Status in Japan

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for Japanese LCTPC group

- Status of LCTPC Japanese group
- General situation in Japan
  - ILC-Japan
  - KEK/IPNS Energy Frontier group
  - “Workspace” at KEK/IPNS

Current status of LCTPC Japanese group

- For LCTPC study in Japan, budget/human resources have been very limited for last few years. Especially, the absence of younger researcher has been a serious problem, so that we have not made much progress for a couple of years.

  Y. Aoki graduated with Ph.D in March
  K. Yumino will graduate in half a year
  A. Sugiyama will retire this March.

- LCTPC related activities at KEK/IPNS may be more limited from FY2023 due to changing the organization scheme and decreasing ILC member. *-> show details later*
- Our goal is still to move quickly toward an engineering design study for ILD/ILC.
- We are also considering the development of new technologies for a future detector.

Our R&D activities

Our immediate issue is to improve the performance of the Asian GEM module, we have developed so far, by optimizing the design and materials.

Remaining major issues

GEM module

- ✓ Improve gas gain uniformity
- ✓ Optimize the design and configuration of the module to resolve the field distortion around the module.
- ✓ Understand the spatial resolution in z (drift) direction.
- ✓ Improve 2-trk separation capability. (optimize the pad size)

Gate system

- ✓ Precise measurement of ion blocking power.
- ✓ Establishing the methods for mass production and quality control.
- ✓ Developing a HV pulser for gate control.

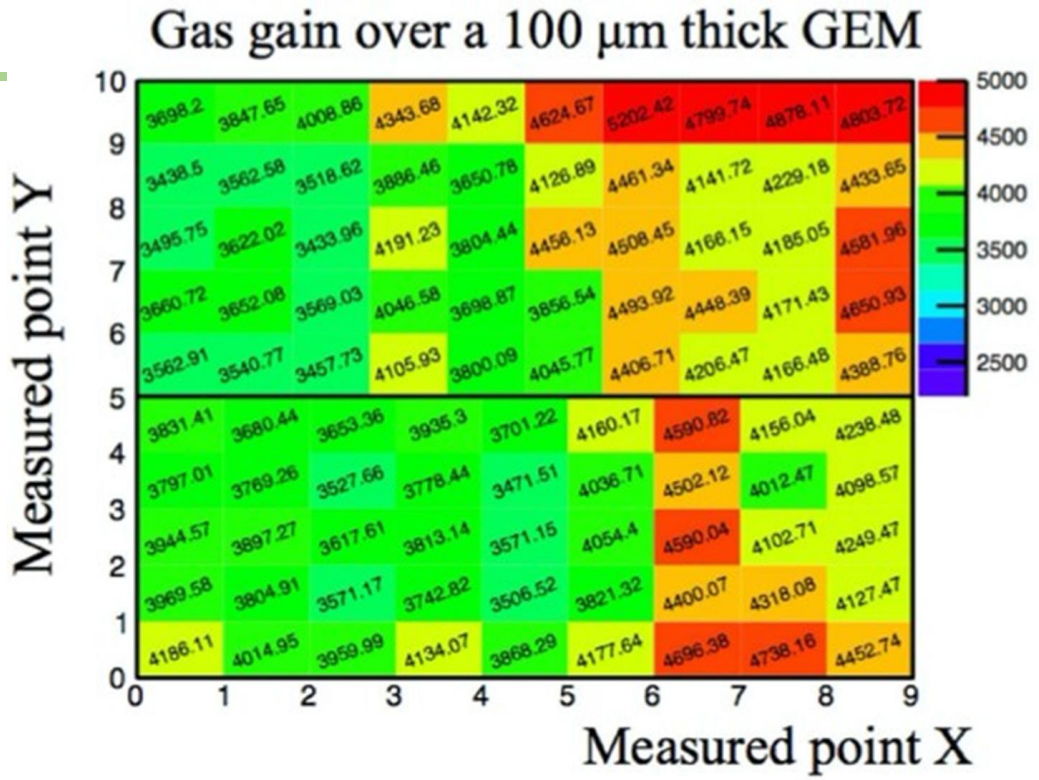
Readout system

- ✓ Electronics for GEM+pad readout.
- ✓ 2PCO2 cooling.

Improving gain uniformity

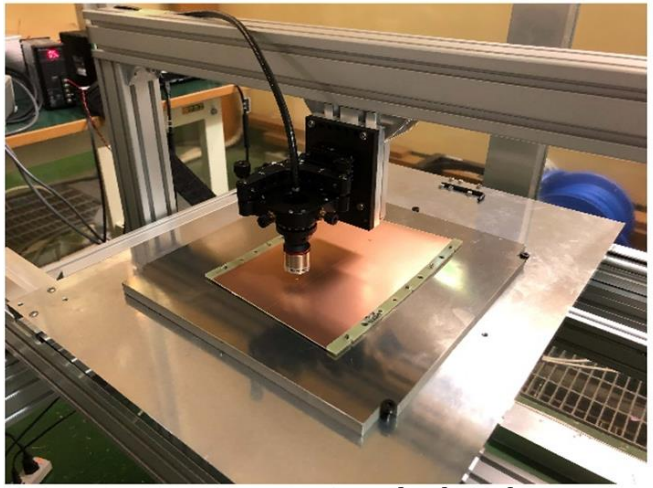
Non-uniformity of the gain has been found in our module.
Depending on the location, the difference can be 50% or more.

The main cause is considered to be non-uniformity of the GEM thickness.

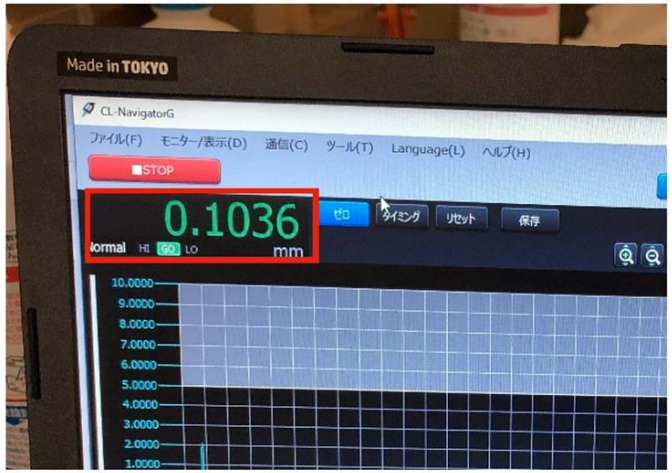


The system for precise measurement of the GEM thickness has been assembled and calibrated.

=> Will examine the correlation between the thickness and the gain.



100 μm nominal thickness



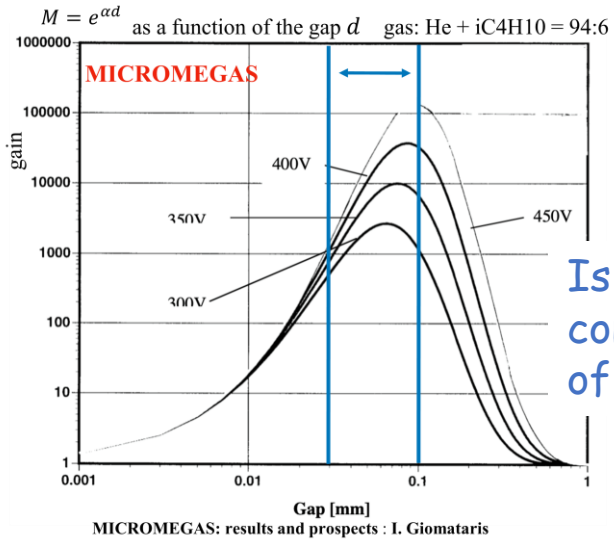
GEM design optimization

Studied by K. Yumino

Study of GEM design optimization has been performed by theoretical approach to find the conditions under which the thickness dependence of the gas gain is minimum.

Procedure

1) Find the plateau in the thickness dependence of gas gain.
2) Find the "stable conditions"
3) Verify the theory by comparing with Garfield++.



Is there a "Stability condition" in the case of GEM?

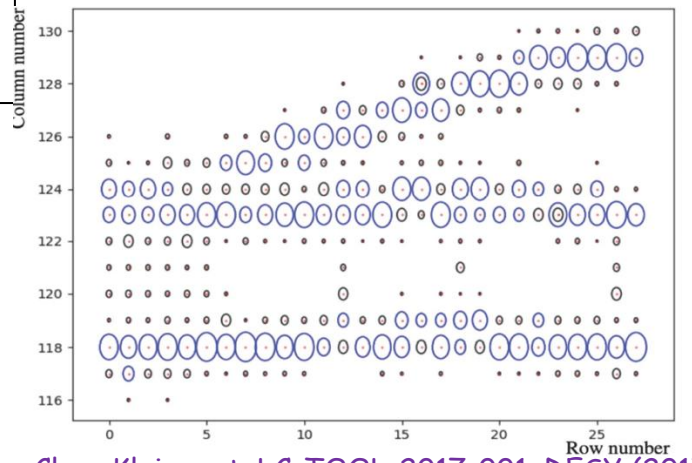
Current Status

- Applied theoretical model (Legler's model) to the simple configuration; parallel plates, but could not find "stable condition".
- Inconsistency in Townsend coefficient obtained by a base model (Alkhazov's model) and the Magboltz.
- A simple microscopic avalanche simulator, which is based on the cross-section data used in the Magboltz, has been developed. Then, we have found the ionization probability depends on z position (position in the drift direction).

Study of 2-trk separation capability using test beam data

2 track separation capability was examined overlaying 2 events of test beam data to make pseudo 2 close tracks.

Studied by R. Nodagashira



Claus Kleinwort, LC-TOOL-2017-001, DESY (2017)

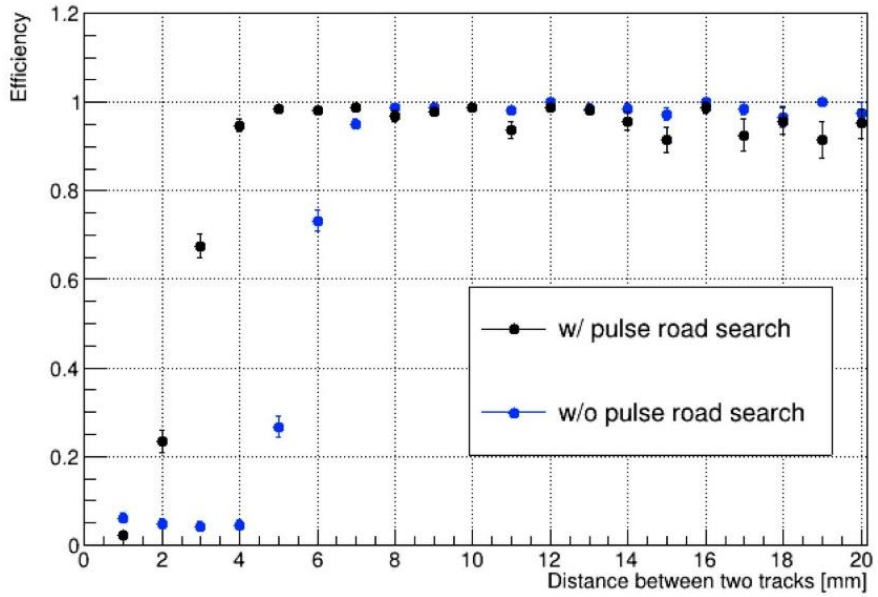
[Hit Finder]
Hit is defined from center of mass of the charge distribution in each pad row.

[Pulse Road Search]

- Track finding is initially performed using a "leading pulses". Here, the "leading pulses" are defined as pulses with charge above the average for a certain pulse charge.
- Pulses found are used for hit and track finding as seeds for initial track settings.

"Pulse Road Search" method can help the performance improve. The performance was improved by optimizing the parameters in PRS. However, further improve is needed for meet the LCTPC requirement. (sufficiently separated with a distance of ~2mm)

Efficiency in rϕ-direction

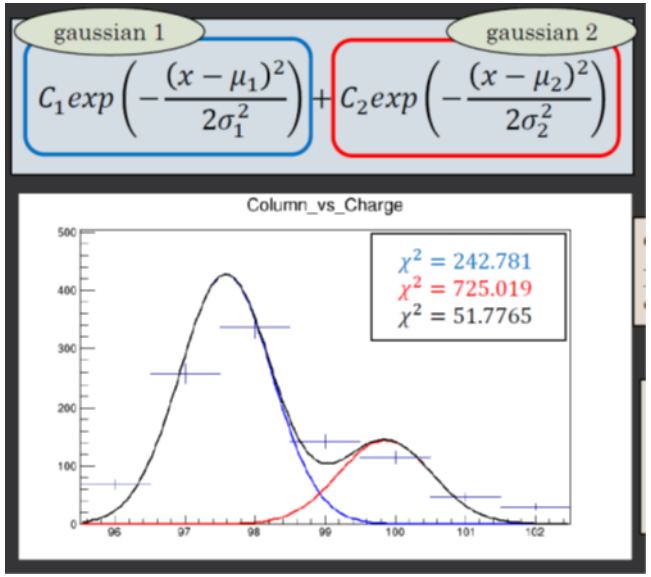


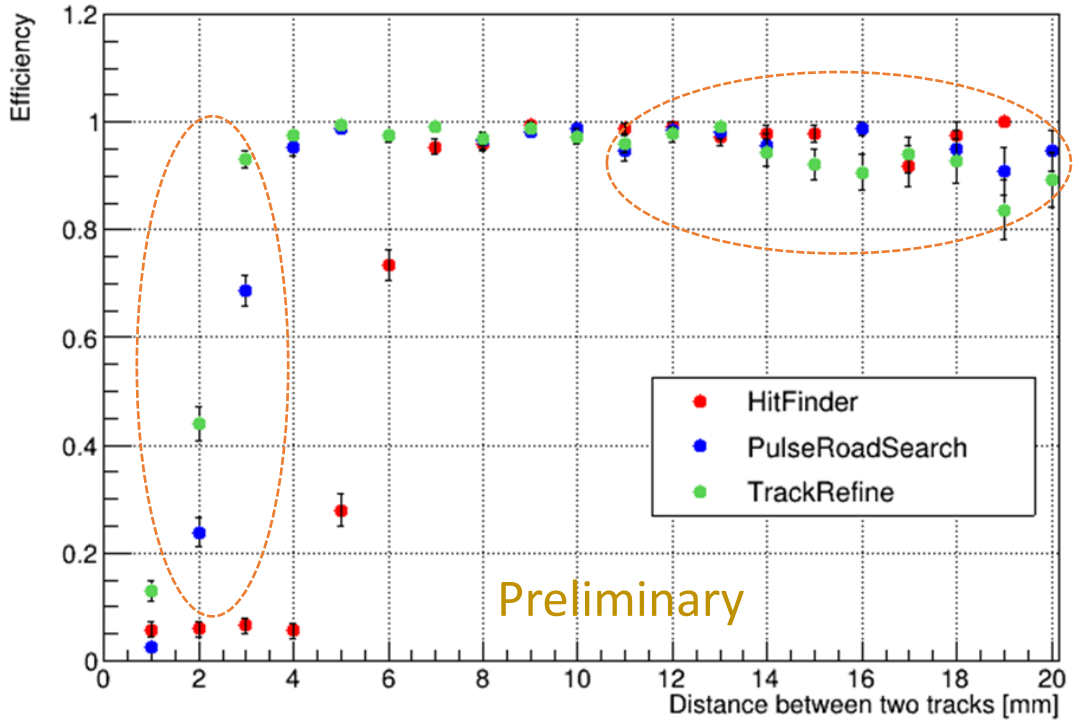
Study of 2-trk separation capability using test beam data

Studied by R. Nodagashira

A new algorithm, "TrackRefine", has been developed.

- A pulse (charge distribution on pads) that is likely to consist of two hits in close range is predicted from the PRS.
- Fitting the 2 gaussians to the charge distribution to identify 2 hit points, then tracking using the hits.





- Separation performance for closer tracks is improved significantly by "TrackRefine" method.
- Efficiency for distant tracks looks degraded.
  → under study
- Simulation study is ongoing to verify the results.

Our R&D activities

Our immediate issue is to improve the performance of the Asian GEM module, we have developed so far, by optimizing the design and materials.

Still many items to be studied …

Remaining major issues

GEM module

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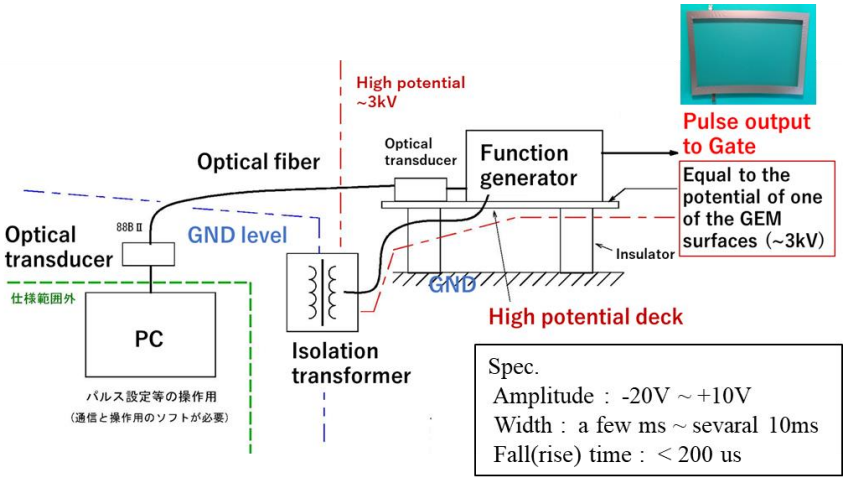


General situation in Japan

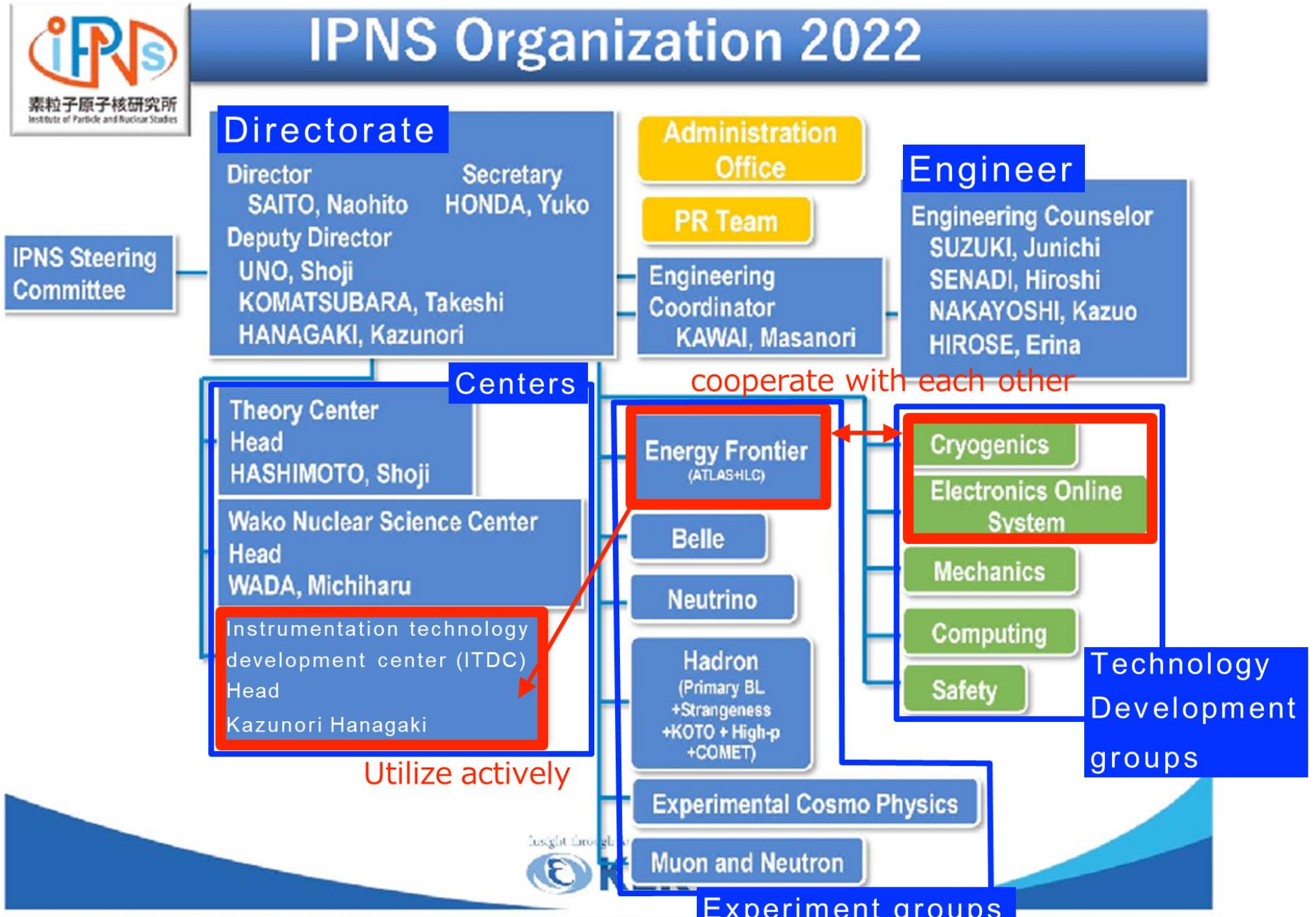
- Japanese government has not taken a clear attitude yet on the ILC.
  - 9.7 Oku yen for an accelerator R&D program is included in the governmental budget plan for FY2013, which is twice larger than the budget of the current ILC-related R&D program.
- "ILC-Japan" was launched in 2021 under JAHEP as a community representative to promote the ILC. They have discussed action items for ILC related R&D in their "Collaboration Task Force".
  (1st meeting will be on 21-Jan-2023)
- The Energy Frontier (EF) group has been formed by merging LHC/ATLAS group and ILC/ILD group in KEK-IPNS.
- Japanese ILD member mainly from universities proposed "Workspace" for the detector R&D (especially for engineering study for finalizing the detector design) for the Higgs Factory and have requested

  1) research space, 2) computing resources, 3) some travel expense for KEK.

  (kick-off meeting was held on 14-Nov-2022, https://kds.kek.jp/event/44212/)
- ILC-J and EF group at KEK-IPNS have started discussion with IDT-WG3 (Detector and Technology R&D group) for the collaborative study.

  There have been two meetings so far, between IDT-WG3 and ILC-J

Higgs Factory workspace at IPNS: kickoff meeting (14-Nov-2022)
https://kds.kek.jp/event/44212/ Talk by M. Tomoto



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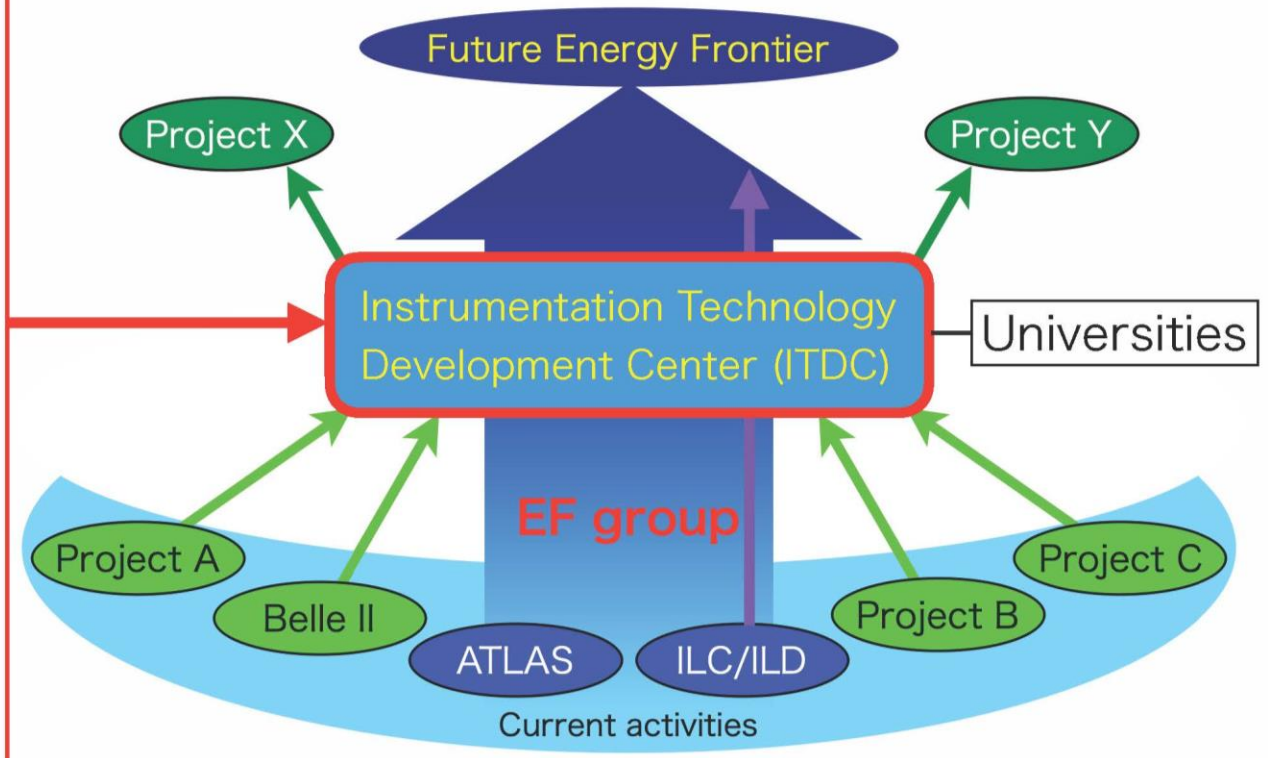
KEK-IPNS Energy Frontier group

- EF group is formed by merging LHC/ATLAS and ILC/ILD groups, to maximize activities for future energy frontier experiments while keeping activities of the ongoing project high with limited person power.
  - Our physics interest is discovering new physics using energy frontier colliders.
    - Direct searches for new physics such as SUSY,
    - Measurement of the properties of Higgs boson, top quark, etc.
  - Our current priority is the success of LHC Run 3 and HL-LHC
    - Physics analysis,
    - Silicon strip and pixel detectors, and
    - Endcap muon trigger system with Thin Gap Chamber (TGC).
  - KEK ATLAS group members do not join ILC/ILD.
  - ILC/ILD specific activities will be kept by Daniel Jeans who will be only KEK ILC/ILD member from 2023.
    - Software developments and physics performance studies are his expertise.
    - Hardware activities led by Daniel in collaboration with university group are under discussion within EF group.
  - Taking into account the expertise of ATLAS group members and KEK, four new activities for “any” future energy frontier experiments has started.

- KEK EF group has started actual works for future energy frontier experiments utilizing Instrumentation Technology Development Center (ITDC) in KEK-IPNS.
- Please let us know, if you are interested in collaboration with us !!

New activities proposed from EF group

- Physics
  - Higgs, top, direct searches
- Semiconductor Detector
  - Monolithic & Hybrid
  - Radiation hardness
    - SiGe BiCMOS
    - LGAD
    - New material
- Electronics
  - Collider Electronics Forum
    - High-end FPGA
    - High speed optical
- Machine Learning
  - AI forum
    - Object ID, Analysis
    - Application to operations
- Superconducting magnet



- Daniel's ILD specific activities
  - Software/physics performance
  - Hardware under consideration

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Background of workspace proposal

- In 2021, KEK/IPNS established the Energy Frontier (EF) group by combining the LHC/ATLAS and ILC groups
  - Current ILC members: D. Jeans, Y. Sugimoto, T. Omori, K. Fujii
  - From FY2023, Daniel will be the only member in the EF/ILC group.
  - Other EF members will use 10% FTE for detector R&D for future colliders
- The number of researchers in universities (HEP groups) working for ILC is also decreasing, especially lacking young researchers and students.
- We are in a difficult situation, however, we want to activate studies of physics and detectors for the ILC in Japan, when “the ILC technology network” for the accelerator is going to start.
- Manpower is a big issue. We need newcomers from the HEP community as well as collaborators from other fields (e.g. technology and engineering).
- We should not limit the activity only for ILC. We may extend it widely for “Higgs factories” to attract more people.
- We need a workspace to gather, and KEK/IPNS is the best place.

Higgs Factory workspace at IPNS: kickoff meeting (14-Nov-2022)
https://kds.kek.jp/event/44212/ Talk by K. Kawagoe

To start up a Higgs Factory workspace we drafted a proposal consulting with the ILD executive team

Proposal for a workspace

We propose to install a Higgs factory detector workspace at KEK. The workspace will focus on experimental and technical issues related to the timely construction of a Higgs factory detector in collaboration with the scientific and technical/engineering groups at universities, KEK, research institutions, and industry, as well as with international collaborators from around the world. The workspace at KEK will serve as a model for a global network of workspaces at which a Higgs factory detector will be engineered and constructed.

Higgs Factory workspace at IPNS: kickoff meeting (14-Nov-2022)
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Proposal (cont'd)

We believe that KEK, with its experience and infrastructures for detector R&D, such as the Instrumentation Technology Development Center, would be an excellent location for such a workspace. We are not proposing a new organization in KEK/IPNS, but request KEK/IPNS some space for research and access to computing resources. We would like to start at a minimal scale so as not to place a heavy burden on KEK/IPNS.

We need

- Some space for research
- Access to computing resources
- Some travel expenses

We need to get the R&D budget by ourselves

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IDT WG3 organization

- IDT-WG3 has been re-organize in Oct 2022.

Leadership of IDT Working Group 3

Coordinator / WG3 Chair	Jenny List	DESY	Germany
Deputy Coordinators	Daniel Jeans	KEK	Japan
	Michael Peskin	SLAC	United States
	Roman Pöschl	IJCLab – CNRS/IN2P3	France
	Jinlong Zhang	ANL	United States

WG3 Subgroups

- Speakers Bureau
- Machine-Detector Interface Subgroup
- Detector and Technology R&D Subgroup
- Software and Computing Subgroup
- Physics Potential and Opportunities Subgroup

Top » Team » WG3 » Detector and Technology R&D Subgroup

Detector and Technology R&D Subgroup (WG3)

Working group conveners

Katja Krüger (DESY), Shinya Narita (Iwate U.), Marcel Vos (IFIC – U. Valencia), Jinlong Zhang (ANL)

Summary

- We have been performing R&D for our Asian GEM module although the resources have been very limited.
- KEK-IPNS organization has been renewed, and we will continue to work on resolving remaining issues in a new scheme, mainly at member universities.
  - We plan to move the experimental instruments for LCTPC study at KEK to universities by April.
- "Workspace" for Higgs Factory has started at KEK-IPNS, and it can be utilized for our activities.
  - We are now thinking about performing (LC)TPC related R&D in collaboration with industries or non-HEP community at the "Workspace".
    e.g.) Study of new GEM material with AIST.
    …

AIST: The National Institute of Advanced Industrial Science and Technology