

# Welcome to ESC17

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the Ninth INFN International Continental School on

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

Oct. 23-28 2017

Mauro Morandin - INFN-Padua



# On behalf of:

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- ◆ **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, the tutors**
  - × and their Institutions/Companies

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# 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

- x the name most likely comes from **“Castrum Brittinori”** (XIth 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.
- x 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 one 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 hosts a "**Hospitality Festival**". Held in the first weekend of September, it includes an entire night of music, dances and events (between Friday and Saturday), some historic commemorations and the final Hospitality Rite (Sunday late morning).
- ✗ In this ceremony **anyone 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

ITALITÀ  
suffragio  
in Italia  
mbre 2016



MARTEDÌ

29.08

FINO AL  
3.09.2017

EMILIA-ROMAGNA

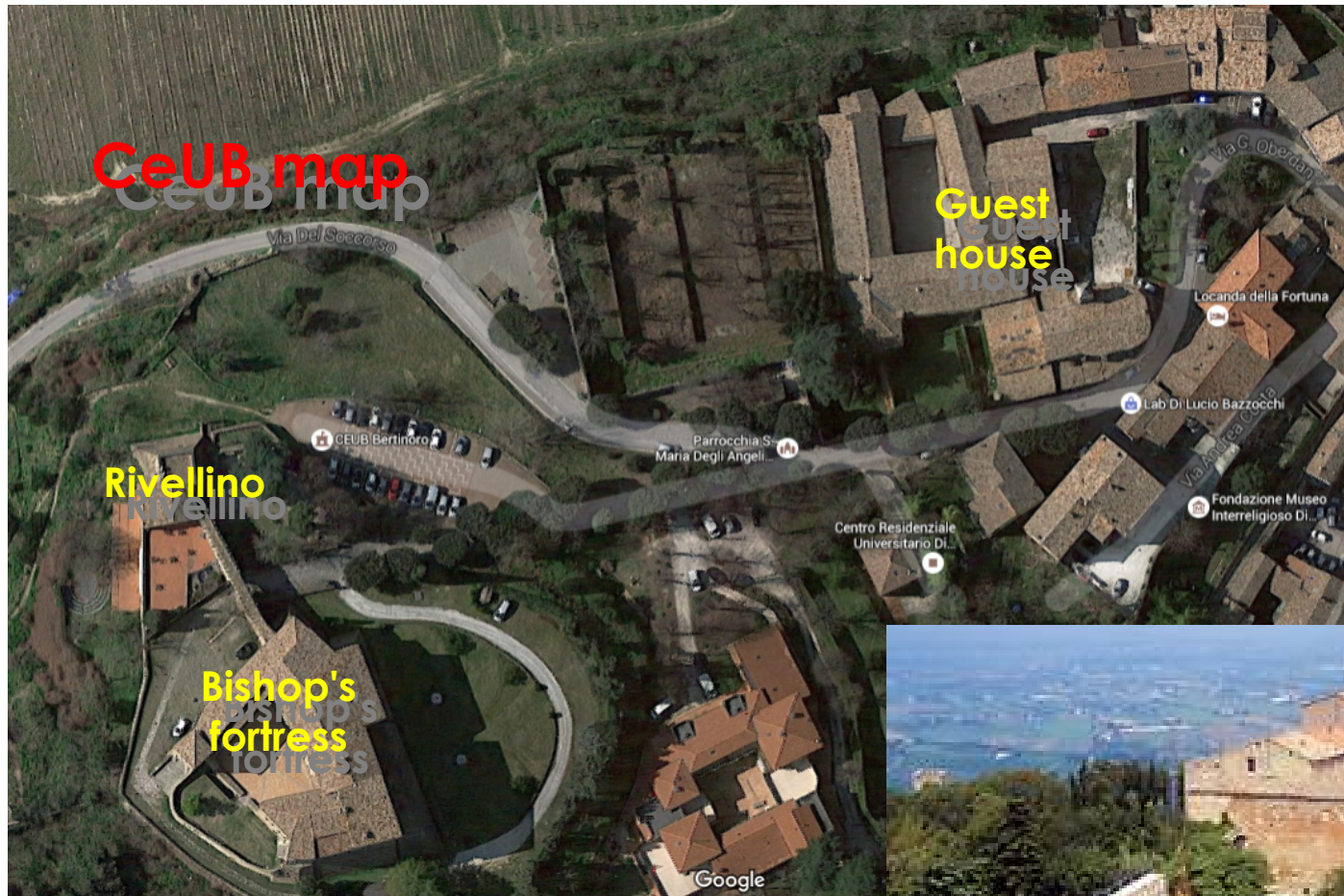
BERTINORO

BERTINORO, FESTA  
DELL'OSPITALITÀ  
2017





# CeUB: University Residential Center of Bertinoro



Visit of the fortress and the  
Interfaith museum  
Wednesday at 2:30 pm



# CeUB: the facilities

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- ◆ 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

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# Why this School





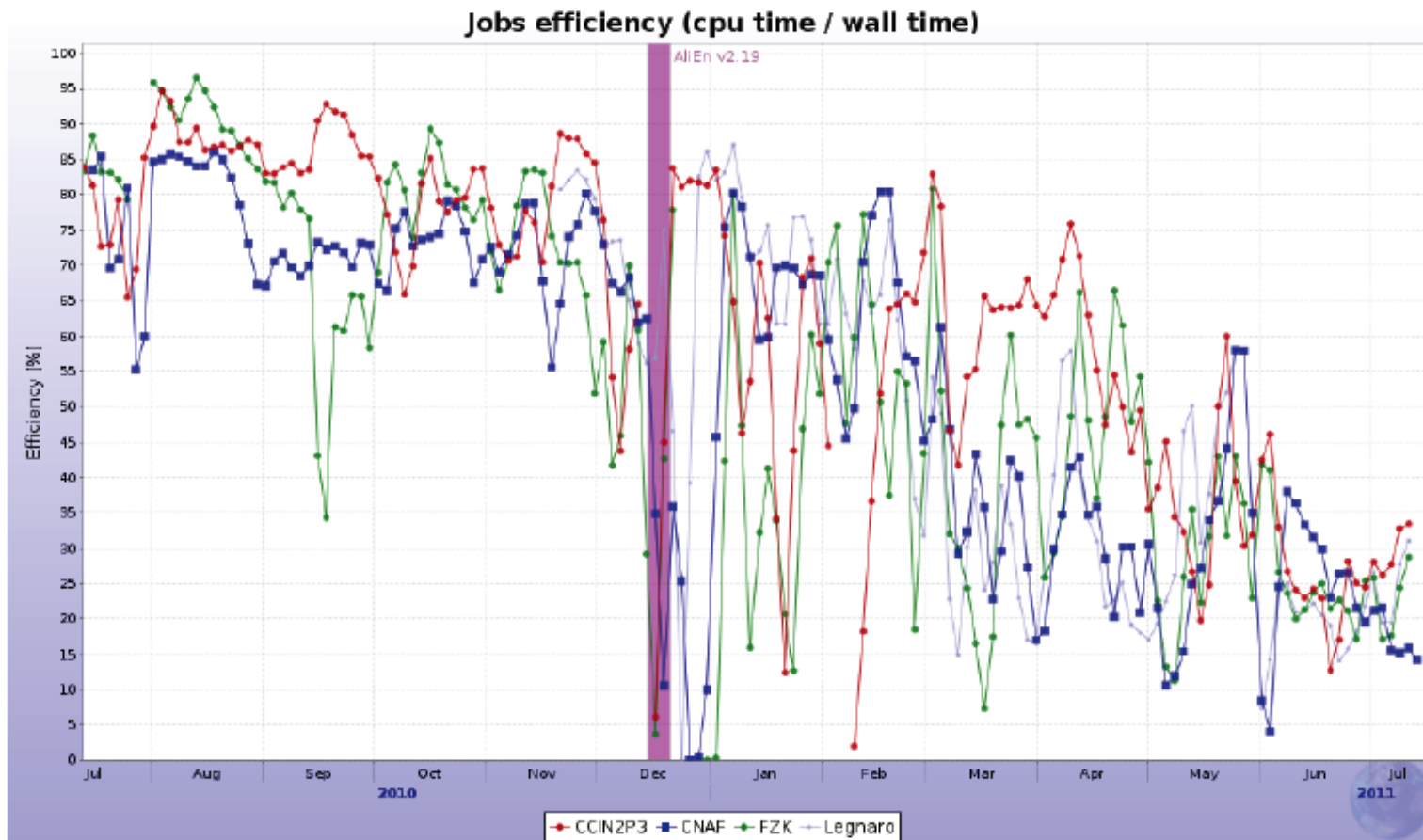
# The context

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- ◆ 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

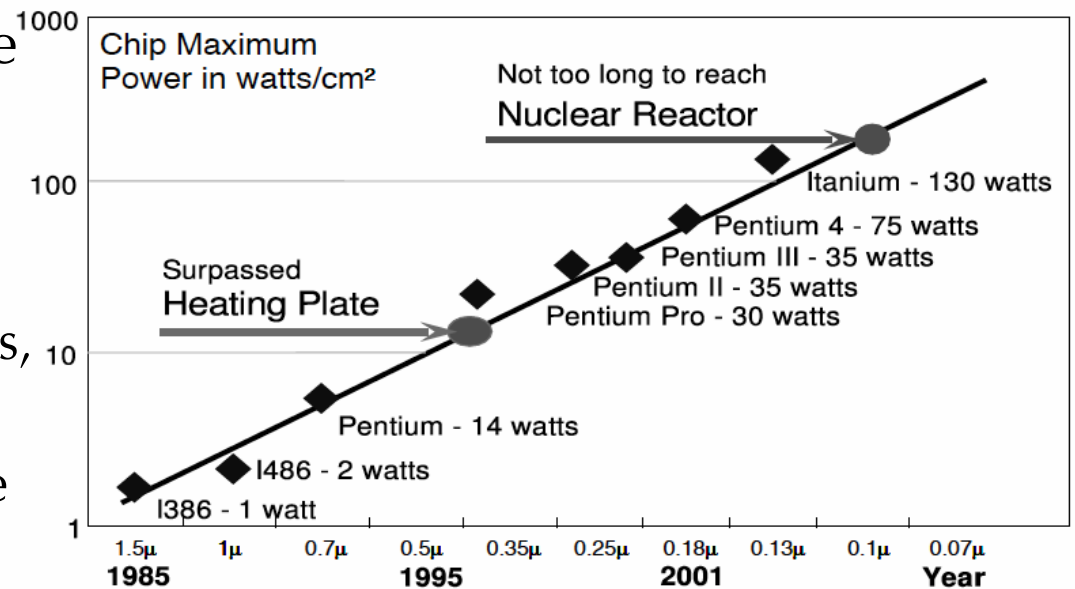
# more recent experience

- × an example from a LHC experiment of how CPU efficiency may drop when real data come in



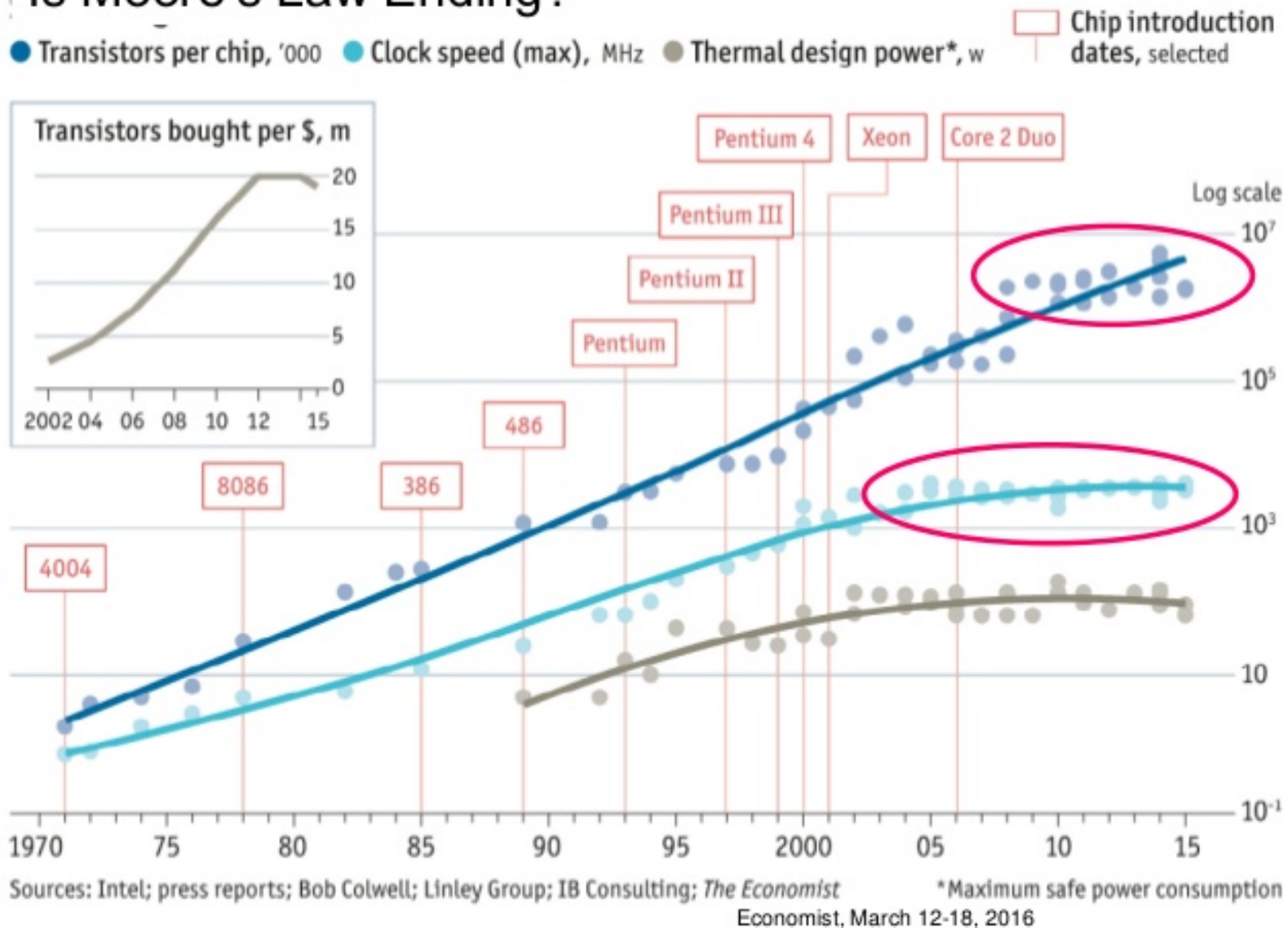
# Why a School about “efficiency”

- ◆ 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



# Why a School about “efficiency” (II)

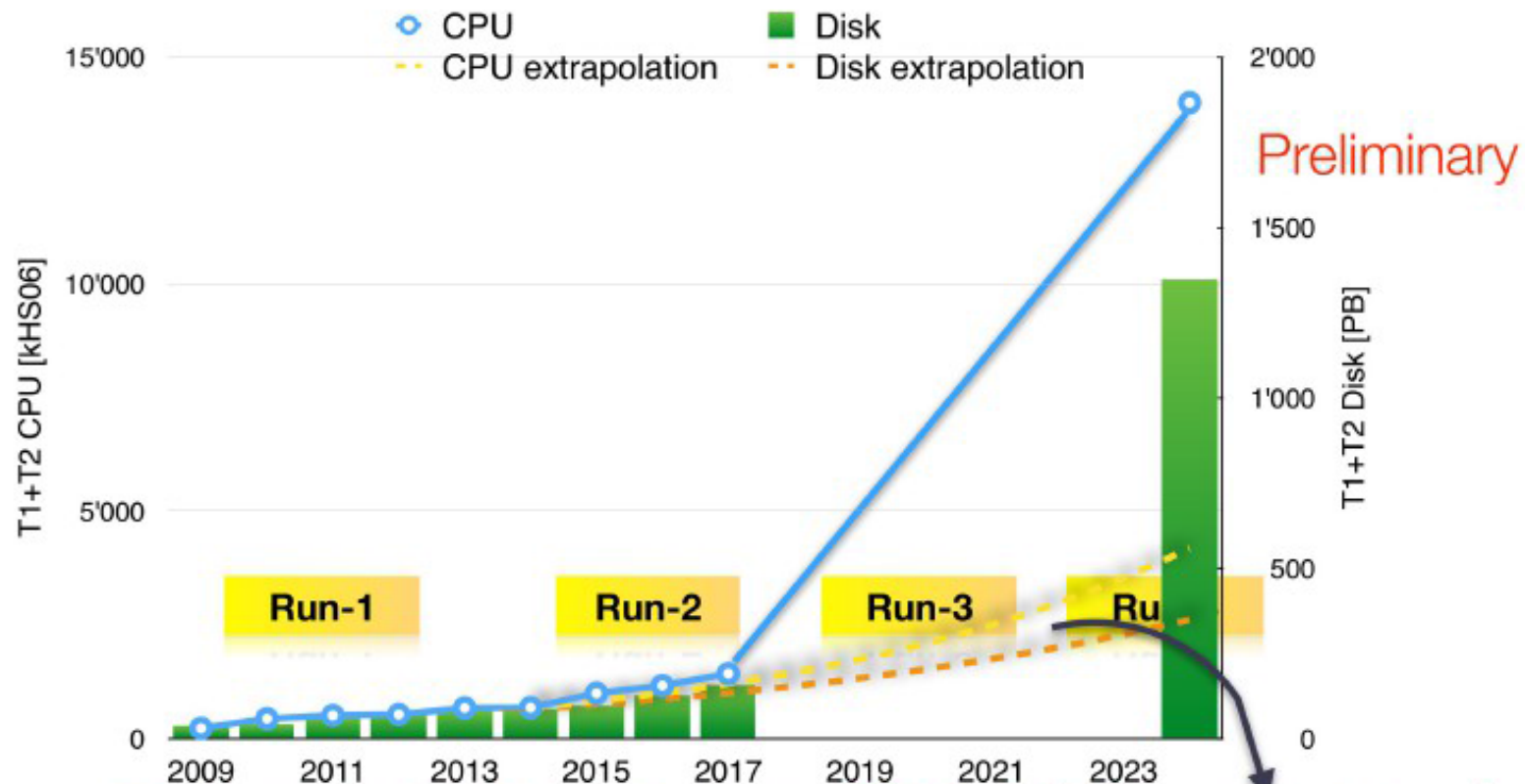
## Is Moore's Law Ending?





# Future may be even more challenging

## ATLAS resource needs at T1s & T2s



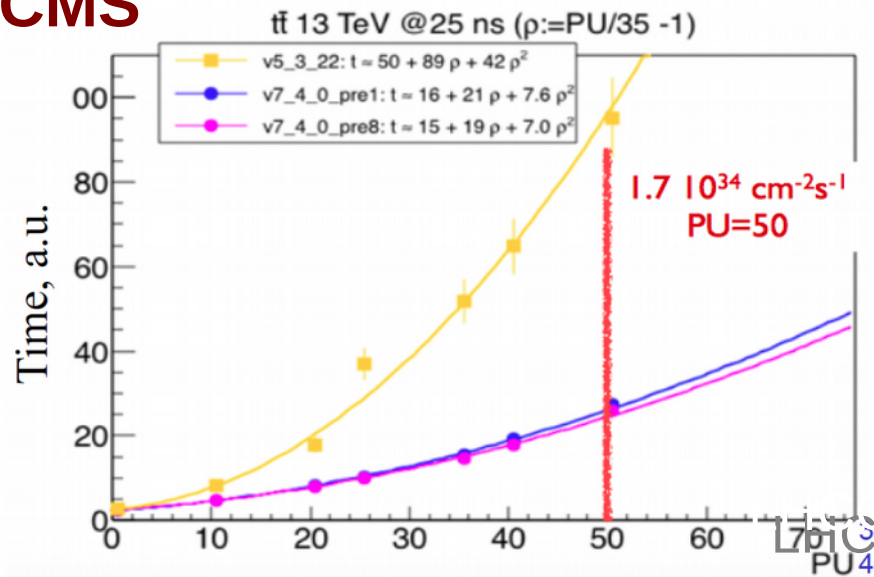
**Extrapolation from 2014 (Moore law)**



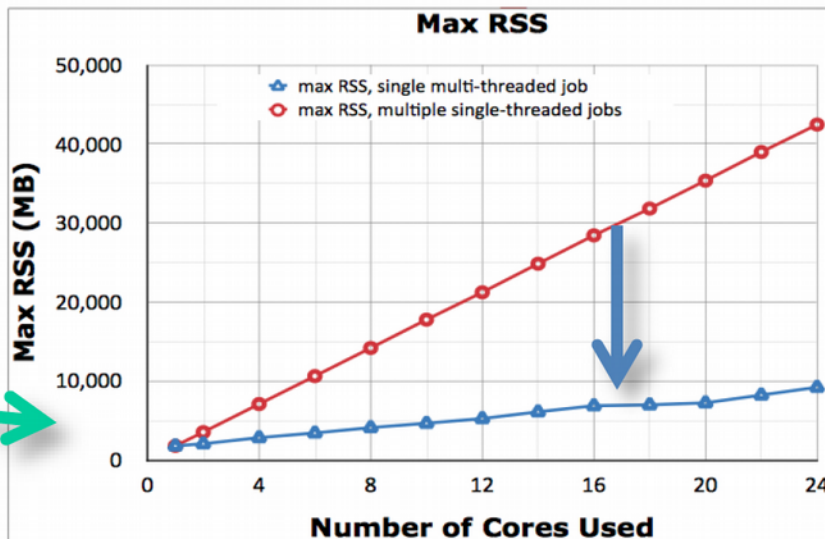
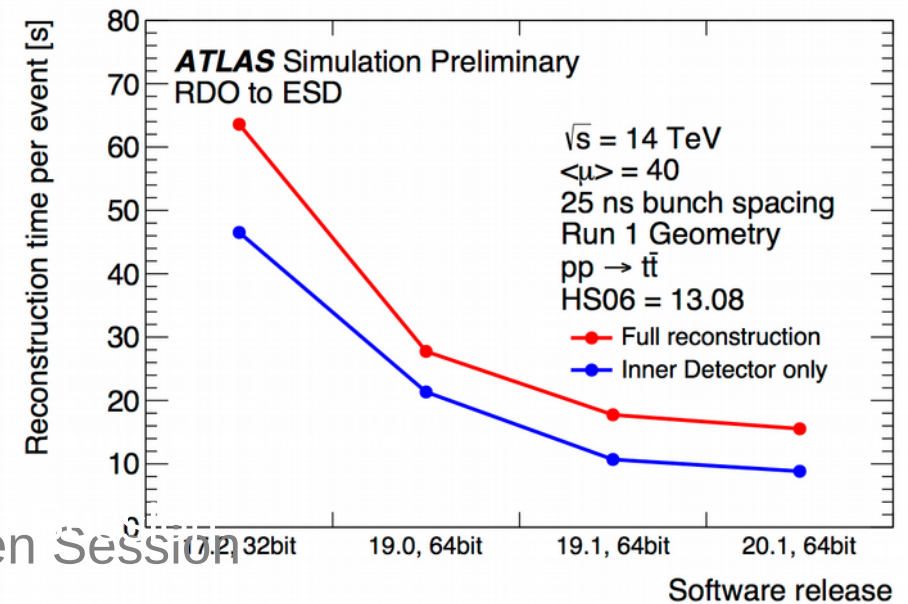
Eric Lançon on behalf of the ATLAS collaboration

# the pay off: recent achievements at LHC

**CMS**

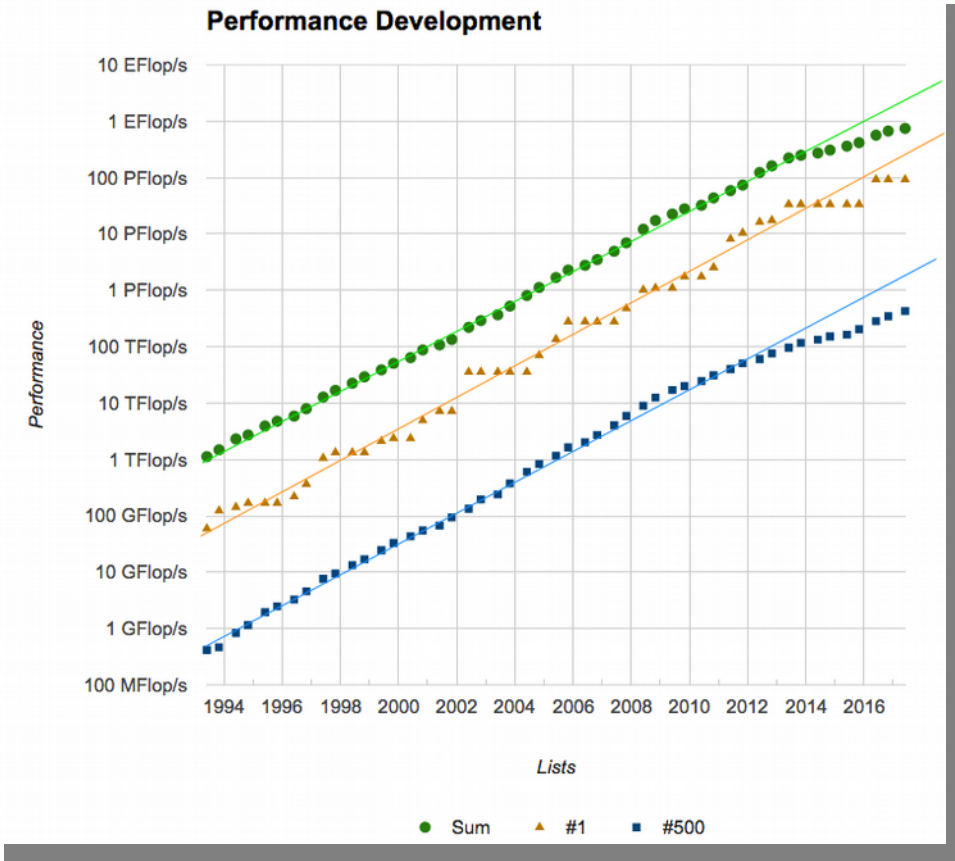


**ATLAS**



# a look at HPC computing

- ◆ the next big milestones for HPC systems is Exascale computing
  - × 1000 PFlops, 1000 PBytes
- ◆ we are progressing towards the goal, although at reduced pace
- ◆ however, **no supercomputer runs real applications faster than five percent of its 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**”



# The School evolution

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- ◆ 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: **memory management** and **parallel processing**



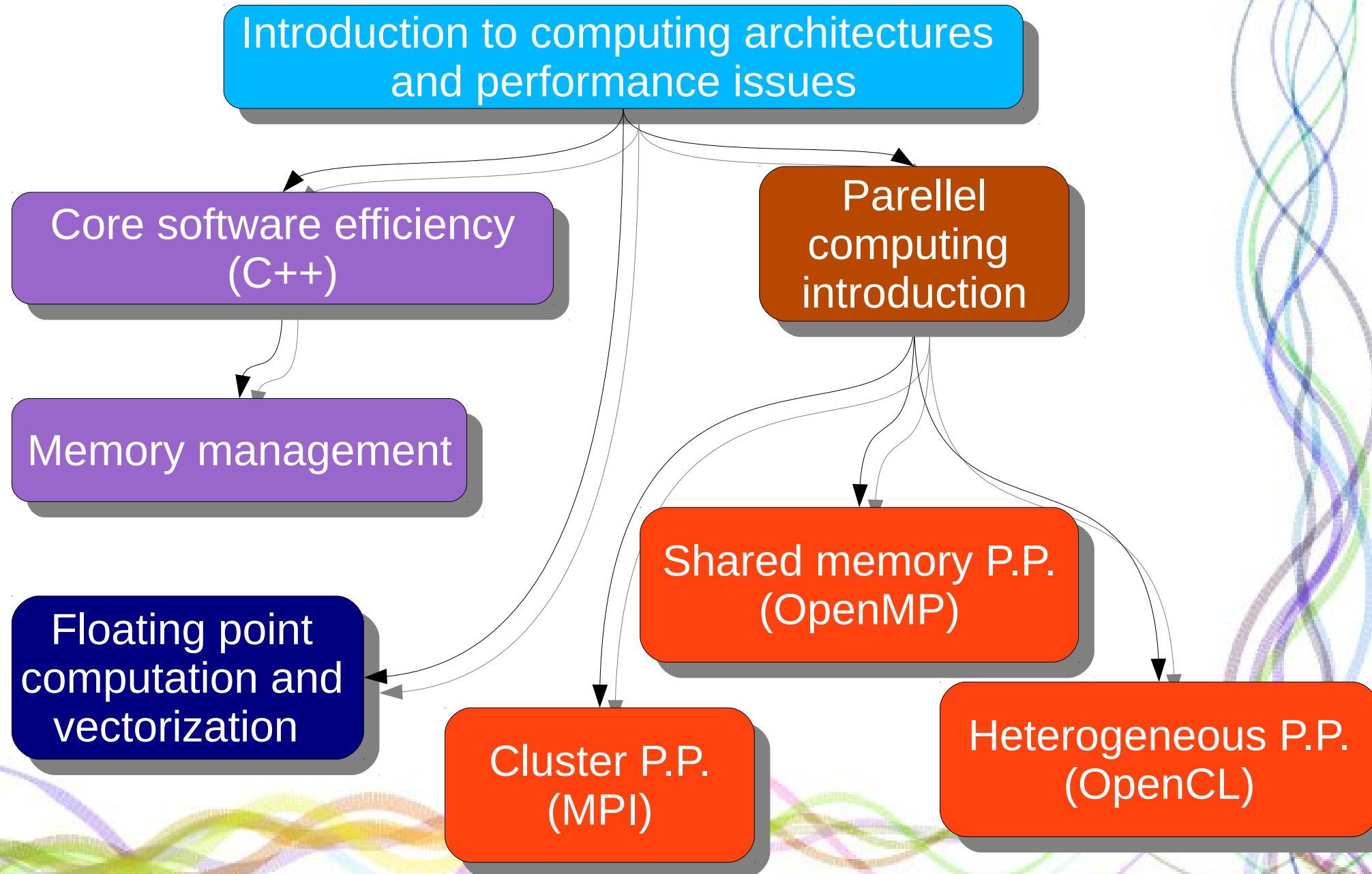
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The 2017 edition



# ESC16 School lecture plan

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# Improving the School

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- ◆ 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:
  - x the **perceived quality** of various aspects of the School
    - ◆ feedback questionnaire
  - x the **competences you have acquired**
    - ◆ final test
    - ◆ a piece of information that is of course **valuable to us too**

# Consolidation time

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- ◆ 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 9h30', i.e.:

x Mo.: 30'

x Tu.: 1h30'

x Wed., Fri.: 2h30'

x Thu. : 2h45'



# Evening lectures

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- ◆ Thursday:

- ✕ Piero Altoè - Nvidia:

- Exploitation of parallel processing in AI applications**

- ◆ Friday:

- ✕ Tim Mattson - Intel

- Surviving the Red Queen's Race: A guide for the perplexed programmer**

# The week together

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- ◆ thank you for preparing the **lightning talks and bringing here your posters !**
  - x we have received slides from **most participants** (21 )
    - ◆ please send us the the missing slides by 2 pm today
- ◆ after the lectures... you **can stay here** until dinner time
- ◆ dinners: on Mon., Tue., Wed. you can organize yourself and **enjoy what local restaurants have to offer**
  - x **a list of restaurants has been distributed** together with the **vouchers** worth 25 €
    - ◆ check which restaurant are closed on Mondays!
  - x if you tell the restaurant that you have the voucher they will usually propose a fixed-cost menu
- ◆ there is a **large room** in the Guest House that is available if you want to stay there together after dinner

# Special events

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## On **Thursday night**

- ◆ **special dinner** at the “Casa Artusi”\* restaurant in Forlimpopoli
  - ✕ two menus available: **meat** or **fish**
  - ✕ please make your choice by today at noon and report any special food requirement

## On **Wednesday afternoon** :

- ◆ **Visit** to the Bertinoro Fortress and the InterFaith museum

## On **Friday night**:

- ◆ **social dinner** “da Serafina”

\*Pellegrino Artusi: “The Science of Cooking and the Art of Fine dining - 1891”

# School computing infrastructure

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- ◆ 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
  - × located at the Padova INFN site
- ◆ **this year:**
  - × each of you will get exclusive access, through a **public login gateway** ([esc-gw.pd.infn.it](http://esc-gw.pd.infn.it)), to a **couple of Intel dual processors (Intel E5520) Linux** servers
  - × you will share the access to a server equipped with **8 Nvidia GPU (Tesla S2050)** for the OpenCL exercise

# Wireless networks

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- ◆ we have here two infrastructures:
  - ◆ **INFN wireless network**, available only in this room, accessed
    - ✗ using Eduroam credentials **[eduroam SSID]**
    - ✗ or via captive portal **[INFN-Captive SSID]**
      - ◆ you should already have the credentials
  - ◆ **Bertinoro wireless network**, available available in all rooms including the guest house **[CeUB SSID]**
    - ✗ credentials should have been given at registration time, otherwise ask Rossana



# Last but not least

**Meteo Bertinoro - Previsioni fino a 15 giorni** 

Emilia Romagna ▼ Forlì-Cesena (FC) ▼ Bertinoro ▼ Scopri di più: [Webcam e altro](#) ▼

Aggiornamento delle ore 7:00 - Prossimo alle 8:30

 Condividi la previsione  MALTEMPO verso Adriatiche e Sud

<b>Meteo Giornaliero</b>	<b>Lun 23</b>  7° 17°	<b>Mar 24</b>  6° 18°	<b>Mer 25</b>  7° 19°	<b>Gio 26</b>  8° 22°	<b>Ven 27</b>  9° 20°	<b>Sab 28</b>  10° 17°	<b>Dom 29</b>  7° 17°	<b>Fino al 6</b>
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**We wish you a very pleasant and  
“efficient” week in Bertinoro**