
End	Competition Ends		Never

HEP meets ML (@conferences and @workshops)



CTD/WIT 2019
Connecting the Dots and Workshop on Intelligent Trackers
IFIC, València, Spain
2nd - 5th April 2019

Connectir

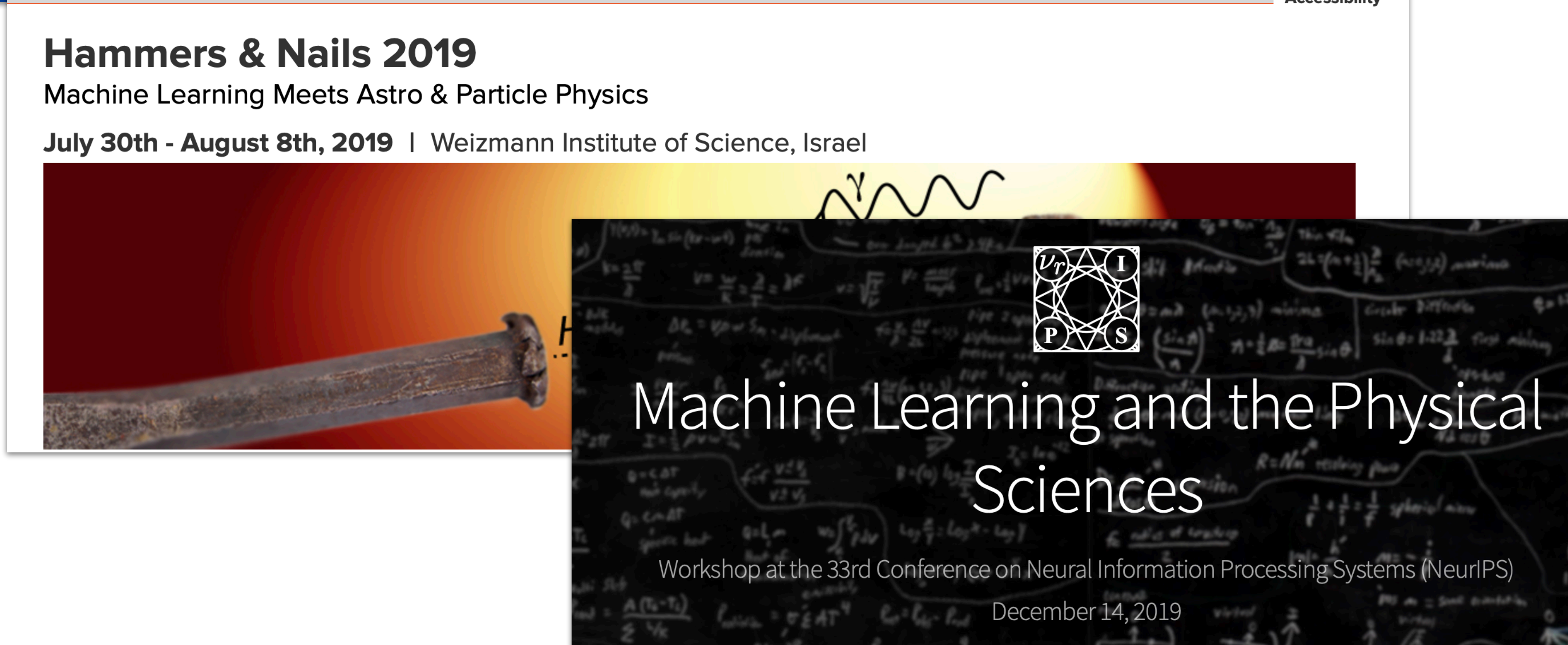
מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

SRitp Workshop

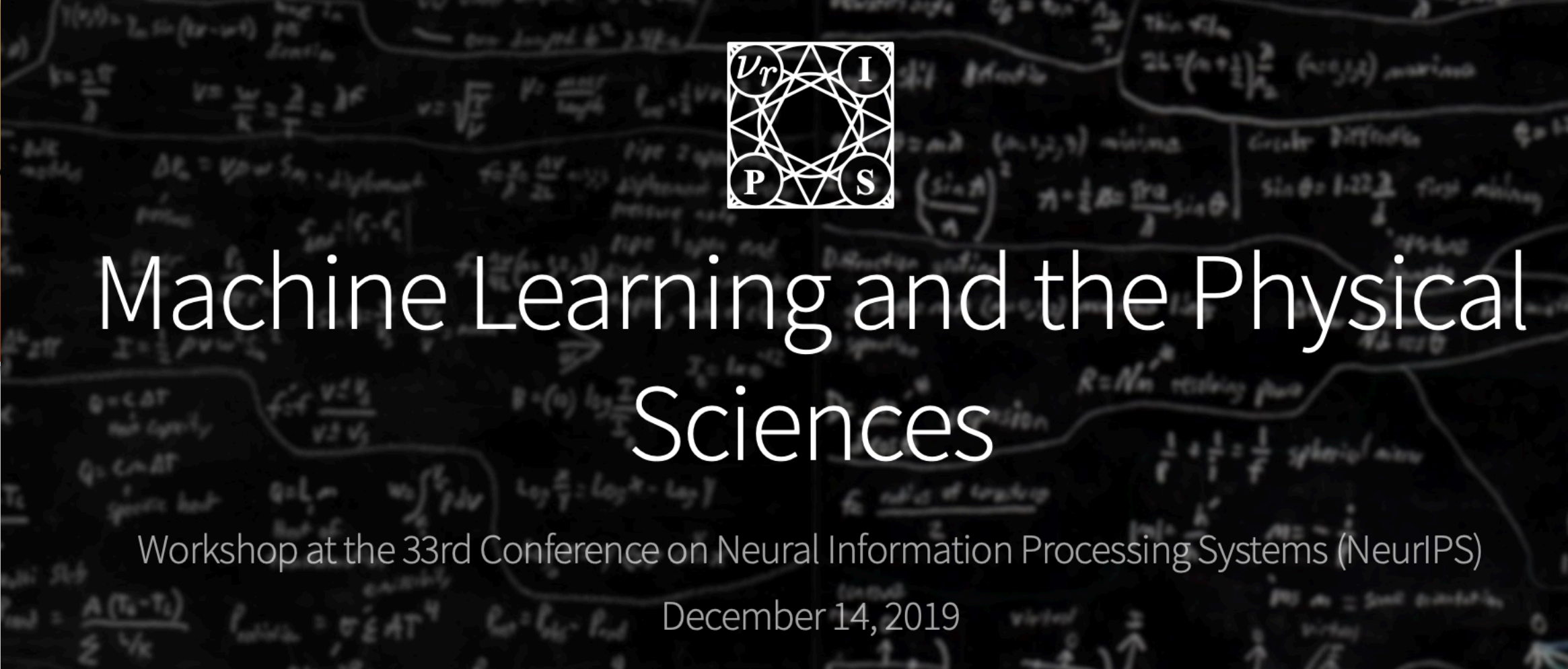

Schwartz/Reisman
Institute for Theoretical Physics

SRitp

Accessibility



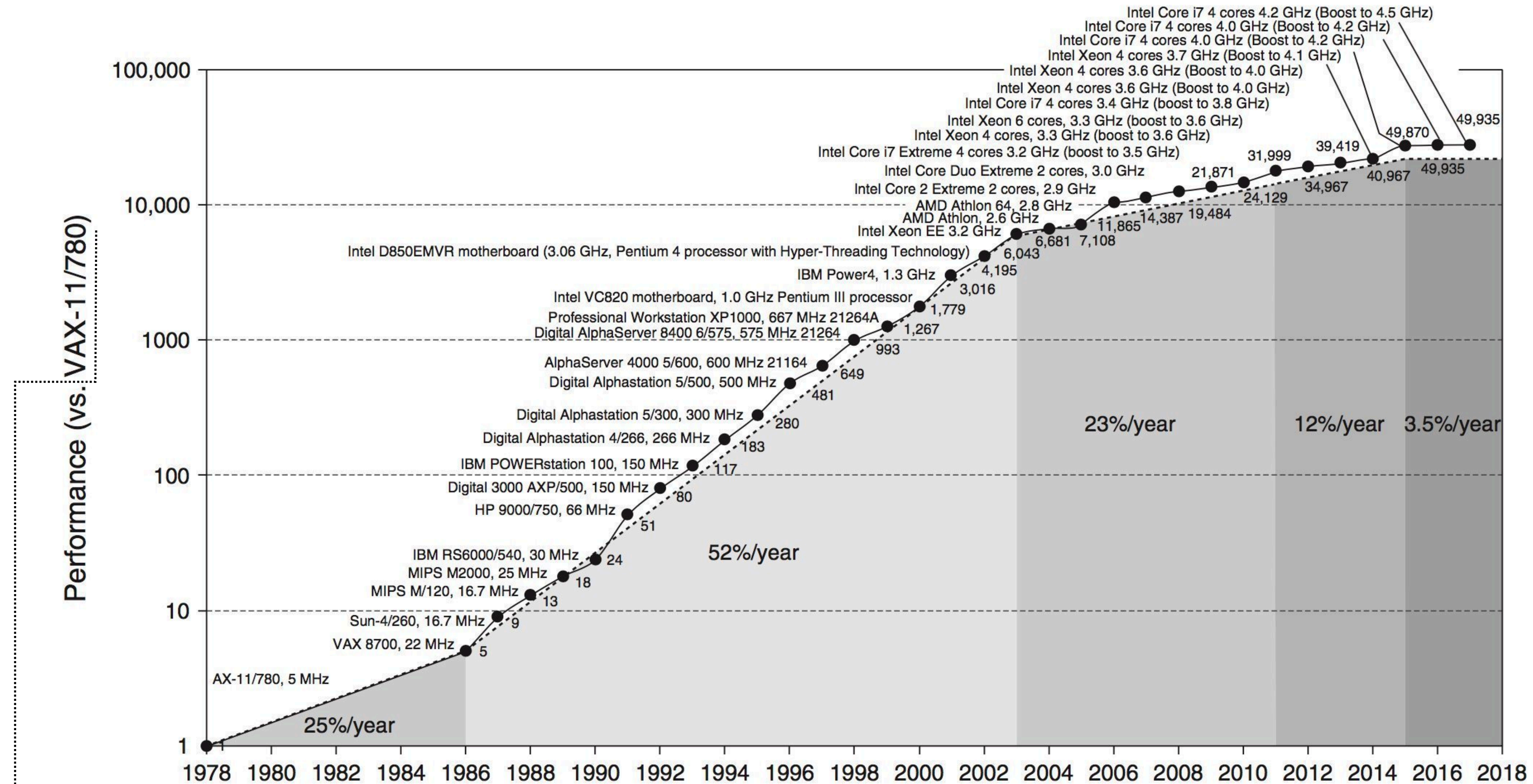
Hammers & Nails 2019
Machine Learning Meets Astro & Particle Physics
July 30th - August 8th, 2019 | Weizmann Institute of Science, Israel



Machine Learning and the Physical Sciences

Workshop at the 33rd Conference on Neural Information Processing Systems (NeurIPS)
December 14, 2019

HEP hits the *post Moore's law era*



HEP hits the *post Moore's law era*

Information

Discussion (0)

Files

Exhibition Objects

Report number	CERN-OBJ-IT-025
Category	Computing and computers
Title	Model of the VAX-11/780
Description	It was the first member of the VAX family of computers, the first commercially available 32-bit computer and the first MIPS (one million instructions per second). It is a family of abandoned mini-computers developed and manufactured by Digital Equipment Corporation (DEC). The name "VAX" comes from an acronym for "Virtual address eXtension" as the successor to the PDP-11. The computer and its operating system (VMS) were designed from scratch. The result was a truly reliable, powerful and user-friendly system. In addition its affordable price has enabled many institutions and universities to acquire it.
Description (French)	C'était le premier membre de la famille d'ordinateurs VAX, le premier ordinateur 32 bits commercialement disponible ainsi que le premier MIPS (un million d'instructions par seconde). C'est une famille de mini-ordinateurs abandonnées développée et fabriquée par Digital Equipment Corporation (DEC). Le nom "VAX" provient d'un acronyme pour «Virtual address eXtension» se proposant comme successeur du PDP-11. L'ordinateur et son système d'exploitation (VMS) ont été conçus à partir de zéro. Le résultat était un système vraiment fiable, puissant et convivial. De plus son prix abordable a permis à de nombreuses institutions et universités de l'acquérir.
Year	1977
Keywords	IT
Physical characteristics	
Location	Building 513-R-052
Availability	On loan
File(s)	



- ▶ **Learning** to **Discover**
 - Maximum of **three scientific contributions** per day
 - Afternoons leave time for discussions, hands on session, *playing around*

09:00	Summary of the TrackML Challenge <i>Institut Pascal, Orsay. Paris</i>	<i>Moritz Kiehn</i> 09:00 - 10:00
10:00	Q&A, Discussion <i>Institut Pascal, Orsay. Paris</i>	10:00 - 10:30
11:00	Track reconstruction with similarity hashing <i>Institut Pascal, Orsay. Paris</i>	<i>Sabrina Amrouche</i> 11:00 - 12:00
12:00	Q&A, Discussion <i>Institut Pascal, Orsay. Paris</i>	12:00 - 12:30
13:00		
14:00	Graph networks for track reconstruction <i>Institut Pascal, Orsay. Paris</i>	<i>Marcel Kunze</i> 14:00 - 15:00
15:00	Q&A, Discussion <i>Institut Pascal, Orsay. Paris</i>	15:00 - 15:30

▶ Learning to Discover

- Every single contribution

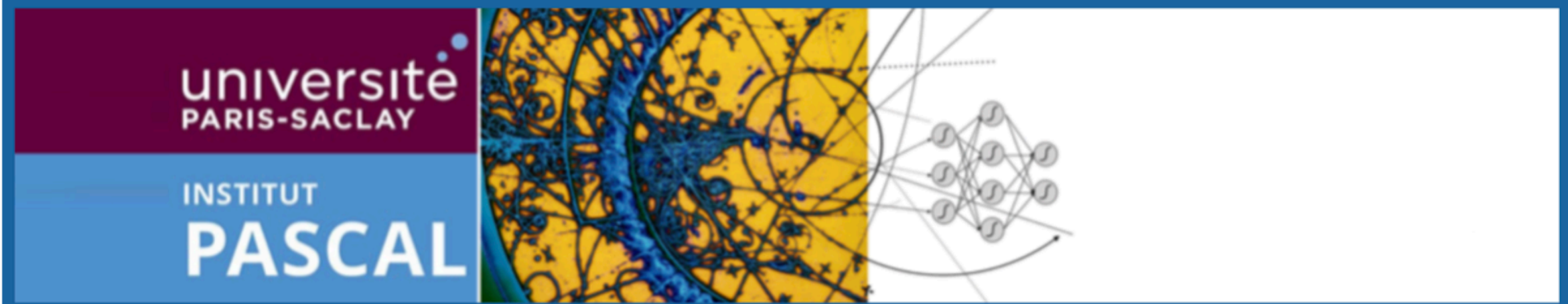
is scheduled for 1.5 hours:

- There is time to present complex things in detail
- There should be enough time to do discuss items and clarify
- We really don't want a conference style
- Interrupt if you have a **question/comment**

- There are still the **coffee breaks** & discussion slots



- ▶ The slides will be uploaded to the [[indico](#)] agenda
 - They should be a good reference of the presented topic
- ▶ We would like to capture the **discussions** & **ideas** during the workshop via [[live notes](#)]



Learning to Discover : Advanced Pattern Recognition

LIVE NOTES | Scientific Program

Monday, 14/10/2019

- ▶ If you haven't done, please fill in the [who-is-who] document

Your name

A picture of me



A picture relevant to my work



What I do:

Fill in here

What I think I can (bring to the workshop):

Fill in here

What I am interested in learning:

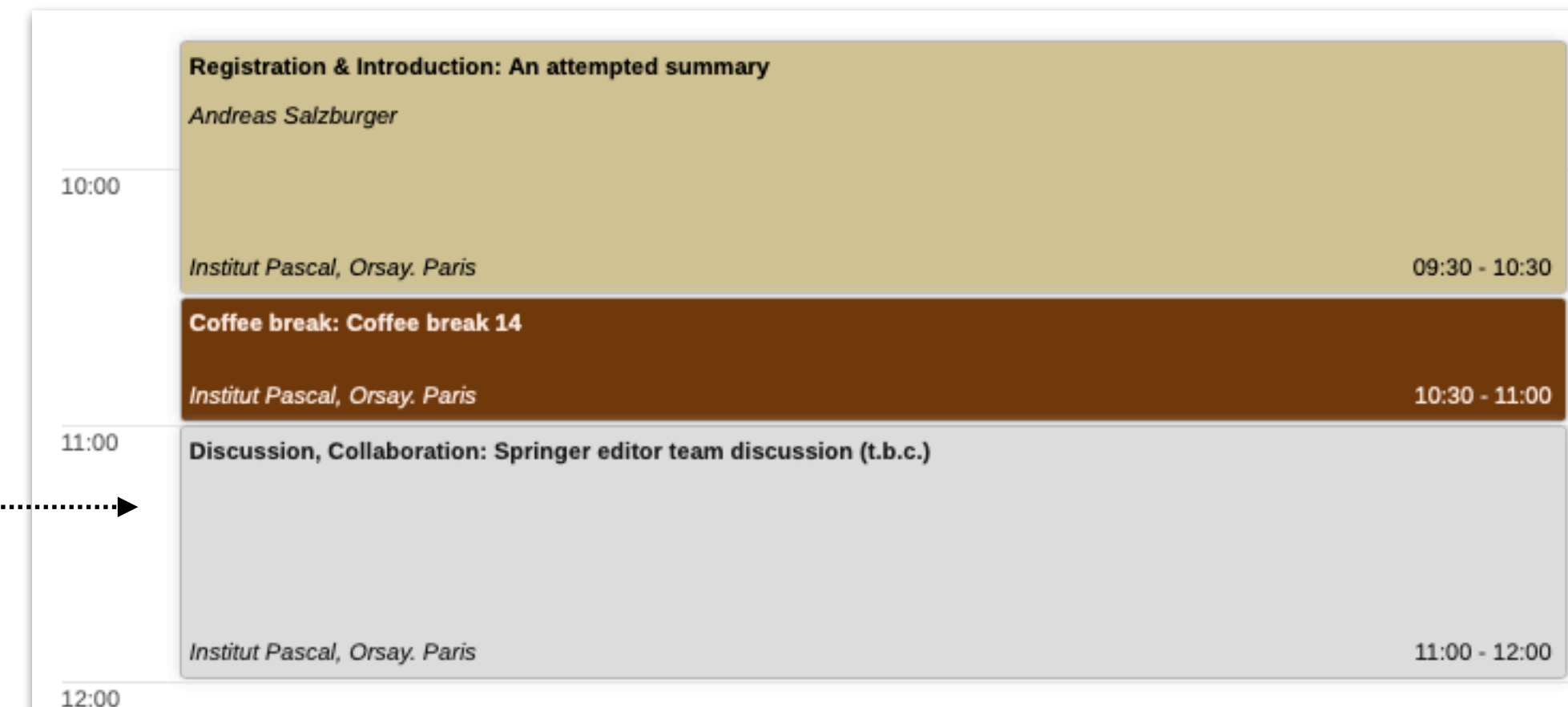
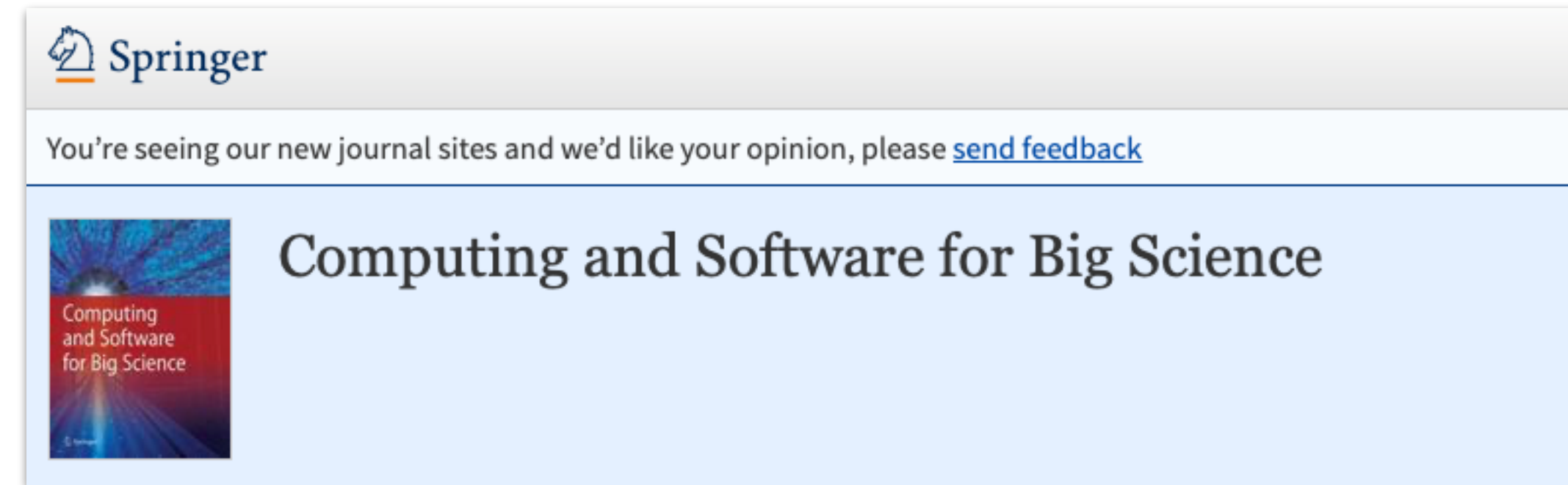
Fill in here

What I want to say as well:

Fill in here

Contact: my.email@host.com

- ▶ **Learning, Discover & Publish**
 - **Springer** offered to cover this workshop in a special issue
 - Terms are relatively free
 - We'd need to form an editorial team
 - Publishing should happen roughly 6 months after the workshop



The image shows a schedule for Friday 25/10. It includes a registration and introduction session by Andreas Salzburger from 09:30 to 10:30, a coffee break from 10:30 to 11:00, and a discussion session with the Springer editor team from 11:00 to 12:00. All sessions are held at Institut Pascal, Orsay, Paris.

Time	Activity	Location	Duration
10:00	Registration & Introduction: An attempted summary Andreas Salzburger	Institut Pascal, Orsay, Paris	09:30 - 10:30
	Coffee break: Coffee break 14	Institut Pascal, Orsay, Paris	10:30 - 11:00
11:00	Discussion, Collaboration: Springer editor team discussion (t.b.c.)	Institut Pascal, Orsay, Paris	11:00 - 12:00

Eventual discussion on Friday 25/10

And finally ...

- ▶ I can only hope this will be a fruitful and successful workshop !