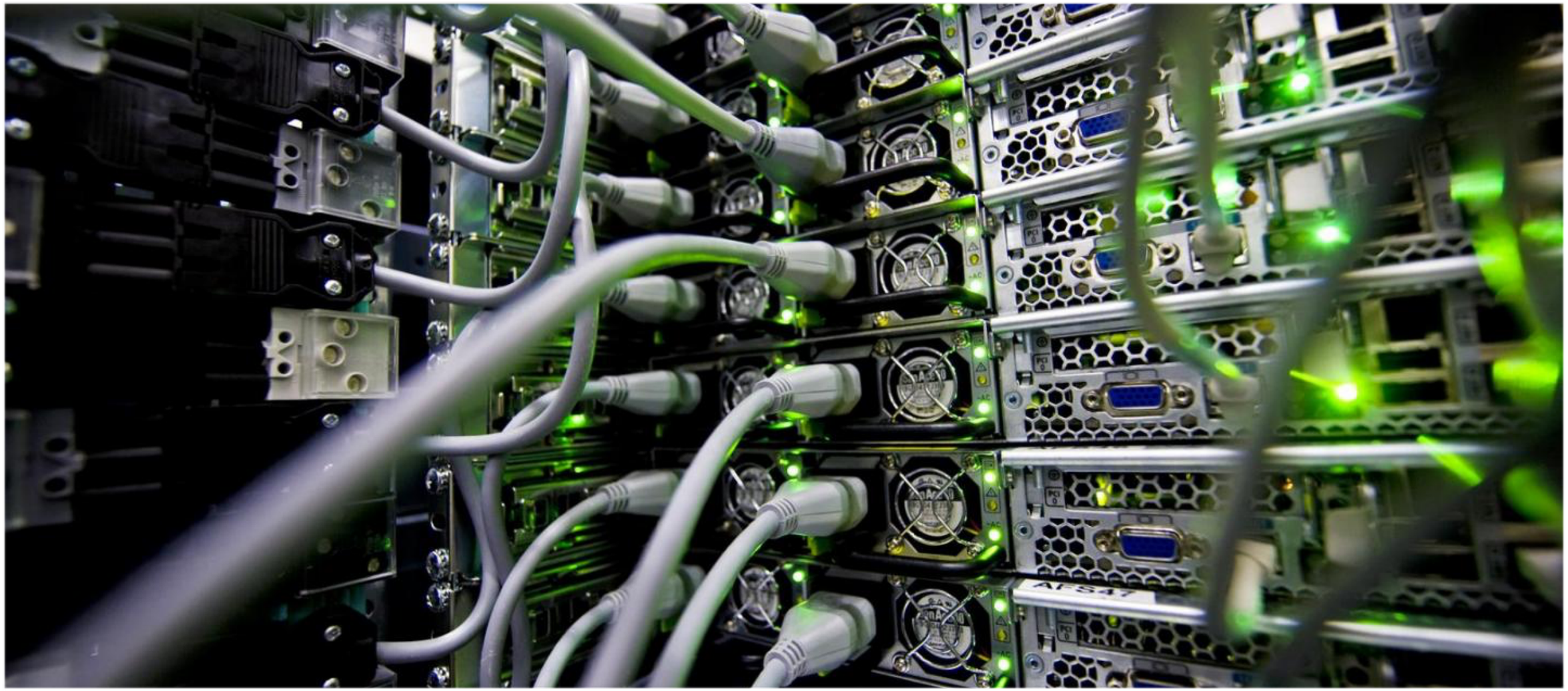

TIDC workshop on Future detector R&D for HEP

DISCUSSIONS: COMPUTING FOR HEP IN TAIWAN

Kai-Feng Chen
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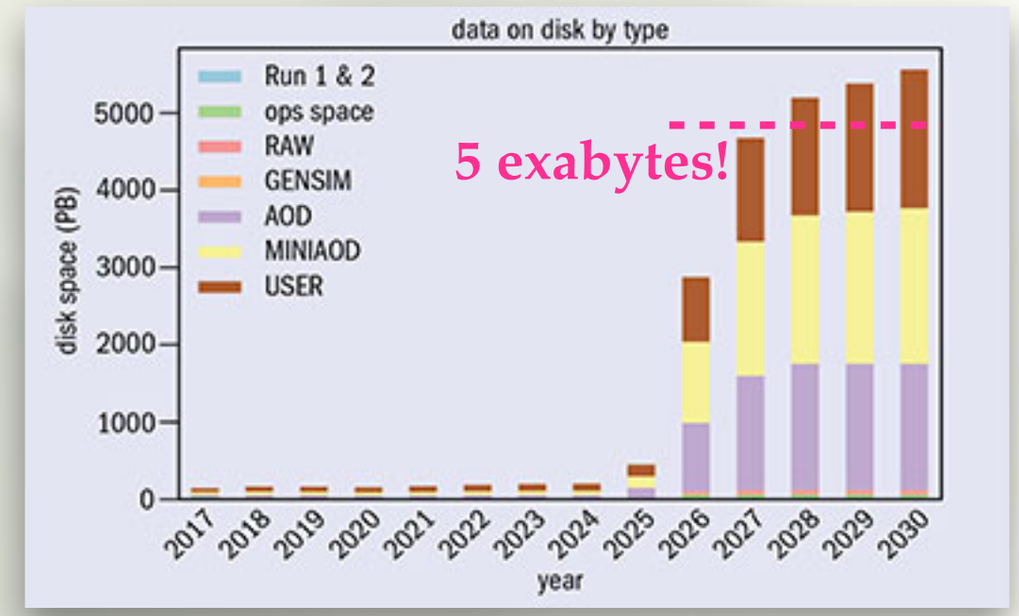
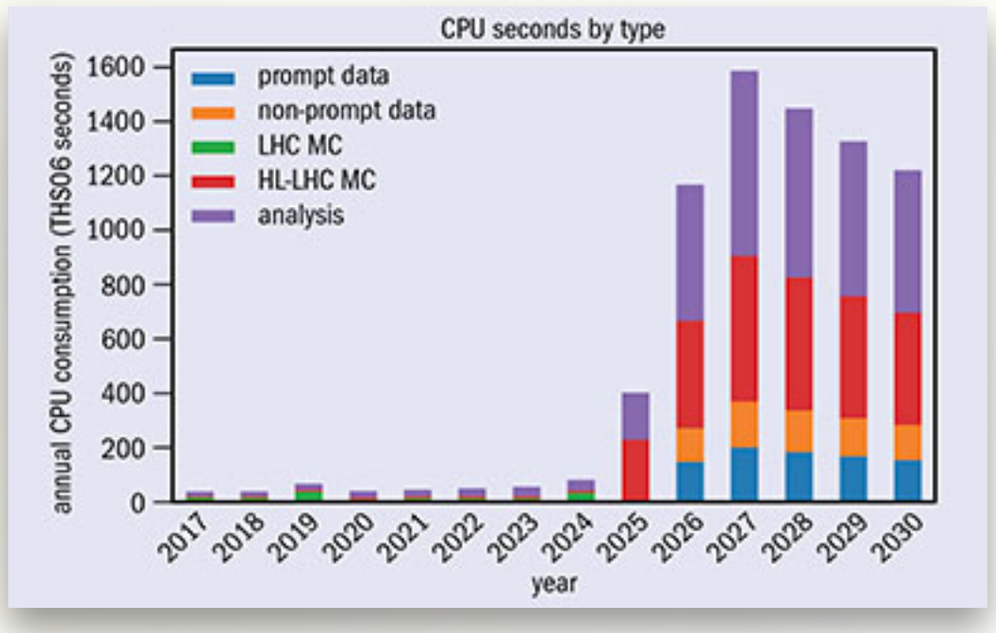
HEP Computing Needs

- Just like we are preparing the new detectors for upcoming HEP experiments, computing is also an important resource for future experiments.
- For example, CMS @ HL-LHC — *factor of 20 increases > 2027*:





  - Similar scale for other experiments too! Need a strong computing support otherwise any data processing & analysis will not work out.

Computing Tasks

- The following tasks/workflow are considered as essential part of HEP computing (LHC-like grid model):

Data Production

Process/reconstruct the raw data collected by the experiments to be a format that can be analyzed. Usually carried out at grid Tier 1 centers.

Monte Carlo Production

Produce the simulated data based on the known physics models and simulated for detector responses. Running at Tier1/2 centers mostly.

Analysis Processing

Convert the data with user analyzer to some compact format (e.g. ntuples) for specific physics target. Mostly at Tier 2/3, or even Tier 1.

Ending Analysis

Loop over the compact data and extract physics information, fitting, produce plots etc. Can be performed on local cluster/ Tier3, or user PCs.

Different experiments can be different constraints and challenges!

The Conditions

- Preparing computing supports are not just buying a lot of computing nodes, connect to electricity power and internet.
- If we want to build our own cluster(s):
  - Where are we going to install the nodes? What's the cost of the room operation and cooling?
  - What kind of computing nodes we want to have? How much and want kind of storage we need?
  - Do we need high-speed connections between nodes and storage, between nodes and outside?
  - The most important: **who is going to operate and maintain the system?** Installing several Linux boxes is completely different from maintaining a professional cluster.
  - …and when/how to upgrade?
- Or, just to purchase the computing power from cloud services providers. But it may not fully fit the needs (e.g. require special configuration to run as grid services, very expansive storage services)…

What do we have now?

- **Shared world-wide grid services.**
- **Academia Sinica Grid-computing Centre (ASGC)**
  - Thanks ASGC for providing grid services and in particular for maintaining the network connections between AS and CERN.
  - **ASGC preserves the know-how and keeping training experts too.**
- **National Center for High-performance Computing (NCHC)**
  - Hosting CMS T2 for now (***many thanks Dr. Chun-Yu Lin's great contributions to the operations!***)
- **Computing centers at universities**
  - e.g. NTUCC hosting the clusters for Belle-II.
- **Local Tier-3s/clusters** @ individual HEP groups.

How to preserve the resources / improve the efficiencies for future HEP computing is essential.

Points of Discussions

- **Can we integrate the computing resources in order to have a better support future HEP projects?**
  - Preserve the **important person power**, since maintaining those services is totally non-trivial!
  - Keep the operation costs (electricity, cooling, broken parts replacement) low / under control.
- **How to catch the rapid development of computation platform?**
  - The choice of classical HPC, CPU+GPU hybrid services, GPU servers, FPGA processors, TPU, etc.
  - Data storage is critical, what are the solutions practically?
- **Join the core development for future HEP computing too?** (e.g. contribute to the next generation service R&D, etc)
- **Collaborations with companies?** (Google, Amazon, cloud service providers, etc.)
- **Collaborations with other fields?** (data science, machine learning, etc.)

TIDC workshop on Future detector R&D for HEP

DISCUSSIONS: REVISION OF WHITE PAPER

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The HEP-ex White Paper

- May this year we have submitted the White Paper (WP) to the MOST. As a reminder, the main theme of the submitted WP is to
  - **Secure the TIDC supports as a regular MOST project;**
  - **Provide guidelines/regulations for future HEP-ex operations (on budget, project, PI transitions).**
  - Submitted/frozen draft: https://docs.google.com/document/d/16neOO5sko1rzCdHBnb7pQfvNUXJlGKXcaeBDHF2Hypc/edit#heading=h.8ak9rnq251jd
- Early this month we received the comments from MOST, with 7 dedicated reviewers. The full review (21 pages) is available below:
  - https://drive.google.com/file/d/1_YumkQicBu_gjMS43kD5S5vRasnJSLlv/view?usp=sharing
  - We have to host a formal meeting (*today, now*), discuss, and provide the responses and revision of WP.
- In order to digest the review easier, a summary of review comments prepared:
  - https://docs.google.com/document/d/1f-Q2x55dHRmx9--8Z6JEbLtAG2ZMrufgpq8z3c-MFTE/edit#heading=h.dtl32snrfduo

Endorsements

- Glad to find that the majority of the reviewers see the WP as a positive route for future HEP-ex field, e.g.:
  - The white paper has done an excellent job in addressing those timely issues.The duration is reasonable, and deserves the endorsement.
  - Planning of common facilities: **Sharing resources among HEP-ex PIs for the construction of TIDC and to secure the development of detector technology are excellent initiatives.**
  - Computation facilities are important infrastructures; both physicists and computer scientists can benefit from working together.
  - Consensus building in the HEP-ex community are affirmative: advocating collaborative efforts before embarking on new major activities can avoid over-committing resources.
  - **This White Paper aimed at setting guidelines for the future is healthy; budget regulations are certainly helpful.**

Issues

- Well, there are indeed issues (*problems/weak points*) raised by the reviewers:
  - The value of this white paper is not high as the **white paper should contain the planning and strategy for the future**, while only simple guidelines were proposed. The rules, which will come up naturally under tight resources, should not be the main point of the white paper.
  - The white paper does not discuss the weaknesses in the present program, and is **lacking in seriously assessing how to make Taiwan experimental physics more important** in the worldwide program in the future.

The two major points listed above are certainly true.

Comments & Suggestions (i)

HEP COMMUNITY-WISE:

- The HEP-ex community has to establish a congenial atmosphere. The success of the WP (budget guidelines, transitions of projects, etc.) heavily depends on the goodwill and unselfish support from all members.
- Should push Taiwan physicists and facilities to play more of a leadership role internationally.
- The budget guidelines might require minor revisions in the future based on community feedbacks.
- Recommend to turn some of the proposed guidelines into reasonable MOST policies.
- Suggest to figure out a scheme to work with astrophysicists (*e.g. ultrahigh energy cosmic rays, dark matter, gravitational waves*).

Comments & Suggestions (ii)

COMMON FACILITY OPERATIONS:

- Given the growing interest in non-accelerator experiments, use TIDC as a platform to develop new / related detector technology.
- The MOST grant distributes unevenly to each PI according to proposal evaluation and academic performance. There is a chance some PIs do not receive any grant, and the granted PIs may need to redistribute their budget for practical use.
  - ➡ This nontrivial process can be replaced by providing a separate wish list of common-facility items (CPU, boards, etc) in priority order to MOST.
- TIDC requires the power to execute or revise guidelines in WP, the HEP-ex community needs to have regular meetings or mechanisms to elect a coordinator / conductor.

Comments & Suggestions (iii)

PROJECT INITIATIVE:

- Taiwan HEP-ex PIs should take up the challenges to initiate truly original new ideas and experiments, led by the Taiwan group.
- Among the future colliders, only the EIC has been approved. A more active participation in sPHENIX or STAR-Forward deserves serious consideration.
- The need of collaborator and the provision of evidence on efforts of promotion made can be set as necessary requirements for calling a new project.
- To avoid duplicate efforts, the WP suggests to form a task force to decide which project to take, with external reviewers. This is hard to work out / difficult to execute practically.
- Suggest to implement a strong policy that no PI can be involved in more than 1 major project. Exceptional cases can be considered on a case-by-case basis.

Comments & Suggestions (iv)

EXPLICIT QUESTIONS:

- The white paper should address more serious issues, e.g., if CEPC or FCC-ee is approved, what will be the corresponding strategies of the HEP community? As personal power and budget will not grow much in the future, any existent or scheduled projects need to be adjusted? If yes, what and how?
- For new recruits: new recruits who can bring in new programs on important subjects require additional support from MOST. How realistic is it?

ACTION ITEMS:

1) Produce responses to all the points in the review summary;
2) Revise parts of WP accordingly and resubmit to the MOST.