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 reconstruction

- 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
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 manpower.

- 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
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
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.
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