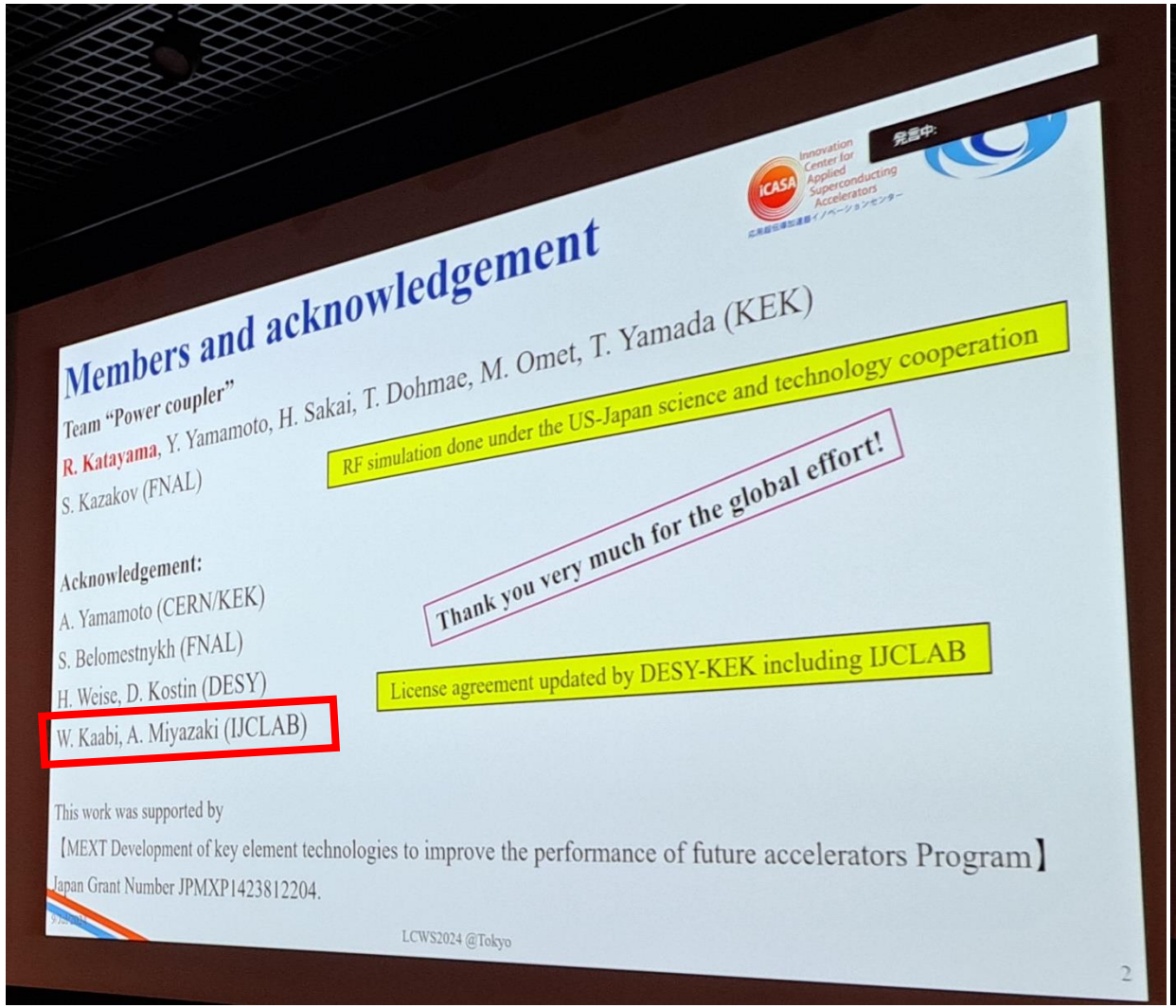
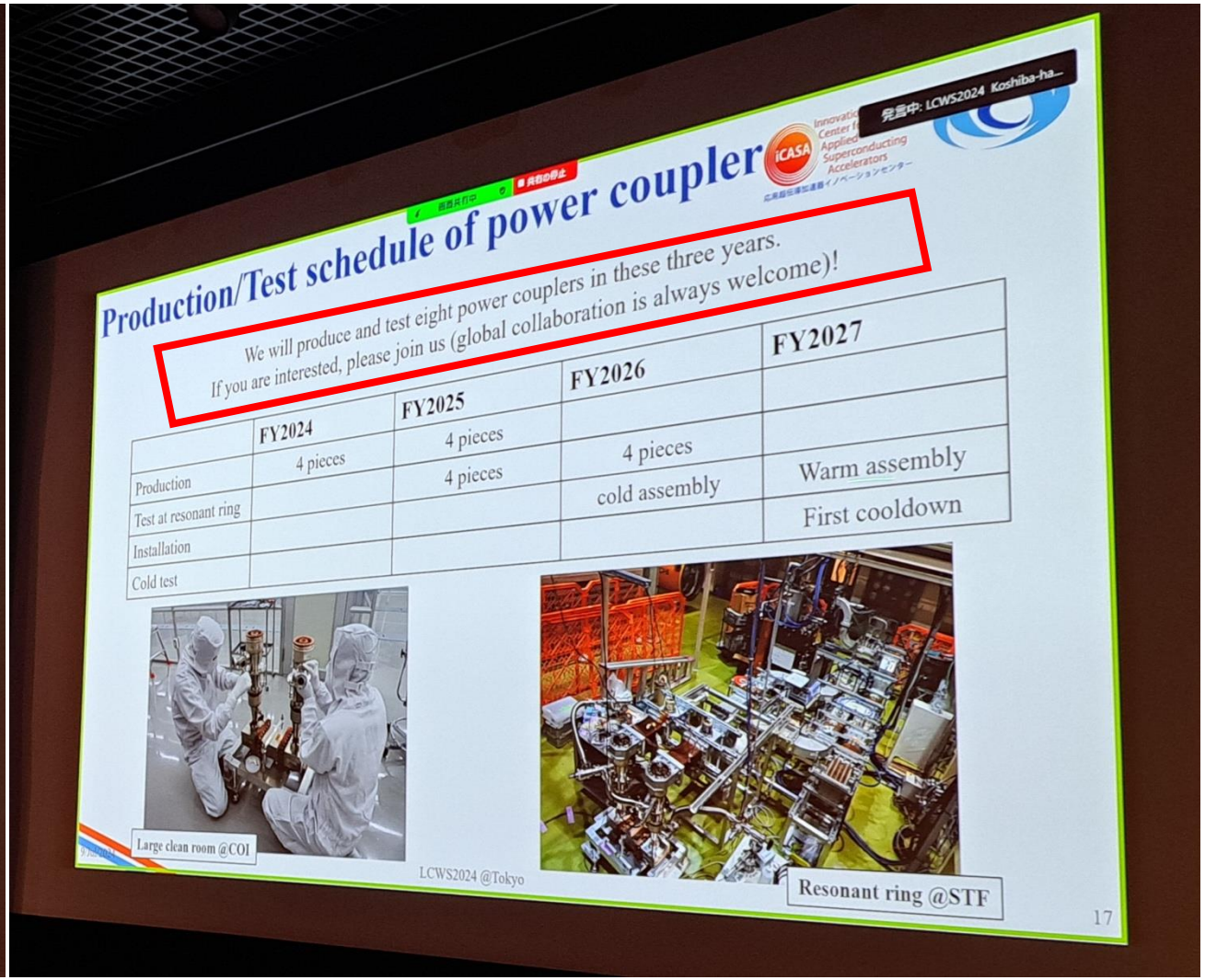
IJCLab-KEK collaboration on SRF couplers / cavities for ERL

Akira Miyazaki

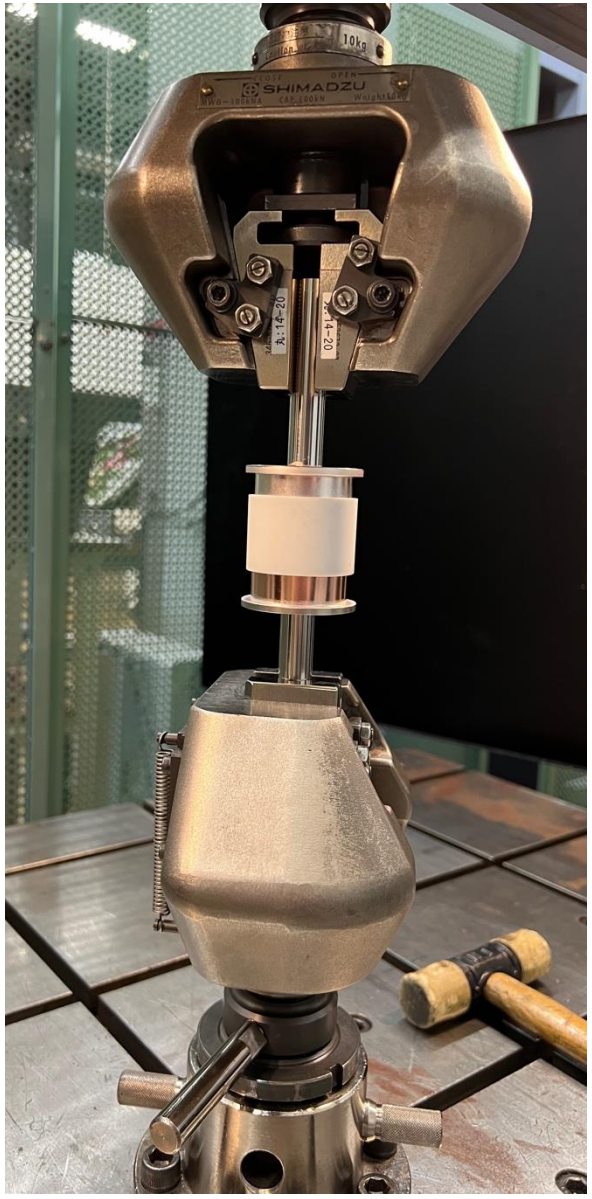
LCWS2024 @ UTokyo: IJCLab is recognized

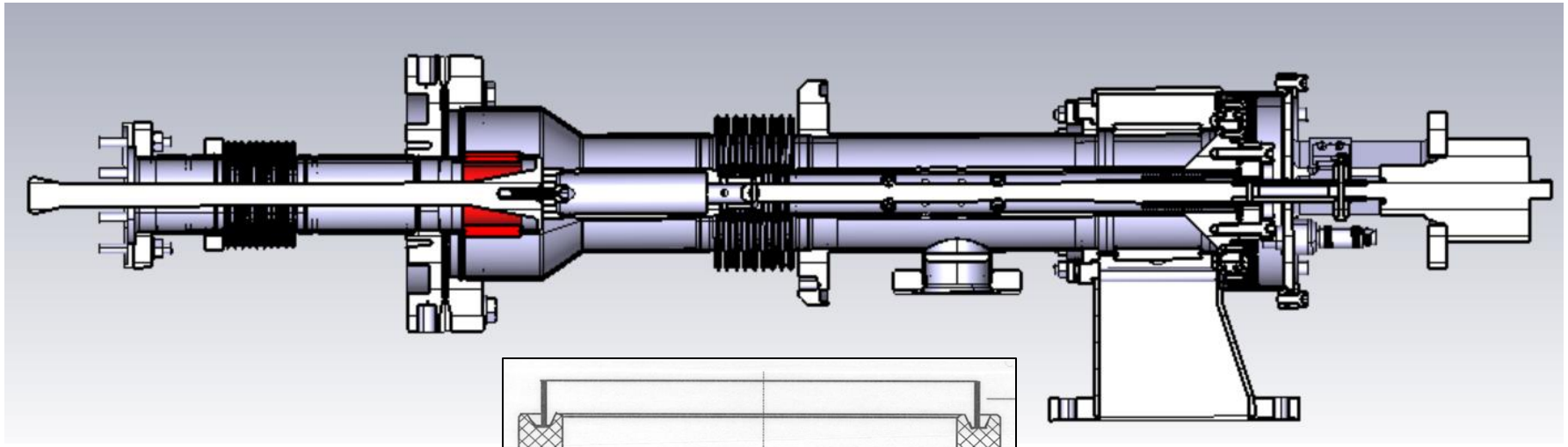


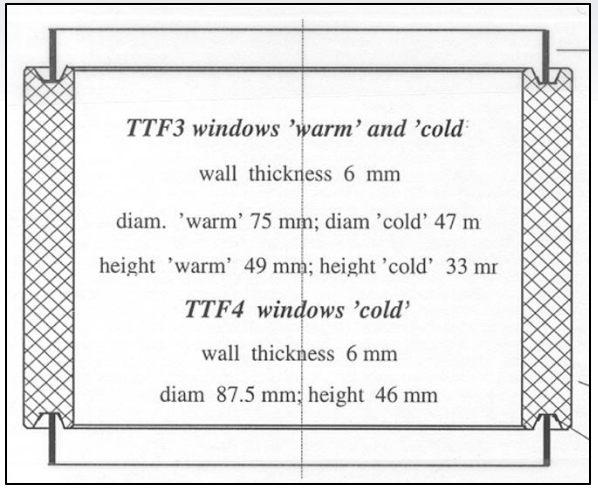


ILC-ITN: RF power coupler's cold CERAMIC

New CERAMIC at KEK



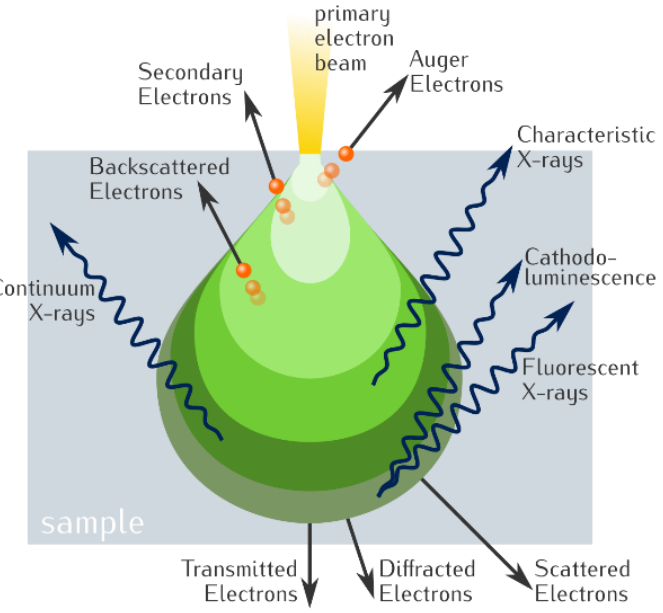


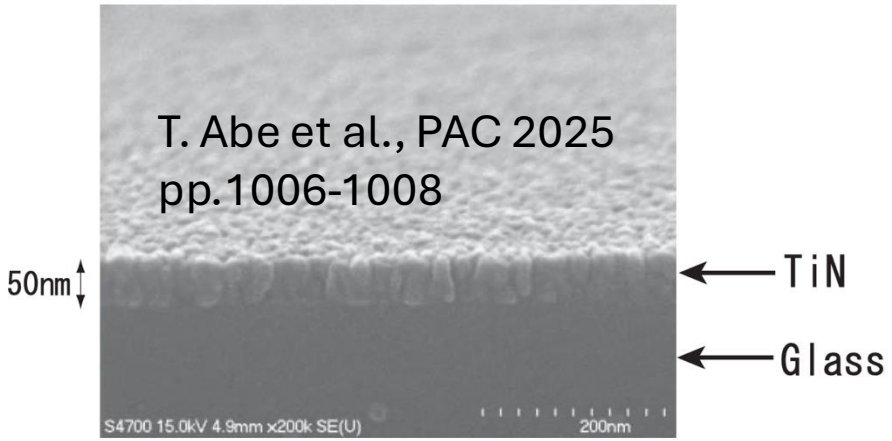


EuXFEL@IJCLab

- EuXFEL specified tensile strength of 43 MPa
- KEK tested new ceramic for ILC-ITN: 14.6 MPa
- Is it OK for brazing?
- No clear documentation remaining at IJCLab
- A left-over of EuXFEL was provided to KEK

CERAMIC's TiN coating and XPS analysis





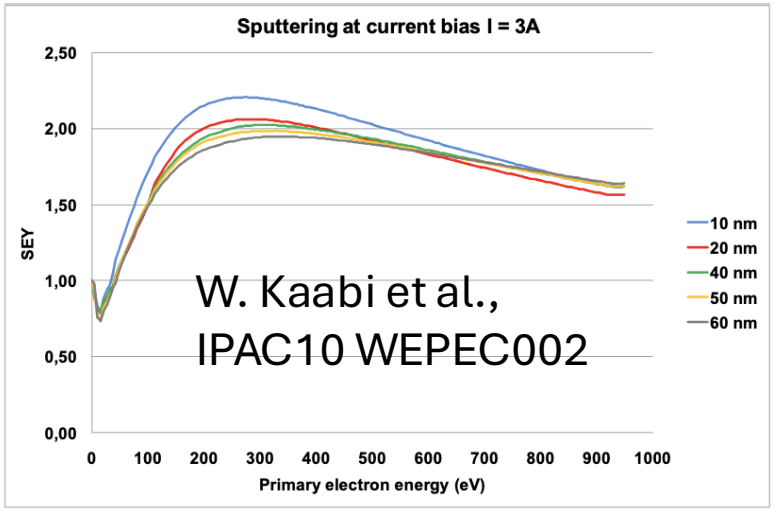


Figure 3: SEY measurements of TiN coated Alumina at different thicknesses and two different current biases.

- TiN coating on ceramic to reduce Secondary Electron Emission Yield (SEY) to mitigate multipacting in couplers
- SEY measurement is possible inside KEK but not XPS profile
- 1 kEUR per sample measurement in other labs in Japan
- Platform Vide & Surface at IJCLab may be able to perform XPS measurement for KEK
- Samples are prepared, TiN coating on November, XPS measurement in December (?)
- Funding (Masterproject SRF)

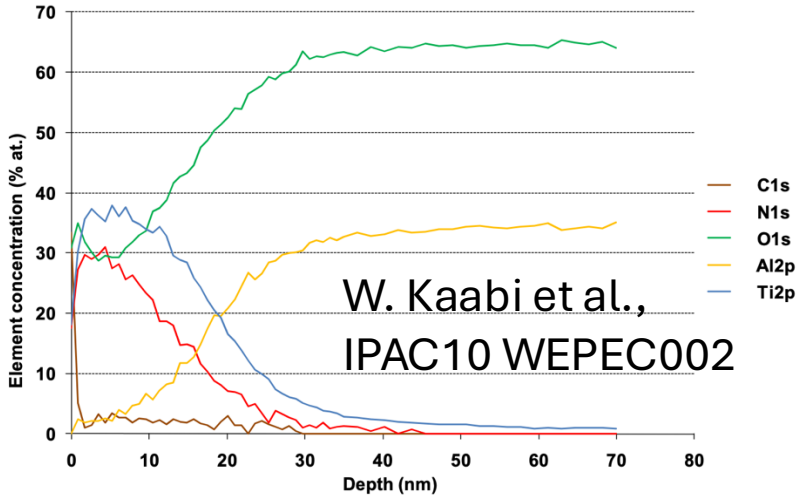


Figure 1: XPS profile of a 30 nm TiN deposit on Alumina substrate.

ILC-type cavity testing for PERLE / cERL

arXiv > physics > arXiv:2410.00789 Search... Help | A

Physics > Accelerator Physics *LCWS2024 proceedings*

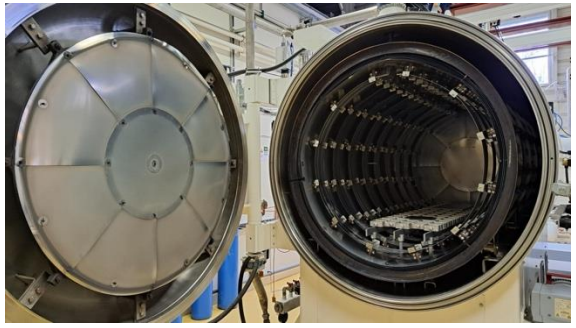
[Submitted on 1 Oct 2024]

SRF programs towards High-Q/High-G cavities in IJCLab

Akira Miyazaki, Mohammed Fouaidy, Nicolas Gandolfo, David Longuevergne, Guillaume Olry, Maël Vannson, Lê My Vogt, Matthieu Baudrier, Enrico Cenni, Fabien Eozénou, Grégoire Jullien, Luc Maurice

process was optimized for the LCLSII project [17]. Since modification of the cryogenic system for fast cooling down takes some time, we will organize the 3rd test of the same cavity in the cryostat at KEK in October 2024. This cryostat has been used to qualify other mid-T baked cavities with excellent control in magnetic fields and cooling for flux expulsion [16]. We will compare this cavity with other reference cavities so that we can conclude the heat treatment process in our furnace.

Qualification of IJCLab's vacuum furnace

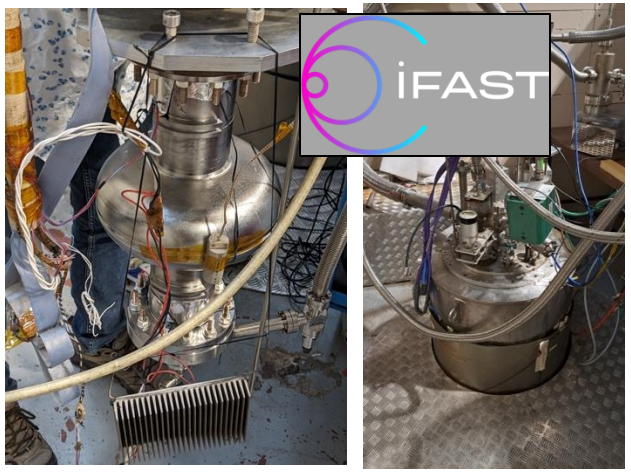


800 MHz PERLE/FCC prototype from JLAB

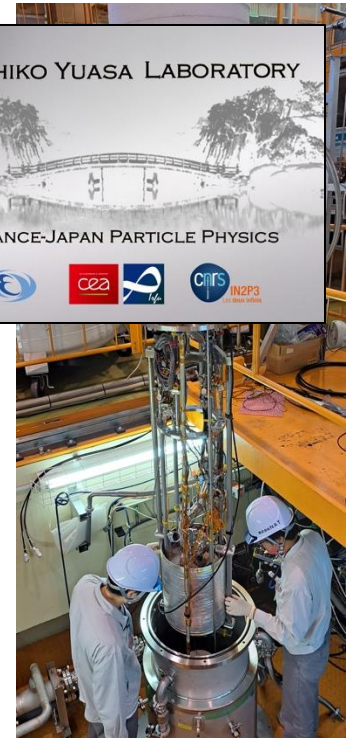
1.3 GHz ILC cavity from DESY

- Limitations were found in present test-stand in CEA Scalay (B-shield, flux expulsion)
- Tests at KEK to take a reference data
- FJPPN "ERL"

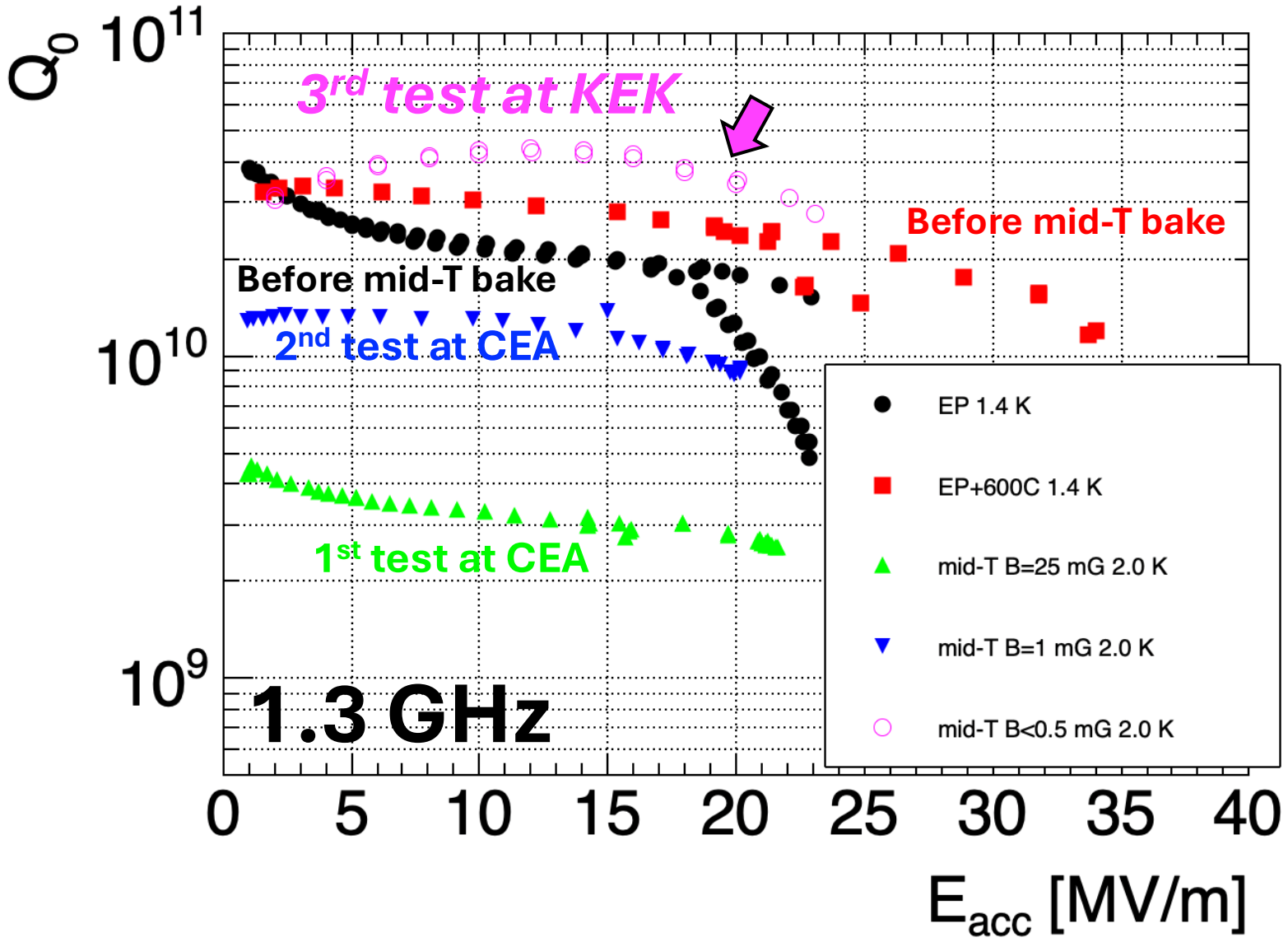
1st and 2nd tests at CEA Saclay

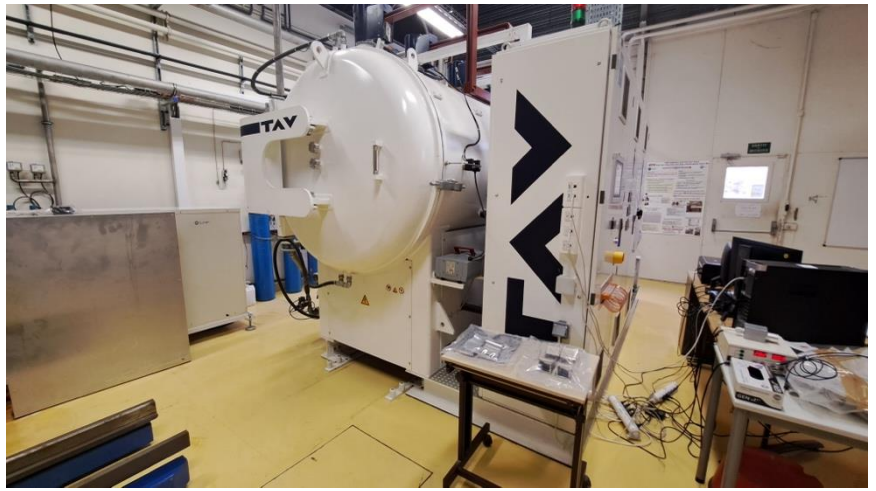


3rd test at KEK-STF: Sep 30 – Oct 4 2024

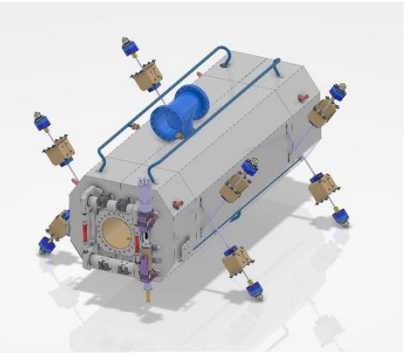


Results are promising for CW machines (PERLE/FCC/cERL)

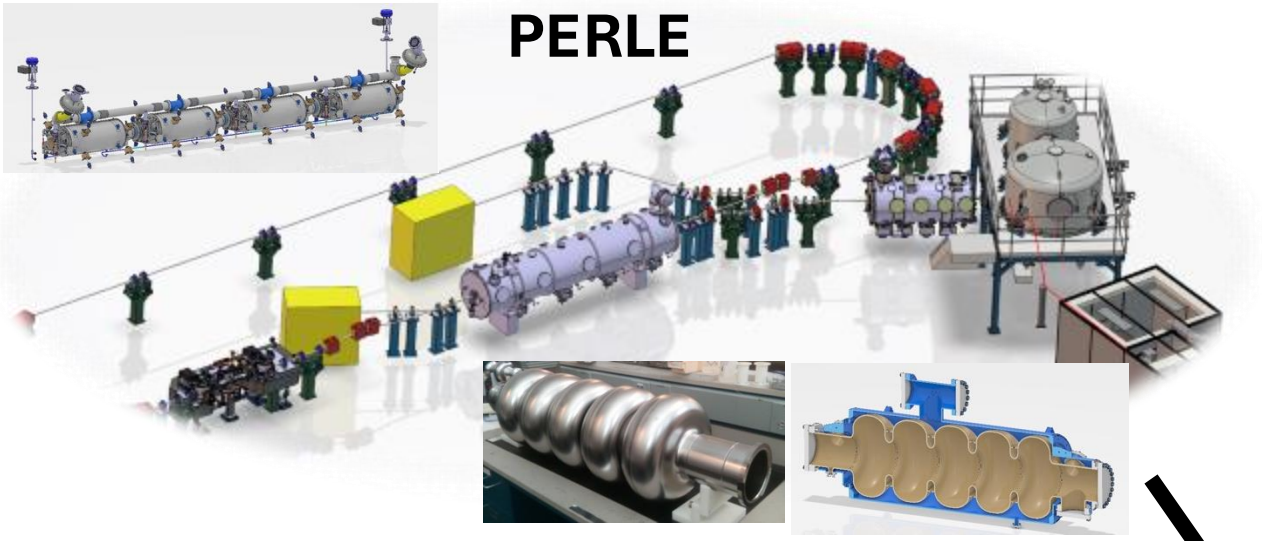




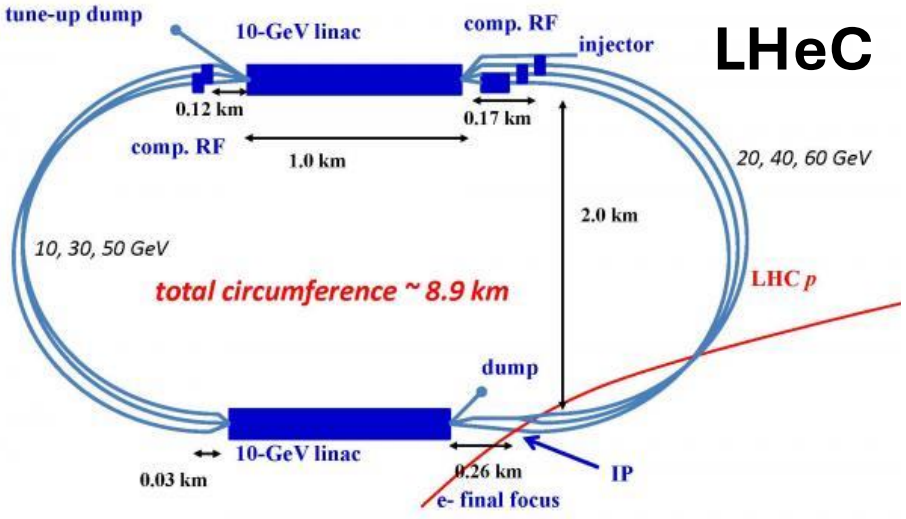
- ✓ Our vacuum furnace is competitive to the world for mid-T bake
- ✓ Magnetic-field compensation is of critical importance
- → We need to improve vertical test as well as designing excellent cryomodule
- → Further optimization for 800MHz cavities



PERLE → LHeC vs Linear Collider with ERL (?)



Baseline



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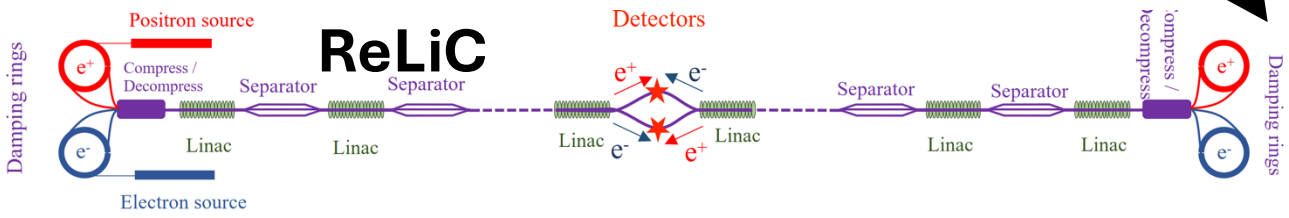
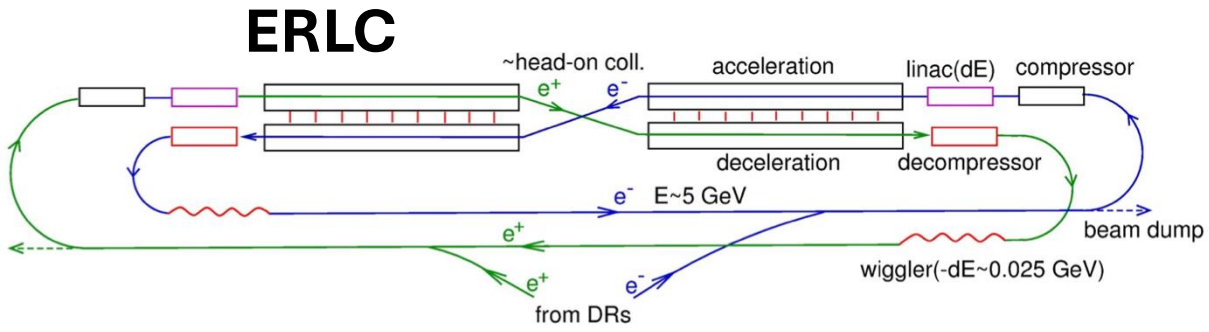
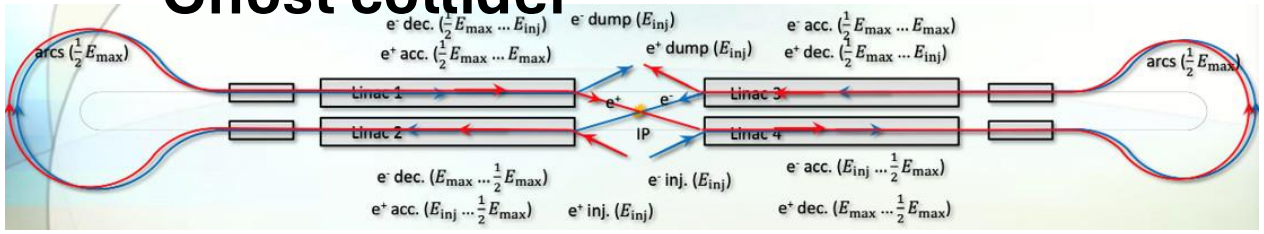
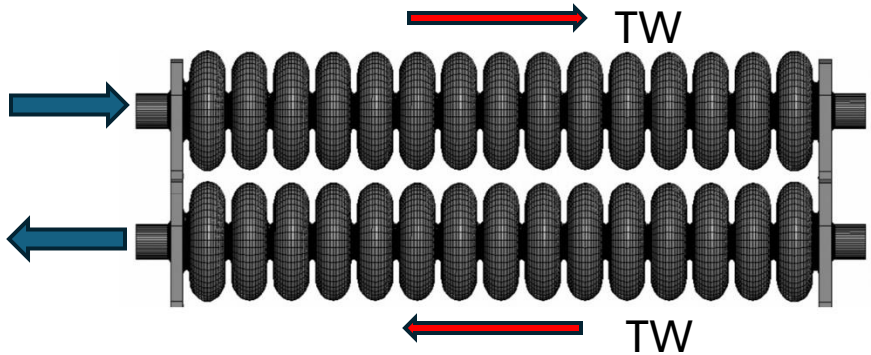




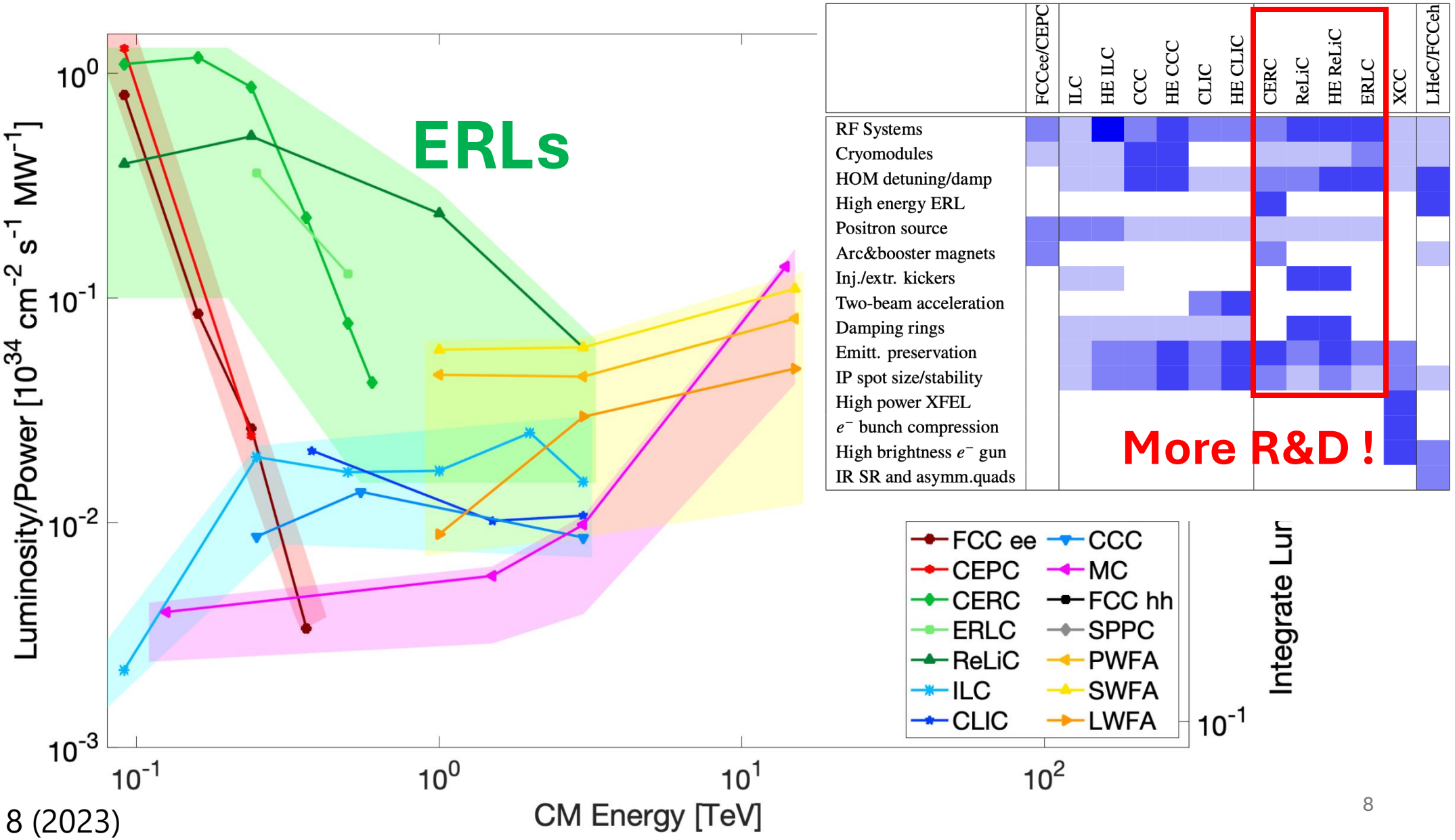




Vladimir Litvinenko LCWS2024

Kaoru Yokoya LCWS2024: ERL as ILC upgrade

Example in colliders: case study in Snowmass



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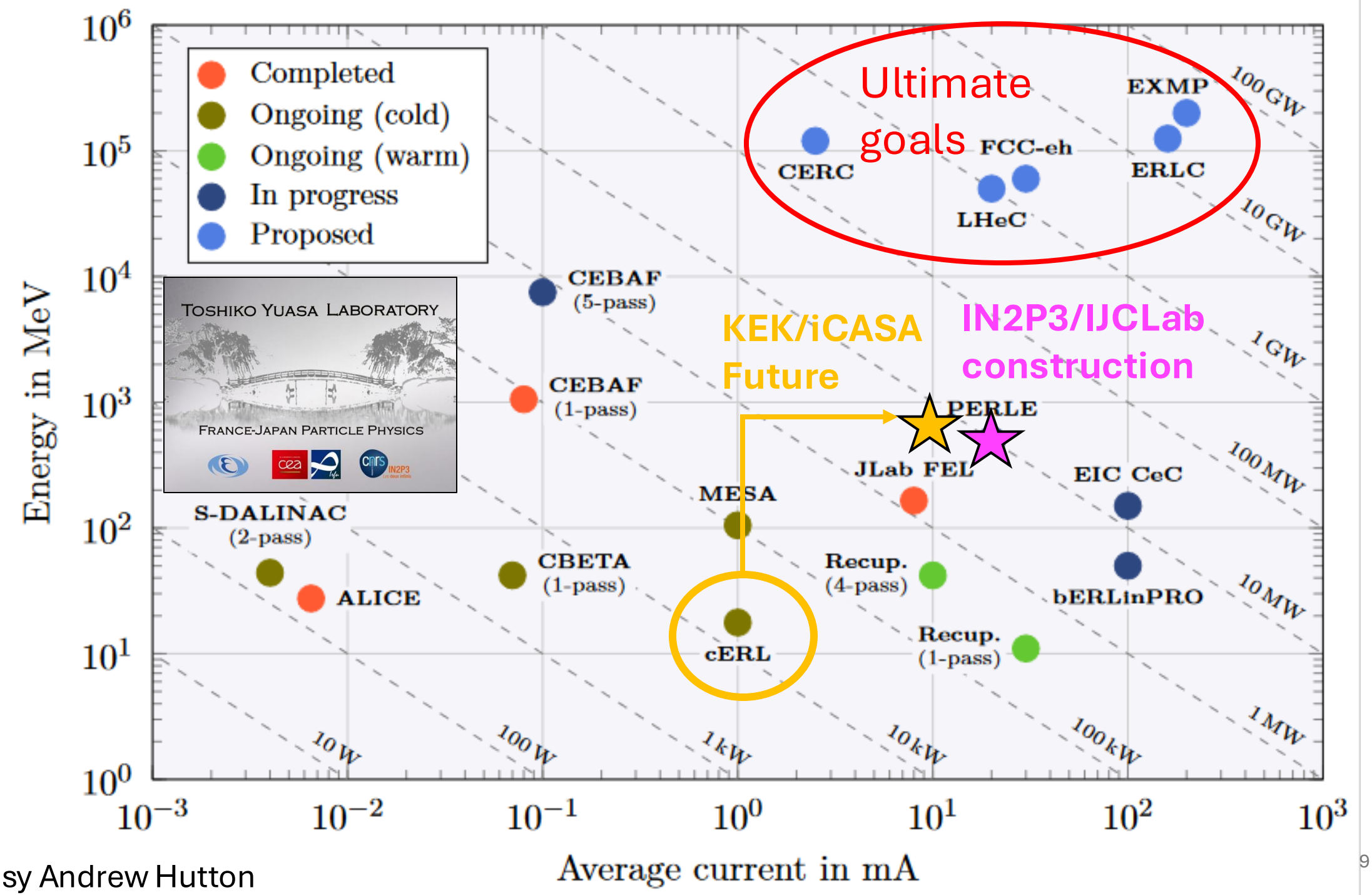

Courtesy Andrew Hutton

Summary

- Small but non-negligible contributions to ILC-ITN with power couplers
  - Ceramic window of EuXFEL to see tensile strength
  - XPS measurement of TiN coating of ceramic in Vide & Surface
- Cavity measurement
  - Mid-T baking with IJCLab's furnace was successfully qualified by KEK
  - IJCLab's vacuum furnace has strategical importance to negotiate with other institutions, such as CERN, FNAL, JLAB, and CEA
- There are several LC-ERL options under consideration
  - High-Q/high-G SRF cavities are key of any ERLs
  - PERLE is a crucial milestone for future ERLs for high-energy physics