

Welcome to ESC22

the 13th INFN International School on

“Architectures, tools and methodologies for
developing efficient large scale scientific
computing applications”

Oct. 3-8 2022

Felice Pantaleo - CERN

On behalf of:

The Italian Institute for Nuclear Physics (INFN)

- × Bologna, CNAF, Padova sites, providing most of the support

The University of Bologna, Department of Physics

The lecturers

- × and their Institutions

Attendance this year

- × received a record number of applications (48, 33% more than in 2021)
- × selection was not easy due to the large number of very good candidates
- × finally 26 participants were selected
 - ◆ 7 from foreign Institutions,
 - ◆ 19 from Italian ones
- × 1 participant had unfortunately to drop out at the very last moment

The site

Bertinoro and hospitality

Bertinoro is a nice medieval village, famous for its **hospitality** and therefore quite well suited as a location for a center like CeUB

- ✗ the name most likely comes from “**Castrum Brittinori**” (XI century) and it is probably due to the frequent stops pilgrims coming from Britain, in their way to Rome, used to take in the quiet surroundings of Bertinoro.
- ✗ A legend says that Galla Placidia, daughter of the Roman emperor Theodosius I, drank local wine in a humble clay chalice and said “Non di così rozzo calice sei degno, o vino, ma di *berti in oro*”.
- ✗ one of the monument in Bertinoro known as **Colonna delle Anelle** ("Column of the Rings" or "Column of hospitality") is a column in white stone with 12 rings erected in 1300 by the noble families to express **their commitment to hospitality**.
 - ◆ Each one of the rings corresponded to a family
 - ◆ foreigners arriving in town, could select the family to be hosted, by **tying** the horse bridles to the corresponding ring

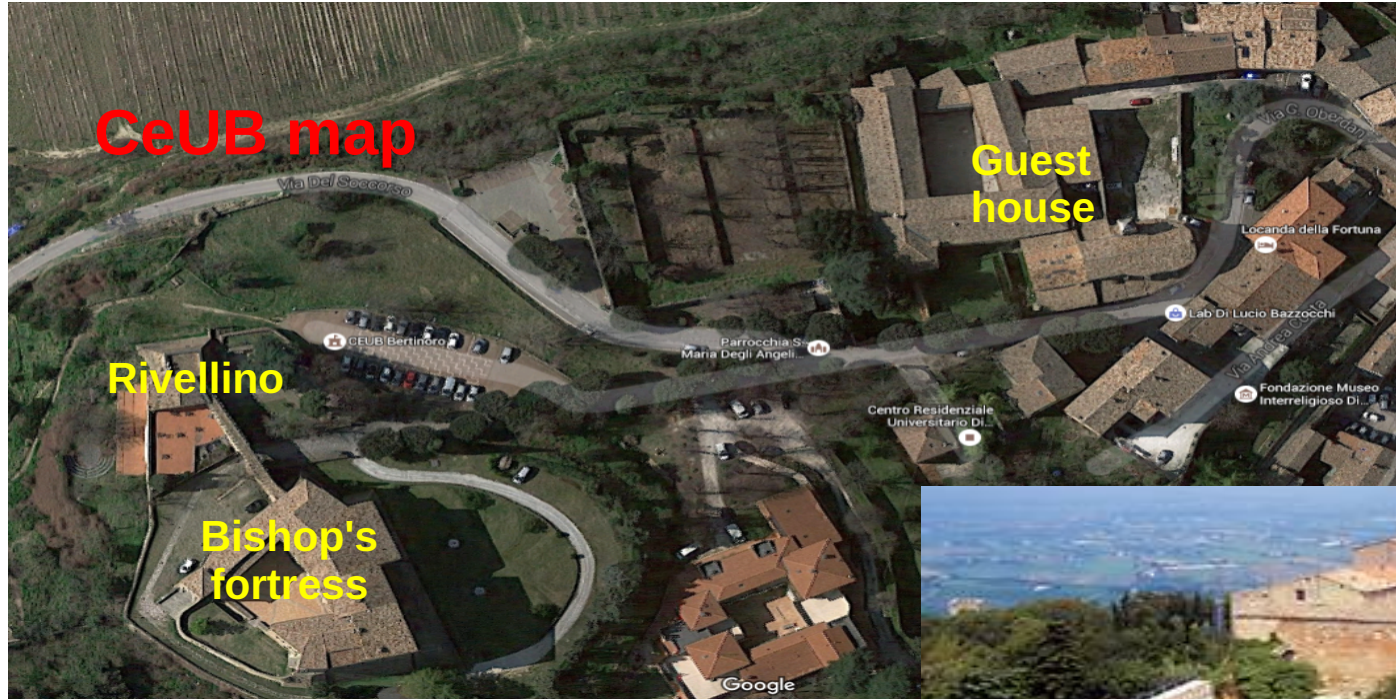


but still today...

- ✕ Bertinoro still hosted a "**Hospitality Festival**". Held at the end of August or first week of September (1/9 – 4/9 in 2022), it includes an entire night of music, dances and events, some historic commemorations and the final Hospitality Rite.
- ✕ In this ceremony visitors **can be hosted** for lunch by a family in the town simply **taking one of the envelopes** tied to the rings of the Hospitality column (which inside has the name of the hosting family).
- ✕ you will not get this opportunity this week, but I'm sure you will at least enjoy the **good food and wine** that Bertinoro will offer to you while you are staying here



CeUB: University Residential Center of Bertinoro



Visit of the fortress and the
Interfaith museum
Wednesday afternoon



CeUB: the facilities

- ◆ the Center was brought back in use with renovation work that started in 1991 in the fortress and in the guest house, followed by integration of additional buildings
- ◆ today the Center offers:
 - ✕ **14 lecturing/meeting rooms** inside the Bishop's Fortress, the Rivellino, St. Sylvester church and the Theatre;
 - ✕ **2 computer labs**, 20 and 50 seats;
 - ✕ **86 bedrooms** (single, twin, double), for a total amount of 130 beds;
 - ✕ a **canteen with 200 seats** for breakfast, lunch and gala dinners.
- ◆ **120+ events** per year
- ◆ up to **30.000** daily presences per year
- ◆ needless to say, in the last one and a half year there have been nearly no activity

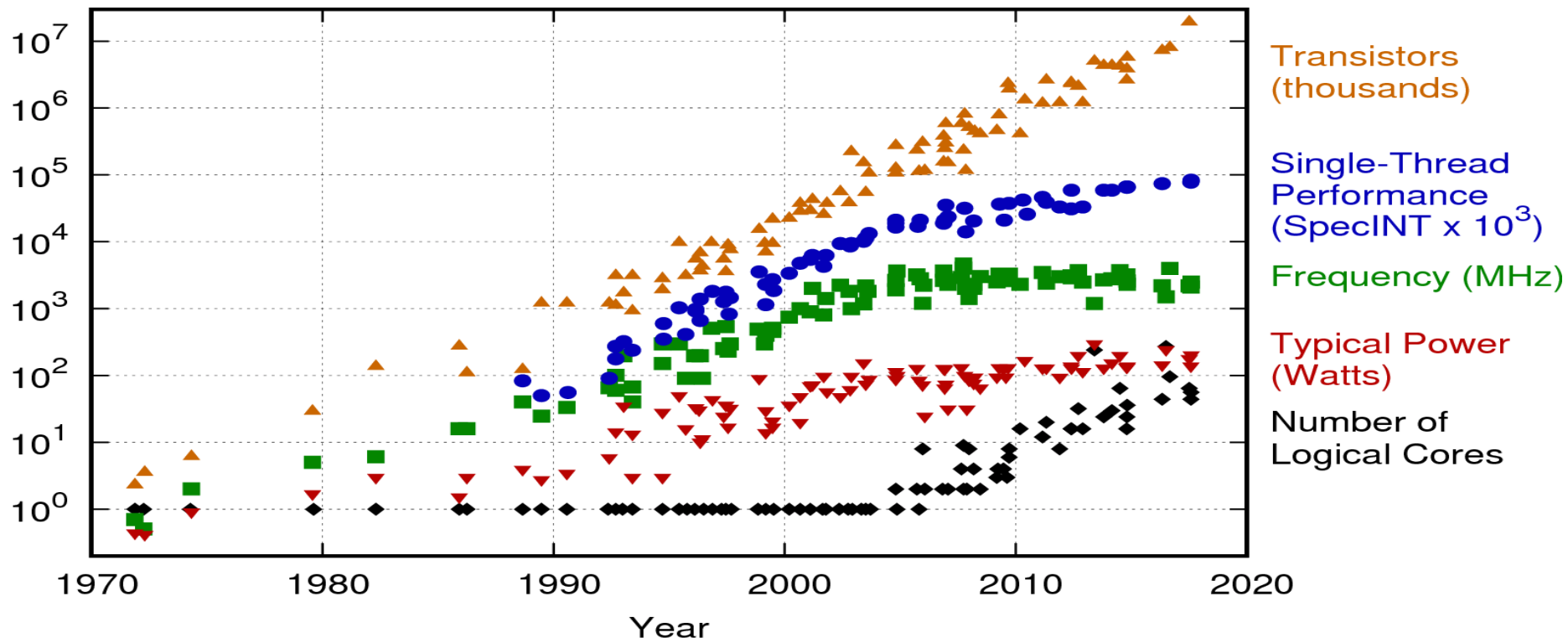
Why this School

The context

- ◆ High Energy Physics has been **heavily relying** on computing since long
 - ✗ for many years the scale of resources needed by HEP experiments was such that the computing centers of the hosting lab **were copying well** with the core computing data processing needs
 - ◆ the UA1/2 experiments that discovered the Z and W bosons at CERN were good examples
- ◆ the model started to break at the end of the last century when experiments, like the BaBar experiment at the SLAC B-factory, had to deal with a **huge amount of data** and the computing power had to be scaled up by more than one order of magnitude w.r.t. **the initial estimates**
 - ✗ the investment needed started to grow very significant
 - ✗ for the first time it was felt necessary to distribute the processing of the data stored on tape to an external center

The end of the free ride

42 Years of Microprocessor Trend Data

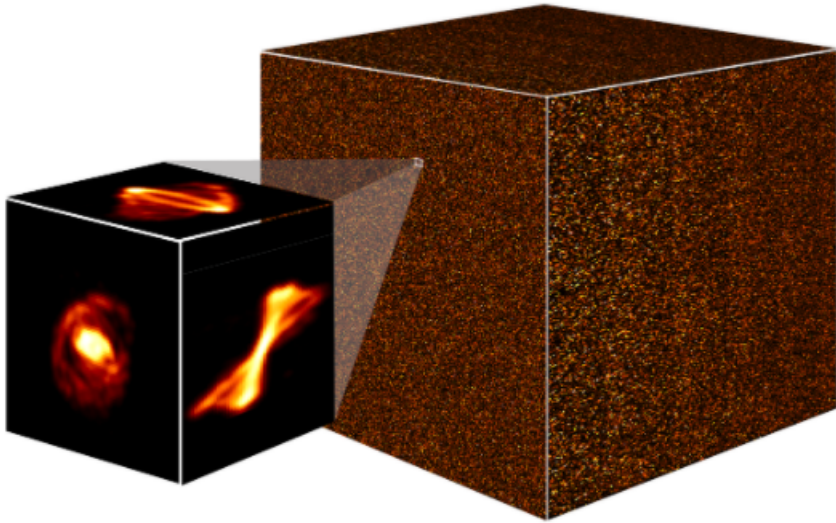


Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten
New plot and data collected for 2010-2017 by K. Rupp

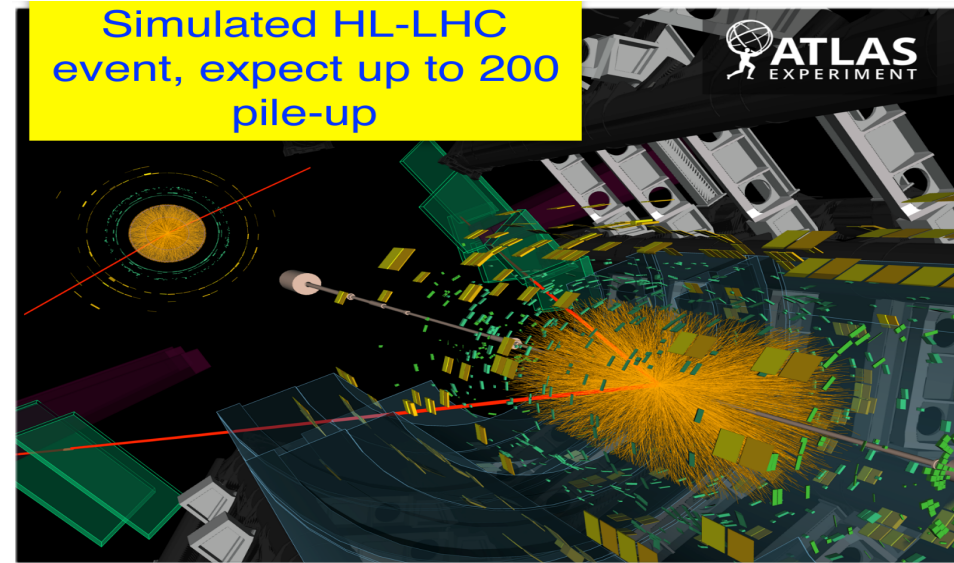
Why a School about “efficiency”

- ◆ The conception of this school was motivated by the awareness that **efficient usage of computing resources** in our field:
 - ✗ **had to be taken seriously**, given the level of computing investment now required
 - ✗ in the past **was not always well understood** and taken into proper consideration
 - ✗ **was becoming more and more challenging** due in particular to the physical constraints in increasing scalar performance and the attempts to exploit anyway Moore's law with new processor architectures
 - ◆ many cores, co-processors, GPU, vector units, etc
 - ◆ memory access getting more and more critical
 - ◆

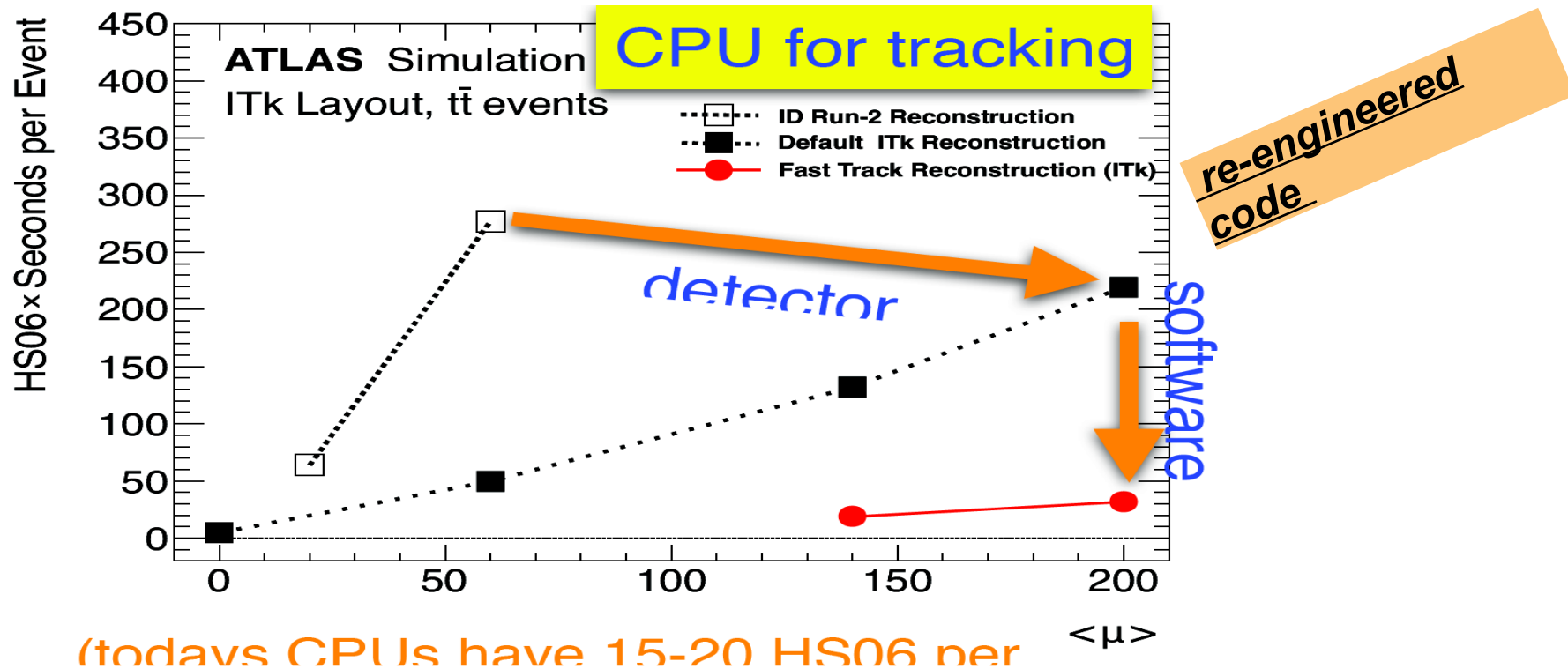
Future will be more challenging...



SKA 1TB data cube

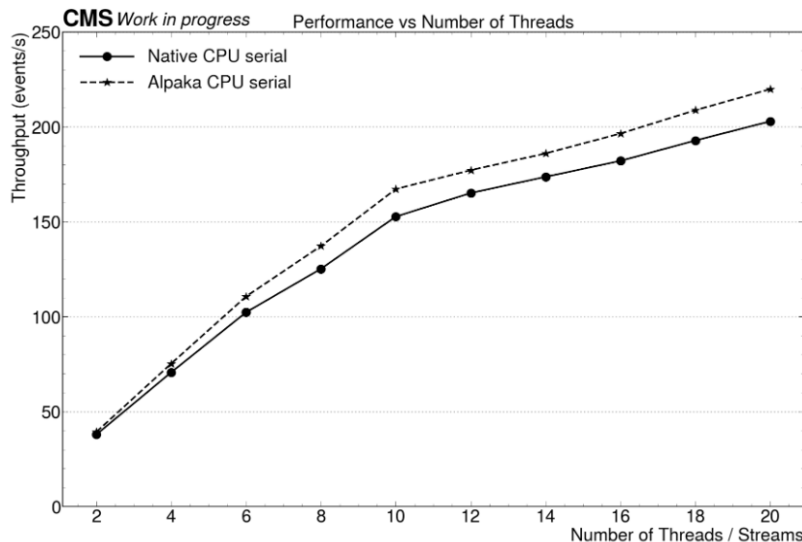
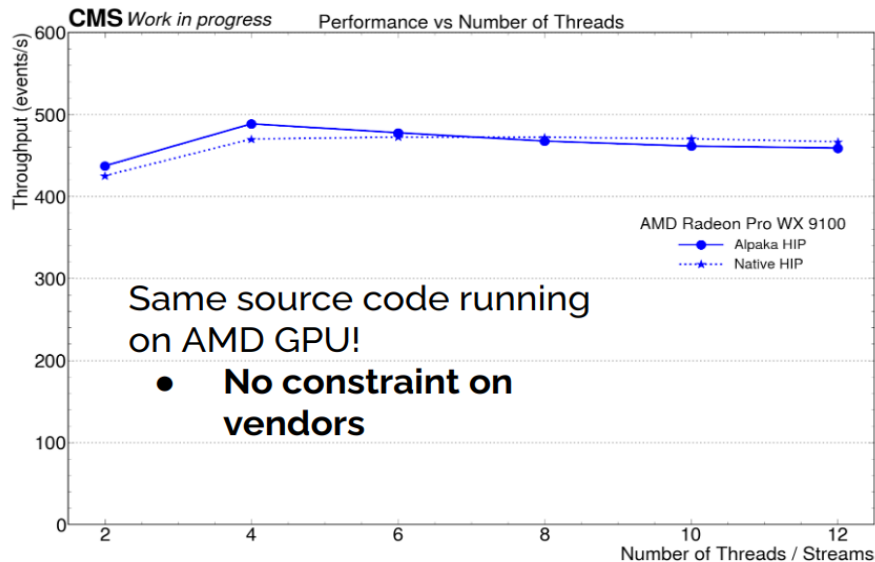
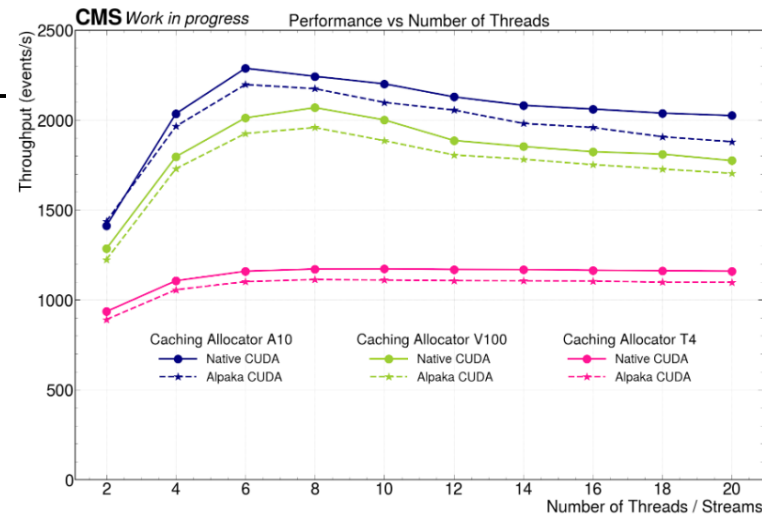


Improving the software pays off



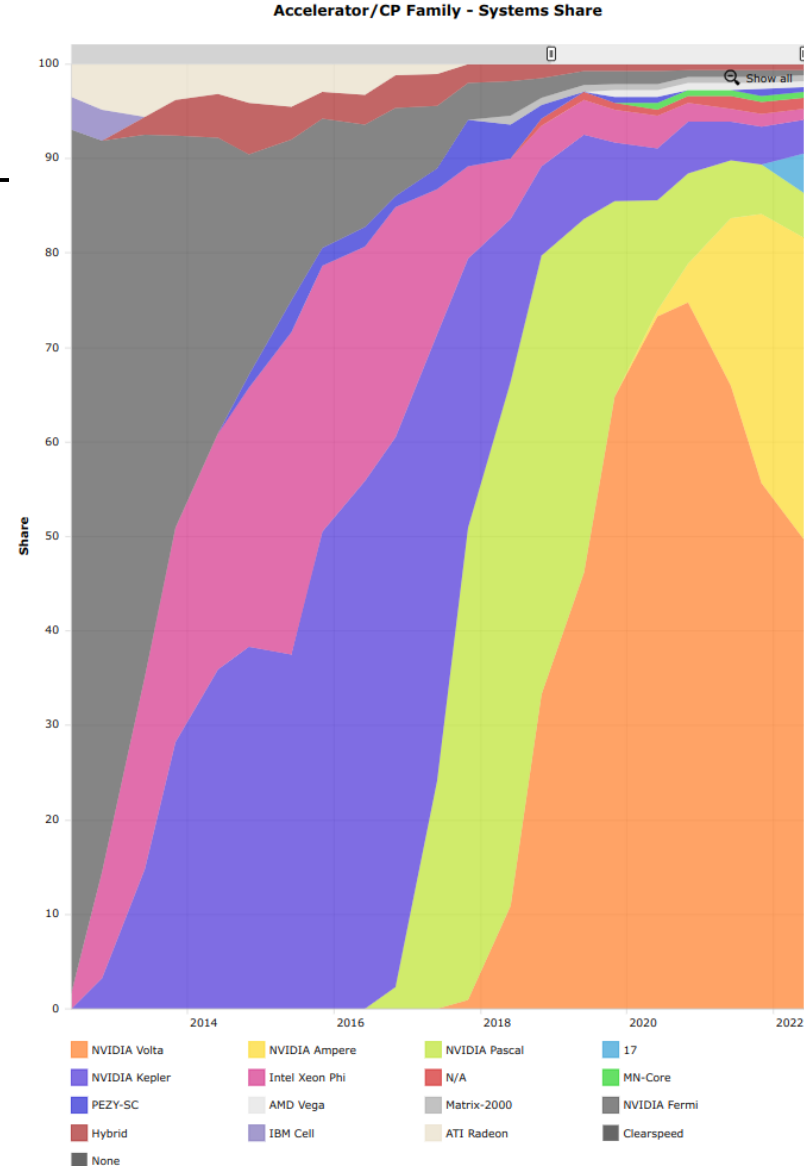
CMS Patatrack R&D

- ◆ Heterogeneous computing and performance portability a reality at LHC experiments



A look at HPC computing

- ◆ Exascale computing
 - ✗ 1000 PFlops, 1000 PBytes
- ◆ however, **no supercomputer runs real applications faster than 10 percent of its maximum peak design speed**
- ◆ the natural trend is towards **poorer and poorer efficiencies** as systems scale out to Exascale
- ◆ “it is not **power** or **reliability** that are the **exascale challenges**: it’s **programmability of complex memory hierarchies**” Bronis R. de Supinski
Chief Technology Officer (CTO) for
Livermore Computing



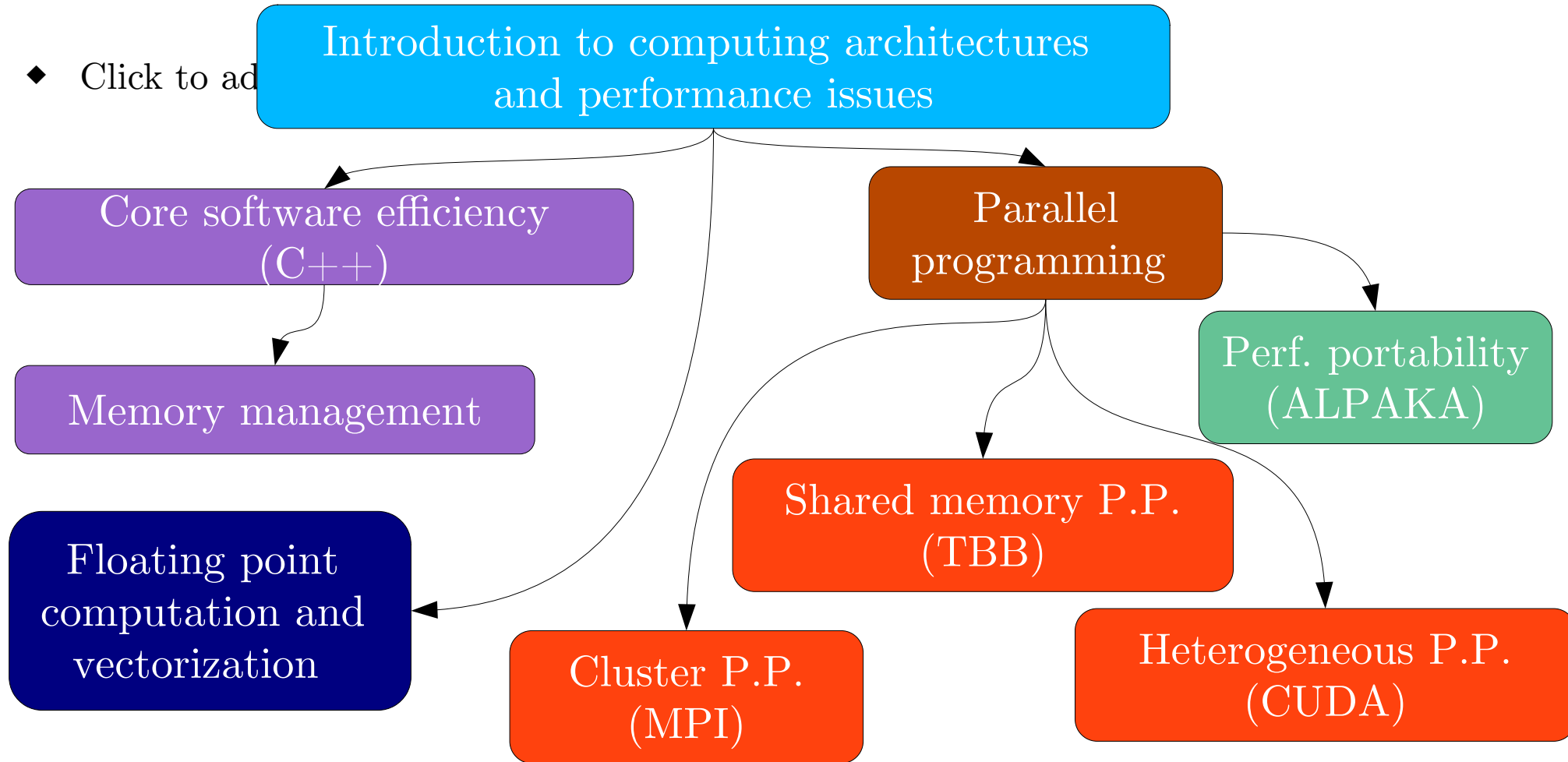
The School evolution

- ◆ In the first editions of the School we tried to embrace **several key aspects** related to the efficient usage of computing resources in scientific applications, from **exploitation of modern CPUs** to **I/O related issues**
- ◆ however we realized that the scope was too vast for a one week long School
- ◆ a few years ago we decided therefore to focus the School on the area where developments looked most disruptive and challenging: **parallel processing**

The 2022 edition

ESC21 School lecture plan

- ◆ Click to add



Improving the School

- ◆ we have been striving to **improve the School** year after year
- ◆ the feedback we got from the students has always been **very useful**
- ◆ on Saturday morning we will give you an opportunity to evaluate:
 - ◆ the **perceived quality** of various aspects of the School
 - ✕ via the feedback questionnaire
 - ◆ the **competences you have acquired**
 - ✕ through a final test
 - ✕ information collected is of course **valuable to us too**

Consolidation time

- ♦ to accommodate the need of students had to have some time for assimilating the material presented in the lectures there are some **consolidation time slots** for a total of ~ 10 hours
- ♦ after the lectures... you can stay here until dinner time

Evening lectures

- ◆ Jan Stephan (CASUS - HZDR)
 - x Wednesday:
 - ◆ **Introduction to software portability among heterogeneous architectures**
 - x Thursday:
 - ◆ **Exploiting heterogeneous architectures: applications and lessons learned**

The week together

- ◆ thank you for preparing the **lightning talks and bringing here your posters** !
 - ✕ we have received slides from **all participants** but **a few**
 - ◆ please send us the the missing slides by 2 PM today
- ◆ dinners: on Mon., Tue., Wed., Thu. you can organize yourself and **enjoy what local restaurants have to offer**
 - ✕ **a list of restaurants with a map has been distributed** together with the **vouchers** worth 25 €
 - ✕ if you tell the restaurant that you are going to use the voucher, they will usually propose an “optimized” menu
 - ✕ **today (Monday)** many restaurants **are closed**
 - ◆ we recommend the **first two** of the list (Enoteca Cà' de Be' and EBC Enoteca Bristot Colonna)
 - ◆ please, **inform Rossana** by the time of the Coffee Beak this morning, if you have already decided where to go and would like **to have a seat reserved**

Special events

On **Wednesday afternoon** :

- ◆ **Visit** to the Bertinoro Fortress and the InterFaith museum
 - ✕ please put your name on the booking sheet that will be posted today afternoon

On **Friday night**:

- ◆ **Social dinner**
 - ✕ please report to the secretary any special food requirement

In case of any change, it will be reported on the agenda hosted in ESC web site

School computing infrastructure

- ◆ we believe that:
 - ✗ **learning-by-doing** is an effective way of **learning**
 - ✗ but it is also an effective way of **teaching**
 - ◆ guiding students **to discover by themselves** new notions and concepts
- ◆ therefore a **computing infrastructure** suitable for supporting hands-on activities has been setup for you
 - ✗ HPC cluster located at the CNAF INFN site
- ◆ **this year:**
 - ✗ each of you will get shared access, through a **login gateway** (bastion.cnaf.infn.it), to:
 - ◆ **three Intel dual processors Linux (E5-2640v2 ivy bridge, 2x8 phys. cores 128 GB)** servers equipped with GPUs (2 x Tesla K20m/40m)
 - ◆ one **Intel dual processor Linux (Gold 6148 sky lake, 2x20 phys. cores 192 GB)** server with 4xv100 GPU
 - ✗ you should have received a mail message with the credentials to login into bastion; if not, check your spam folder, or let us know
 - ✗ there is a dedicated web site with teaching material and exercises: <https://infn-esc.github.io/esc22/>

Wireless network

- ◆ **Bertinoro wireless network**, available available in all rooms including the guest house [CeUB SSID and eduroam SSID]
 - ✗ credentials should have been given at registration time, otherwise ask Rossana

Mattermost

- ◆ A mattermost team was created:
- ◆ https://mattermost.web.cern.ch/signup_user_complete/?id=sqgsn4tzzpntxymhhkcqct3for

Join it to receive communications, interact, provide feedbacks

You have brought sunshine to Bertinoro!

Meteo BERTINORO ▶ Previsioni fino a 15 giorni 

Emilia Romagna ▼

Forlì-Cesena (FC) ▼

Bertinoro ▼

Scopri di più: **Webcam e ...** ▼

Aggiornamento delle ore 10:36 - **Prossimo alle** 11:15

 Condividi la previsione

Qualità dell'aria »  Buona

Previsioni 365 giorni  Novità

Meteo Giornaliero	Ven 30  14° 17°	Sab 1  13° 21°	Dom 2  12° 23°	Lun 3  15° 23°	Mar 4  12° 23°	Mer 5  12° 23°	Gio 6  12° 23°	Fino al 14
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We wish you a very pleasant and
“efficient”, great week in
Bertinoro