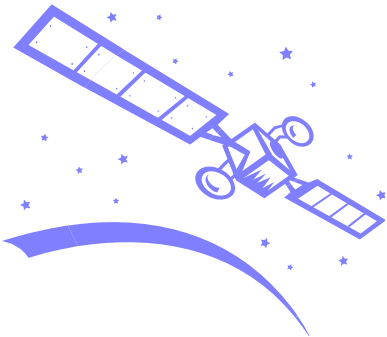


The 5th Nano-Satellite Symposium

New Receiving Ground Antenna Using Active Phased Array Antenna for Nano-Satellites

S.Ooe, S.Nakata, ○M.Iwashita, N.Kaya
Kobe University, Japan





Presentation Outline

▪ Introduction

- Purpose
- Phased array antenna

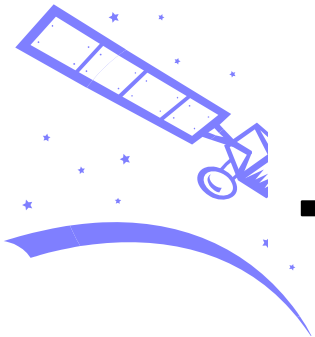
▪ Configurations

- Structure of ground station
- 8-array antenna system

▪ Improvement

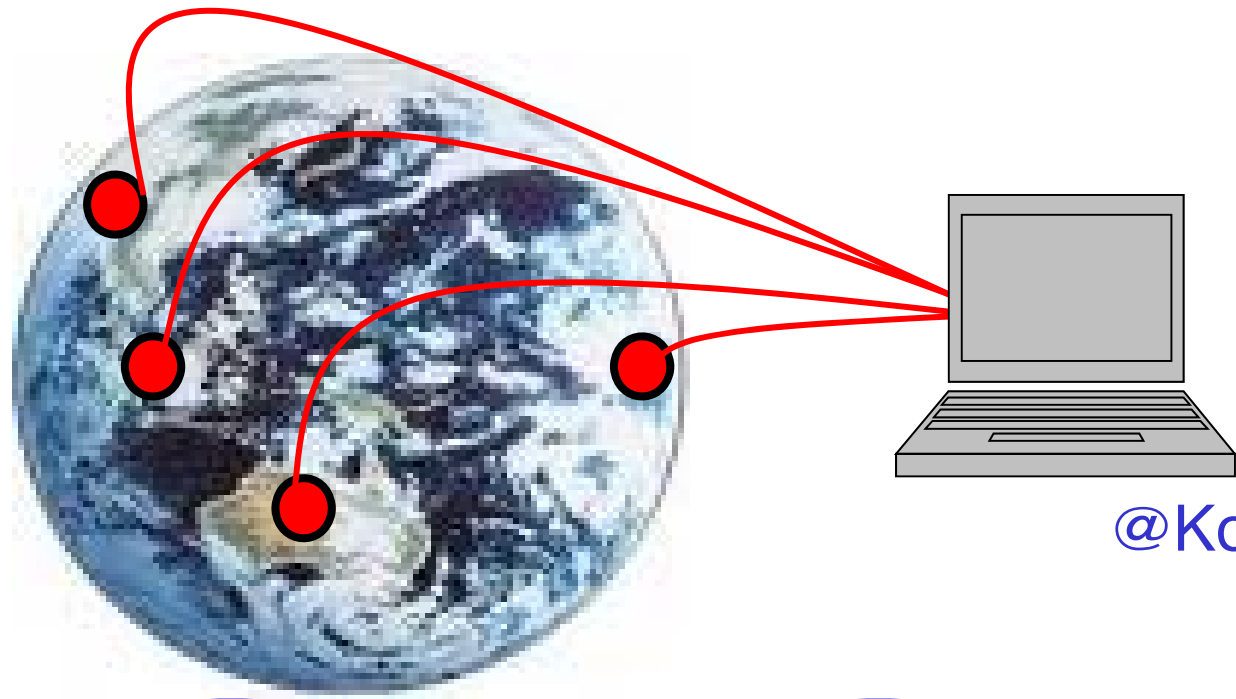
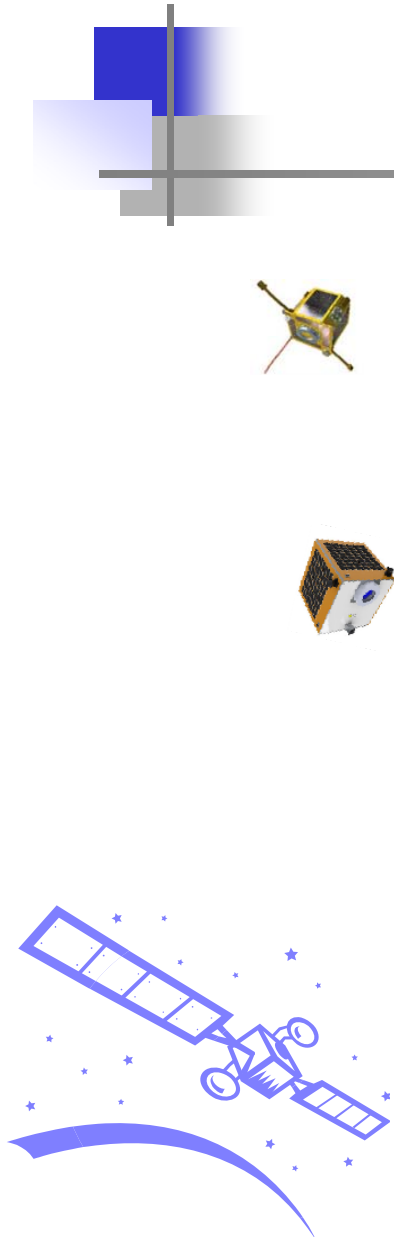
- Digital phase shifter
- 8 GHz Pre-amplifier

▪ Schedule



—Introduction—

Purpose



Anytime!

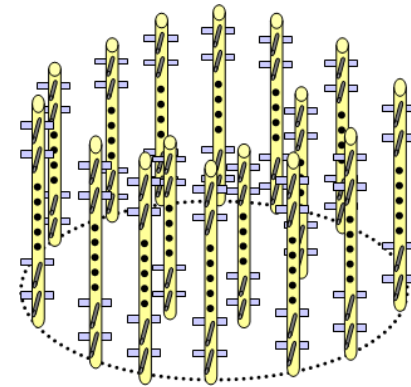
Anywhere!

—Introduction—

Active Phased Array Antenna

★ Active phased array antenna

- Electrical drive
- **Free from mechanical maintenances**
- Scanning fast
- Concurrent communication



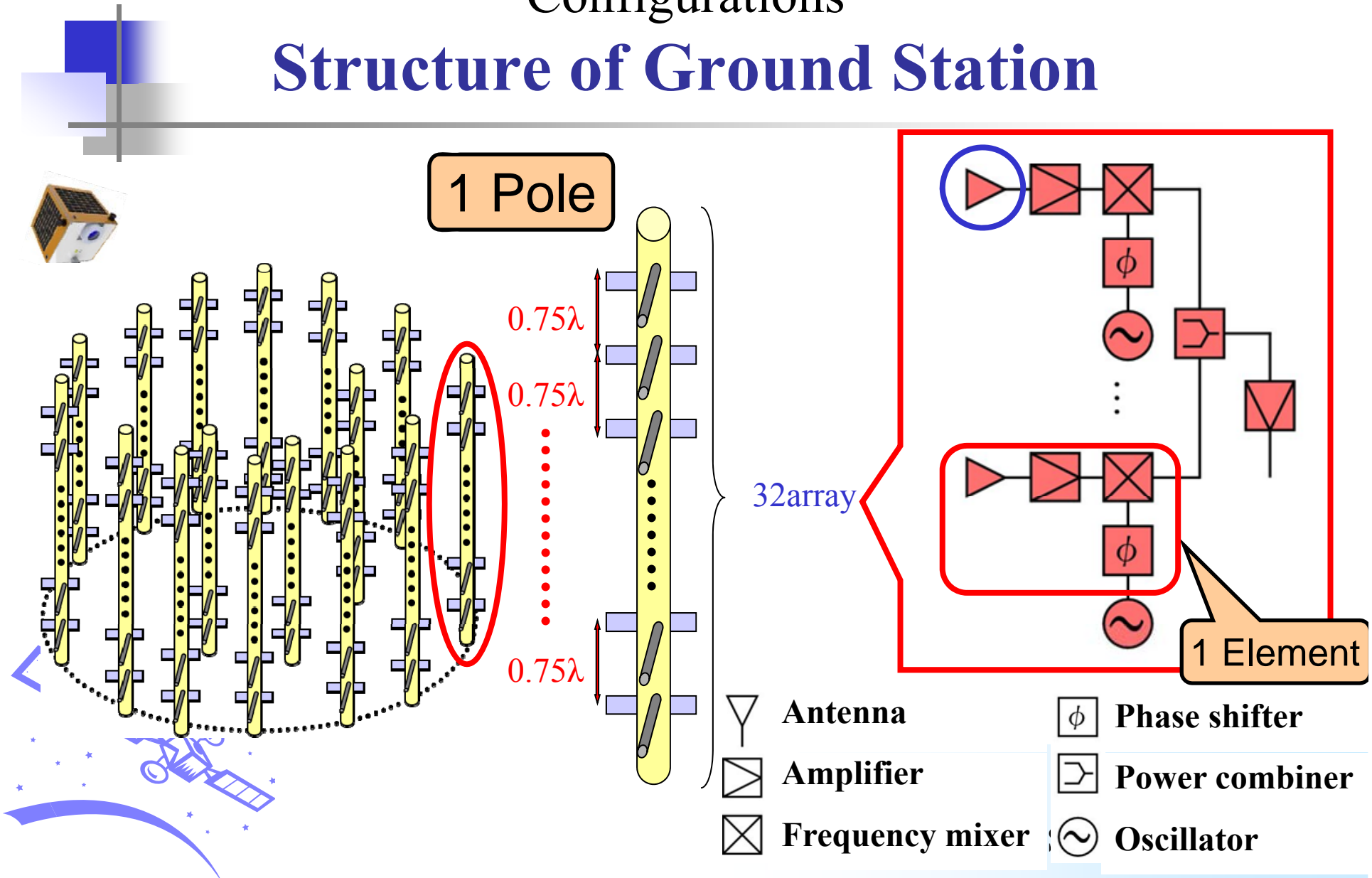
★ Conventional parabolic antenna

- Mechanical drive
- **Needs the mechanical maintenances**
- Scanning slow
- Single communication

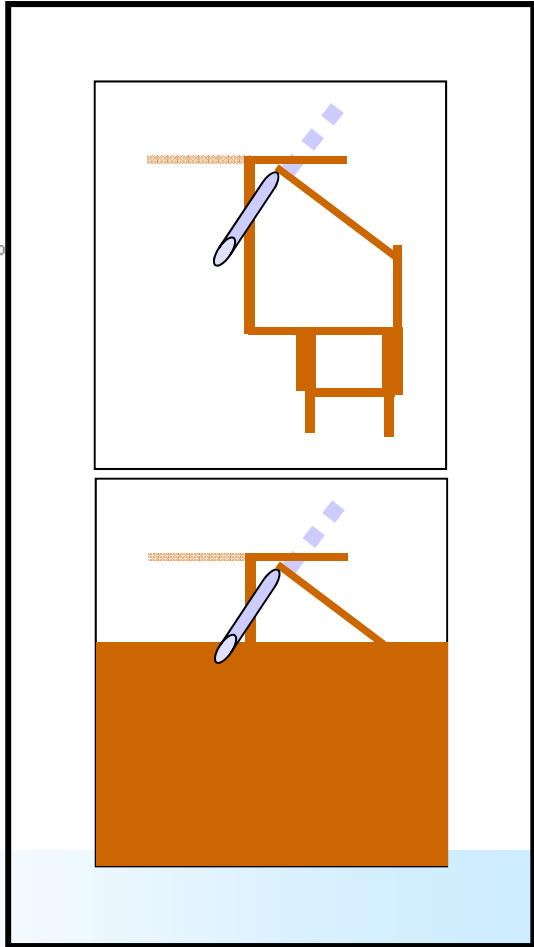
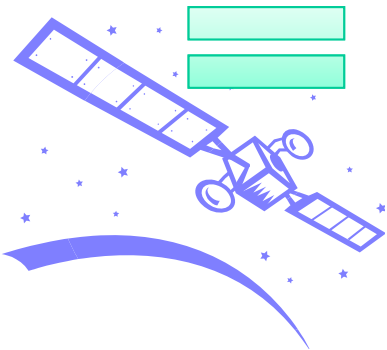
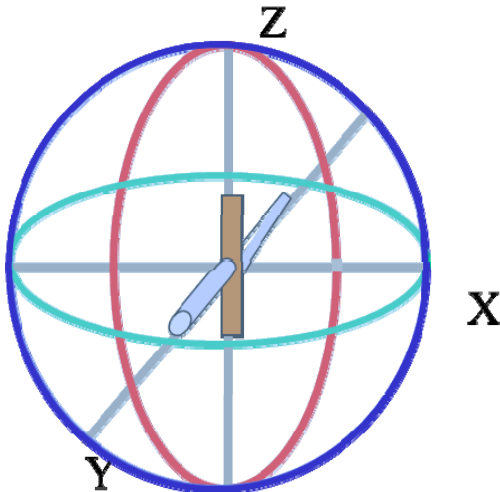
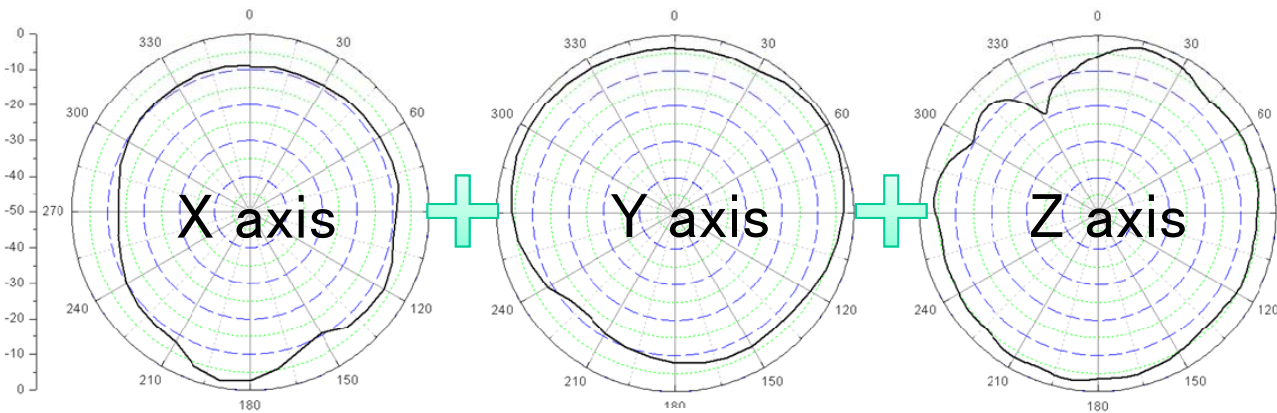


—Configurations—

Structure of Ground Station

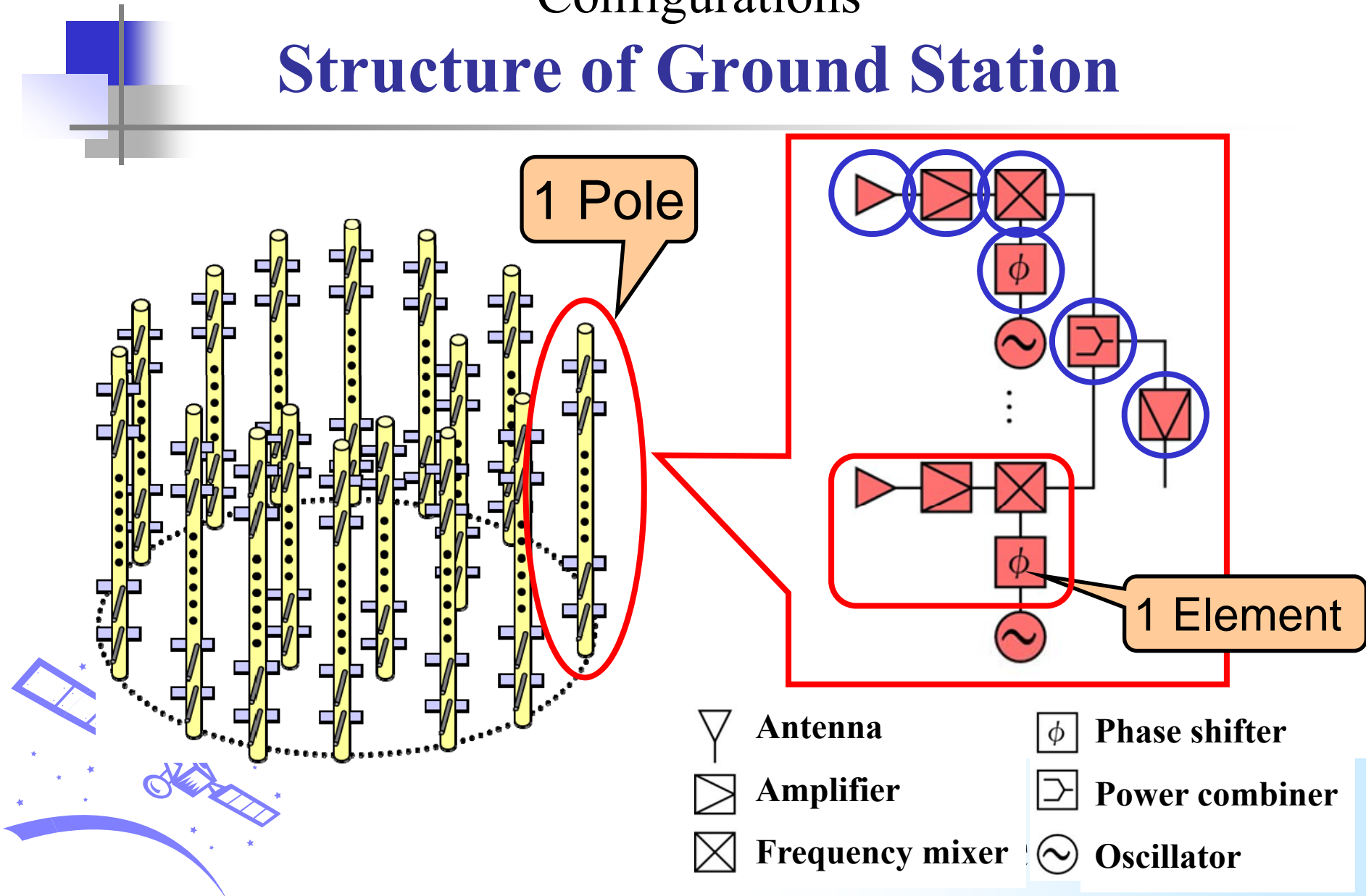


Cross Dipole Antenna



—Configurations—

Structure of Ground Station



Control System for ground station

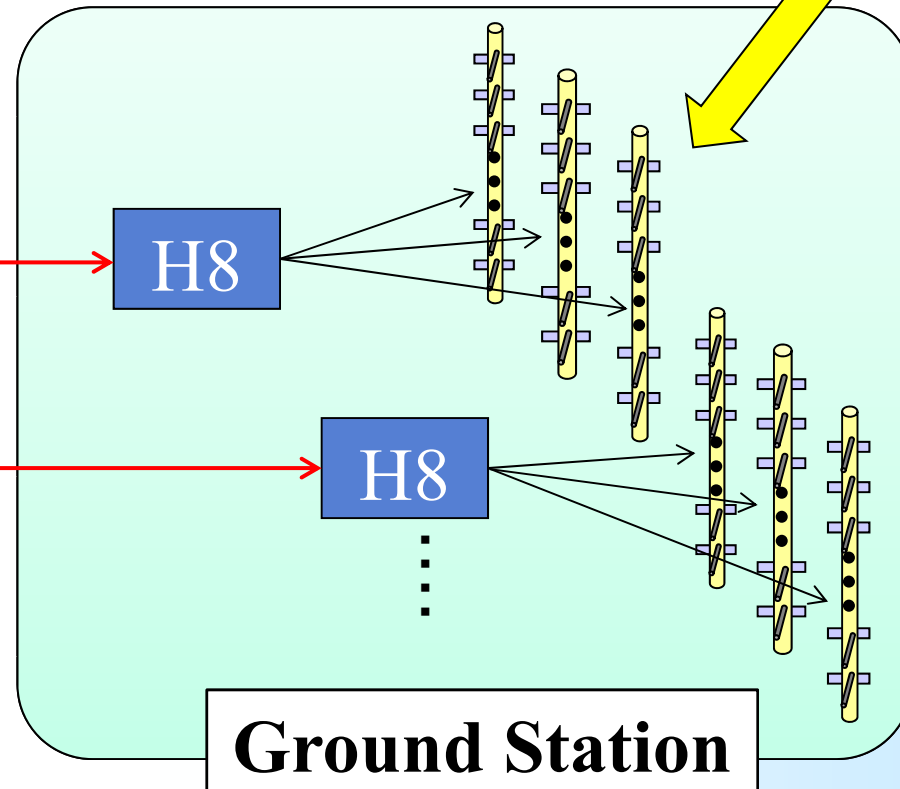


PC

internet

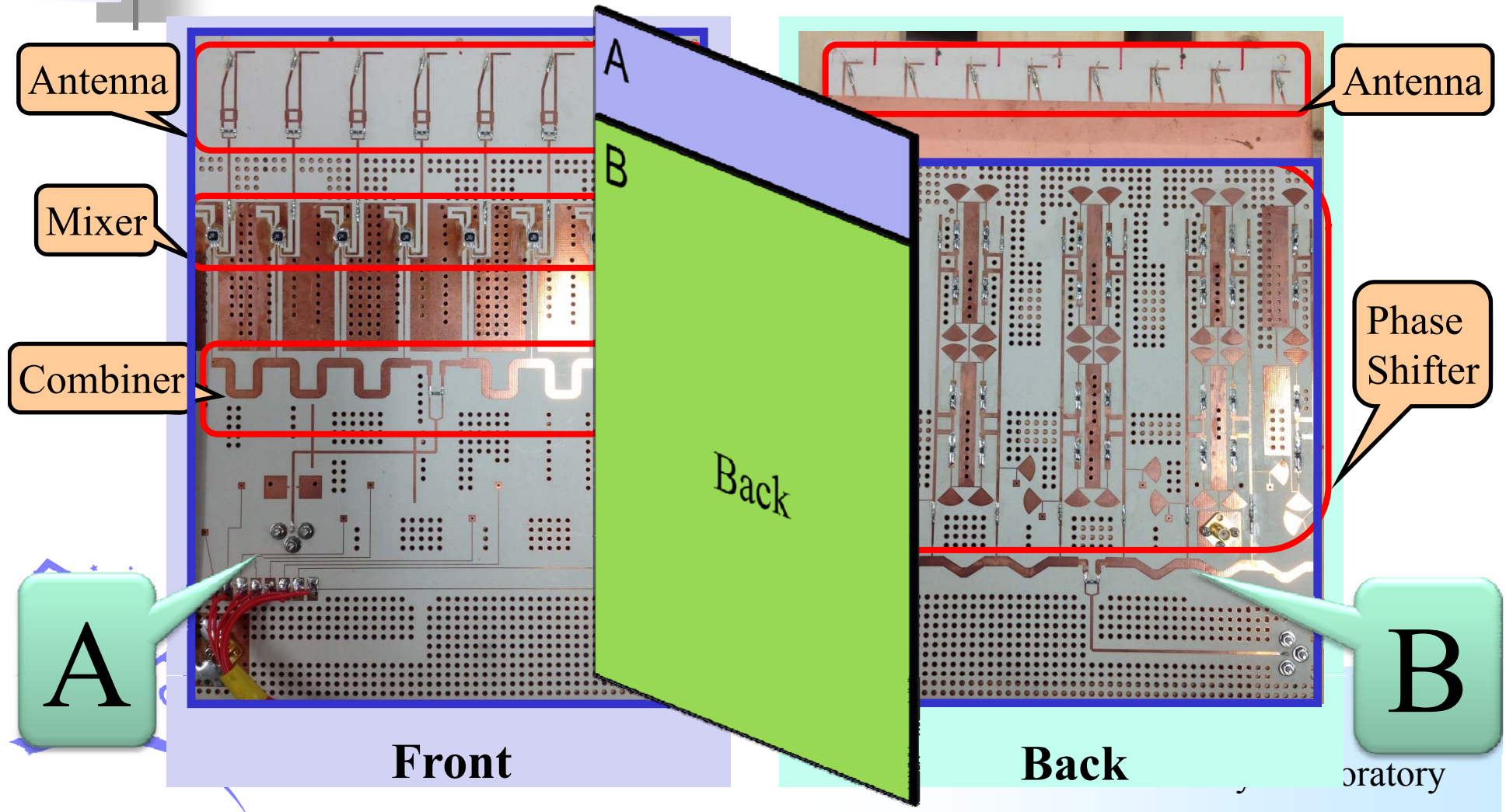
microwave

Nano-satellite



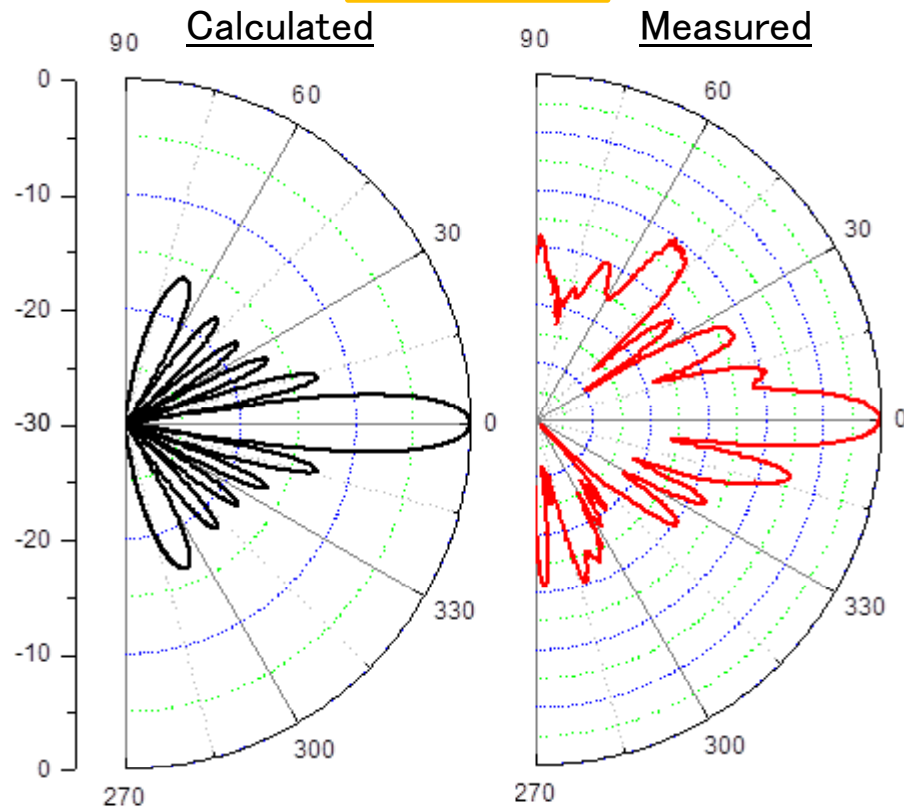
—Configurations—

8-array antenna system

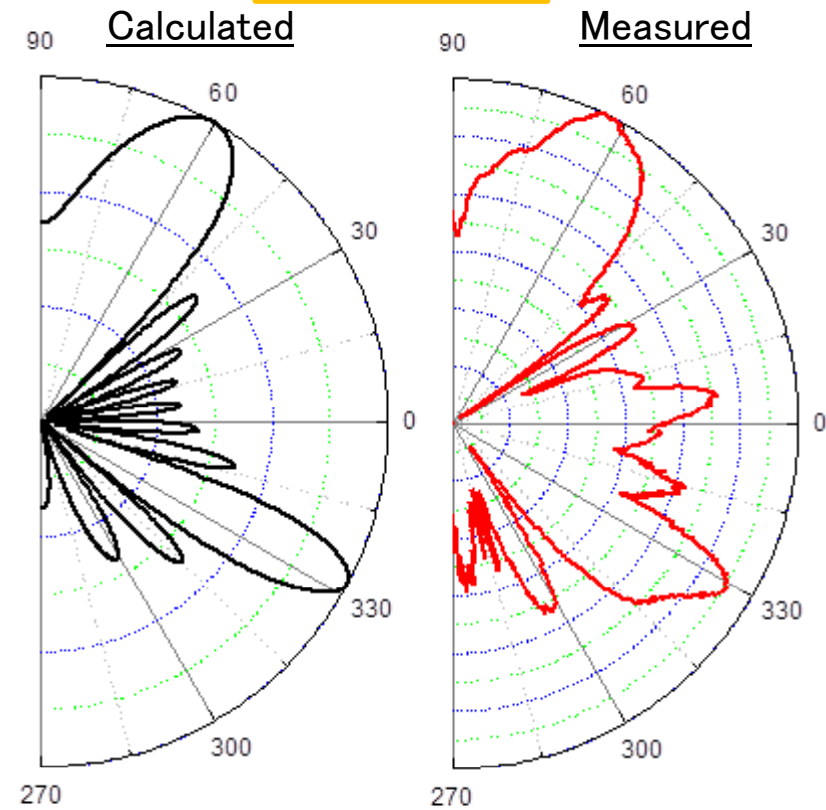


—Experiments— Beam directions

0 degree

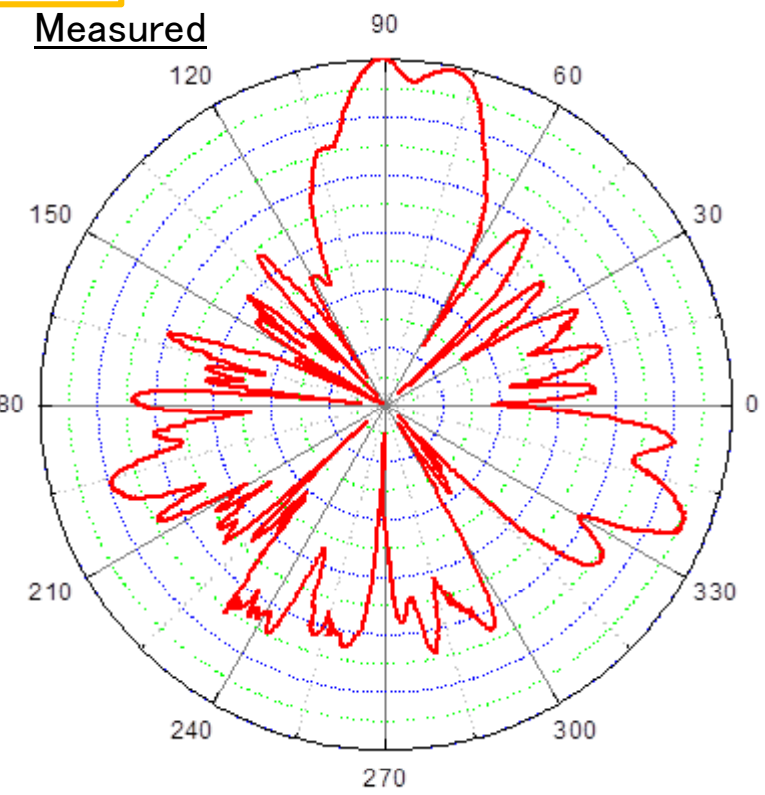
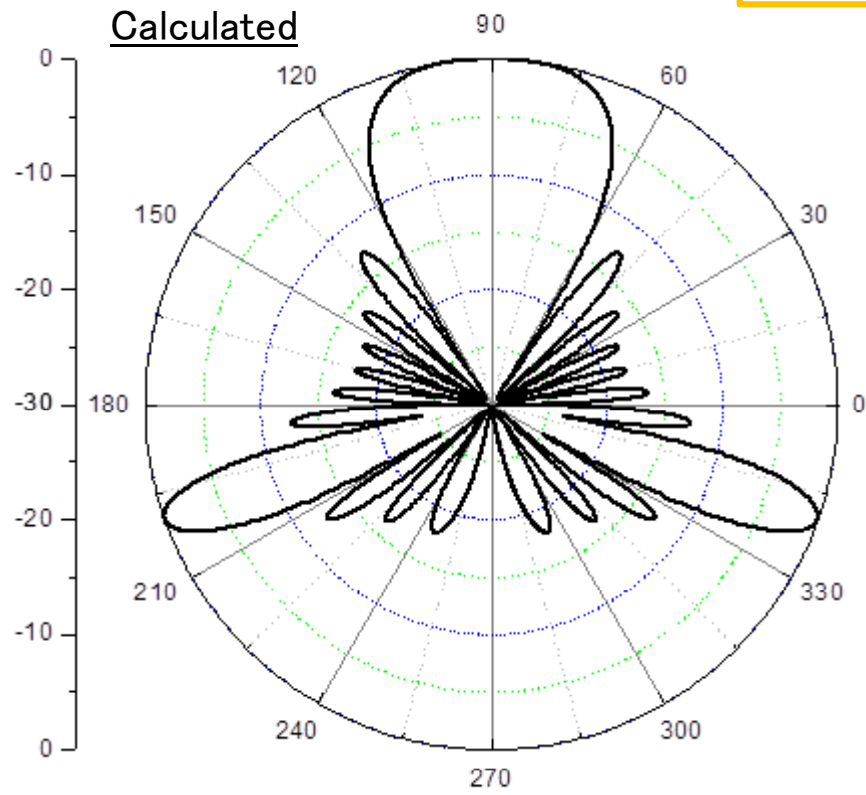


60 degree



—Experiments—
Beam directions

90 degree

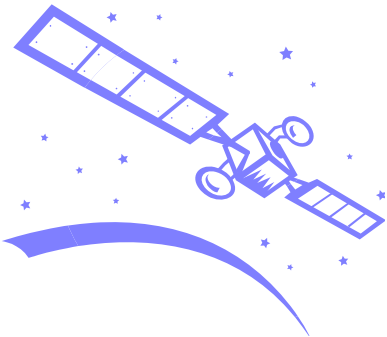




Improvement

- Analog phase shifter \Rightarrow Digital phase shifter
 - Space saving
 - Stabilization of the phase control and the characteristic

- Mounting pre-amplifiers (8GHz)
 - Amplification of the receiving signal

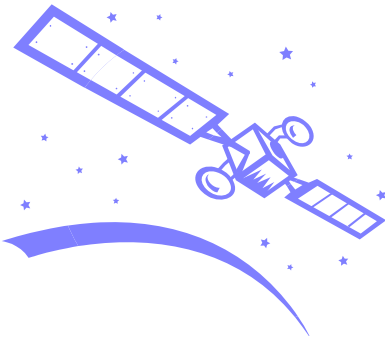




Improvement

- Analog phase shifter \Rightarrow Digital phase shifter
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—Improvement—

Digital Phase Shifter

digital phase shifter



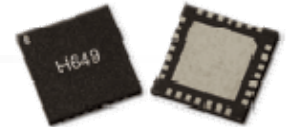
6 bit digital phase shifter

Manufacturer : Hittite

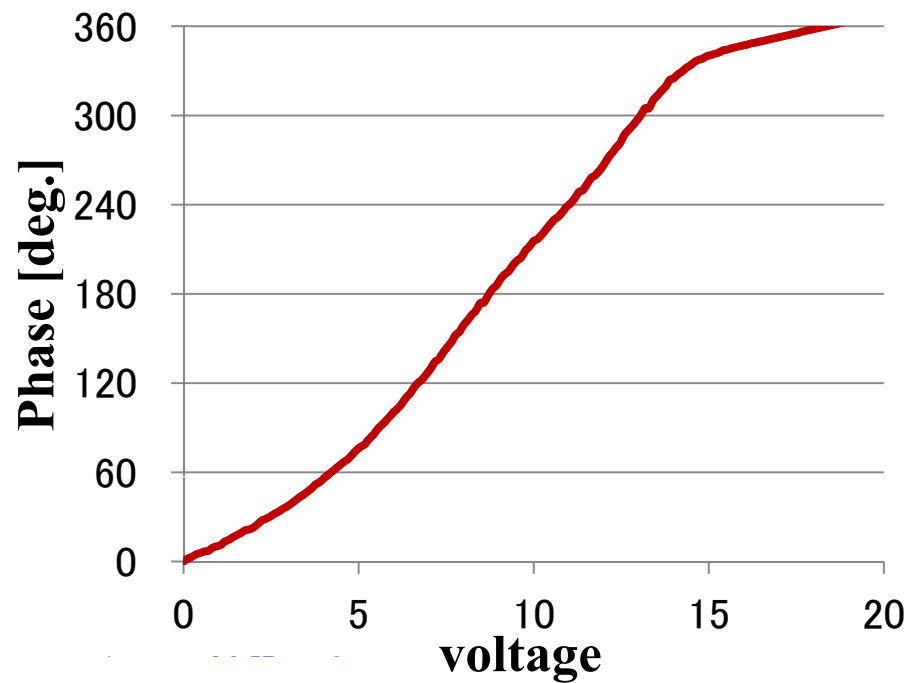
Frequency range : 3 – 6 GHz



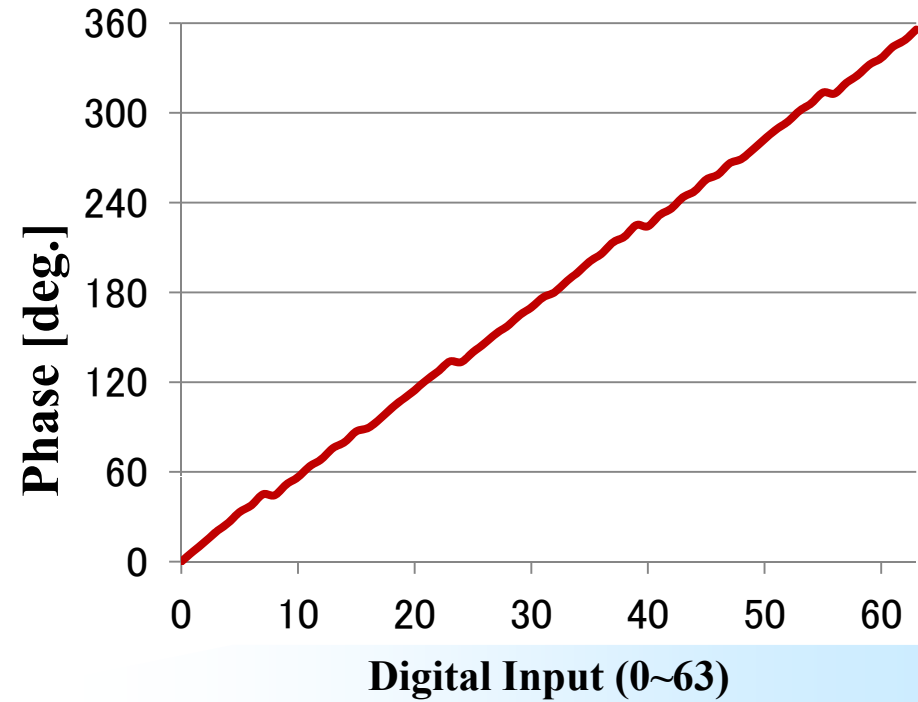
Phase shifter –Phase value–



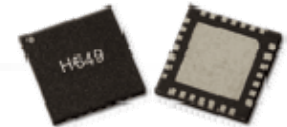
Analog phase shifter



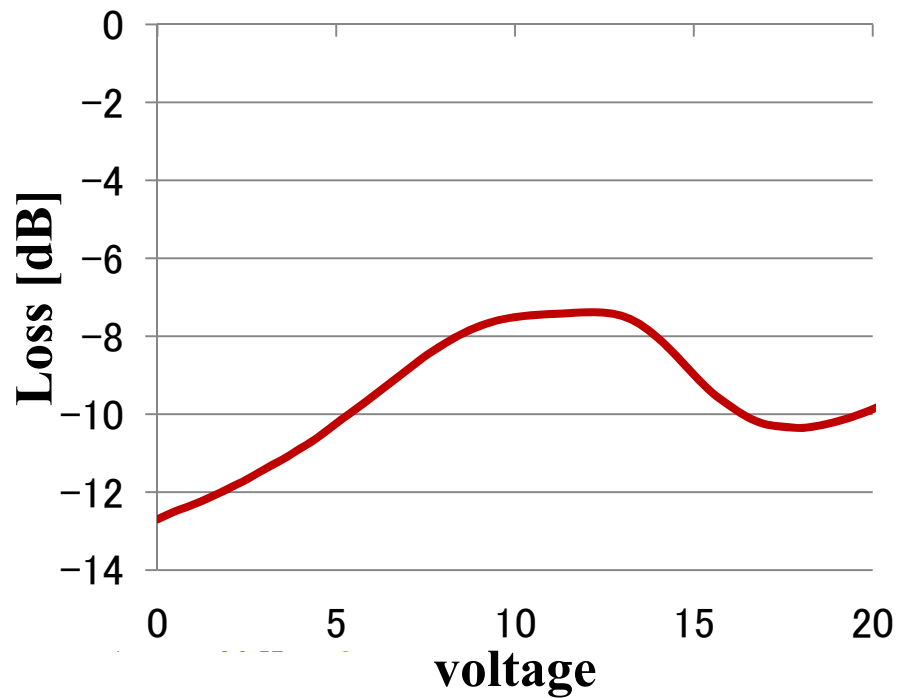
Digital phase shifter



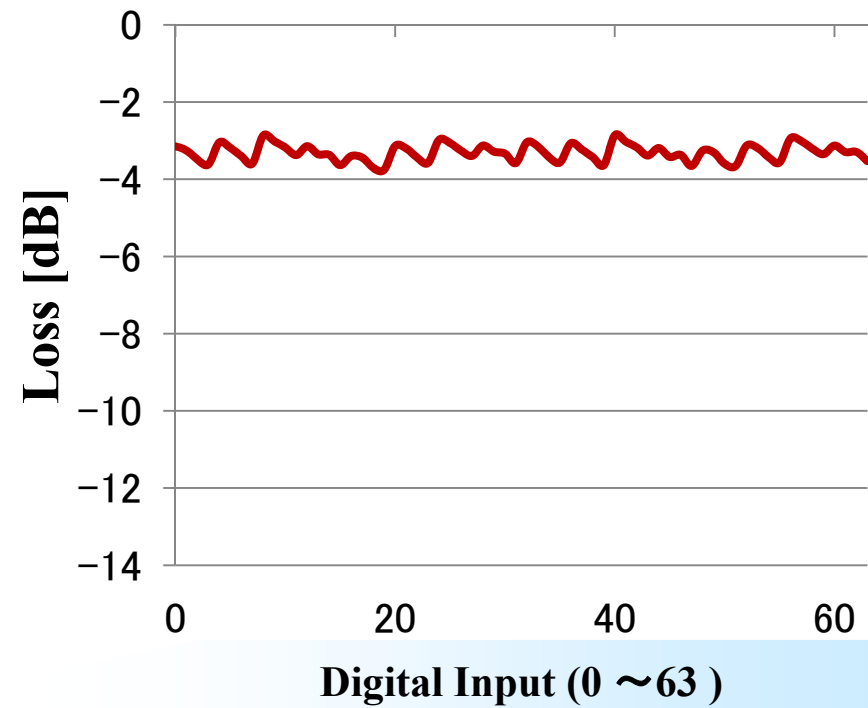
Phase shifter –Insertion loss–



Analog phase shifter

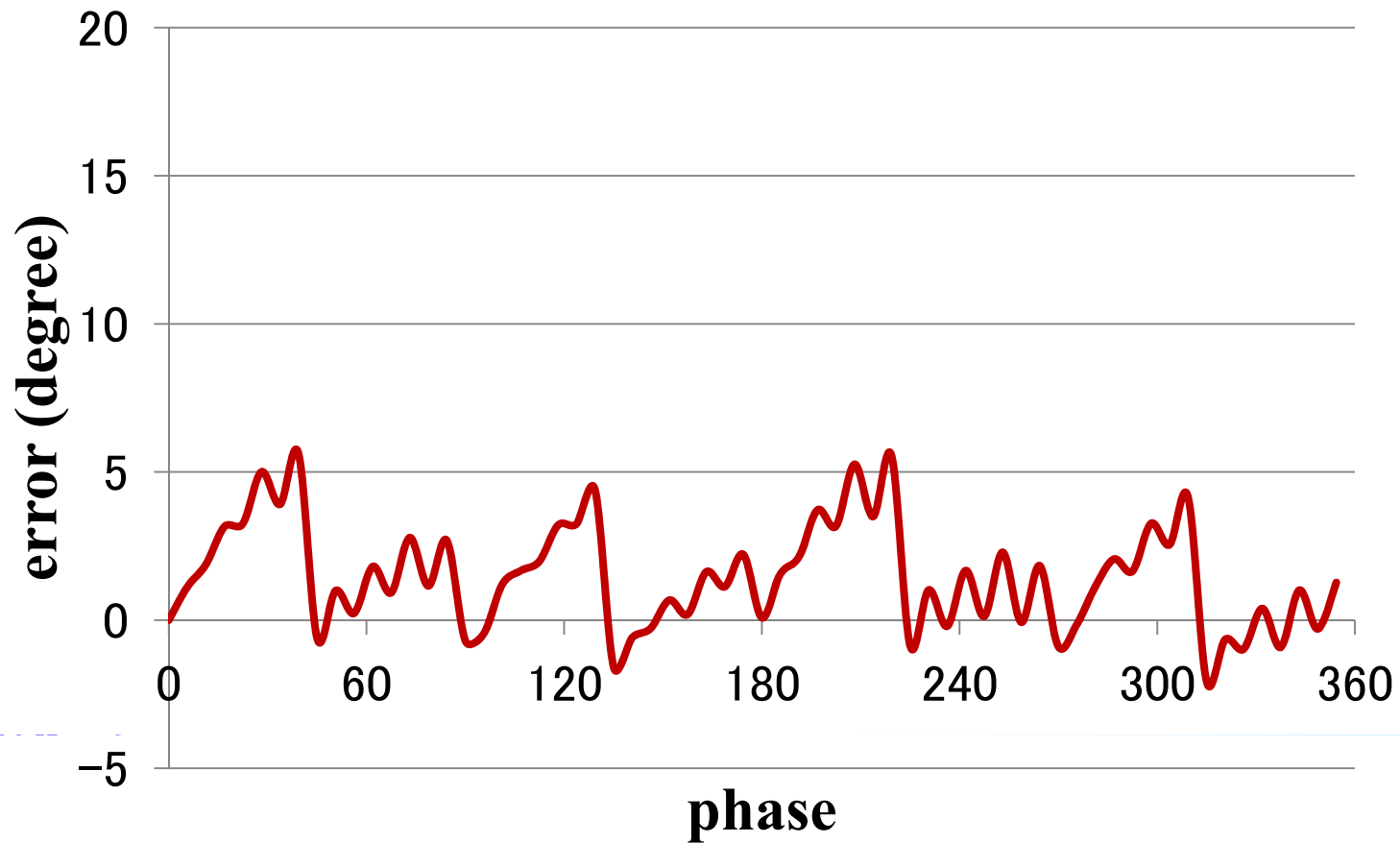


Digital phase shifter



Phase error

Digital phase shifter

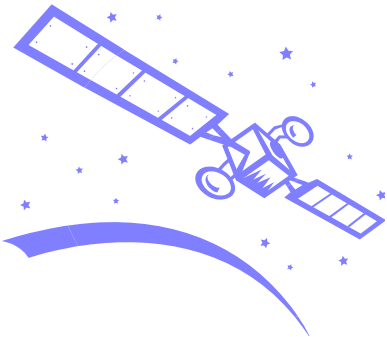




Improvement

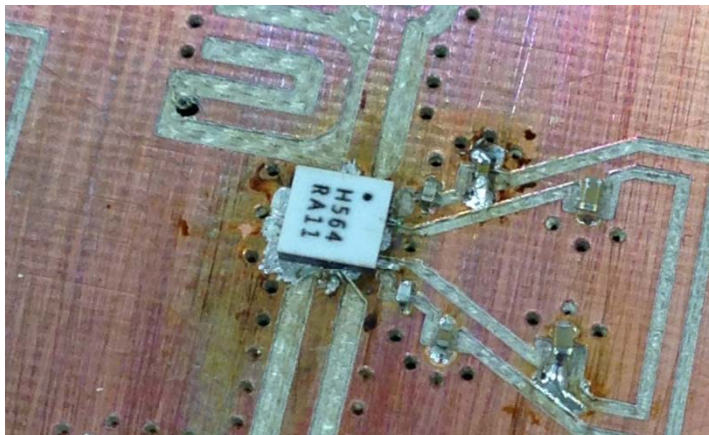
- Analog phase shifter ⇒ Digital phase shifter
 - Space saving
 - Stabilization of the phase control and the characteristic

- Mounting pre-amplifiers (8GHz)
 - Amplification of the receiving signal



—Improvement— 8 GHz Pre-amplifier

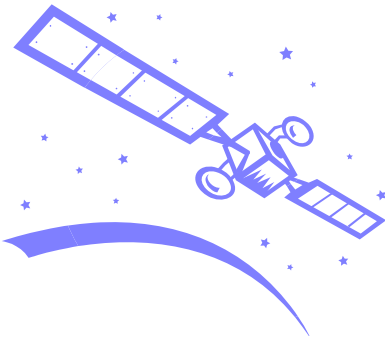
8 GHz Pre-amplifier



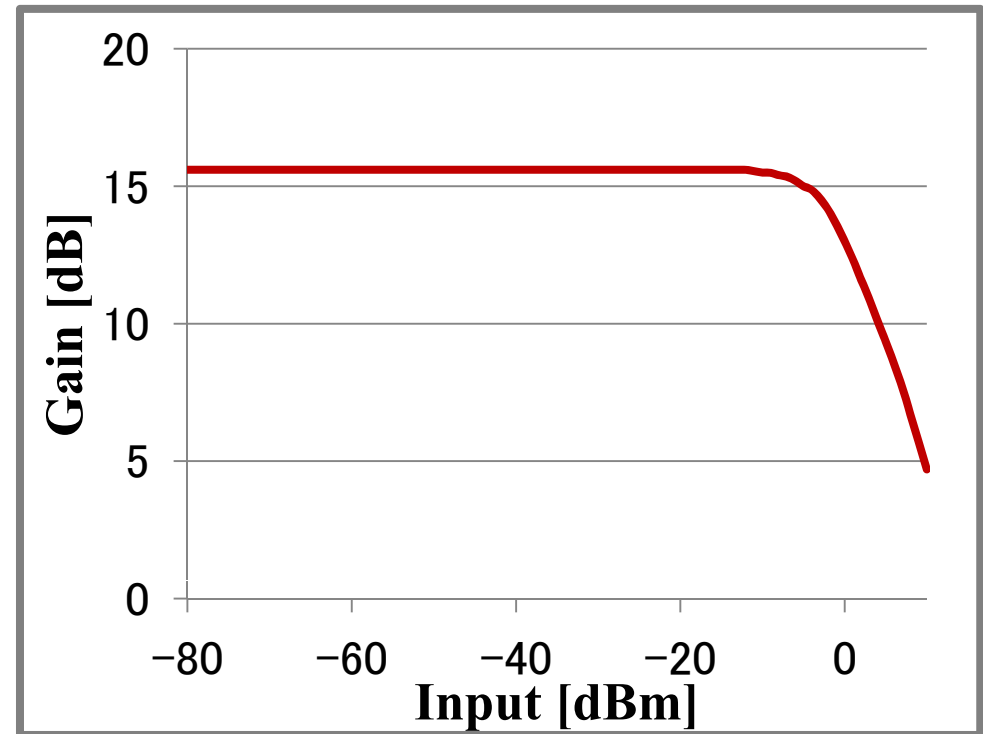
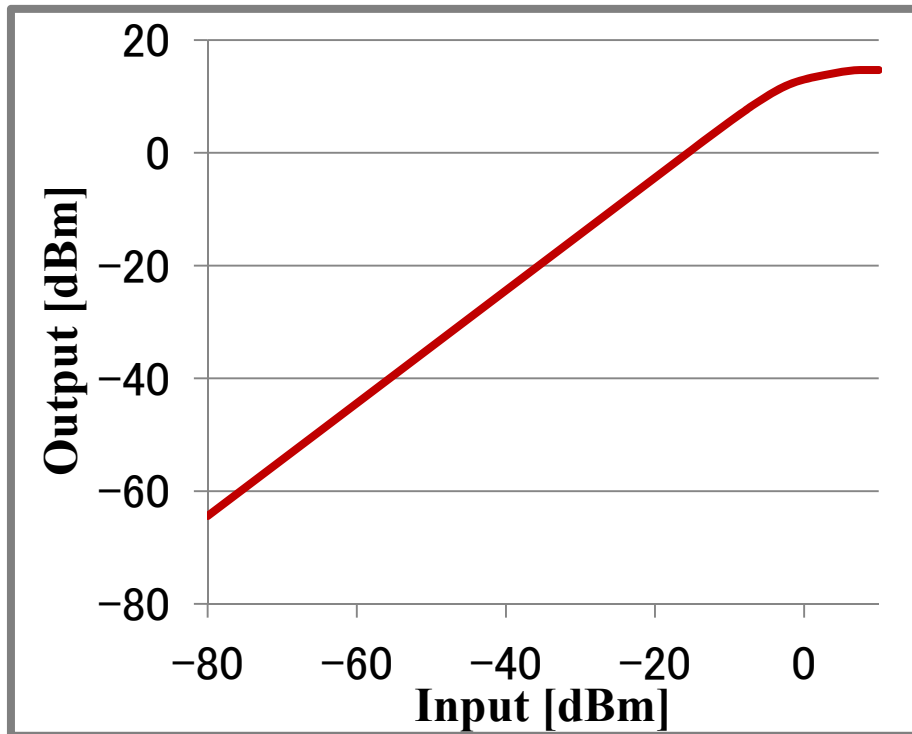
GaAs Low Noise Amplifier

Manufacturer : Hittite

Frequency range : 7 – 14 GHz



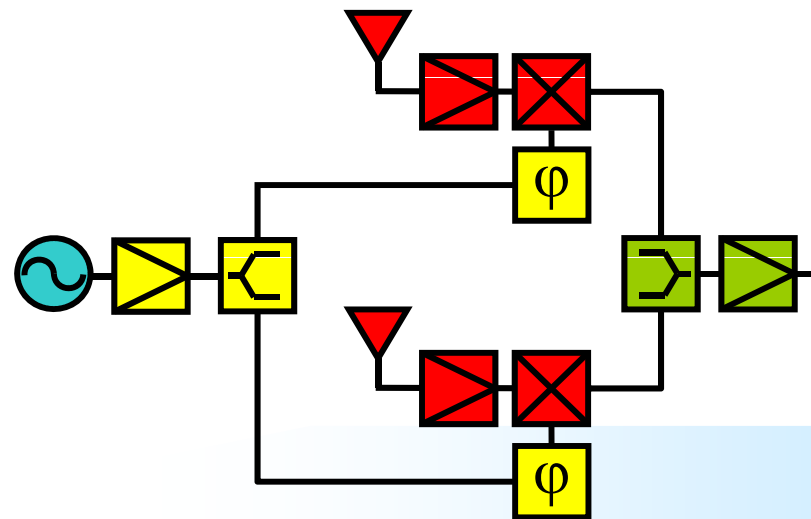
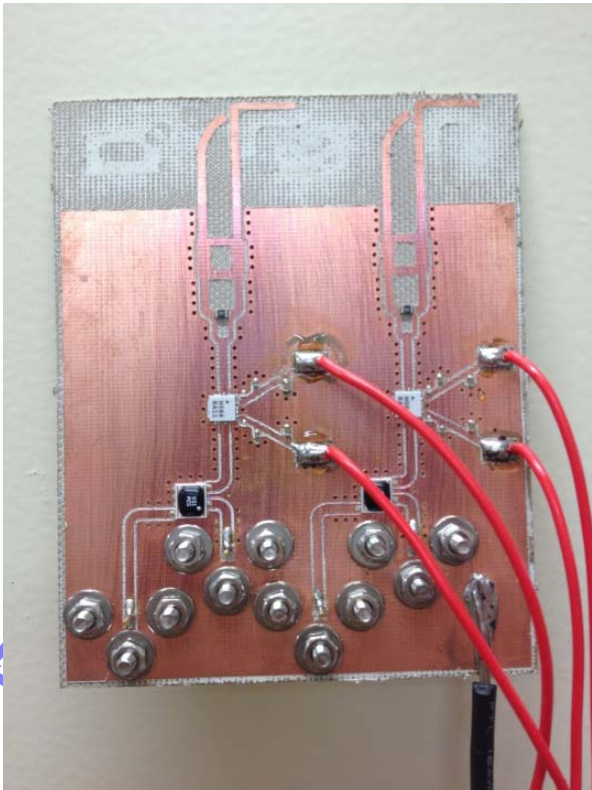
—Improvement— 8 GHz Pre-amplifier



2-array circuit

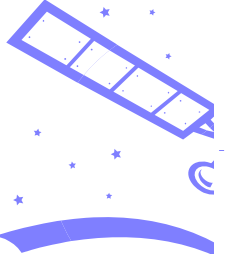
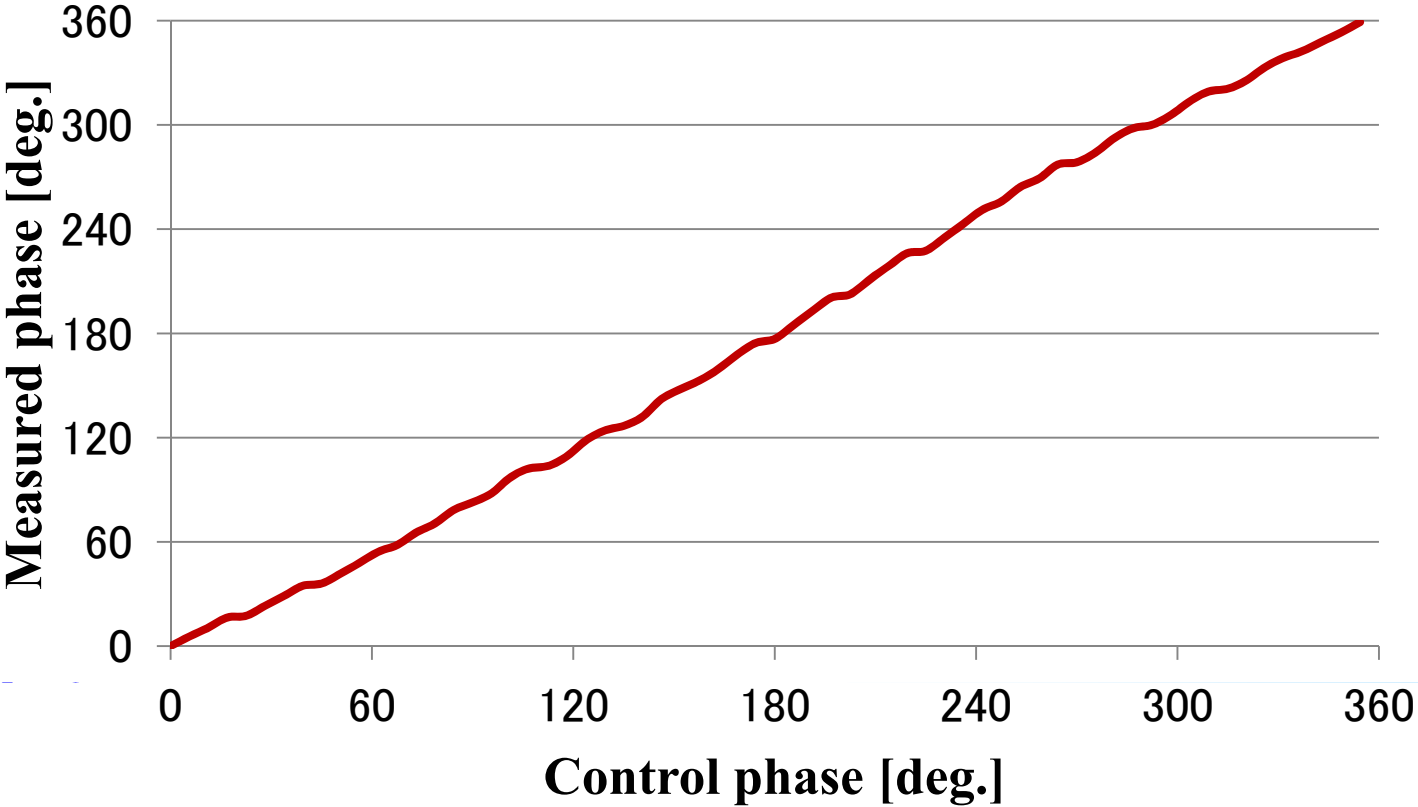
2-array Experiment for Confirmation of ...

- ① Phase shift of the receiving signal
- ② Phase synthesis



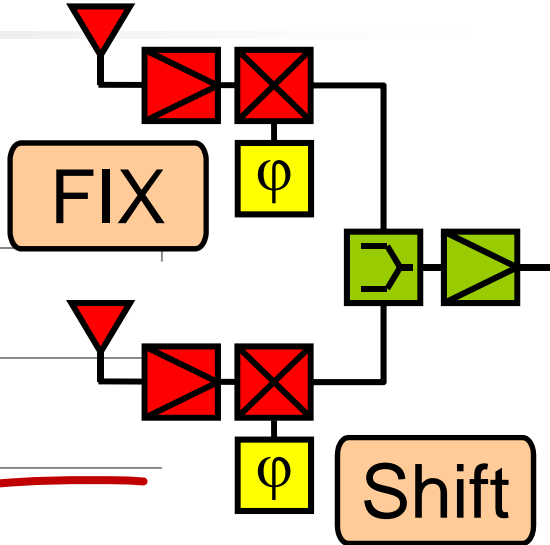
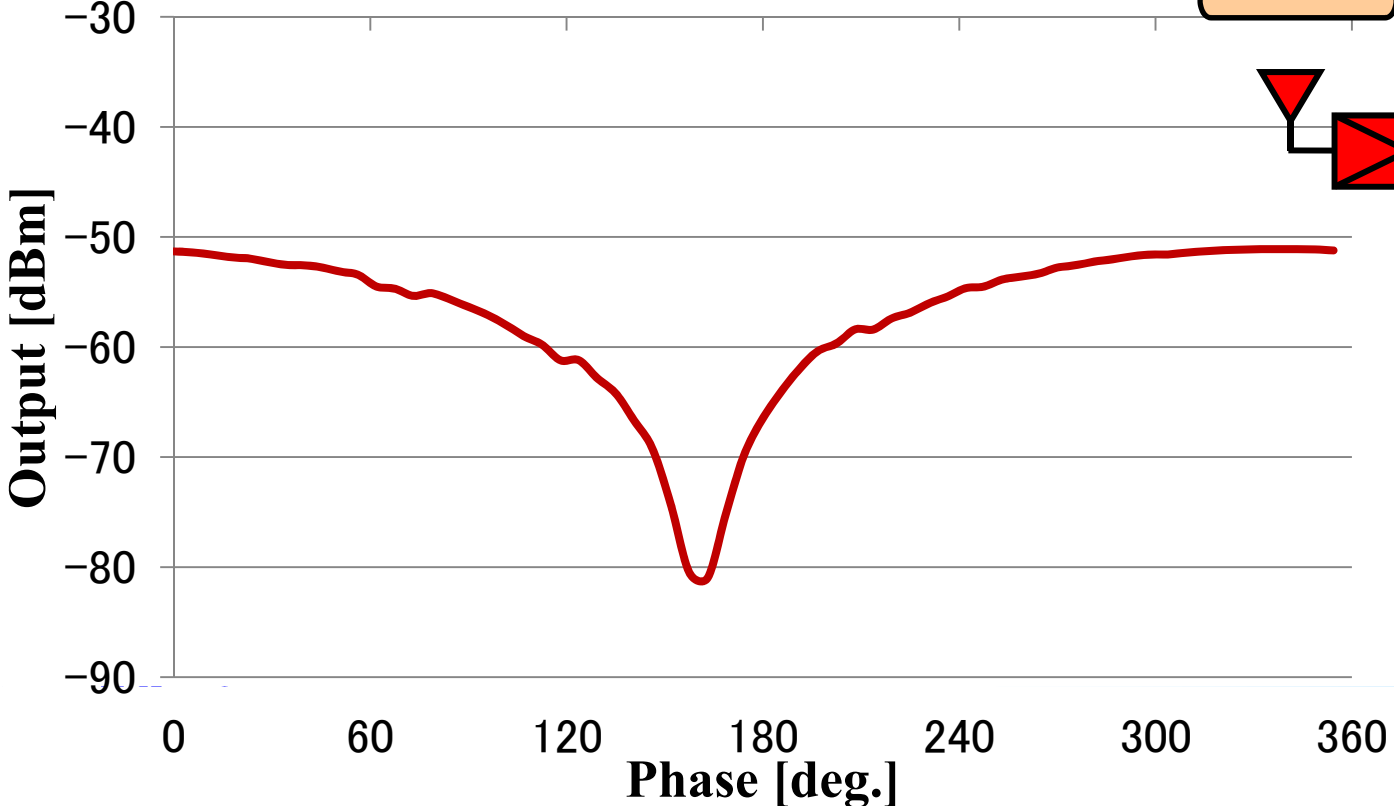
2-array circuit

① Phase shift of the receiving signal



2-array circuit

② phase synthesis





Schedule

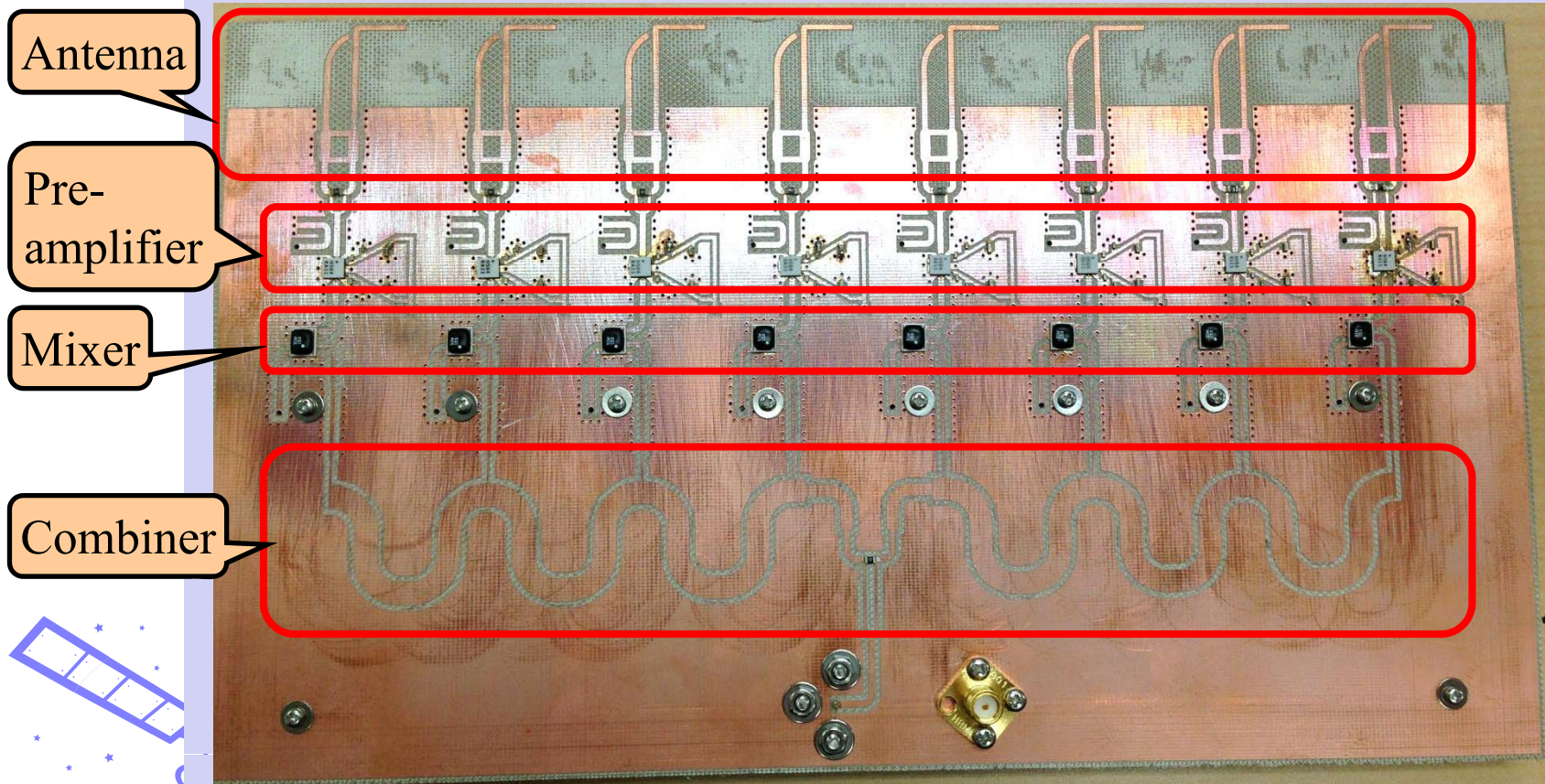
November ...New 8-array antenna system
fabrication and experiment

December ...fabrication of antenna poles



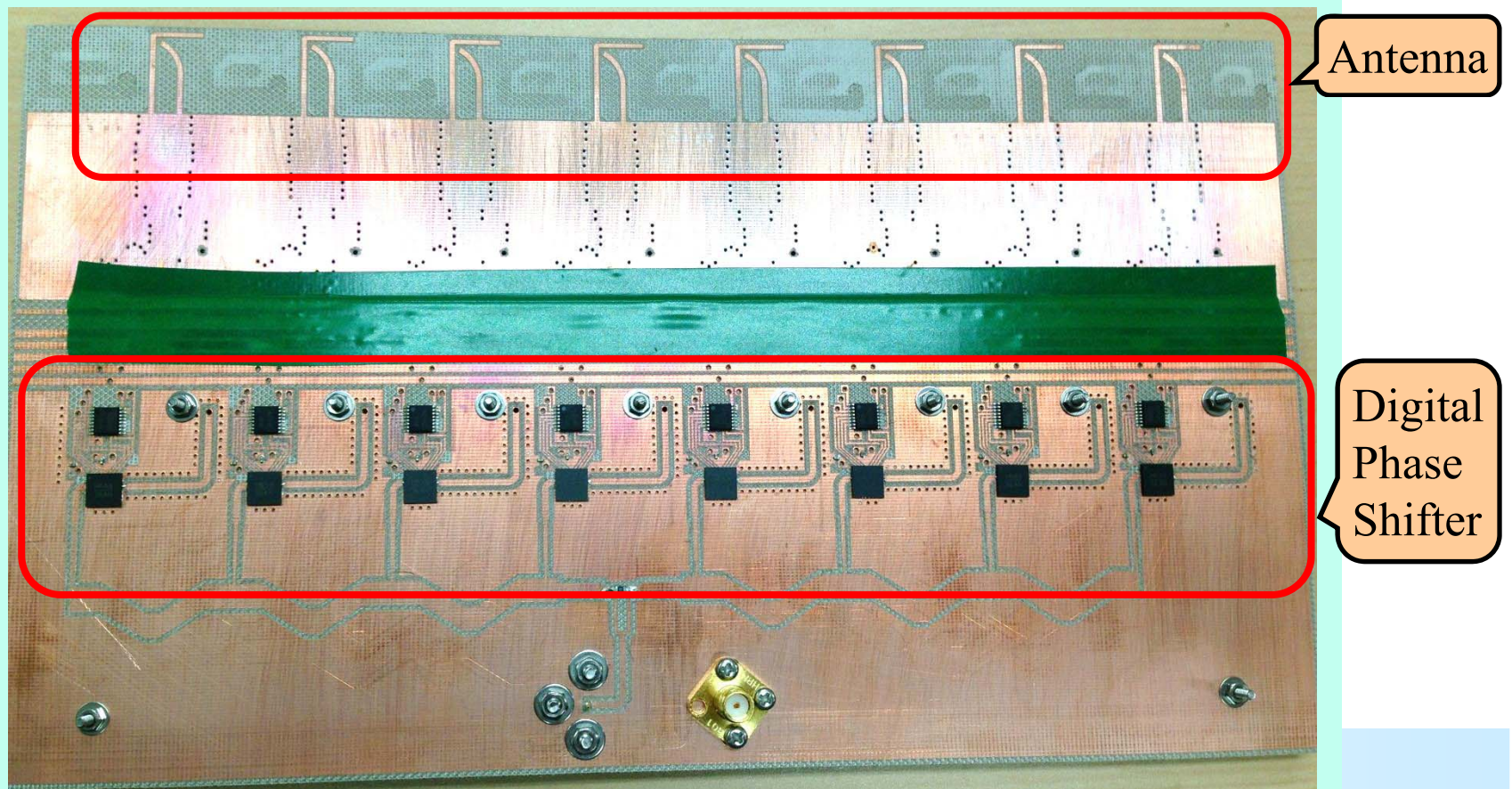
January ~ ...Total experiment of
the grand station

New 8-array antenna system



Front

New 8-array antenna system



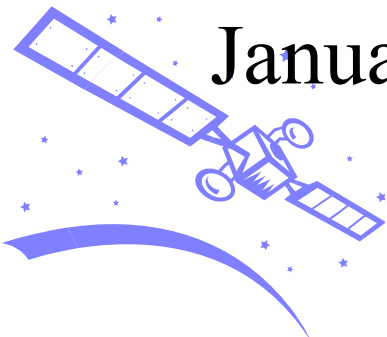
Back

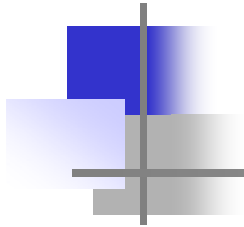
Schedule

November ... 8-array circuit
fabrication and experiment

December ... Construction of antenna poles

January ~ ... Total test of the ground station





Thank you for your attention.

