Future e^+e^- accelerators computing challenges and requirements

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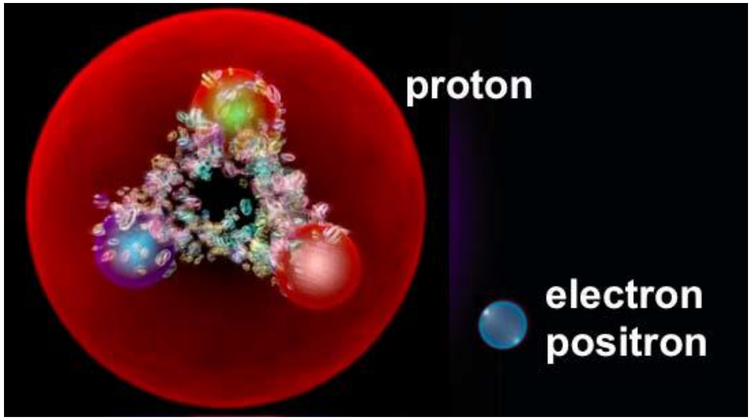
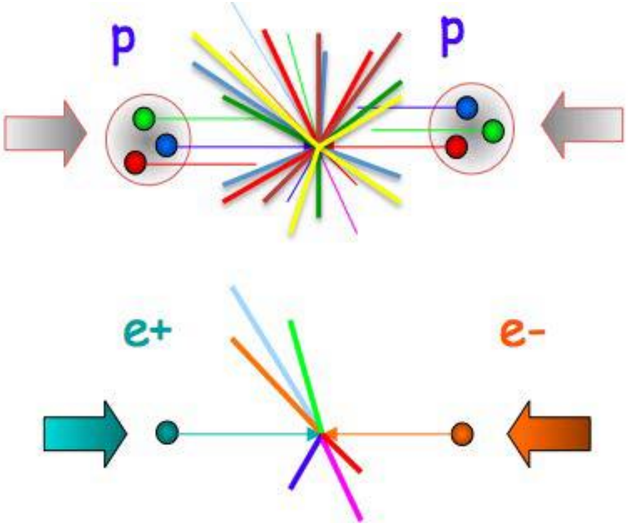
Advantages of e^+e^- colliders

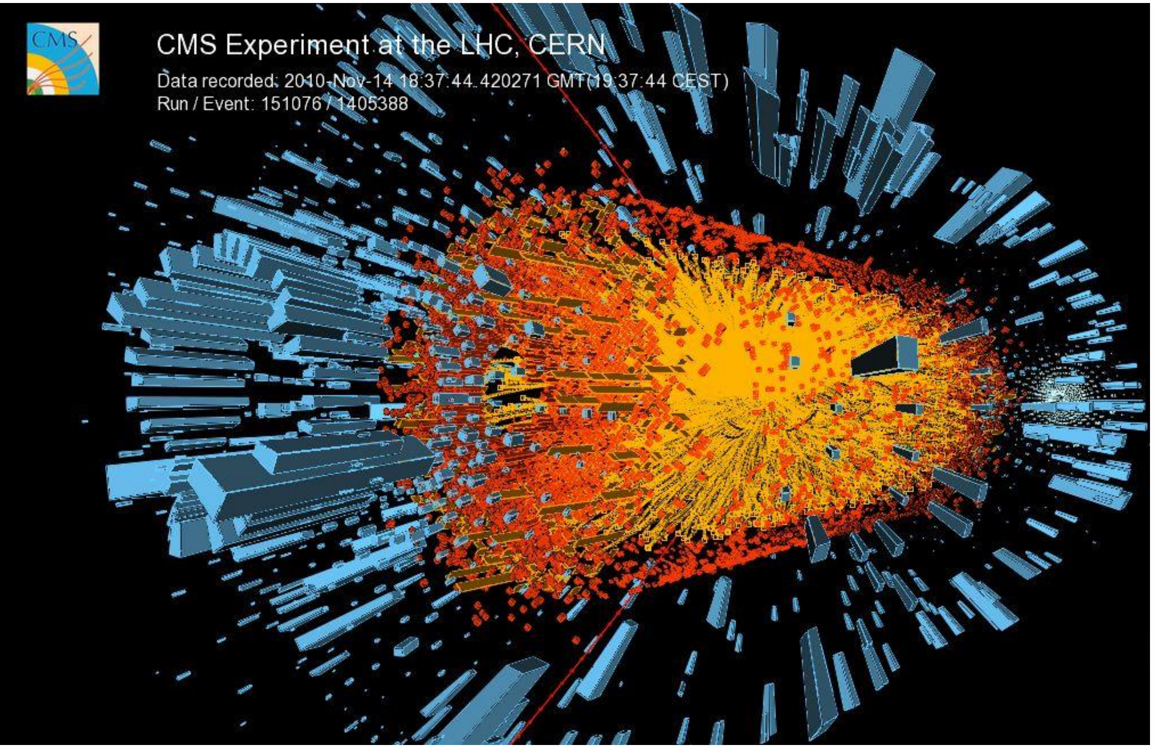




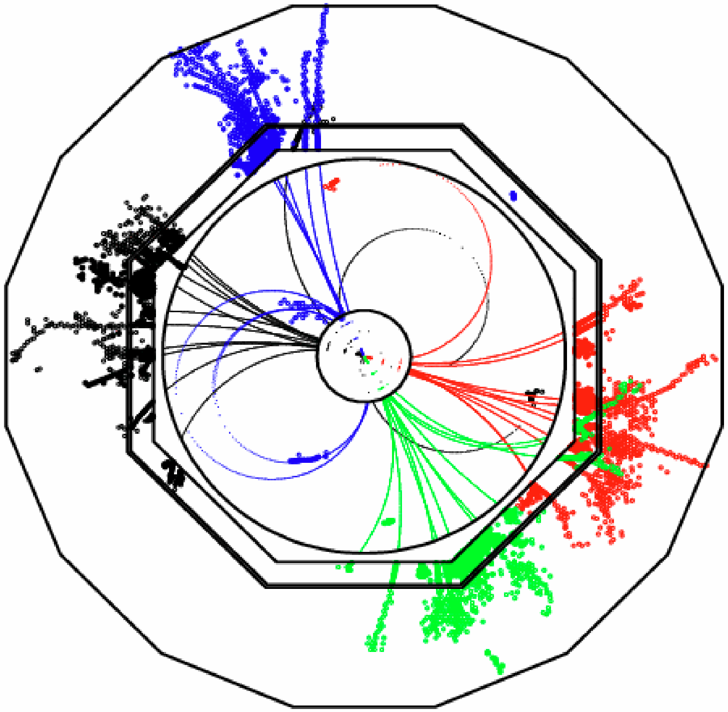
p-p collisions	e^+e^- collisions
Proton is compound object • Initial state not known (variety of processes) • Limits achievable precision	e^+/e^- are point-like • Initial state well defined • High-precision measurements
High rates of QCD backgrounds • Complex triggering schemes • High levels of radiation	Cleaner experimental environment • Trigger-less readout • Low radiation levels
High cross-sections for colored-states	Superior sensitivity for electro-weak states

Hammer vs scalpel

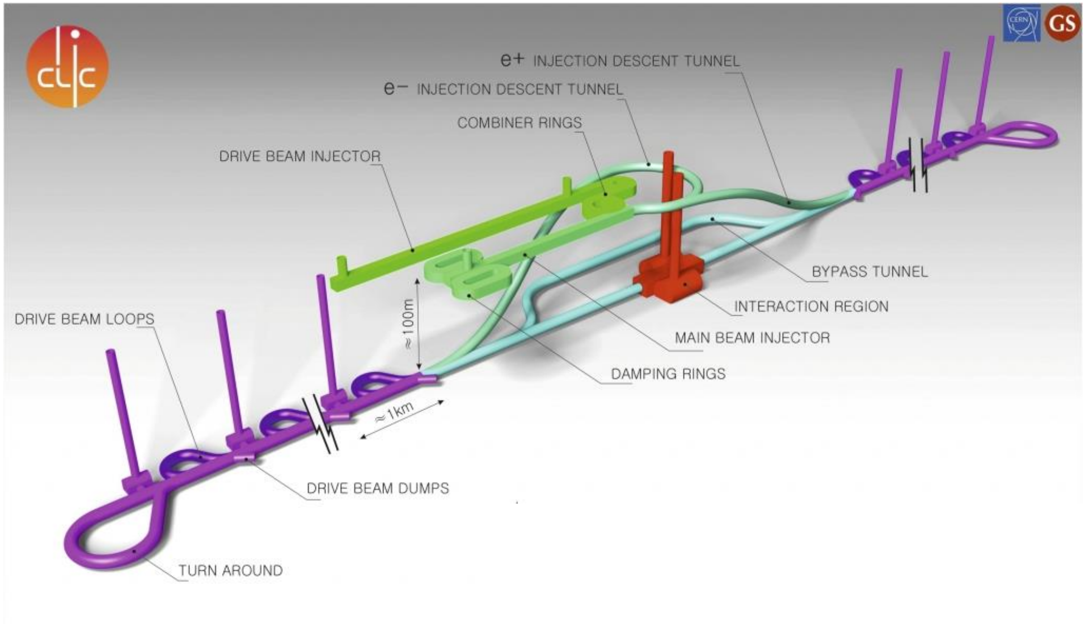
Hammer: LHC



Scalpel: e^+e^- collider

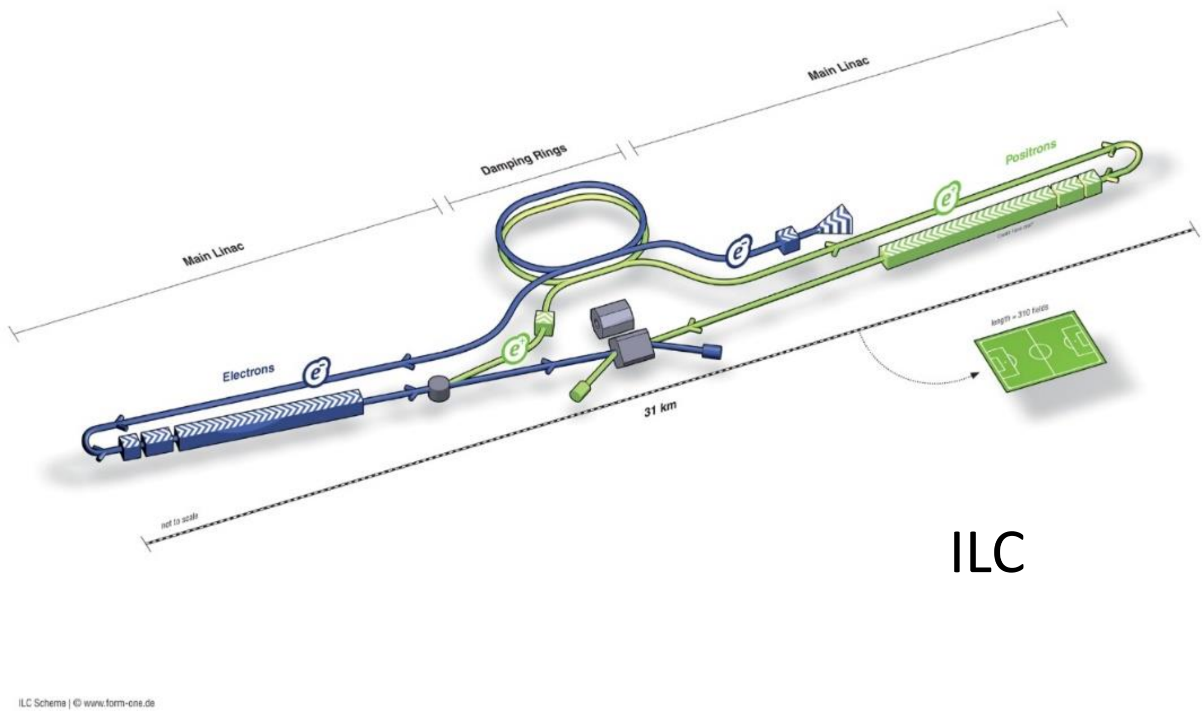


Projects of future e^+e^- colliders



CLIC SCHEMATIC
(not to scale)

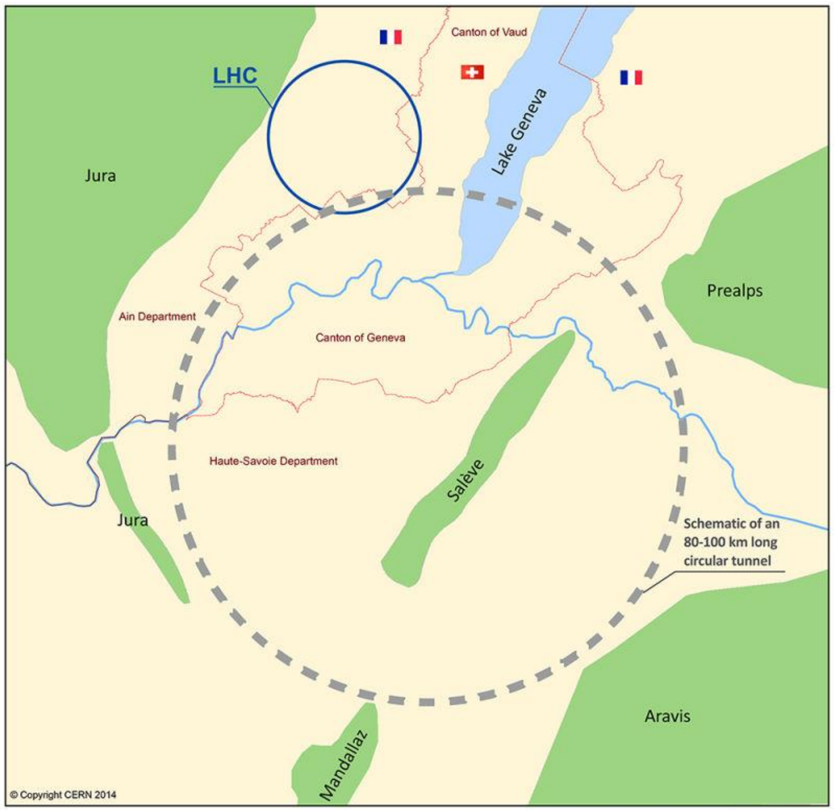
Linear colliders



ILC

Projects of future e^+e^- colliders

Circular colliders

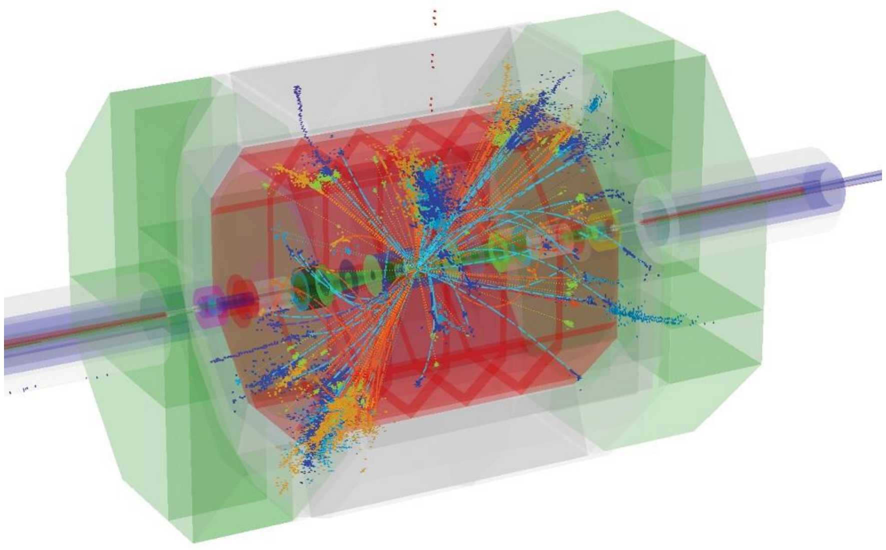


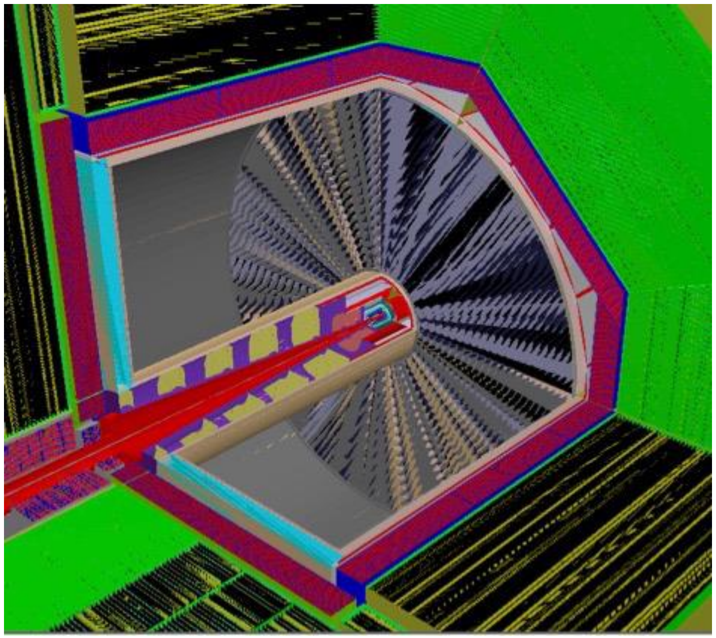
FCC-ee

CEPC

Challenges for the computing system

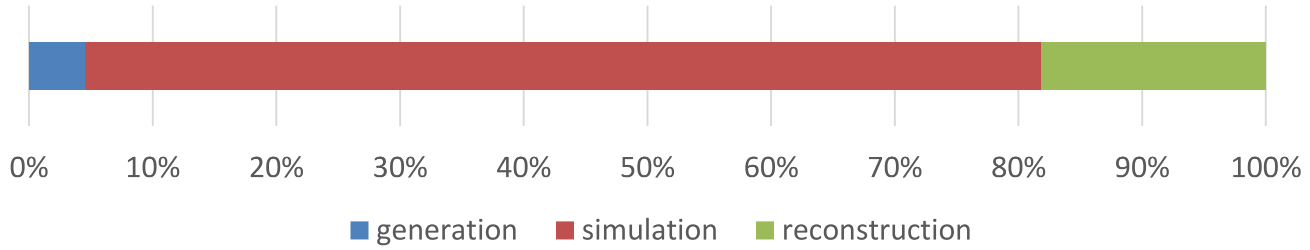
- Exploring the opportunities which would be provided by the future e^+e^- colliders needs large scale Monte Carlo simulations
- Monte Carlo studies are performed for:
  - physics benchmarks
  - detector optimization – variations of individual detector parameters
  - test beam data analysis





Monte Carlo production

- The Monte Carlo (MC) production campaign was the largest consumer of resources. There are three job types:
  - MC generation – to generate particles,
  - MC simulation – to simulate interaction of particles with the detectors,
  - MC reconstruction – to reconstruct observable from deposited energy in detectors.



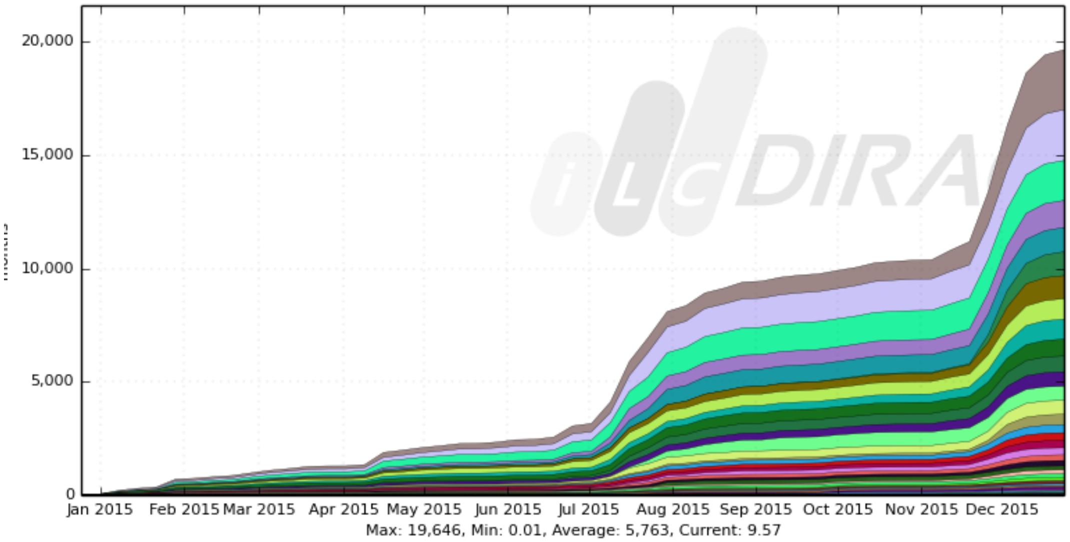
Software developing

- The new simulation framework was created.
- Integration of ILC Software with DIRAC – iLCDirac
- Easy interfaces for users to create and send jobs

```
from DIRAC.Core.Base import Script
Script.parseCommandLine()
import UserJob
import Marlin
import DiracILC
d = DiracILC()
j = UserJob()
j.setOutputSandbox("recEvents.slcio")
m = Marlin()
m.setVersion("ILCSoft-01-17-09")
m.setSteeringFile("Steering.xml")
m.setInputFile("SimEvents.slcio")
j.append(m)
j.submit(d)
```

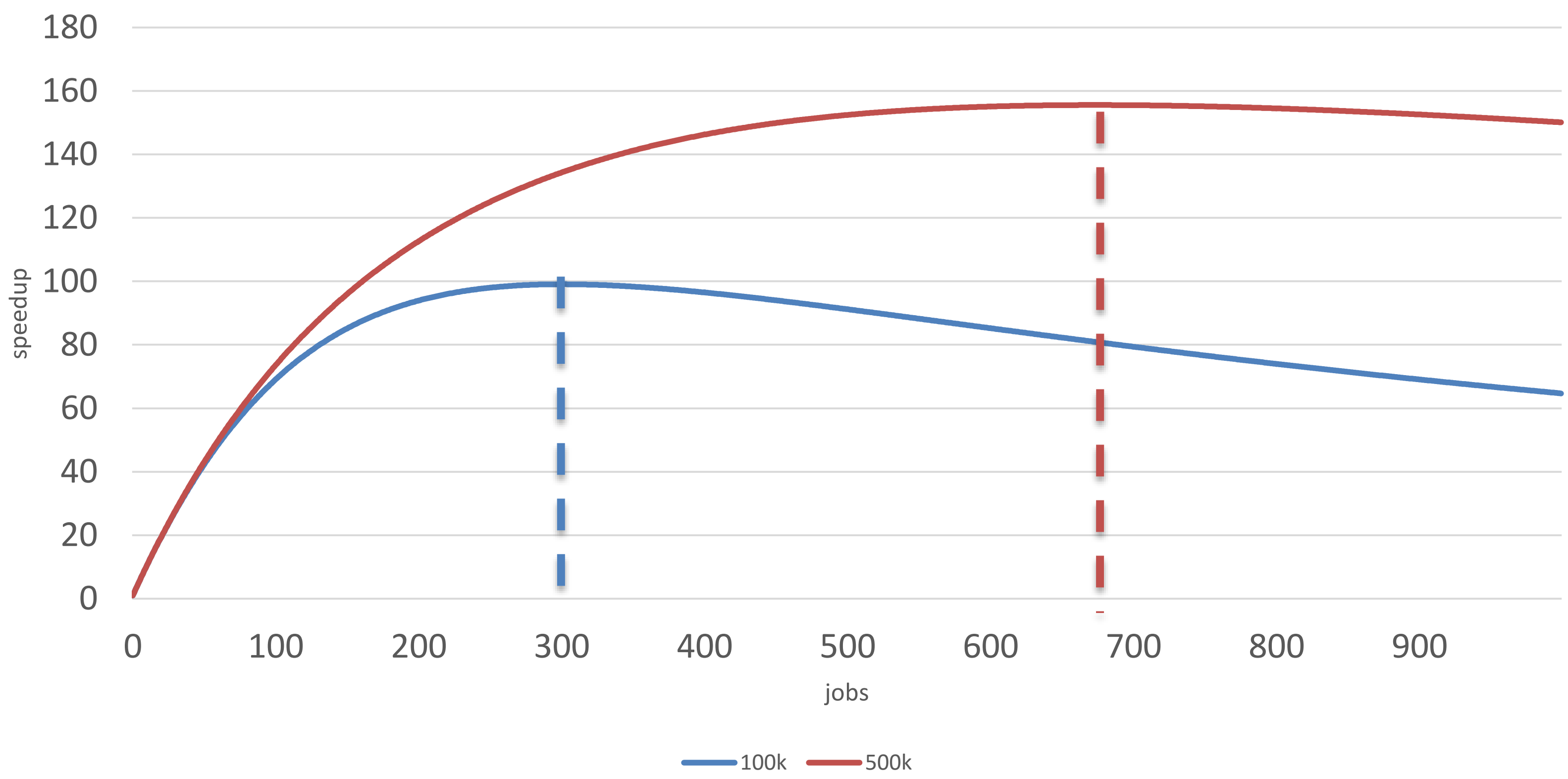
Computing resources

- 41 sites available on the world (including CYFRONET)
- Reached a peak of 20 000 jobs in parallel
- Overall consumed CPU time ~1700 CPU years in 2015.
- On the summer of 2016 the big MC production is planned → more resources will be required



Optimization

- Reduce size of produced data
  - Above 1PB – full MC events information
  - ~20TB – subset of the data required for most of physics analysis
- Computational granularity of jobs



Summary

- A new electron-positron accelerator is expected for future particle physics.
- Large amount cores and storage will be required for centralized MC production.
- Performance measurements and optimization are important.