

# **Transfer function measurement for a general building using CWI method**

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# Background

- Protection resources for radiated EMP disturbances
  - A free-space loss between a EMP source and victim while controlling a distance to victim by building a fence (IEC 61000-4-36)
  - A conductive loss that is provided by conductive objects, such as concrete and rebar, composing a building to be protected (IEC TR 61000-5-3)
  
- Objects of our study
  - Investigates building's defense capability for EMP attack
    - Building → Commercial building, EMP source → HEMP and IEMI
  - Measures a shielding property for commercial buildings
  - Develops an efficient method to measure a shielding property of large-sized buildings

# Recently



# Preliminary Measurement (1)

- Target buildings for shielding property measurement
  - Selected two general buildings, each of which is composed of concrete walls and large windows



KTL Headquarter

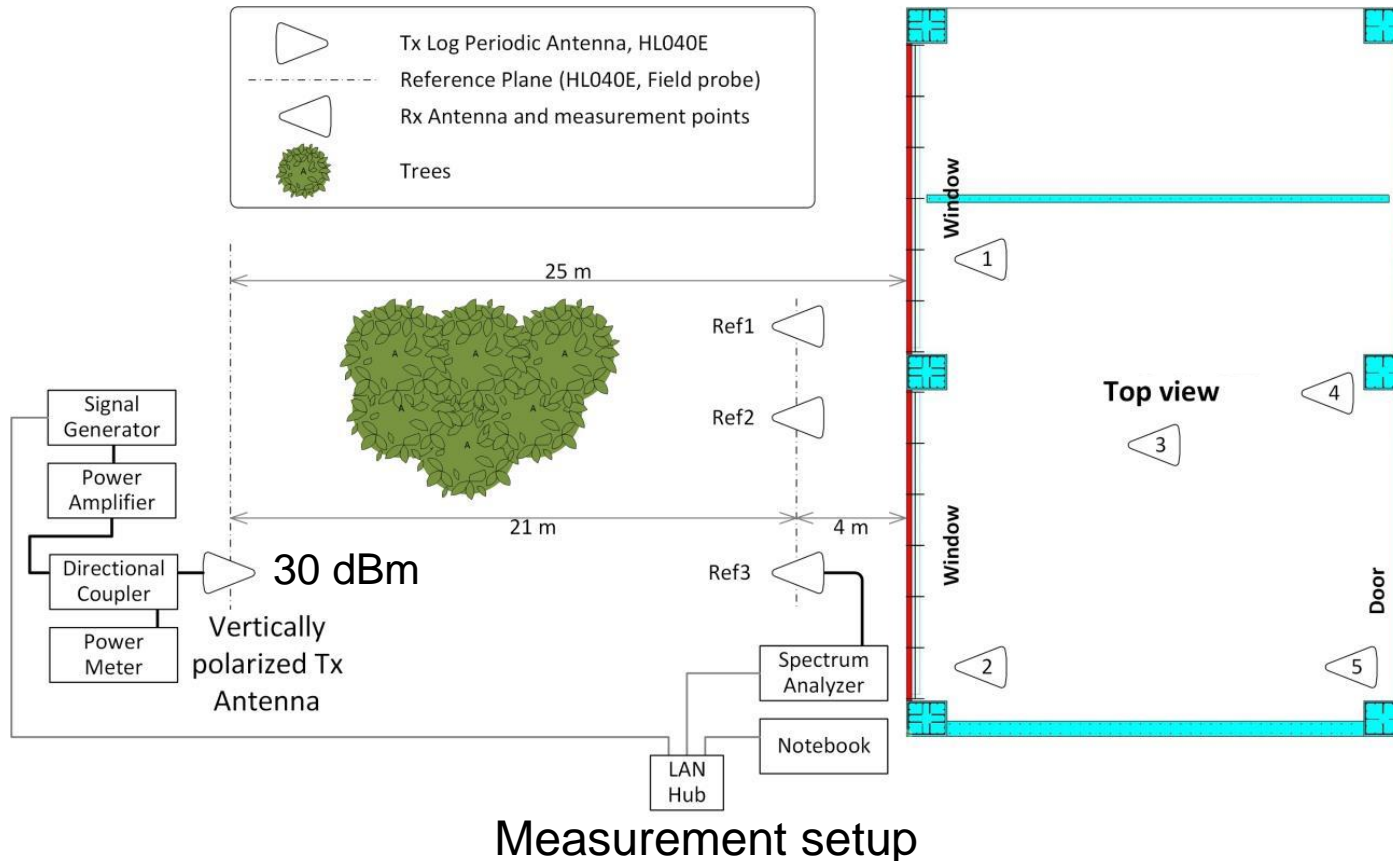


Korea Aerospace University

Buildings for Measurement

# Preliminary Measurement (2)

- Shielding property measurement



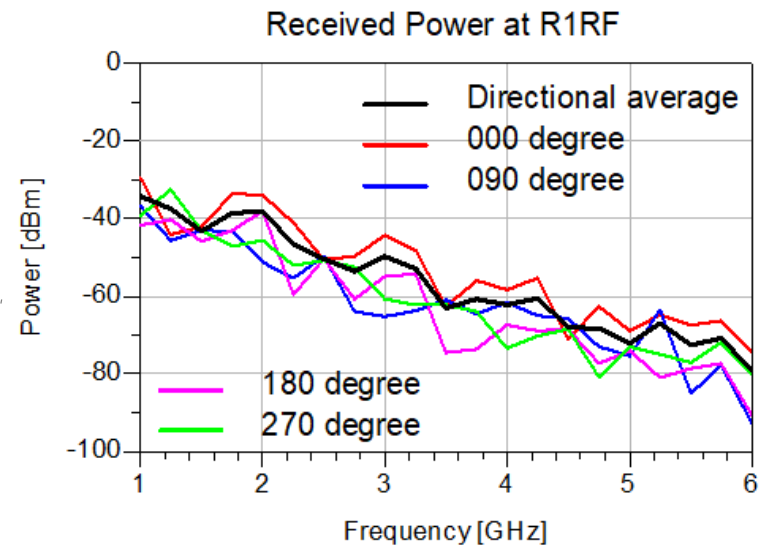
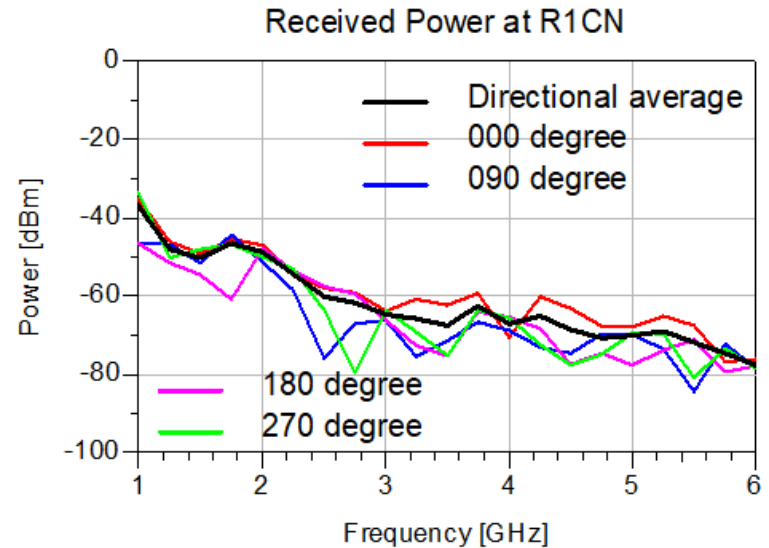
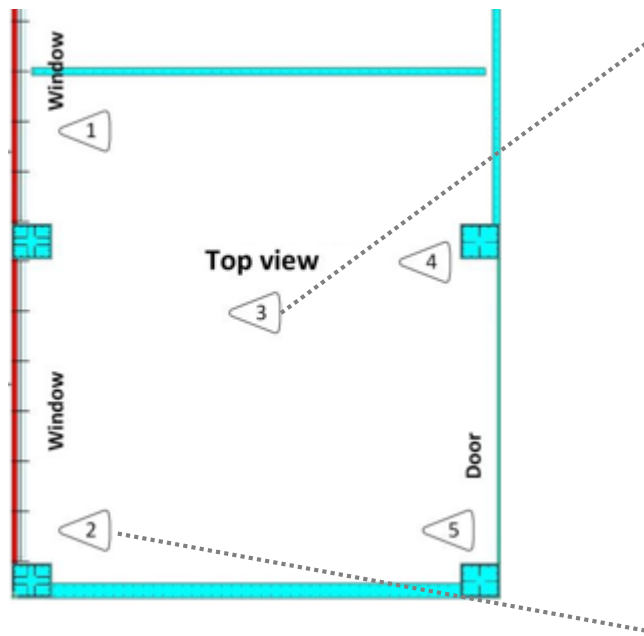
- Measured receiving power as changing antenna direction at each of multiple position



# Preliminary Measurement (3)

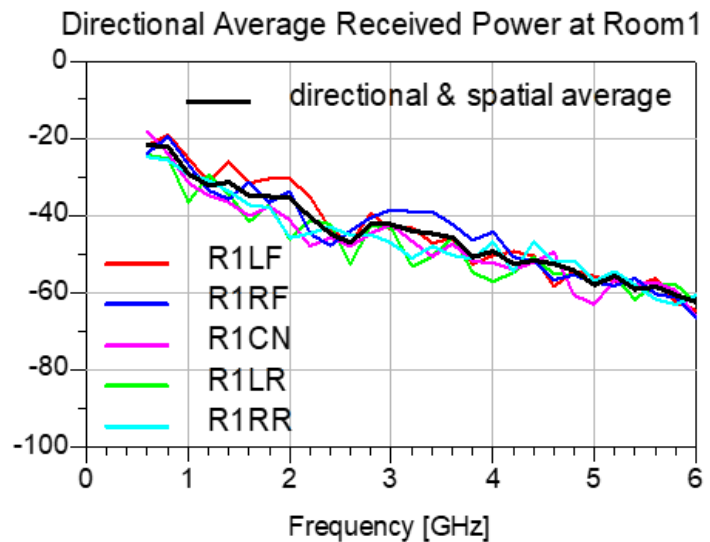
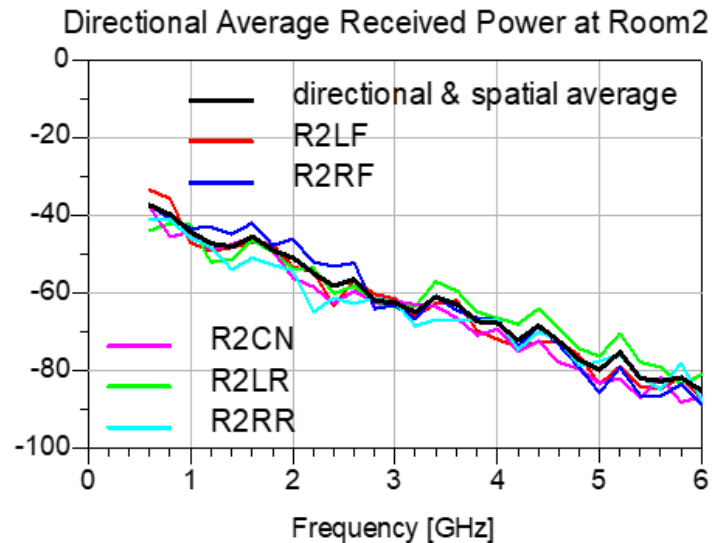
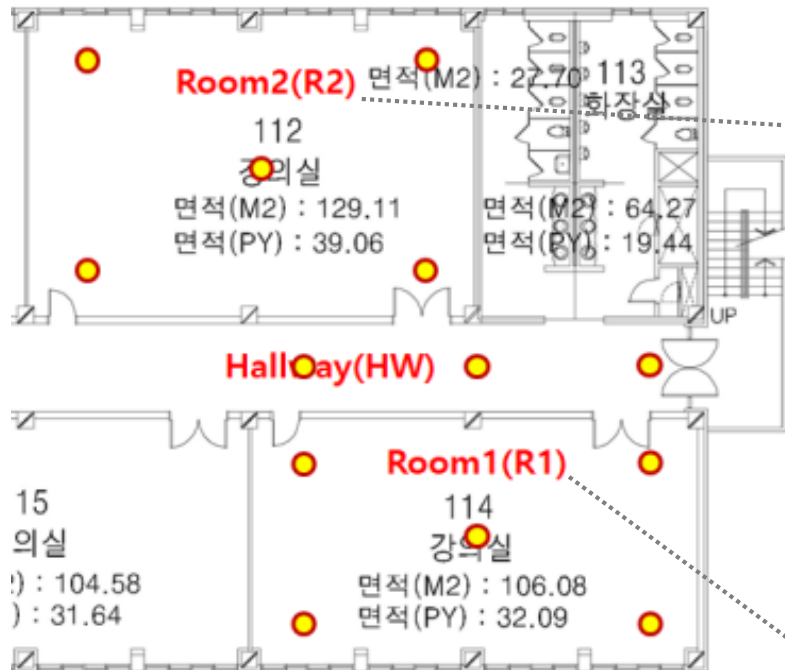


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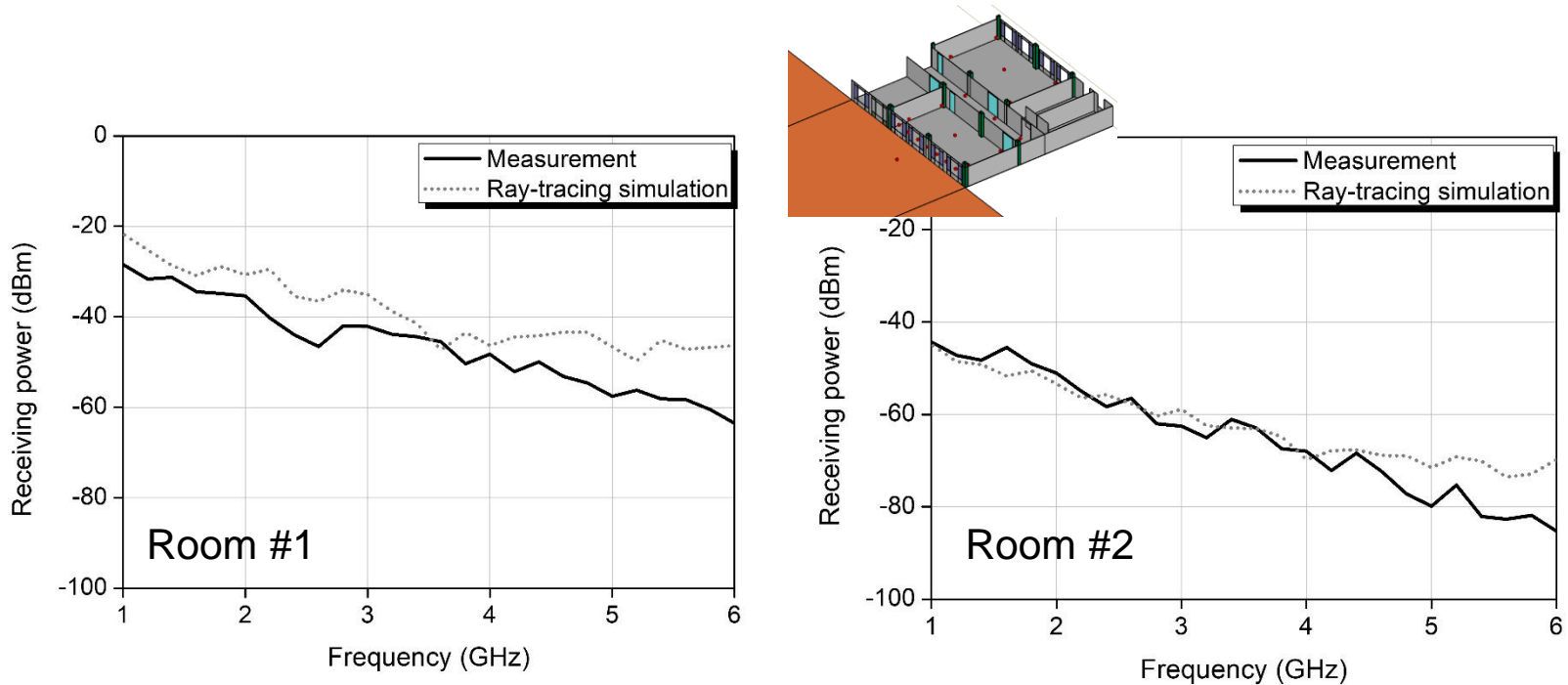
Receiving power at KTL Headquarter

# Preliminary Measurement (4)



# Preliminary Measurement (5)

- Comparison with simulation results



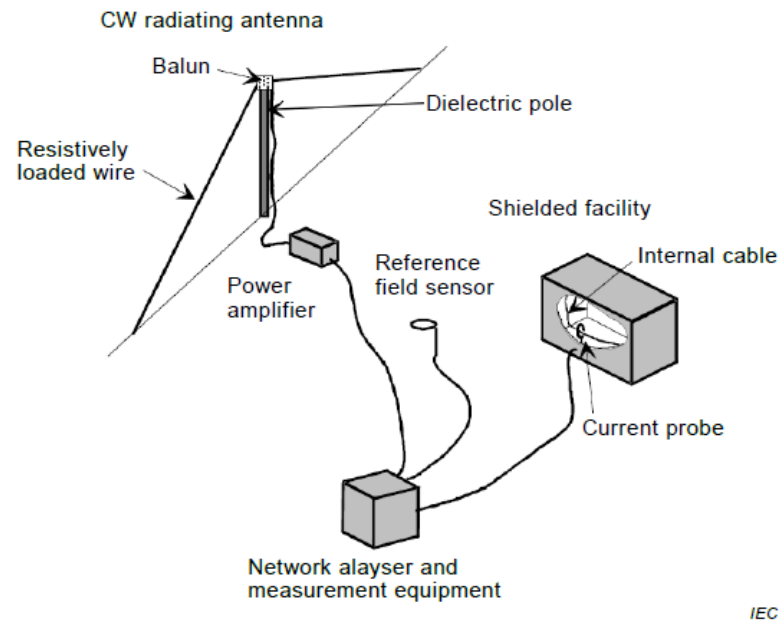
Comparison between measurement and ray-tracing simulation

- Observes good agreement between measurement and simulation results



# Measurement Issues (1)

- How to measure reference ?

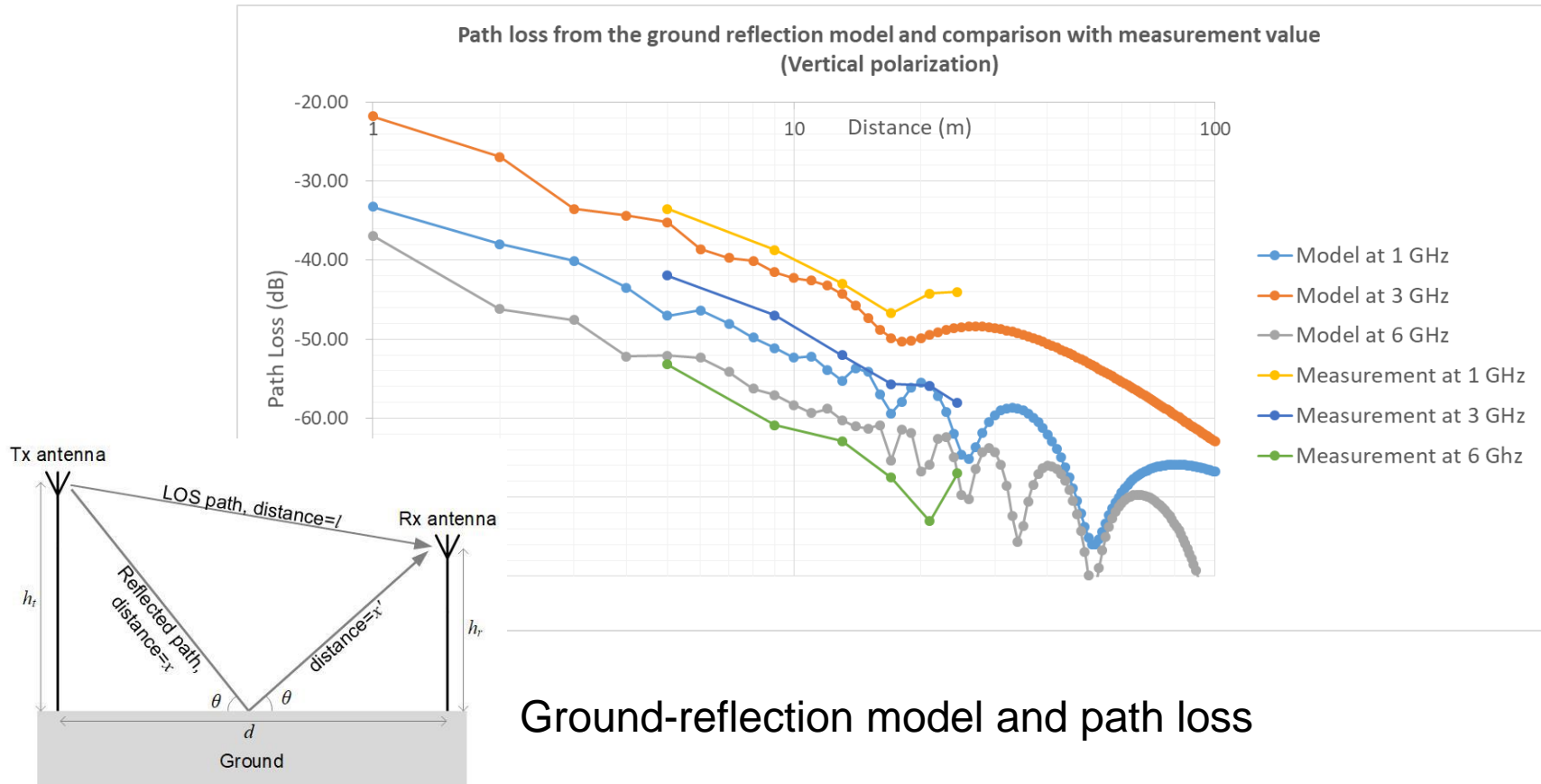


Reference measurement for CWI method (IEC 61000-4-23)

- To minimize reflection from a target building, keeps a distance between a reference point and target building
- Places a transmitting antenna enough away from a target building and as well as from ground

# Measurement Issues (2)

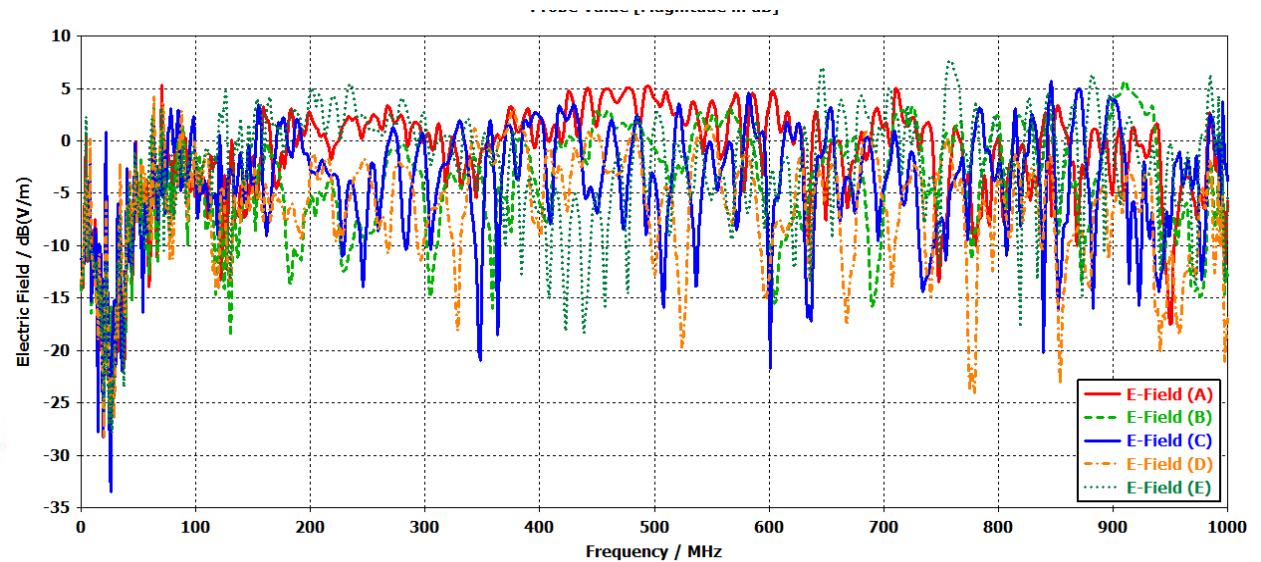
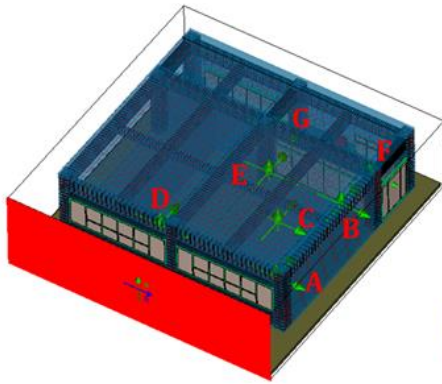
- But, hard to meet the requirements for a transmitting antenna → places a transmitting antenna on ground and close by a target building



- Reference measurement affected by ground reflection between a transmitting antenna and a target building

# Measurement Issues (3)

- How to represent variation on space ?

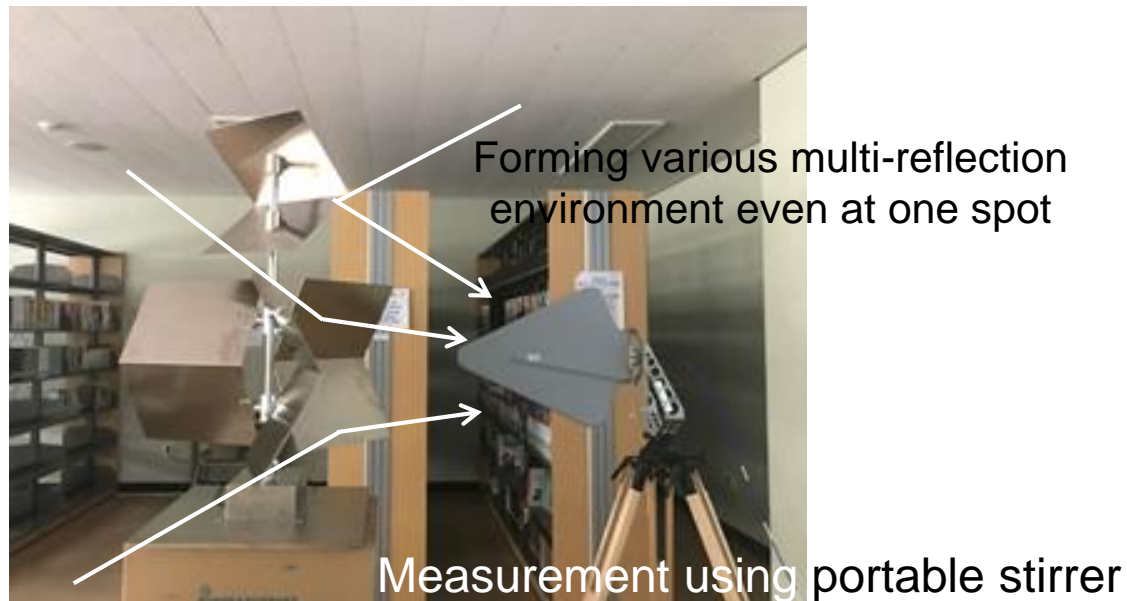


Receiving power inside building room

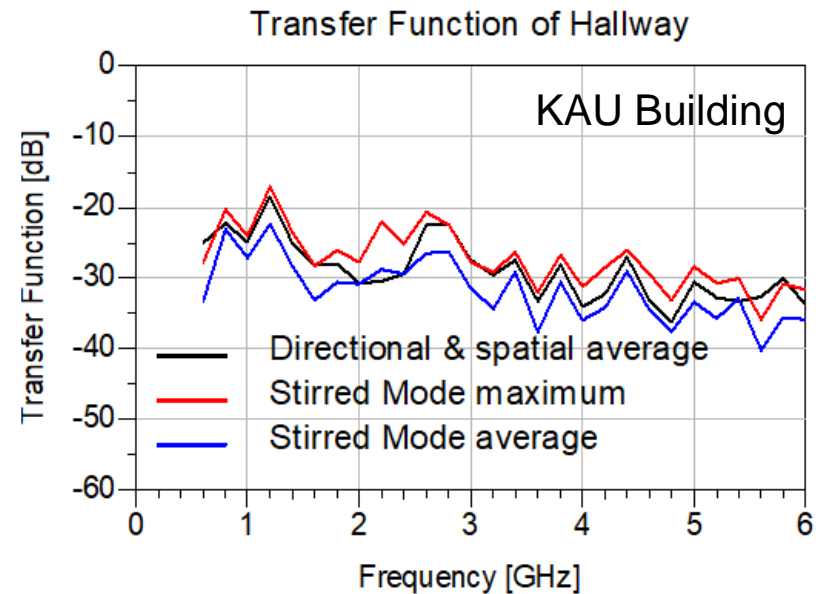
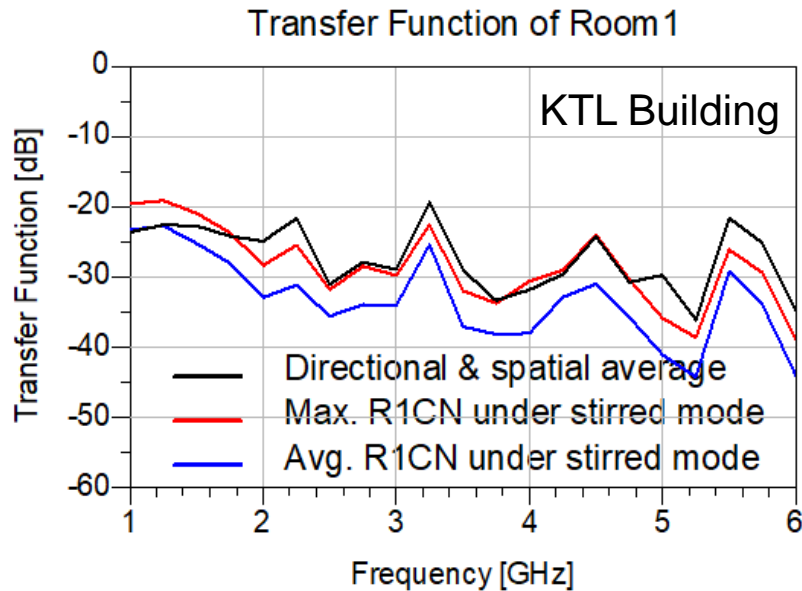
- Conducts measurement repeatedly at multiple points of space  
→ Increases measurement time and effort for a large-sized building
- Requires more time and effort when considering antenna direction and polarization

# Our Approach (1)

- Reciprocal measurement
  - Switches transmitting and receiving points, transmitting inside and receiving outside respectively → Able to remove ground reflection
- Pseudo-reverberation environment measurement
  - Measures a receiving signal as rotating a stirrer → Able to measure a space-representative value without multiple spot measurement



# Our Approach (2)



Measured transfer function

- The space average is almost equal to the maximum under the pseudo-reverberation environment method

# Future Plan

- Continue to research on measurement method for a large-size building
  - Develops reflection-free reciprocal measurement method
  - Analyzes the stirrer's effects further to investigate accuracy of the pseudo-reverberation environment method
  
- Contribution to SC 77C
  - Reports our research results to SC 77C as a working group member
  - After refining the measurement methods, proposes a new work project for amendment of IEC 61000-4-23 or new standard