Key outcomes from the BESSY II Meeting

Refine the manuscript, Validate at BESSY II — nominal-α in July, nominal & low-α in November

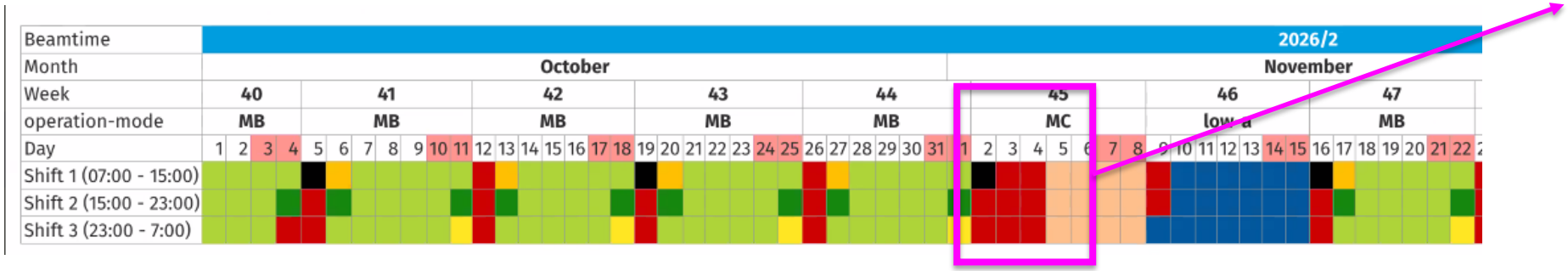
1. Manuscript revisions

- Noise measurement setup
- Underlying measurement principle
- Positioning

2. Validation experiments at MLS & BESSY II

- Nominal-α validation and data delivery at MLS (July 2026)
- Low-α operating-point experiment at BESSY II(November 2026)
- Comparison of two signal-processing methods (Δ/Σ vs raw signal)

Planning to do low-α study



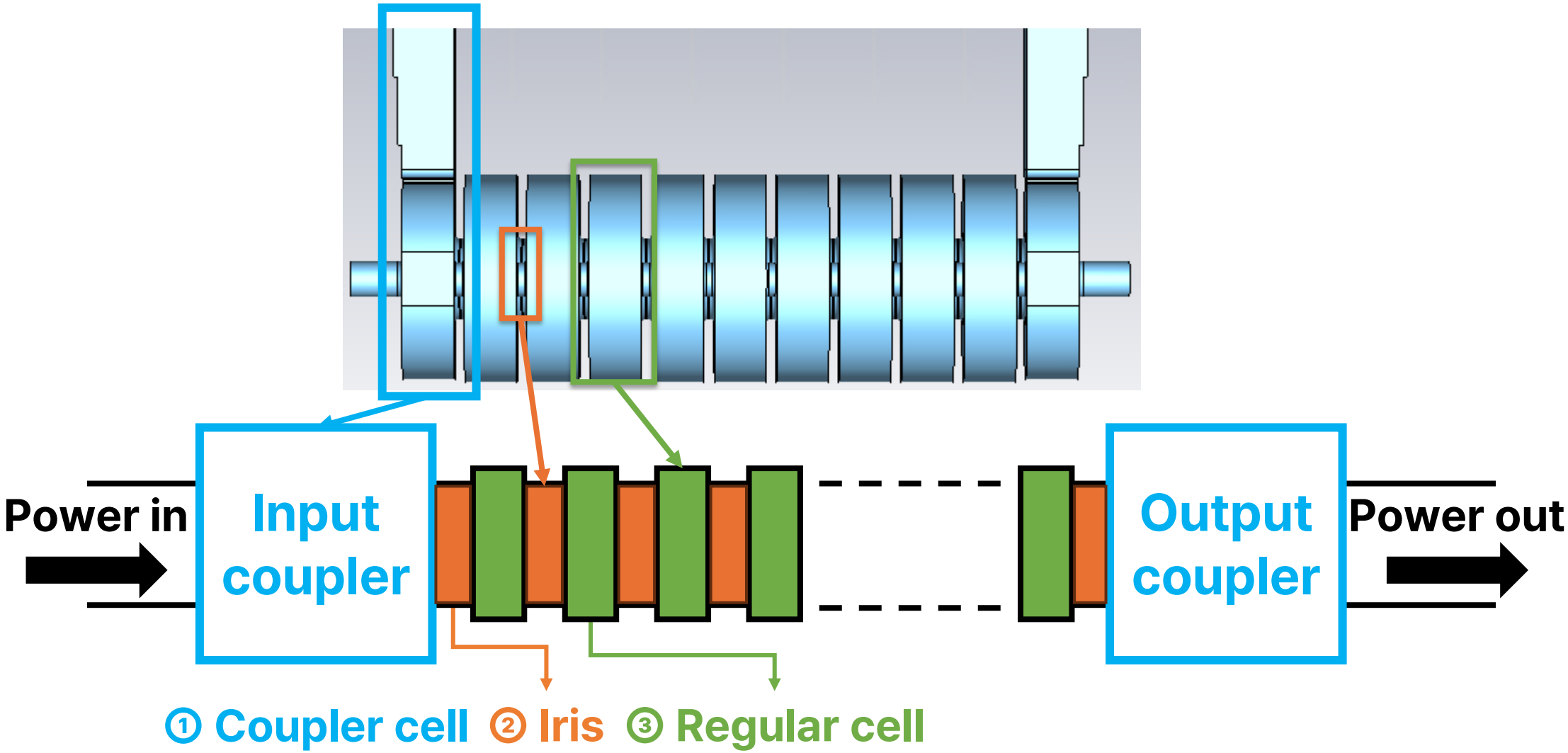
Tuning Status of Deflector

The error exceeds the range of tuners.

Geunwoo Kim

Cavity structure and key regions

Coupler cell → iris → regular cell



Coupler tuning uses a detuned cell as the reference

Compare the regular-cell response with the coupler-cell reference.

Set reference

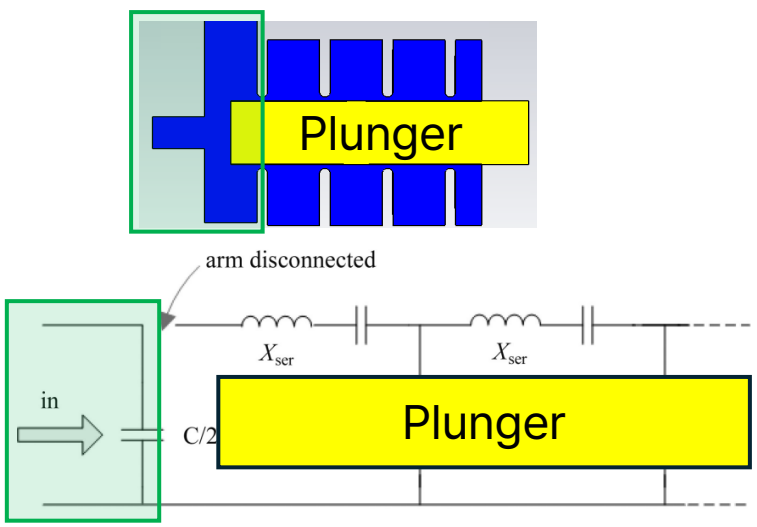
- Detune coupler cell

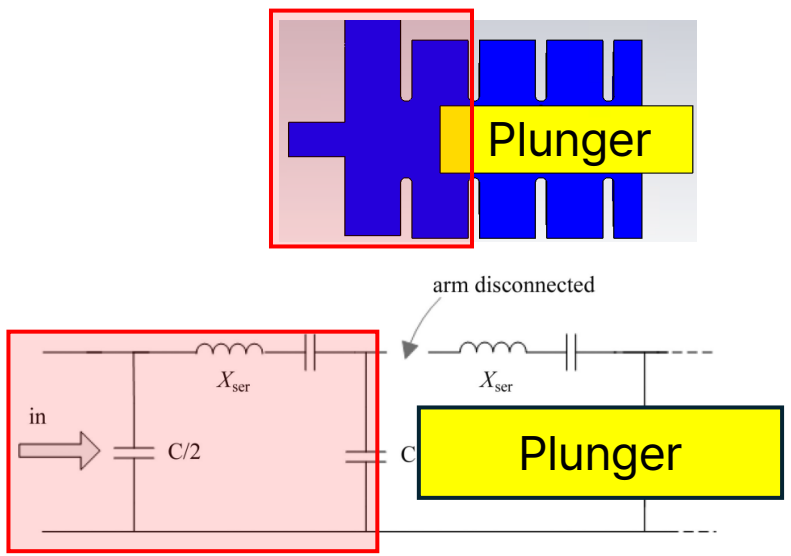
Measure response

- Detune 1st regular cell

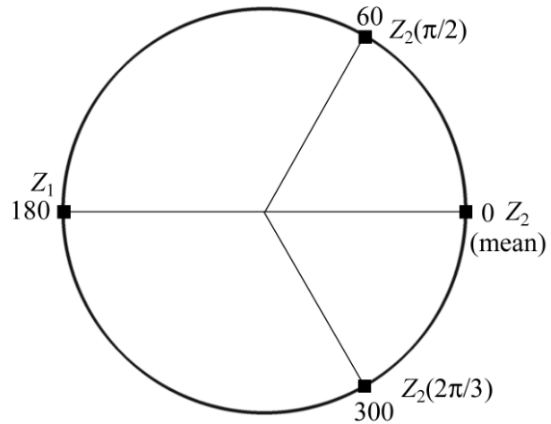
Target phase

- 60°, 0°, 300°
- 60° spacing



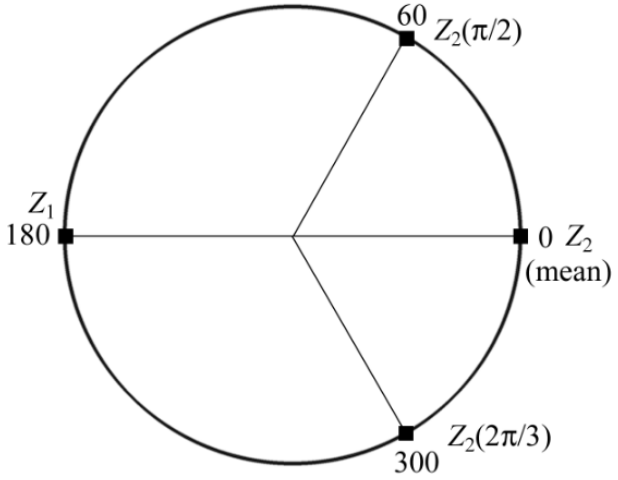


Wang *et al.*, HEP&NP 30(6), 2006.

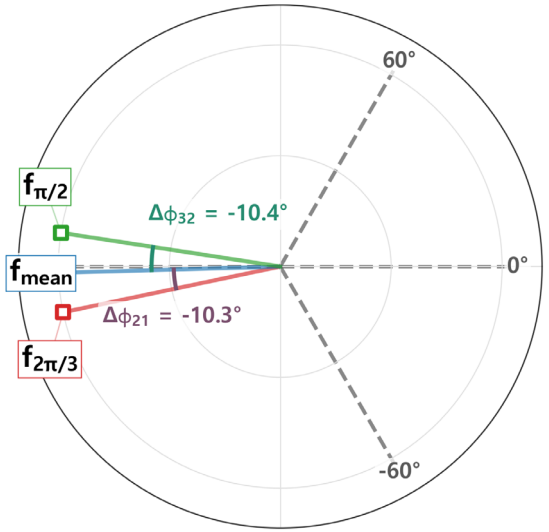


Measured phase deviation worsens at 1.5 cell

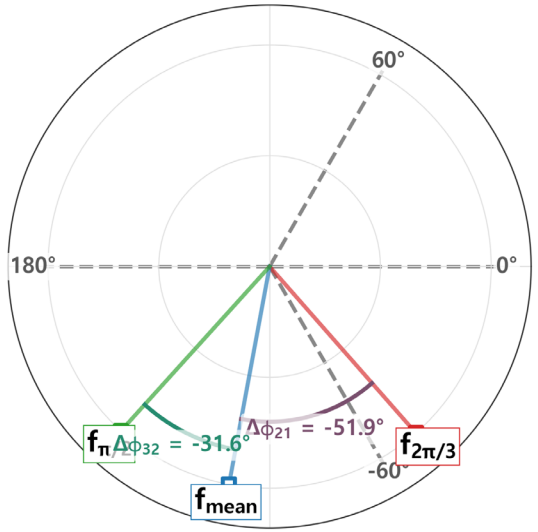
Phase spread increases from ~10° at 0.5 cell to 32–52° at 1.5 cell.



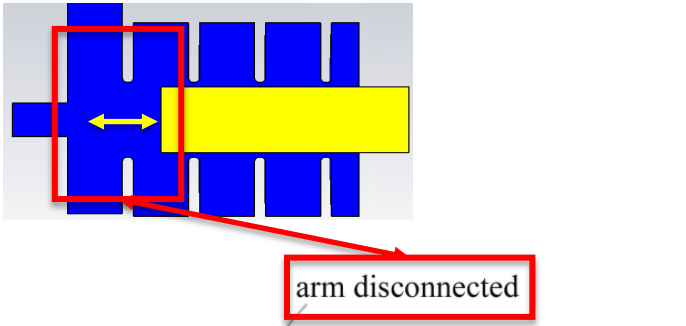
0.5 | 0.5_portE: Polar phase

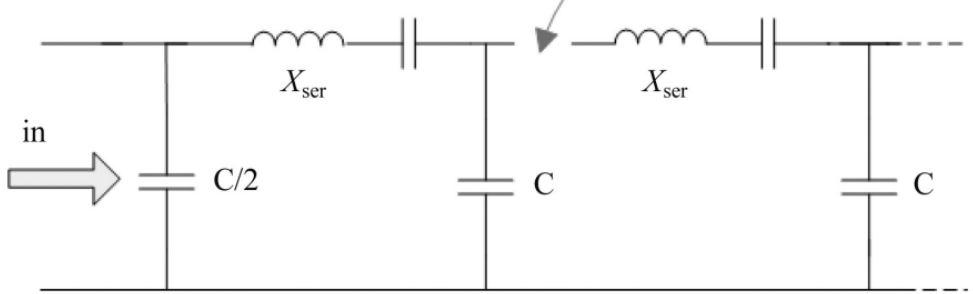


1.5 | 1.5_portE: Polar phase



➢ Is cell-centered detuning valid?





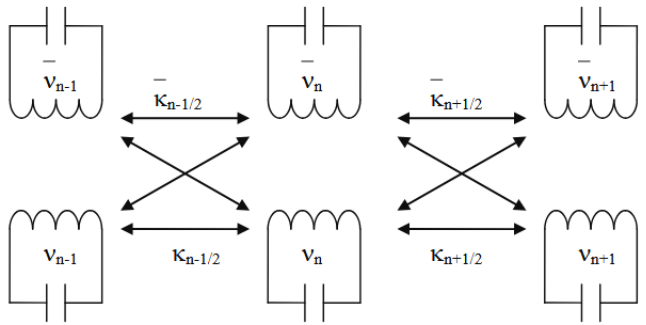


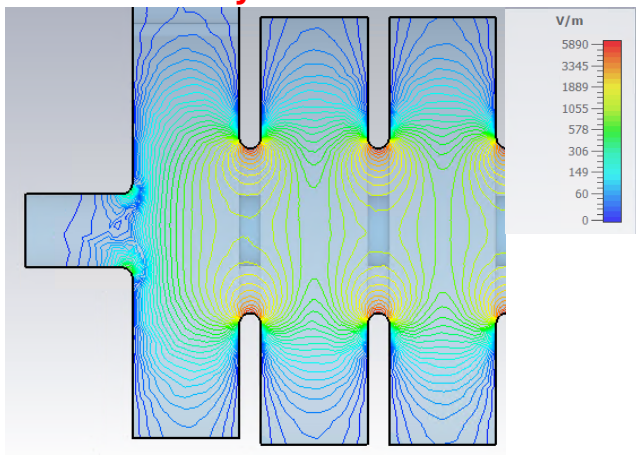
Fig. 2: Two-chain equivalent circuit model of a dipole cavity

EM field distribution analysis

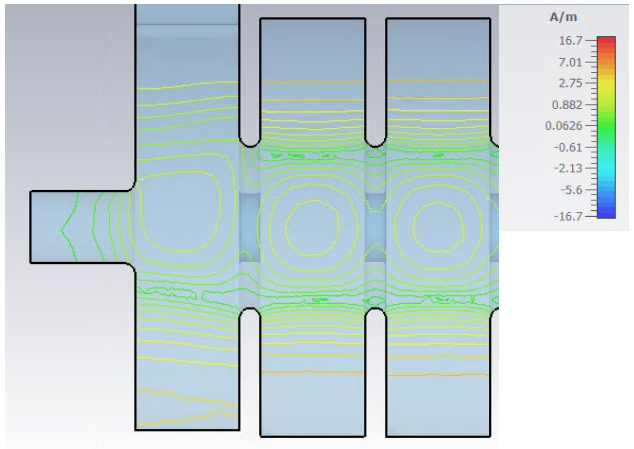
Proper plunger operation may require adjusting the detuning position.

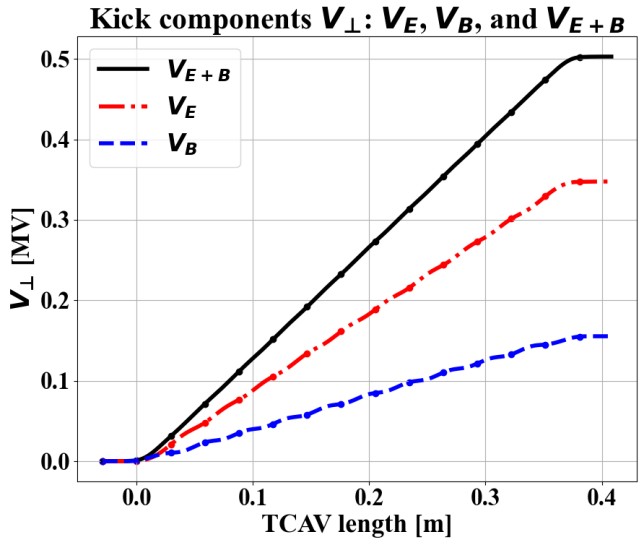
- Peak values of both E_y and H_x occur in the iris rather than in the cell.
- The E-field is the dominant contributor to the kick.
- $\frac{E_{iris}}{E_{cell}} \approx 2.44$

<Max(E_y) distribution>



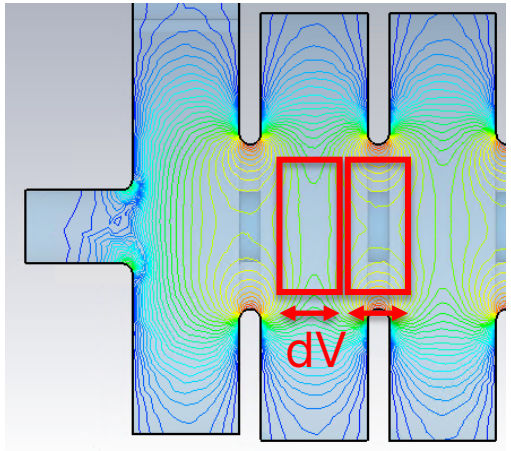
<Max(H_x) distribution>





Iris plunger may improve decoupling

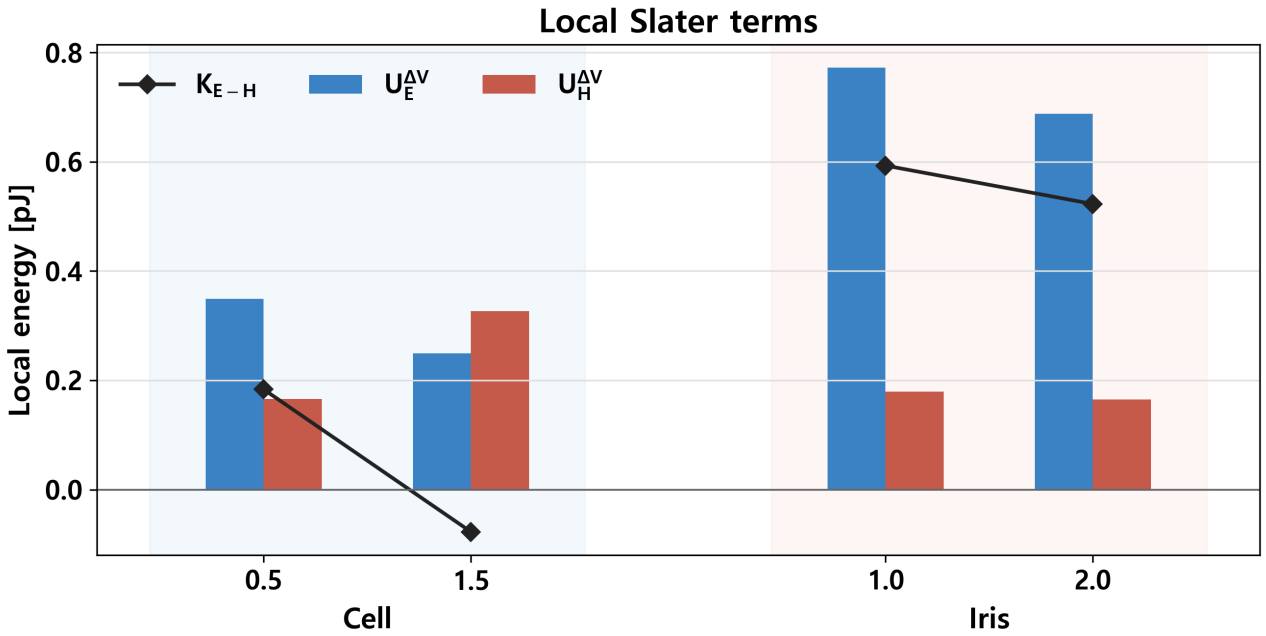
For the same perturbation, local Slater sensitivity is ~4.6× higher at the iris.



Local Slater Perturbation

- $K_{E-H} = \frac{1}{4}\int_{\Delta V}(\epsilon_0|E_0|^2) - \mu_0|H_0|^2)dV$
- Iris-to-cell sensitivity: $\frac{|K|_{\text{iris}}}{|K|_{\text{cell}}} \approx 4.6$

➢4.6× sensitivity → better decoupling



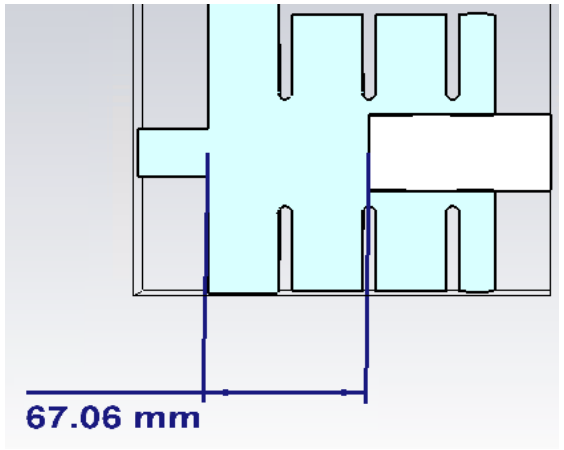
Geometry sensitivity

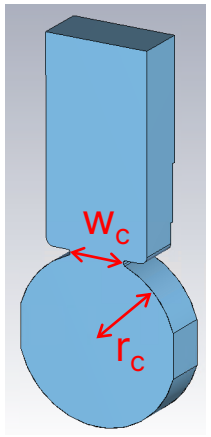
Can an iris-centered plunger detect cell-geometry changes?

Kyhl coupler setup

- Plunger position: 2.0 iris
- Sweep coupler geometry and track ΔΦ

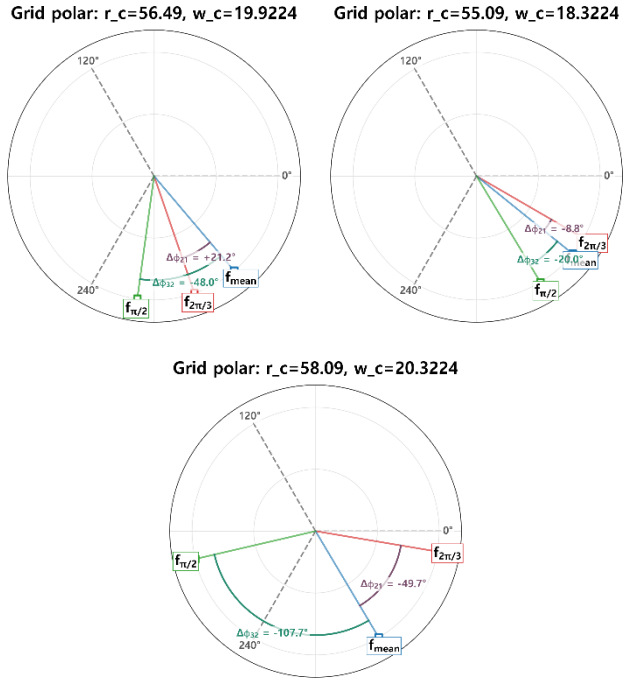
Goal
Compare ΔΦ: iris vs. cell





Parameters

1. Coupler radius r_c
2. Coupler width w_c



<① Set plunger position>

<② Sweep coupler geometry>

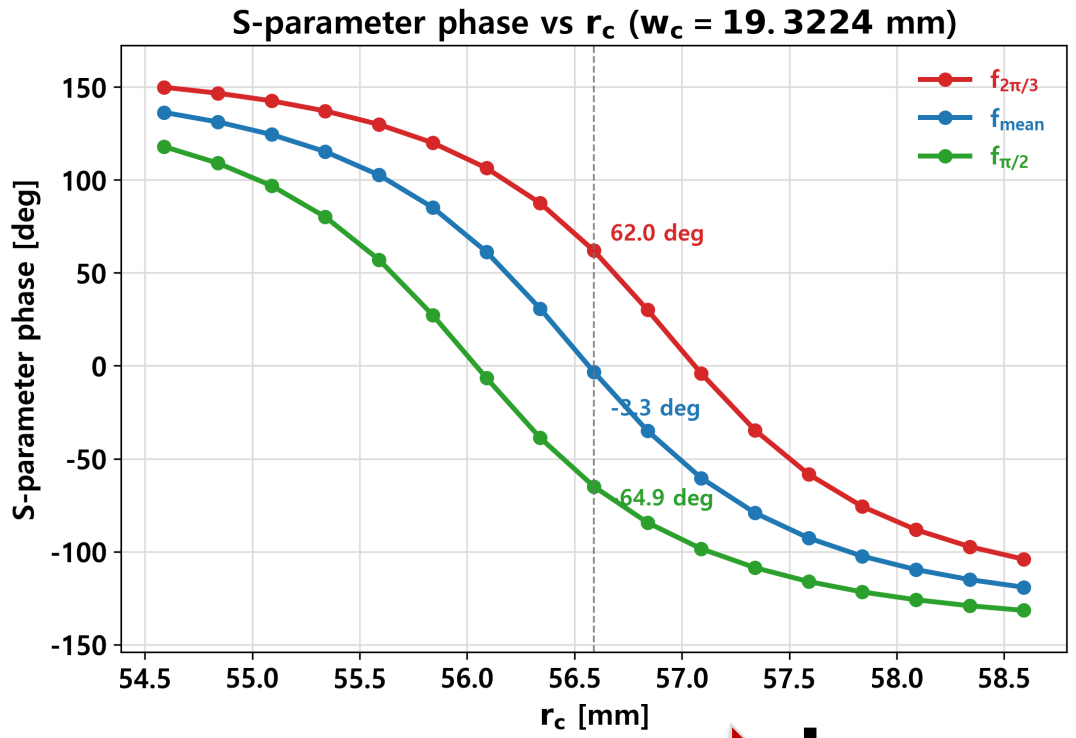
<③ Evaluate ΔΦ sensitivity>

Coupler radius drives phase shift

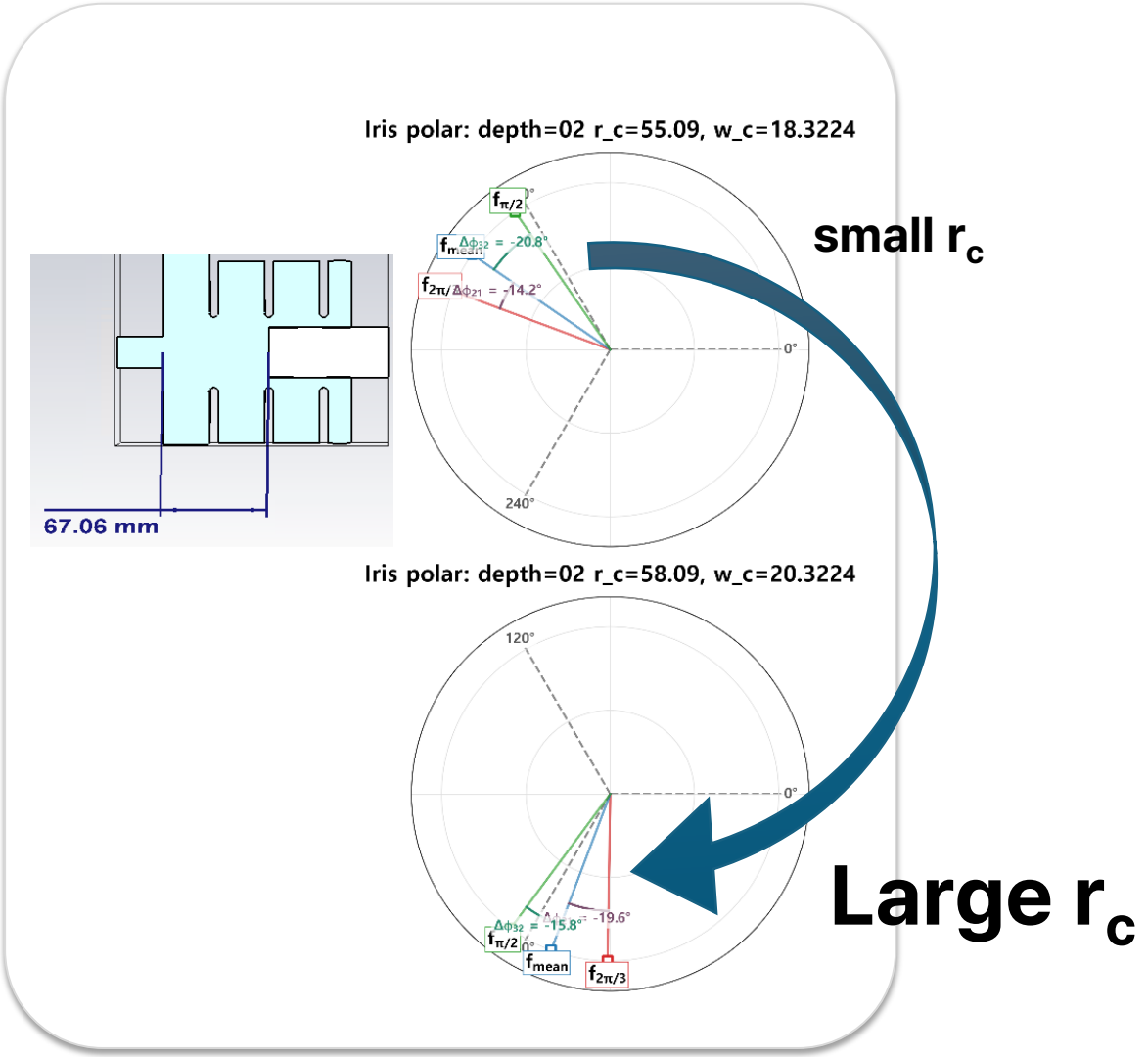
2D sweep identifies r_c as the dominant geometry parameter.

Key relationship

Larger r_c → lower Φ → clockwise rotation



small r_c → **Large r_c**

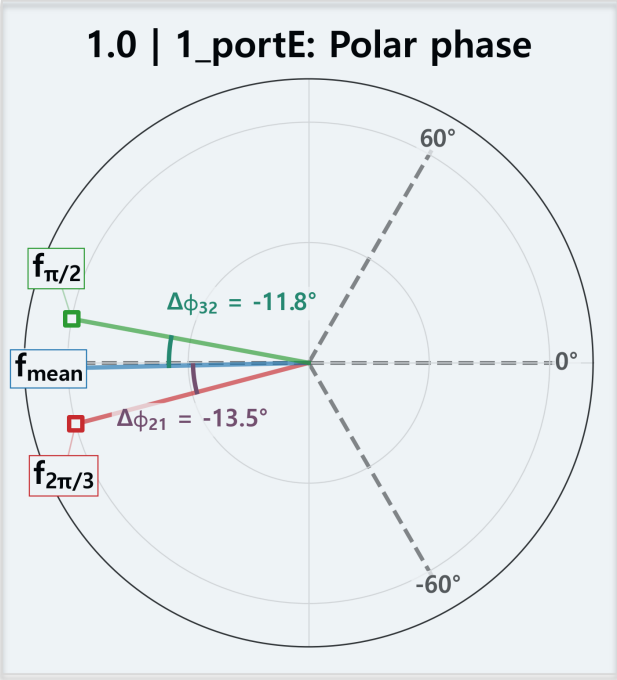


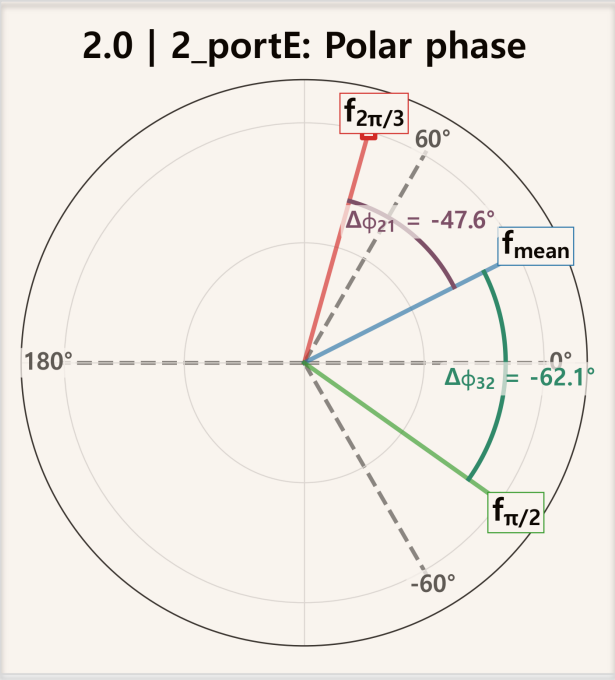
Initial measurements indicate a reduced cell radius

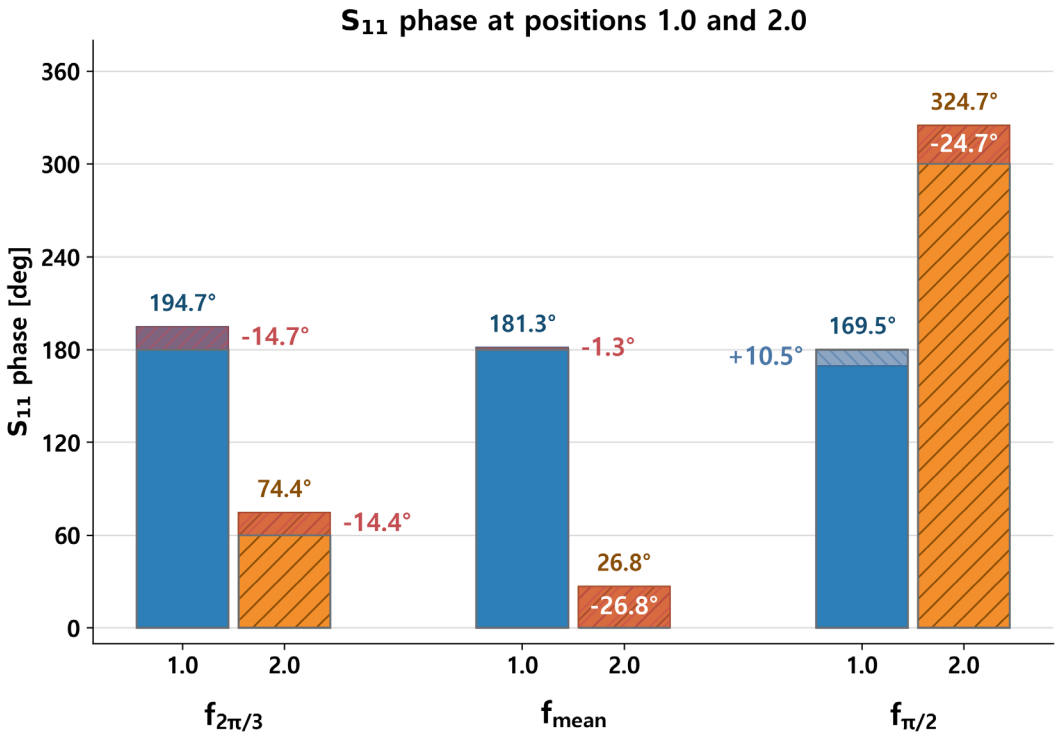
Insufficient r_c → expand the cell radius.

Initial data measurements

- Increase r_c → Decrease Φ
- Expand the cell radius with the tuner.





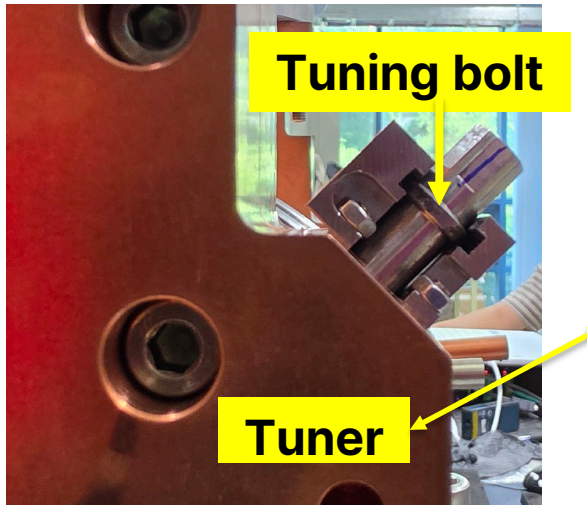


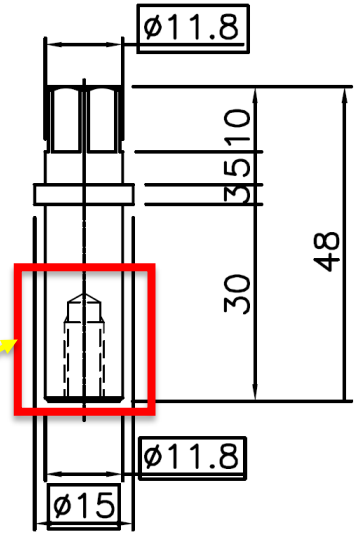
Tuning reduced the phase error by ~10°

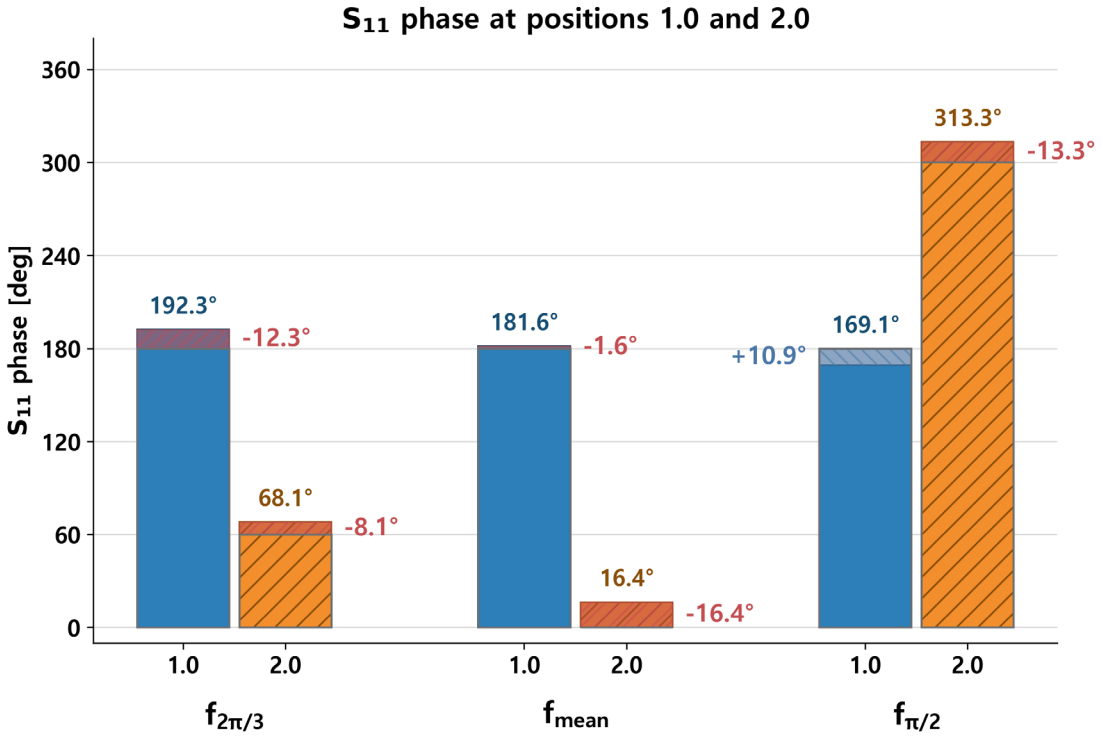
Pulling the tuner outward expanded the cell radius as expected.

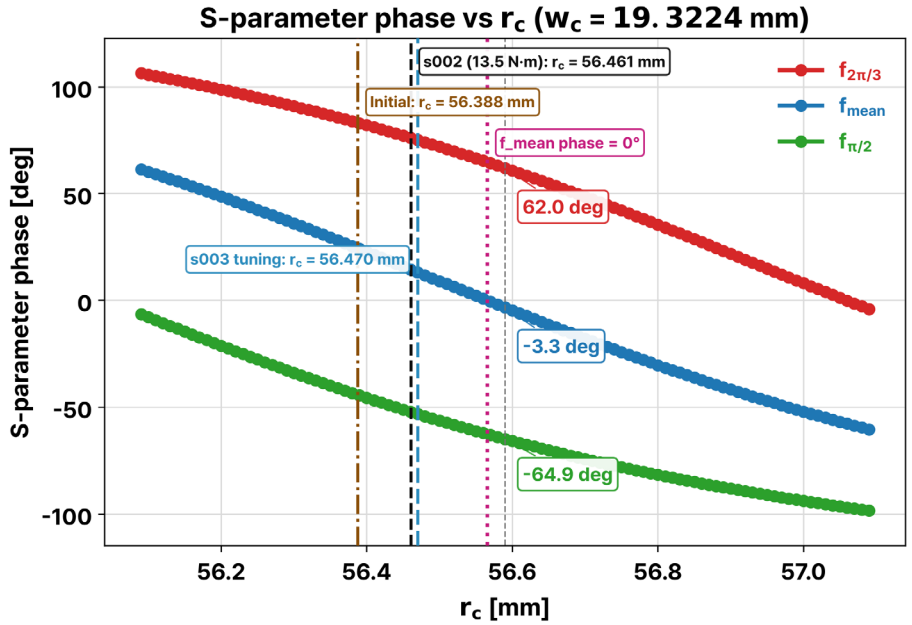
Pull tuner outward → larger r_c → lower phase

Measured correction: ~10°









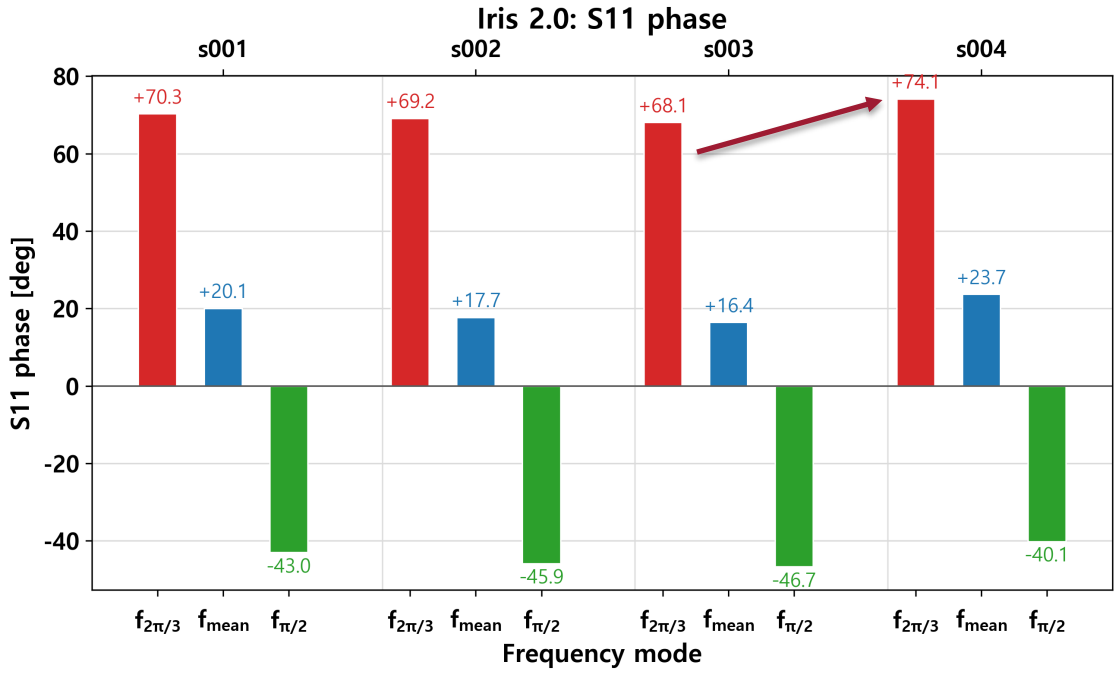
Mechanical separation reversed the tuning response

The phase shift changed sign after the tuner detached from the bolt.

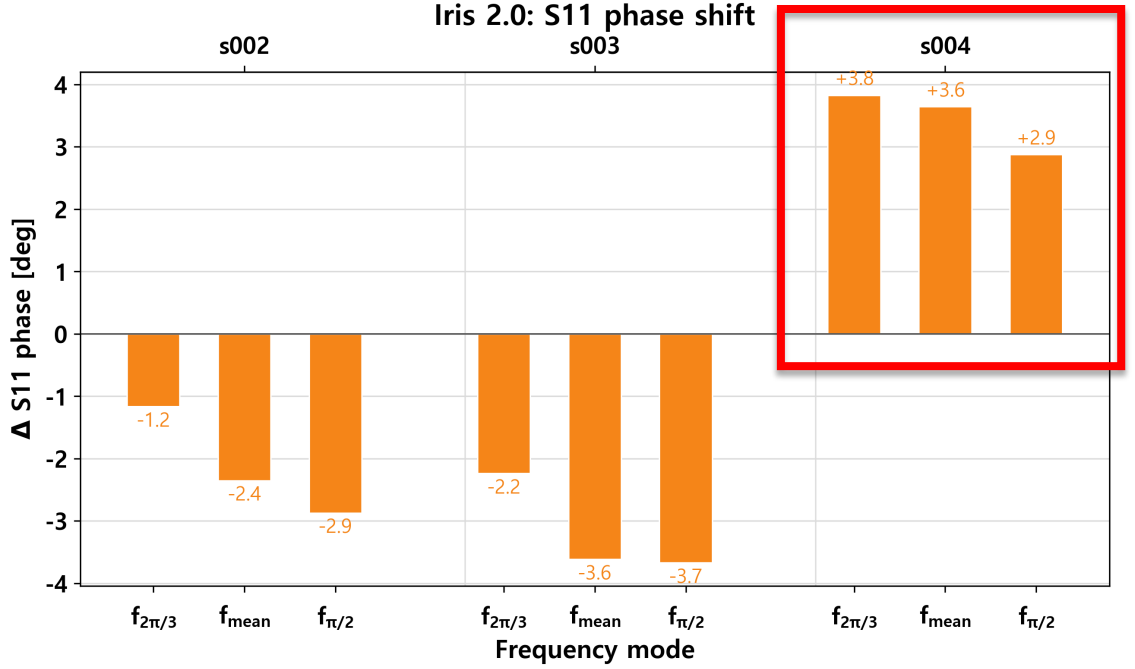
Useful correction: ~10°

Tuning-bolt separation → expanded structure returned toward its original shape

<Absolute S_{11} phase>



<ΔS_{11} phase>

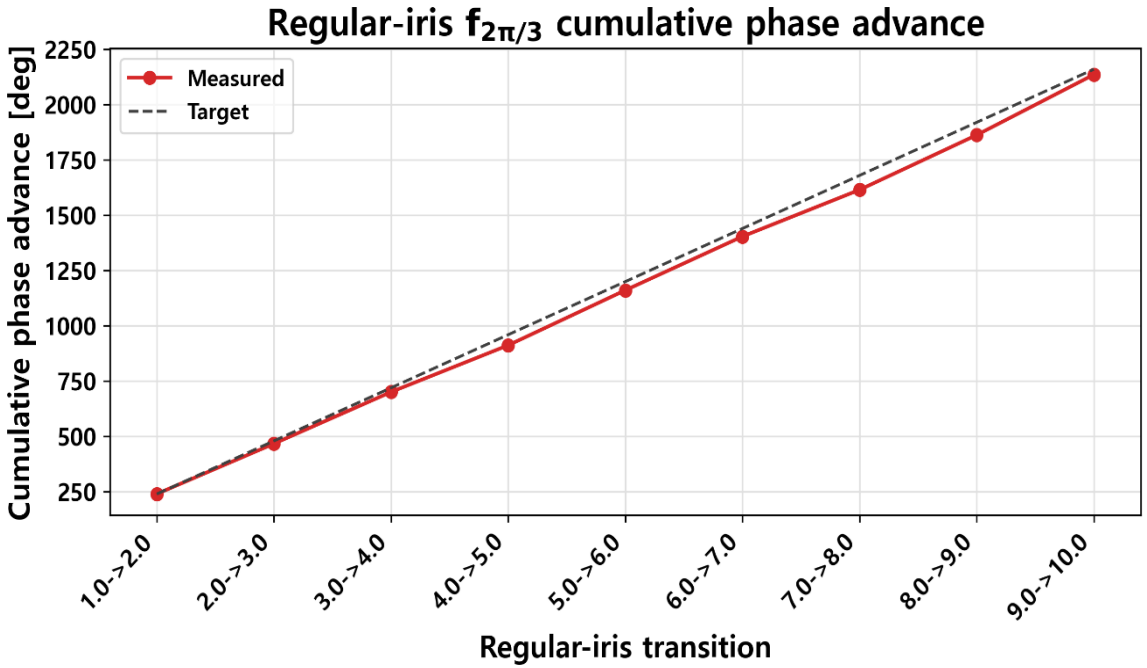


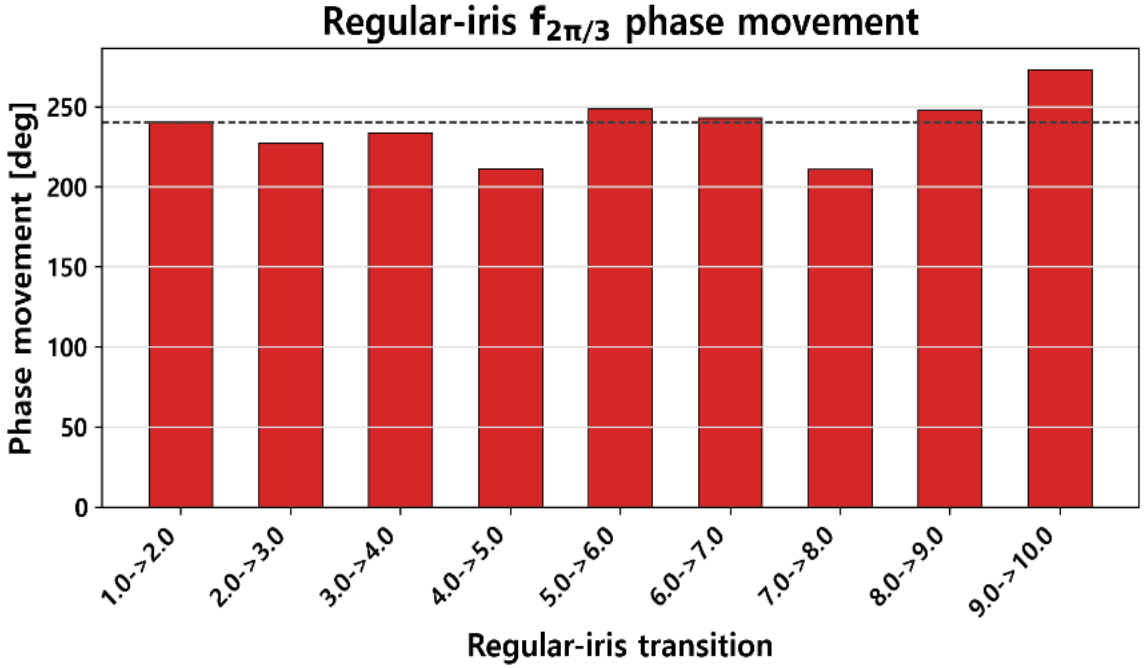
Cumulative phase follows the target despite cell variation

Local phase shifts vary, but cumulative error remains limited.

- Measured phase shifts across 9 iris transitions

Cumulative IRIS ΔΦ profile





Iris-centered tuning works, but the correction range is limited

1. Iris-centered tuning

Iris sensitivity is ~4.6× higher.

2. Cell radius controls phase

Larger r_c → lower Φ; measured r_c is too small.

3. Tuning range is limited

~20° correction was required, but only ~10° was achievable before excessive pulling disconnected the tuner.

➢ **Meet with the XFEL team and industry people next Monday.**