Low background counting facility in CJPL and preparation for electroformed copper production

Hao Ma
Tsinghua University/CDEX collaboration
2015.10

CJPL 中国锦屏地下实验室 China Jinping Underground Laboratory

Outline

- Motivation
- Low Bkg Counting Facility(LBCF) in CJPL
- Design of new member GeTHU2s
- Electroformed Cu and our plan
- Summary and outlook

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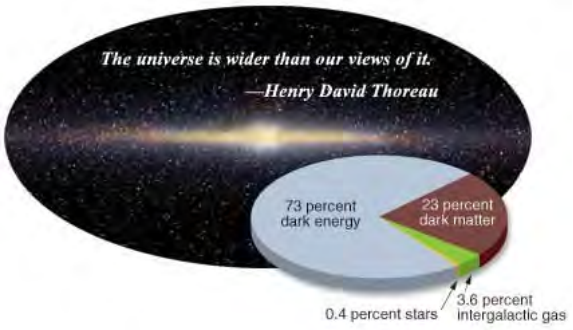
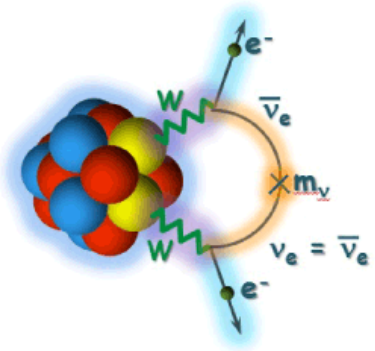
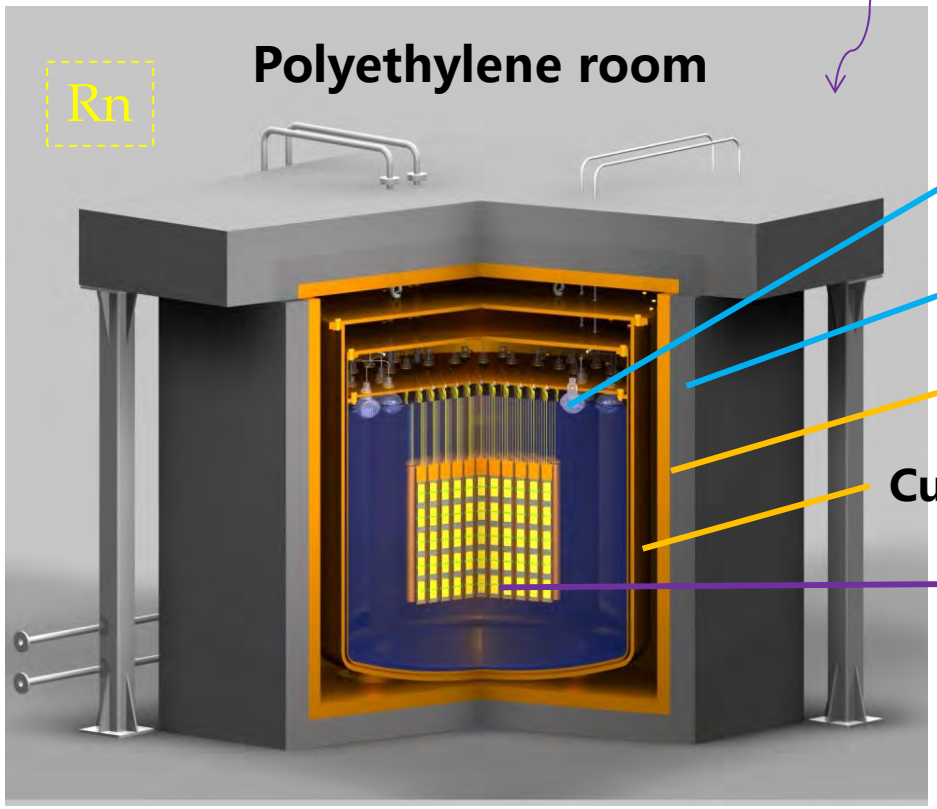
Motivation



Extremely low background



Neutrinoless
double beta decay



CDEX

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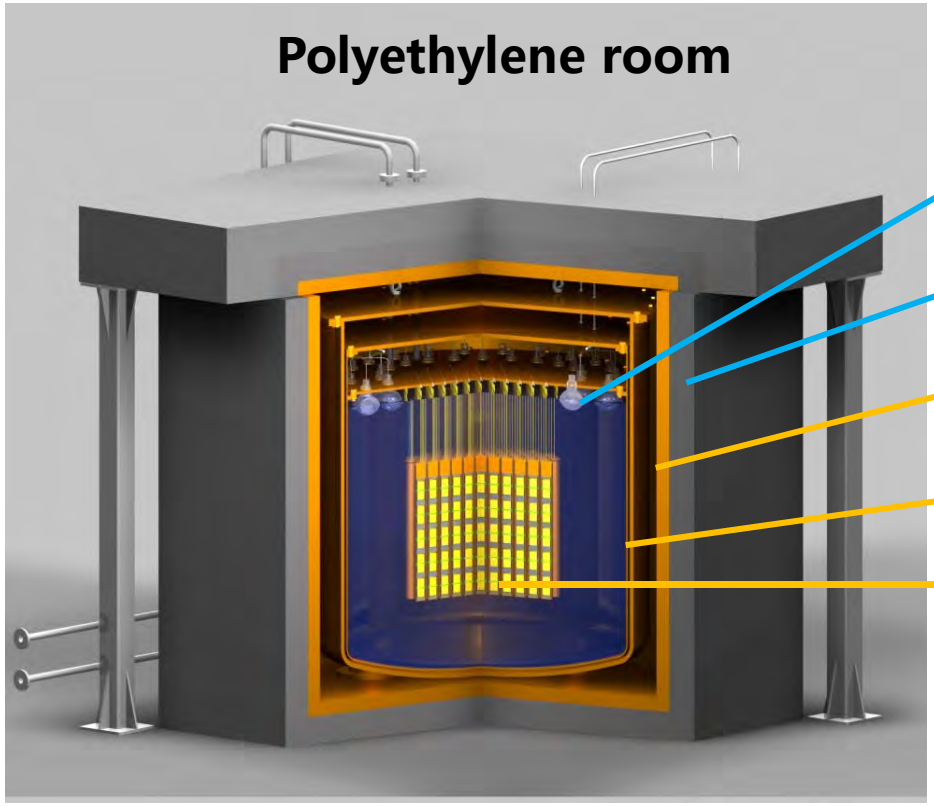
CDEX@CJPL



CDEX

PMTs

Lead

Copper

Cu cryostat

HPGe

Radio-impurity

Screening & selection

ULGS(Ge)
ICP-MS/GDMS
NAA…

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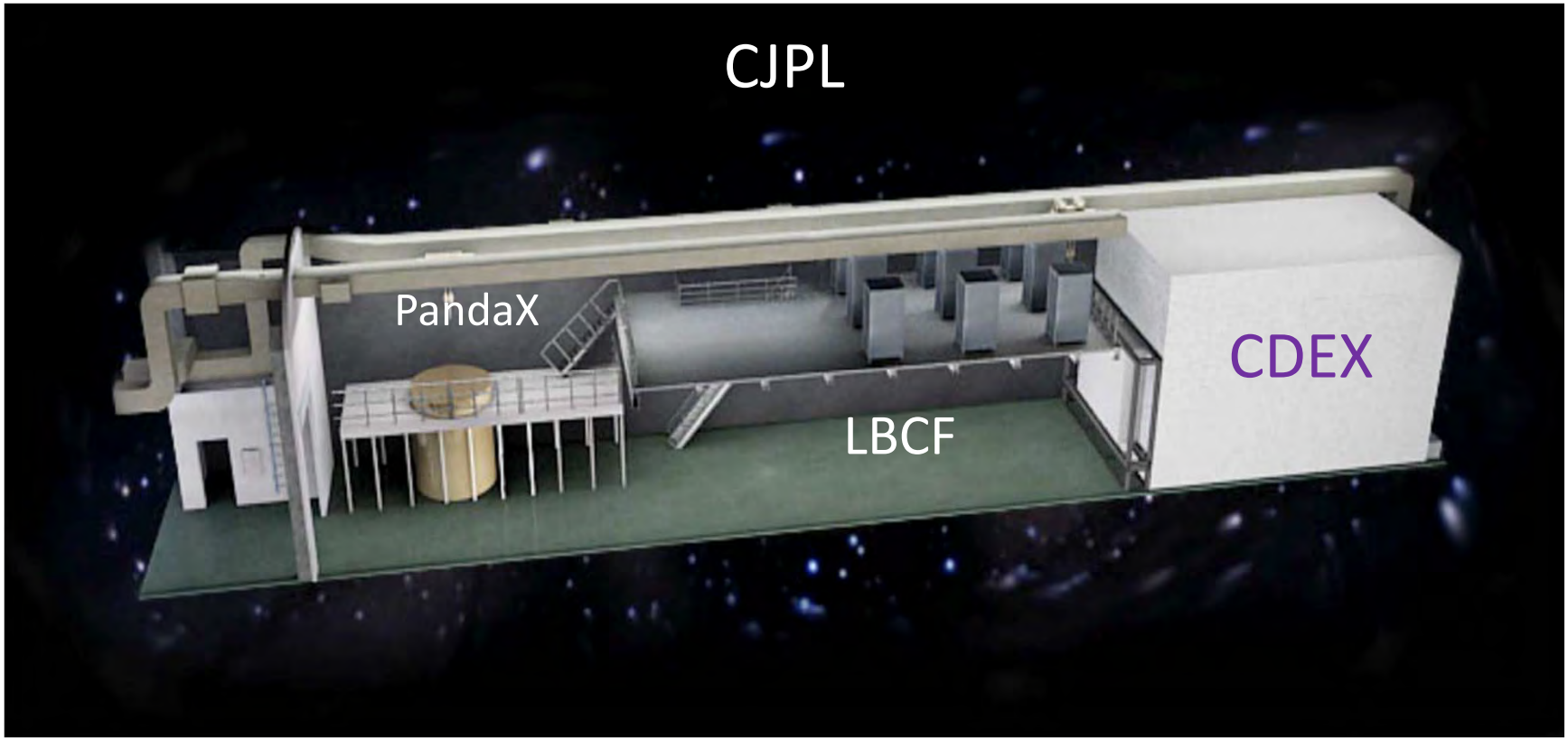
LBCF in CJPL



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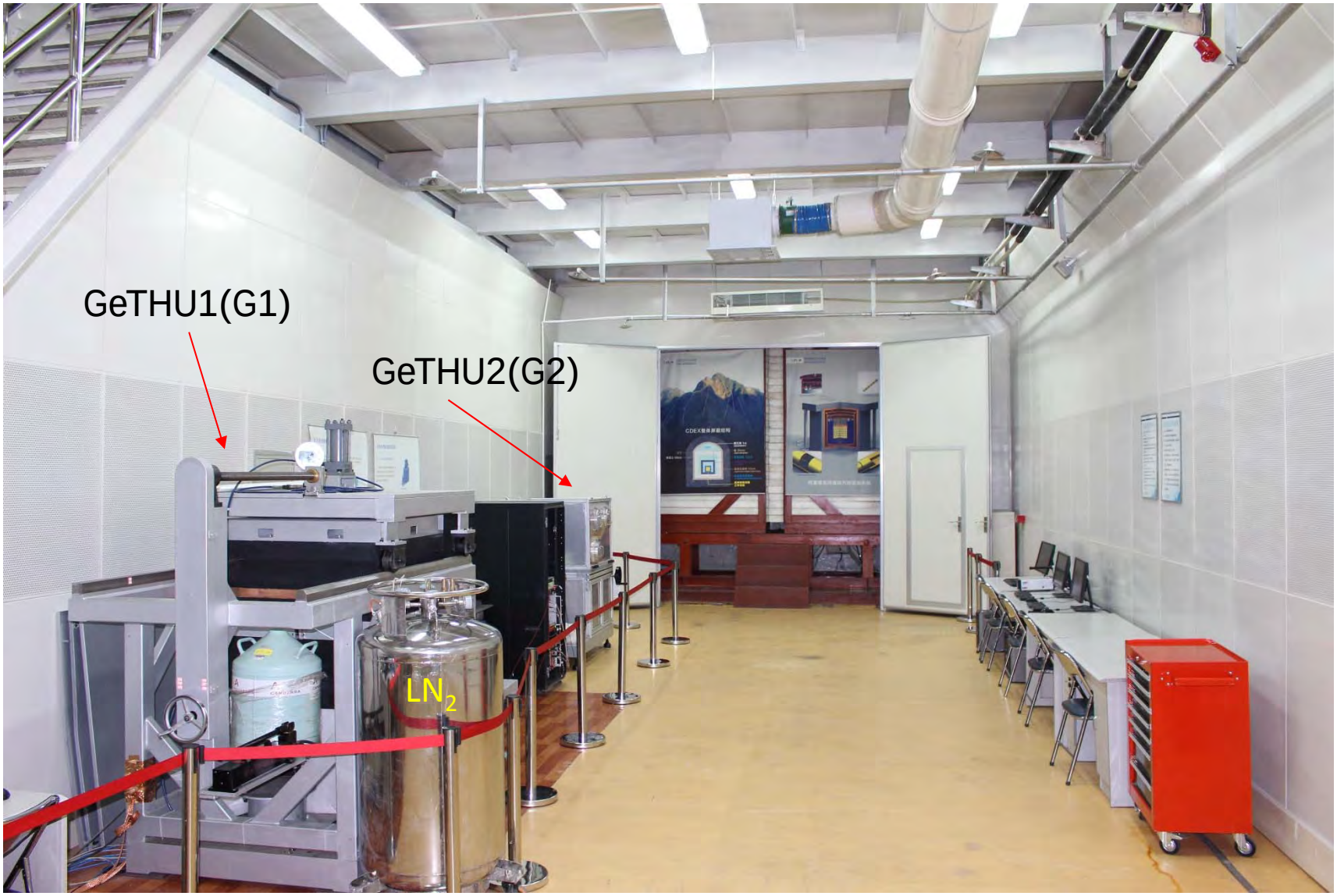

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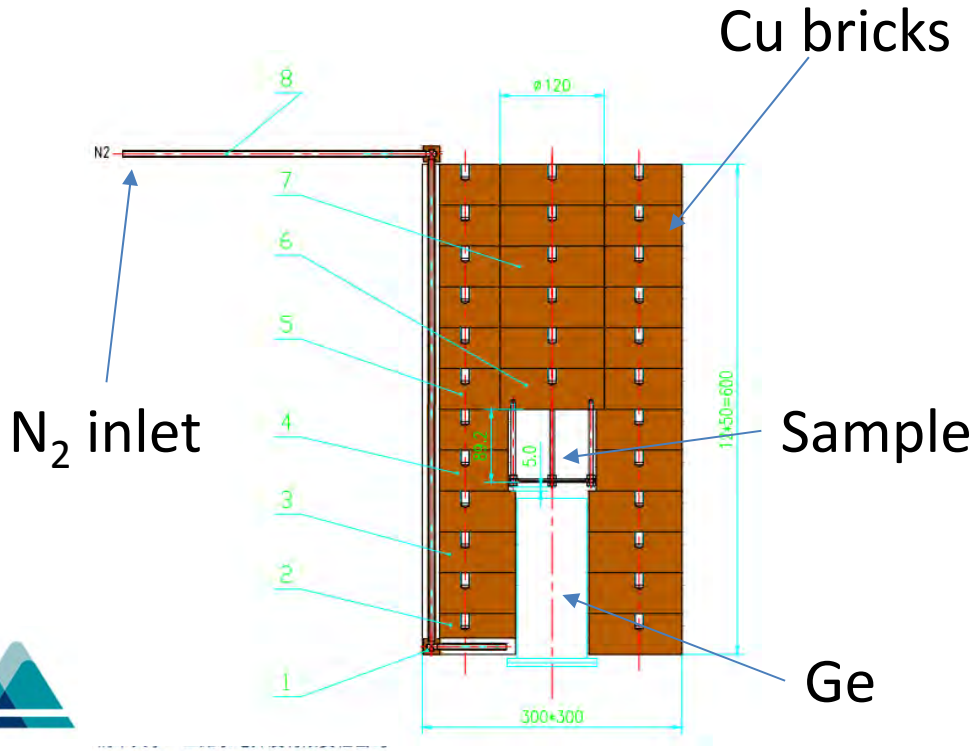
A Photo of CJPL-I hall by Yue Qian

Status of GeTHU1(G1)

- N type from Canberra
- ~900g
- Sensitivity
  - ~1mBq/kg
- Material screening for CDEX-10

Status of GeTHU1(G1)

- Upgrade chamber shielding
  - Cu bricks ready
  - Assembly at the end of this year



To improve sensitivity

Status of GeTHU2(G2)

- BEGe from Canberra
- ~1.1kg

- Sensitivity
  - ~1mBq/kg

- Material screening for CJPL-2

Status of GeTHU2(G2)

- Upgrade glove box: more air-tight/sealed
  - change o-rings
  - change gloves with butyl rubber ones
  - change plastic N_2 lines with copper ones
  - etc...

Everything is underway…

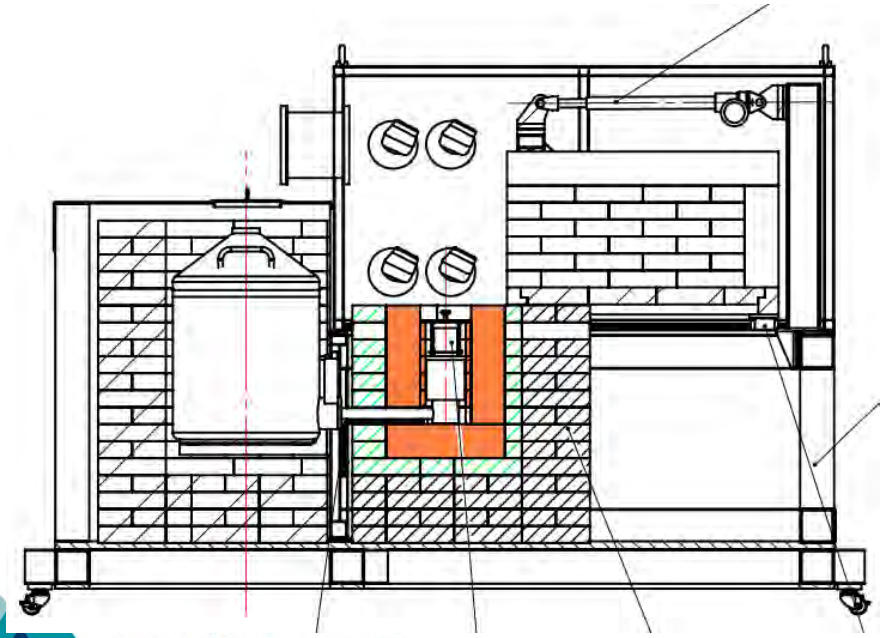
New member: GeTHU2s(G2s)

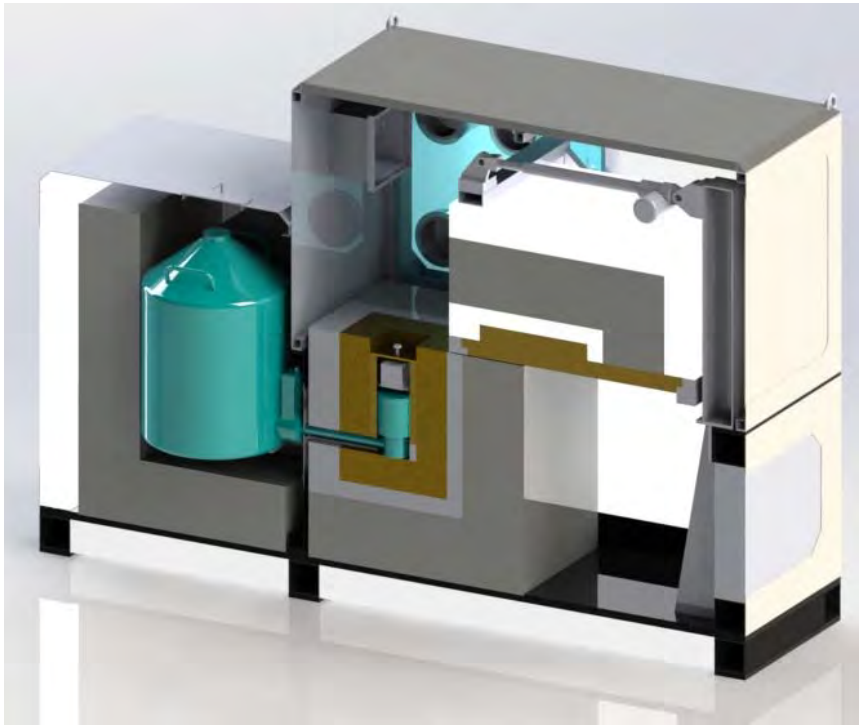
- Sister detector of G2: BEGe from Canberra
  - Crystal：φ91.5x31.6mm (~1.1kg)
  - Relative Eff ：67%
  - FWHM：1.67keV @1332keV(^{60}Co)
  - C/P ratio：74.2

Design of GeTHU2s(G2s)

- Some experience from G1&G2
  - more air-tight
  - more shielding on LN_2 tank side

Short cold finger: 30cm





LBCF in CJPL

- Special thanks to Pro. Alan Poon from LBNL for his constructive advice and comments

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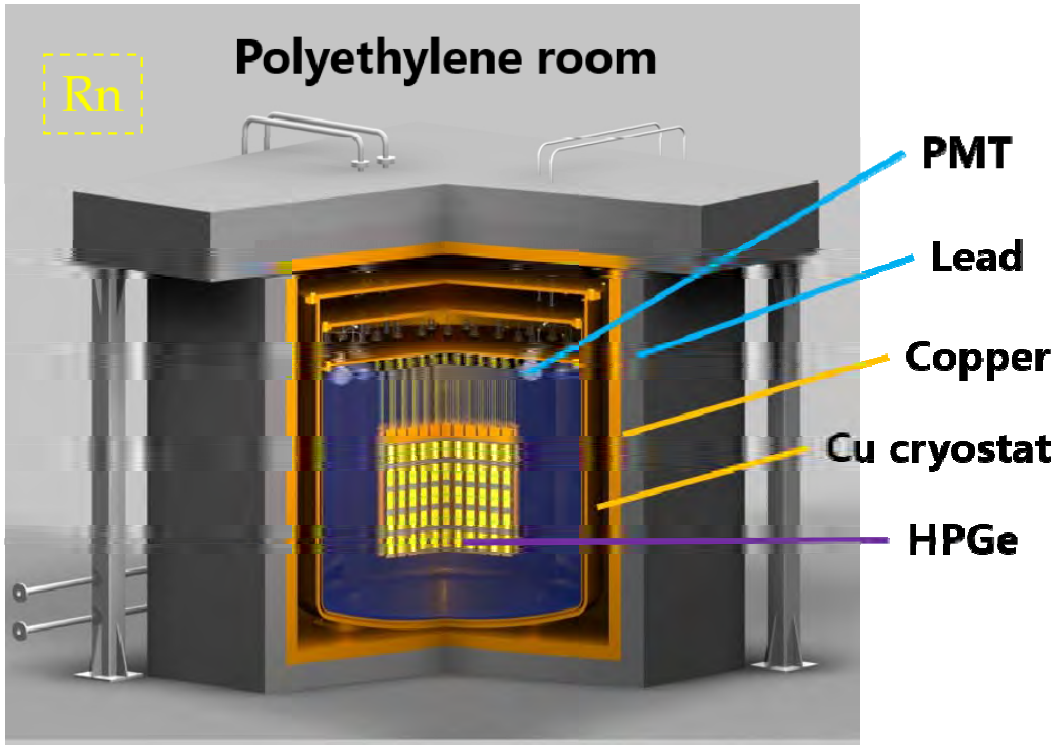
Demand for Cu

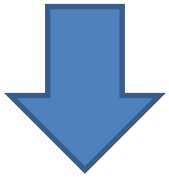
- Key material for DM and 0νββ experiments
  - Detector mounts
  - Cryostat
  - Inner shielding



CDEX

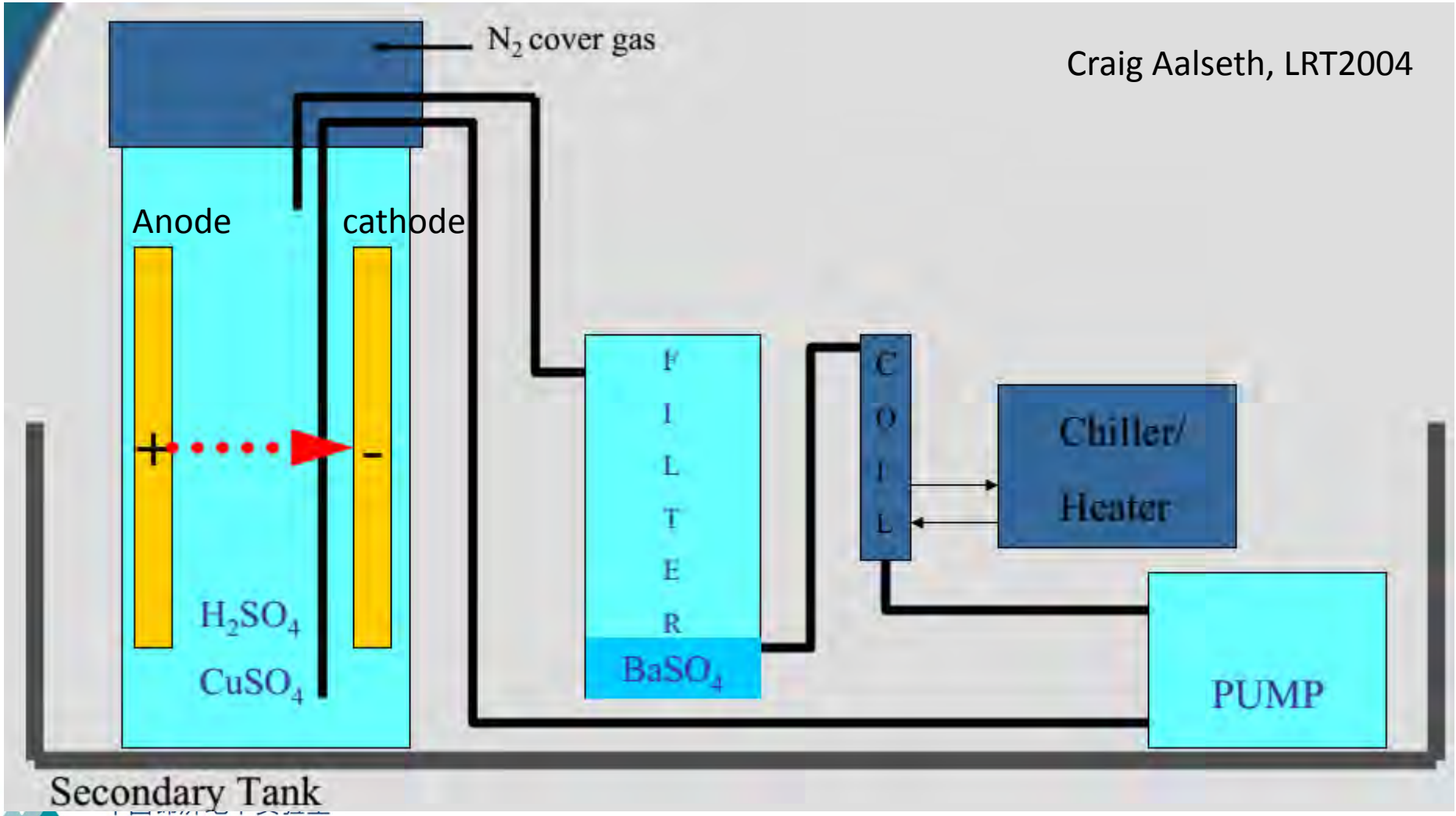
Electroformed Cu

- Commercial OFHC: several tens of μBq/kg ^{232}Th,^{238}U
- Experiment requirement: equal or less than 1μBq/kg



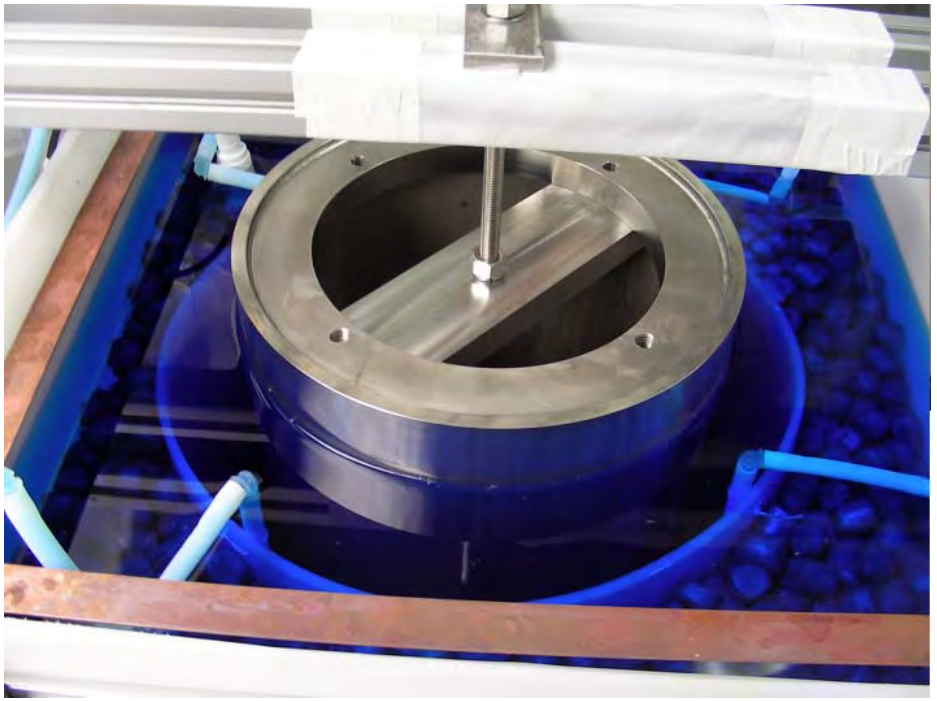
- Electroforming commercial cooper underground
  - reduce ^{232}Th,^{238}U
  - prevent from cosmogenic ^{56,57,58,60}Co

Overview of PNNL's method



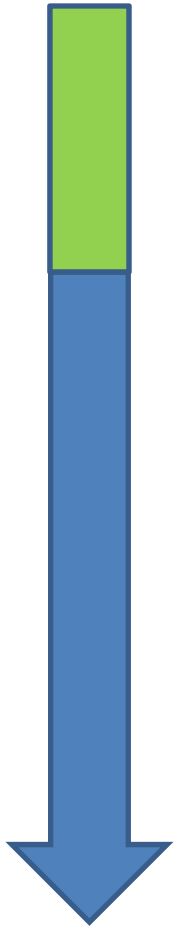
PNNL's Cu Eforming facility

E. W. Hoppe, LRT2010

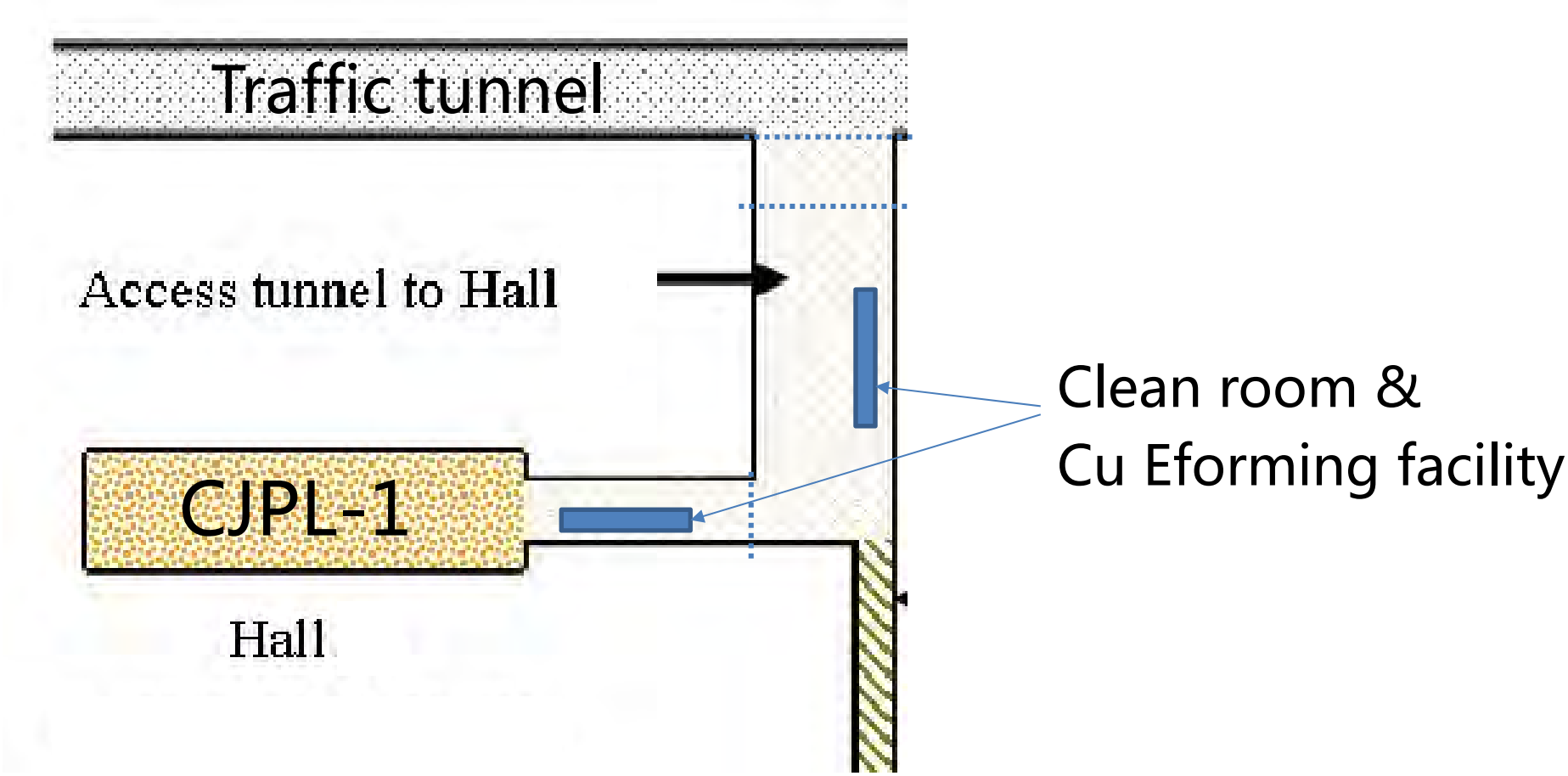


Plan of Cu Eforming in CJPL

- Method from PNNL's pioneer work
- Prototype device to set up procedure in Tsinghua campus
- Construct a clean room in CJPL-1 tunnel
- Establish Cu Eforming facility in the clean room
- Produce Eforming Cu for experiments in CJPL

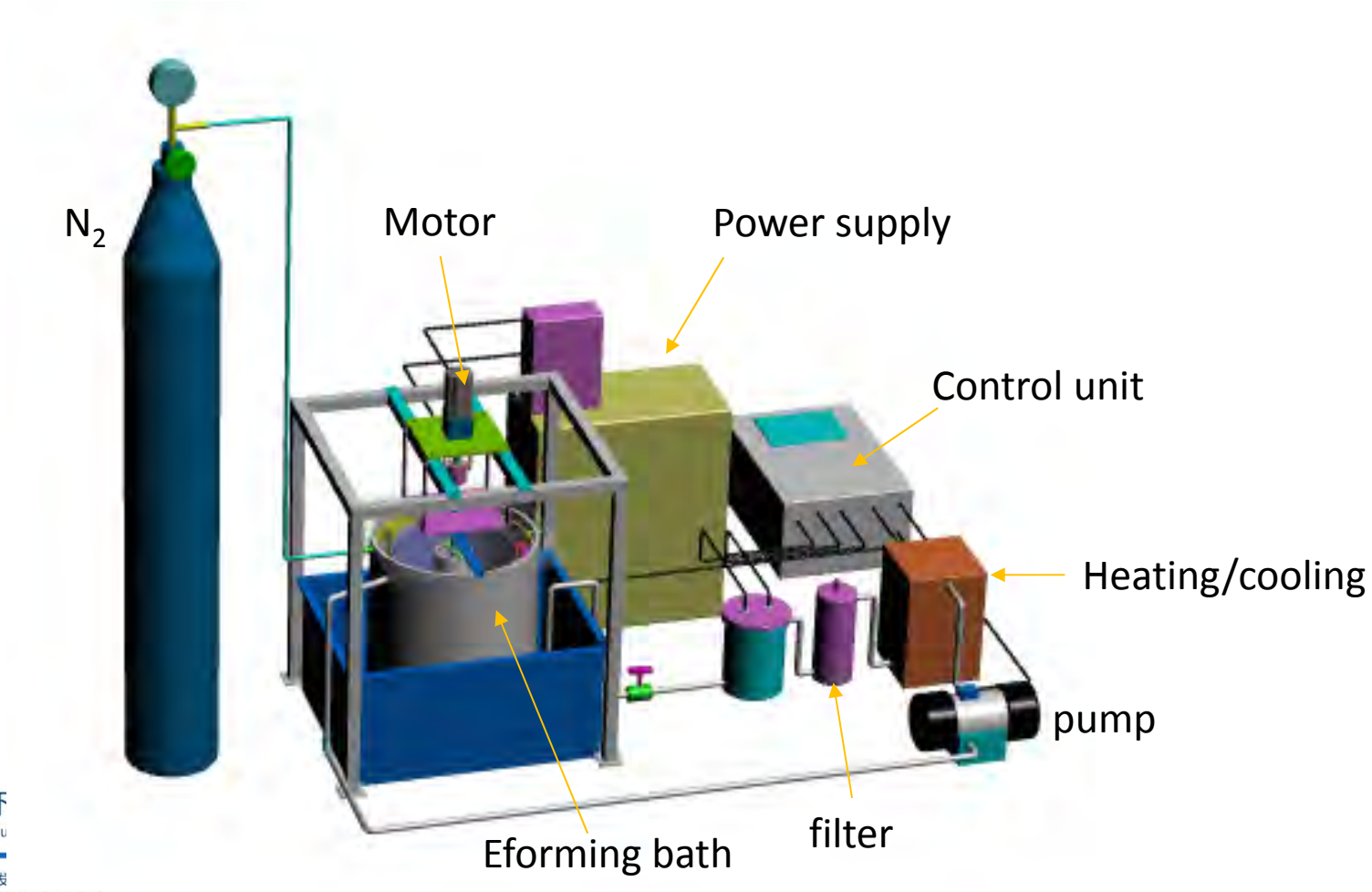


Possible location of facility



Status of Cu Eforming facility

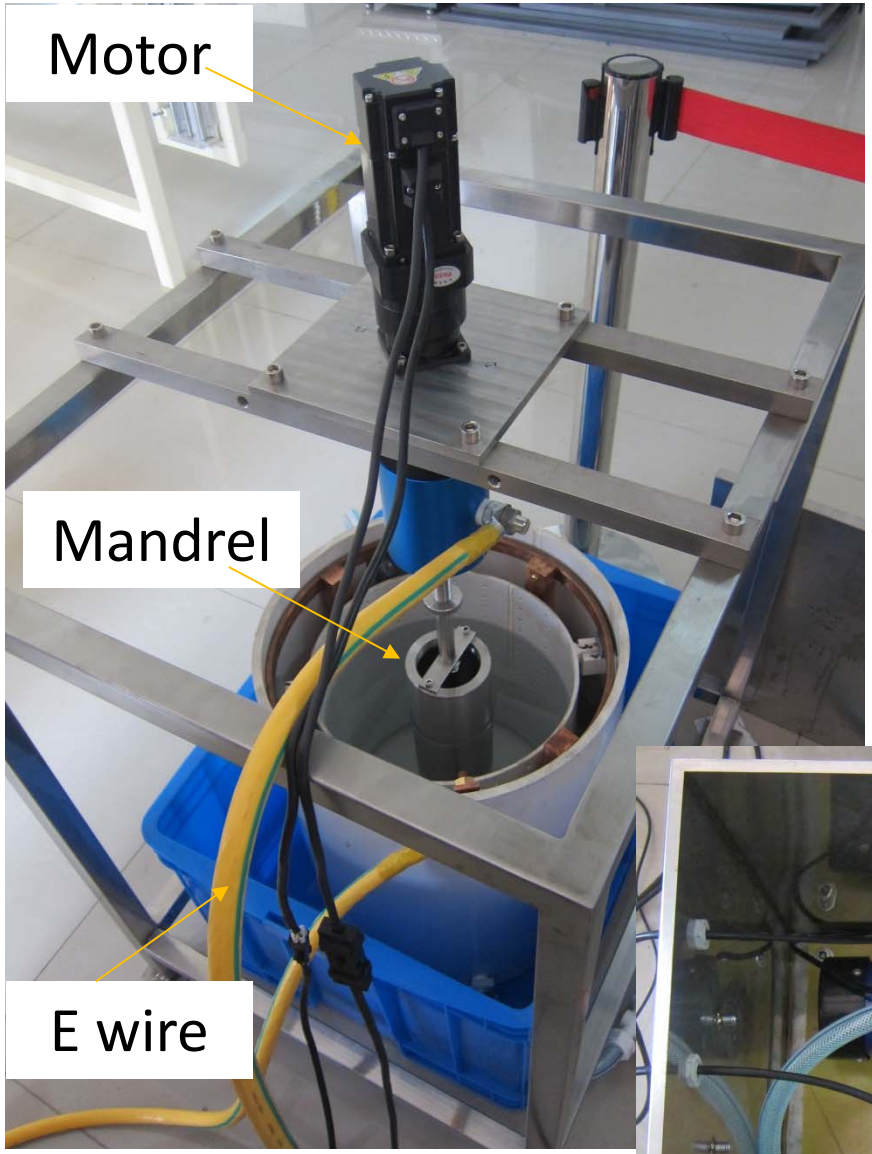
- Design of prototype device

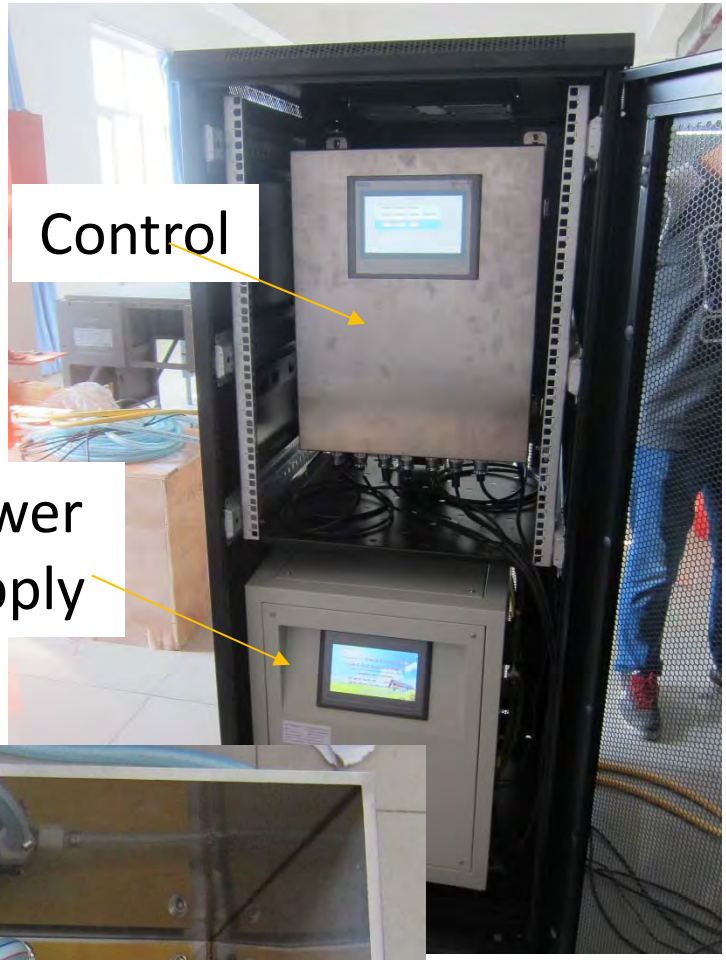


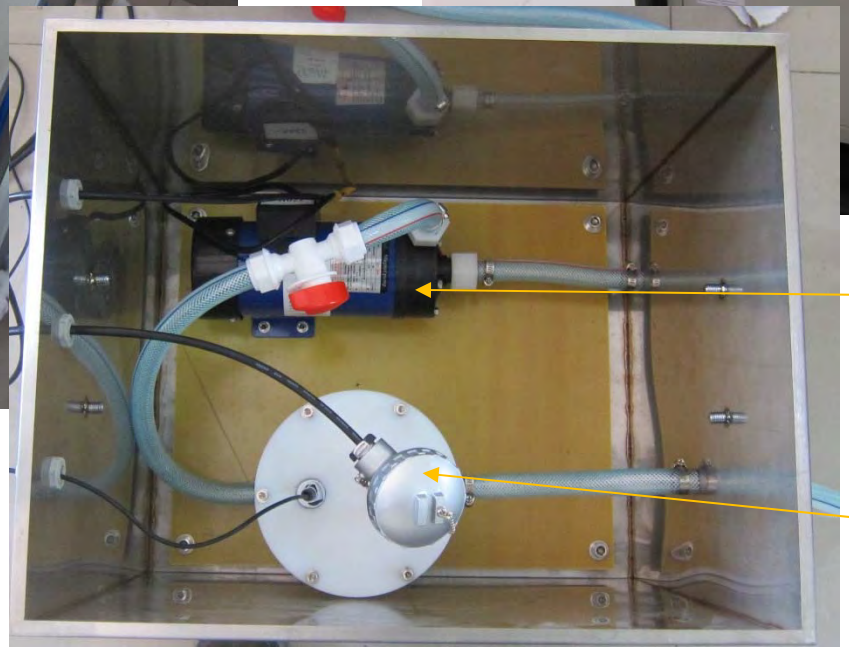
Status of Cu Eforming facility

- Prototype device
  - –Eforming bath
    - Stainless steel mandrel
  - –DC power supply
    - Output: 5V, 500A, adjustable
  - –T and pH monitor

To be tested in Tsinghua campus


Motor
Mandrel
E wire


Control
Power
supply


Pump
Monitor

Summary and outlook

- GeTHU1&2 are busily running for material screening of CJPL-2 and CDEX, and will be upgraded to achieve lower background.
- GeTHU2s is coming at the end of 2015.
- Prototype device of Cu Eforming will be tested in Tsinghua campus.

Thanks for your attention!

On the way to lower background…

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