
# IHEP with HSF

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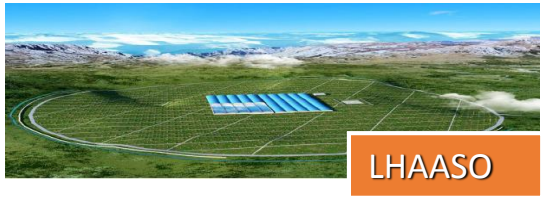
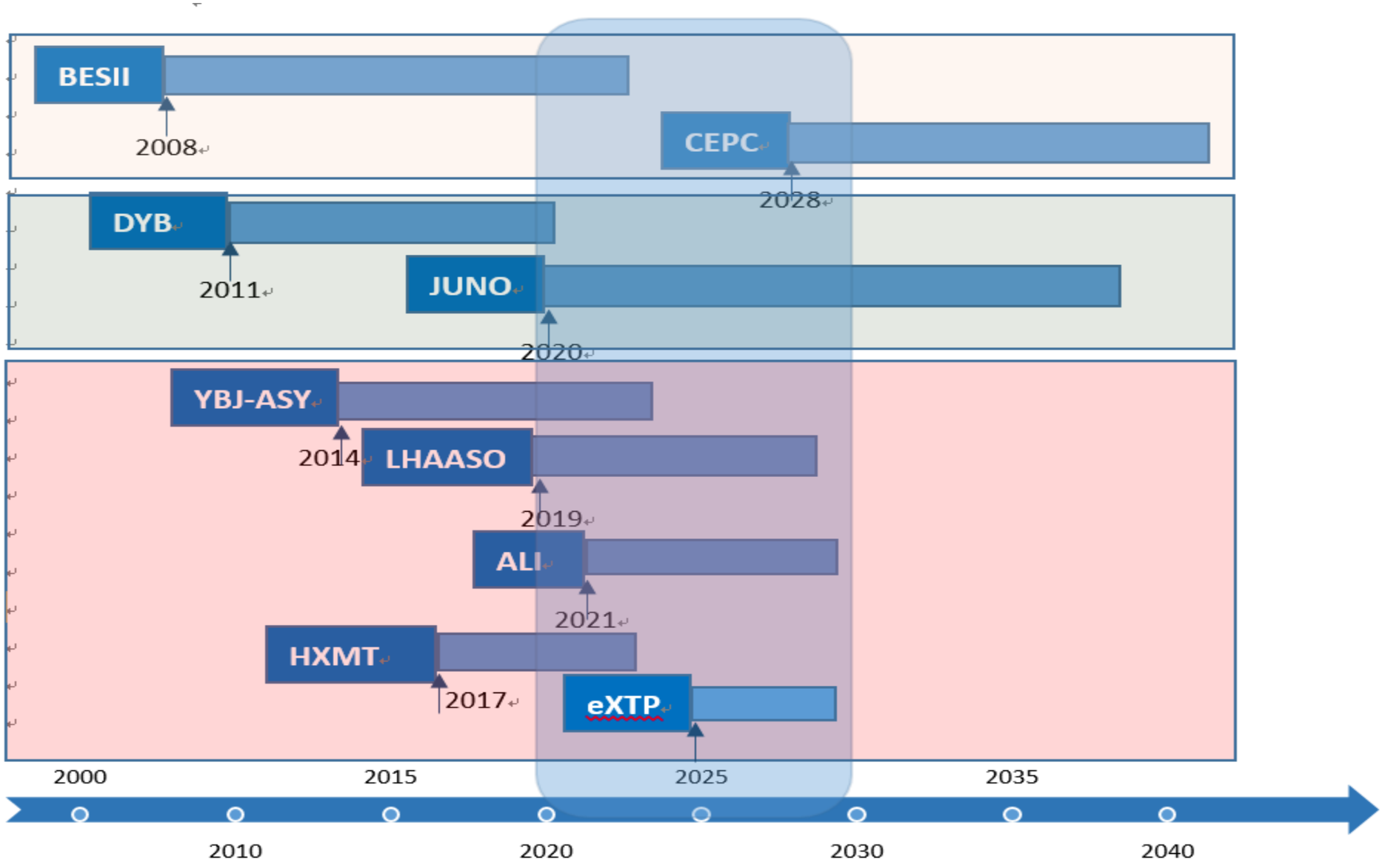
# IHEP Experiments (Reminder)

- Collider :
  - BESIII – Study physics on tau-charm energy region
  - CEPC – Precision measurement of the Higgs/Z boson
- Neutrino :
  - DayaBay – measurement of the missing angle
  - JUNO -- determine neutrino mass hierarchy and precisely measure oscillation parameters
- Astrophysics:
  - LHAASO -- detector array for high energy gamma ray and cosmic ray detection ( after YBJ)
  - Ali -- Observation of Gravitational Waves
  - HXMT/eXTP -- X-ray astronomy satellite for high energy astrophysical space observations



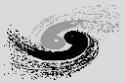

# Time line （Reminder）



# IHEP software and computing team

- IHEP software team (mainly from experiments, also from computing center)
  - BESIII
  - JUNO
  - CEPC
- IHEP computing team (from IHEP computing center)
  - HTCondor Cluster
  - Storage ( Lustre, EOS, Castor)
  - Network
  - Database and Web services
  - Distributed computing
- ~20 staffs for software, ~37 staffs for computing

# BESIII software (1)



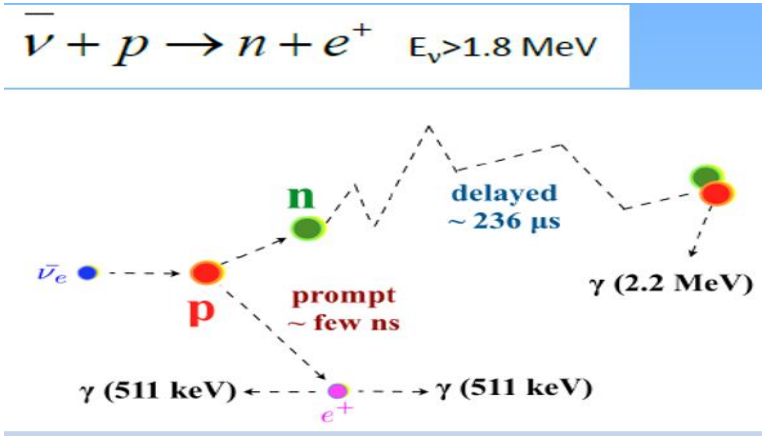
- BESIII is in its 10th year and software is mostly stable
  - Use Gaudi as the underlying software framework from the beginning
- With large aggregated data, analysis will become a significant part of BESIII data processing
- I/O is bottleneck for physics analysis
- Some studies on speeding up analysis already started a few years ago
  - Partial Waves Analysis with GPU
    - Got experience, but only used by small groups due to complexity
    - Would like to extend it to the whole group in an easy way
  - High performance analysis clusters based on Hadoop
    - BESIII Physical Analysis on Hadoop Platform (CHEP2103)

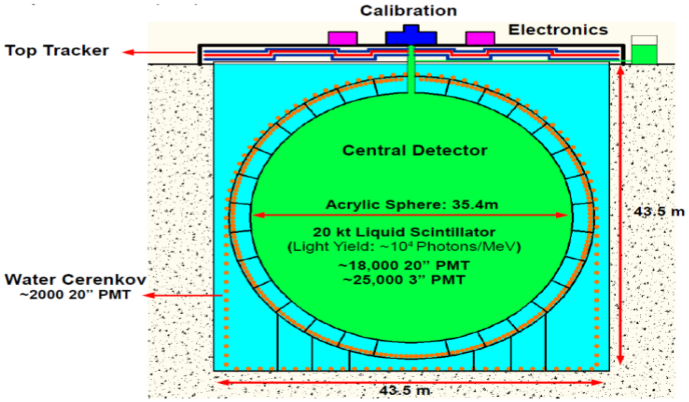
# BESIII software (2)

- Data analysis would be their interested points
- In the following 2 years, inner chamber of MDC is planned to be upgraded with CGEM, development of corresponding software is one of main task.
  - The research of application of machine learning in PID or tracking is ongoing
  - They are also interested in ML for recontruction
- Also interested in Gaudi new features on Accelerator and Multi-threading

# JUNO software (1)

- JUNO takes data in 2021, the largest software group in IHEP
  - Work on framework, simulation, reconstruction
- The central detector is made of liquid scintillator (LS) and ~18,000 PMTs
  - For such a large LS detector, the rate of cosmic muons reaching the inner detector is about 3 Hz
- Crucial part or special requirement of the experiment
  - Understanding muon induced background, one 100Gev comic Muon create several millions of optical photons
  - Event correlation, analysis has to cover more than one event in one loop

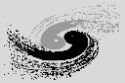


# JUNO software (2)

- SNiPER framework was developed to meet special requirements of Neutrino program
  - Multi I/O stream, Event correlation and Hits mixing
  - Light-weighted and simple, becoming a common framework for IHEP medium and small experiments
- Simulation of massive optical photons produced by Muon push us to consider efforts on parallelism
  - Multi-threading with Geant4.10.x, future with GeantV
  - Full simulation using massive parallelism with GPU
  - Fast simulation with Machine Learning
- In Reconstruction, precisely rejecting muon induced background is the hard part due to complexity of effects of optical photons in LS
  - Start to try CNN for Muon Reconstruction

# Cooperation interests in JUNO



- In software framework, from framework level
  - Support multi-thread, multi-process, ML, GPU and other heterogeneous infrastructures
- In simulation, reconstruction and analysis
  - Parallelism and ML to speed up
- Also need common Condition Database Infrastructure
  - Discuss with crest, cms condb, frontier on the HSF condition data solution as JUNO condb infrastructure

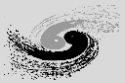
# CEPC software

- CEPC software is still in its early stage
- Would like to benefit efforts from HL_LHC
  - Common infrastructure and tools
- Currently interested in
  - Future software framework, Gaudi?
  - Geometry description, DD4HEP?
  - Packaging tool

# Summary for software

- Generally speaking, Framework, Data Analysis, Reconstruction, Simulation, packaging tools are all what we are interested in
- But different experiments have different focuses because of man power
- Ways of joining from IHEP side
  - Closely combined with what experiments need
    - Eg. Parallelism to solve Muon problem
  - Closely combined with the funding supported
    - Eg. NFS and CAS supports HPC, ML applications in HEP
- Software group in IHEP are keen to join, but need time to eventually fit in the working mode
  - Can start from one or two points, eg. CEPC work on DD4HEP
- Workshop and tutorial in IHEP or China can be a good way to deepen the cooperation

# IHEP Distributed Computing (1)



- IHEP distributed computing is built in 2014 for BESIII, then JUNO and CEPC
  - Integrate resources from collaborations and commercial resources
- With very limited manpower (1~3 people), make things as easy as possible
  - Adopt DIRAC as WMS, simple and flexible
  - Simple computing model, allow sites to join just as clusters, one big data center……
  - Anyway, just “easy” grid
- Good cooperation with DIRAC community
  - Join DIRAC consortium in 2016
  - Benefit a lot from DIRAC
  - Join the efforts on common need

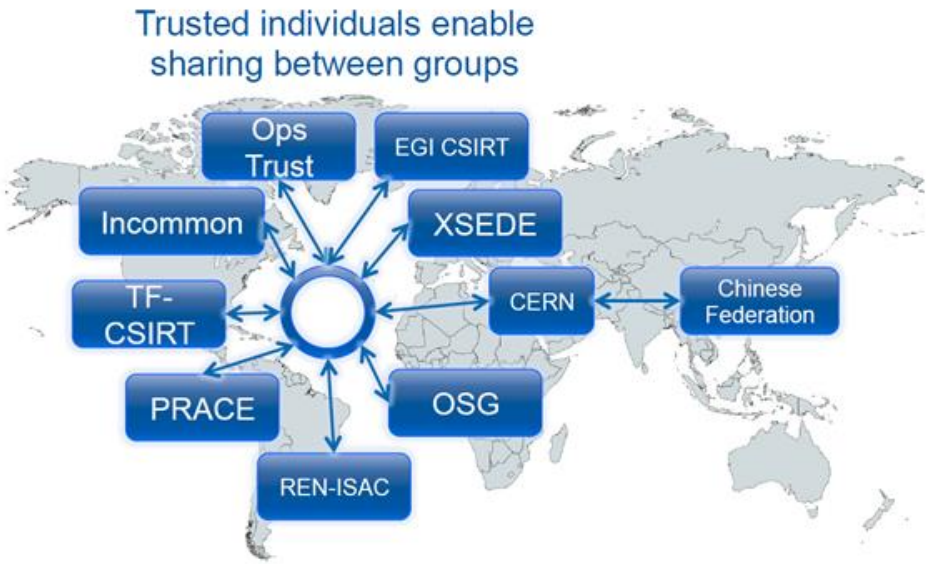
# IHEP Distributed Computing (2)

- Recent efforts and cooperation with DIRAC
  - Become a common infrastructure for multi-experiments
    - Work have been done on WMS and file catalog
    - Need more efforts on condition database, bookkeeping, monitoring, data transfer, production system……
  - Integrate more available resources
    - Done with Cloud, Cluster……
    - and also consider HPC
  - Multi-core supports for parallelized experiment software
    - Efficiency need to be further study with real use cases

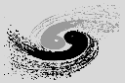
# Network and Cyber Security

- Cooperation on network and cyber security
  - Join LHCONE in 2018
  - IHEP established the Chinese cyber security federation in June 2016
  - Held the workshop on Cyber Security for HEP since 2017, sharing the workflow, experiences and knowledge on WLCG security

- Foreseeable further collaboration
  - Establish more comprehensive and practical solution in cyber security
  - Research on the new network technologies



# Summary for Distributed Computing



- Future experiment CEPC plans to use distributed computing as main way to organize resources
- It is important for us to follow WLCG working group on evolution of Scientific Computing Infrastructure for HEP, AAI, security, data management, etc.
- With limited power, could start as one of test points for WLCG new solutions in Asia
  - Could have more contributions and involve in developments if group and funding grew
- Currently pay attention to the DOMA and AAI working group
  - Common data federation, data transfer, data management solutions
  - Interested in joining AAI federation
  - Meeting mostly in US and Europe time zone, not easy to join, one difficult part

# Summary

- IHEP software and computing group are interested in joining HSF working groups
  - Our experiments share common concerns as LHC
- Already have some involvements, but not so much
  - Have people join HSF workshop, but few
- Need time and ways to get more involved
  - Familiar with working mode of the working group
  - Get more involved the activities of working group
  - Small group of workshop and tutorials in China would be helpful
- Would be more focus on fields what our funding supports and our experiments currently need