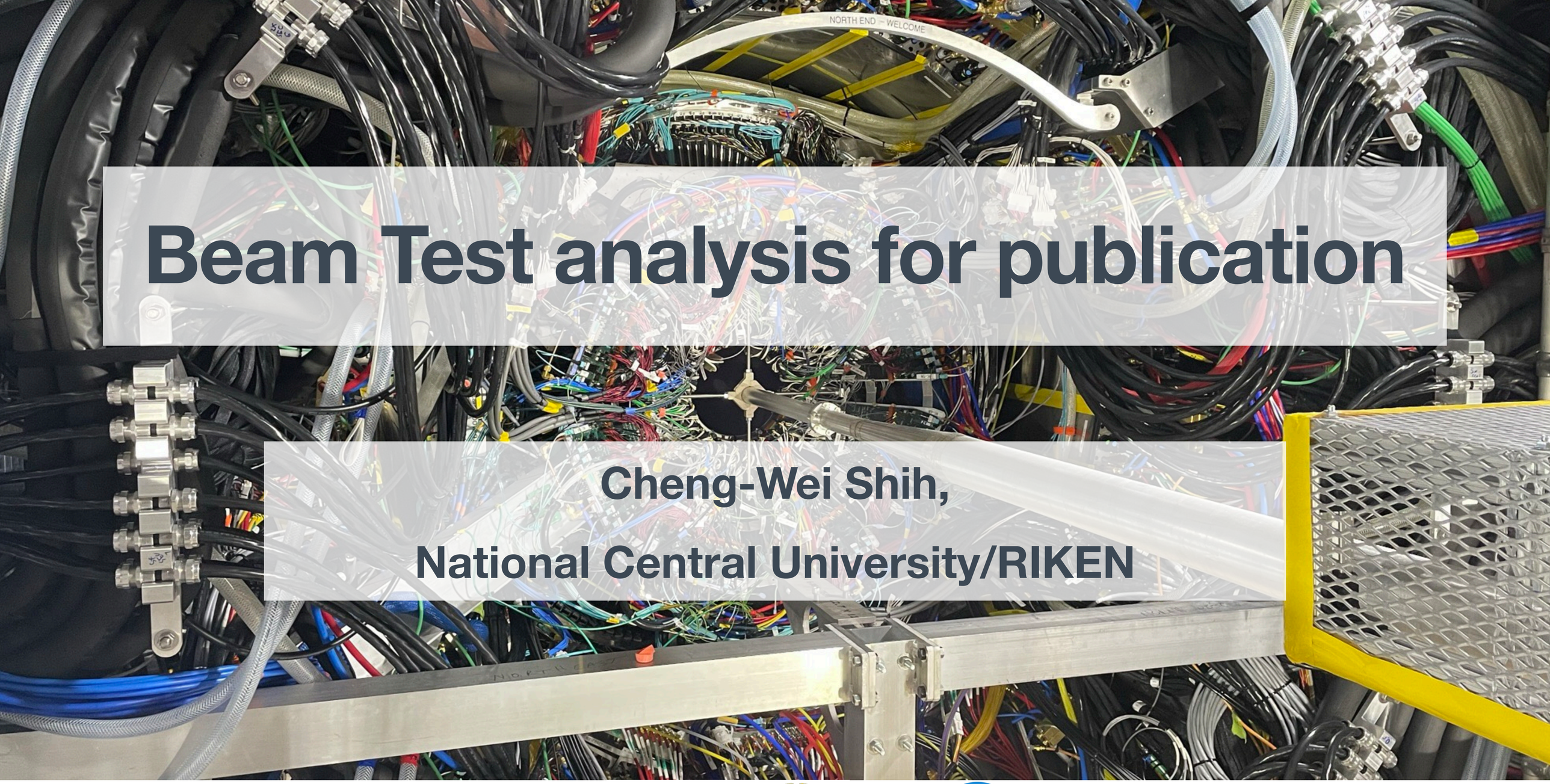


Beam Test analysis for publication

Cheng-Wei Shih,

National Central University/RIKEN

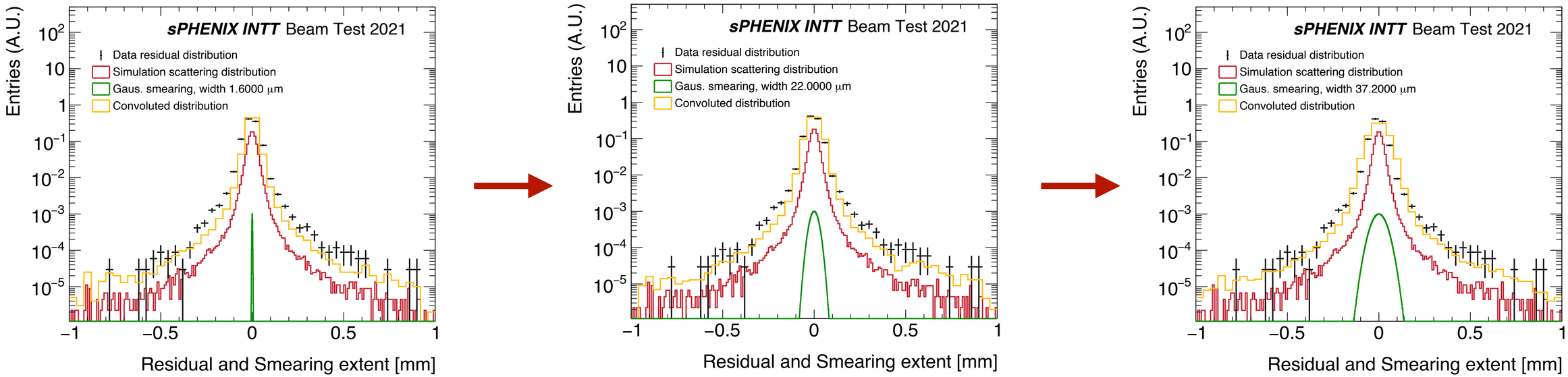
July 11th, 2025
INTT meeting

INTT hit spatial resolution

- Expected INTT hit spatial resolution = $78\ \mu\mathrm{m}/\sqrt{12} = 22.52\ \mu\mathrm{m}$
- Measured residual distribution = the convolution of
  - Pure scattering distribution σ_{MS}
  - Spatial resolution of the reconstructed track σ_{track} (L0-L2 interpolation)
  - Spatial resolution of the device under test σ_{DUT} (ladder L1)
- $\sigma^2_{\mathrm{measured}} = \sigma^2_{\mathrm{Scattering}} + \sigma^2_{\mathrm{track}} + \sigma^2_{\mathrm{DUT}}$
  - Equation valid only if the pure scattering and measured residual distributions follow the Gaussian distribution (Which might not the case. But you could have an idea about the relation)
- $\sigma^2_{\mathrm{track}} = \mathrm{k} \cdot \sigma^2_{\mathrm{plane}}$, $\mathrm{k} = \dfrac{\sum_{\mathrm{i}}^{\mathrm{N}} \mathrm{z}_{\mathrm{i}}^2}{\mathrm{N}\sum_{\mathrm{i}}^{\mathrm{N}} \mathrm{z}_{\mathrm{i}}^2 - (\sum_{\mathrm{i}}^{\mathrm{N}} \mathrm{z}_{\mathrm{i}})^2}$, where z is the plan location in the beam direction
  - Assuming the layers used for the track reconstruction have the same spatial resolution
  - If the track layers are symmetrically distributed on both sides of the DUT → k = 1/N
  - For the case of INTT, $\sigma^2_{\mathrm{track}} = \frac{1}{2}\sigma^2_{\mathrm{plane}} = \frac{1}{2}\sigma^2_{\mathrm{DUT}}$ (track layers are identical to the DUT. And layers are placed symmetrically)
- **For the INTT beam test, the measured residual distribution = convolution of pure scattering distribution and a Gaussian distribution with the Gaussian width of $\frac{3}{2}\sigma^2_{\mathrm{DUT}}$**

INTT hit spatial resolution

- **For the INTT beam test, the measured residual distribution = convolution of pure scattering distribution and a Gaussian distribution with the Gaussian width of $\frac{3}{2}\sigma^2_{\mathrm{DUT}}$**
- Approach:
  - Employ the pure scattering distribution from simulation
  - Convolute the distribution with a Gaussian distribution with different width
  - Quantify the agreement between the data residual distribution and the convoluted distribution by the chi-square method
  - σ_{DUT} = width of the best matched Gaussian distribution / $\sqrt{3/2}$



INTT hit spatial resolution

- Expected INTT hit spatial resolution = $78\ \mu\mathrm{m}/\sqrt{12} = 22.52\ \mu\mathrm{m}$
- Measured spatial resolution = 17.9 $\mu\mathrm{m}$
  - Thanks to the charged sharing and the 3-bit ADC of FPHX chip

Plot to be in paper (tentative)