国土地理院
Geospatial Information Authority of Japan

New receiving system for VGOS Station in Japan

Yoshihiro FUKUZAKI

Geospatial Information Authority of Japan (GSI)

Ministry of Land, Infrastructure, Transport and Tourism

Ishioka VGOS Station

Ishioka 13m antenna

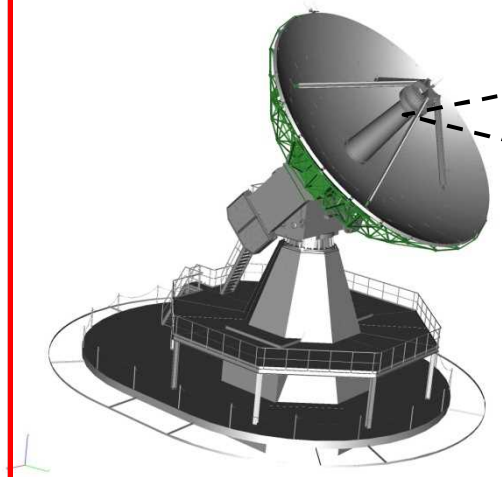
New Project for VGOS in Japan

- New VGOS Station under construction
- Antenna itself completed at the end of March
- Fully compliant with VLBI2010 (VGOS) concept
- Observing facilities including the following components,
  1. Antenna (Single)
  2. Front-end
  3. Up-Down Converter
  4. Data Processing & Acquiring System
  5. Precise Frequency Standard (H-maser)

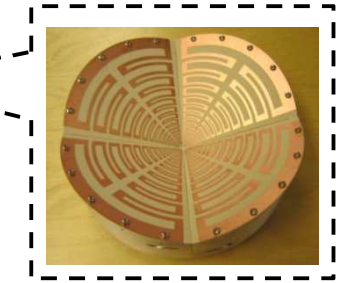
  (6. Operation Building)

Components

Antenna side

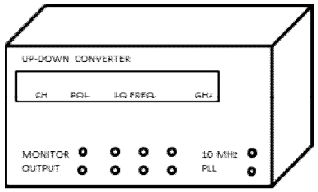


1. Antenna



2. Front-end

Operation Building side



3. Up-Down Converter

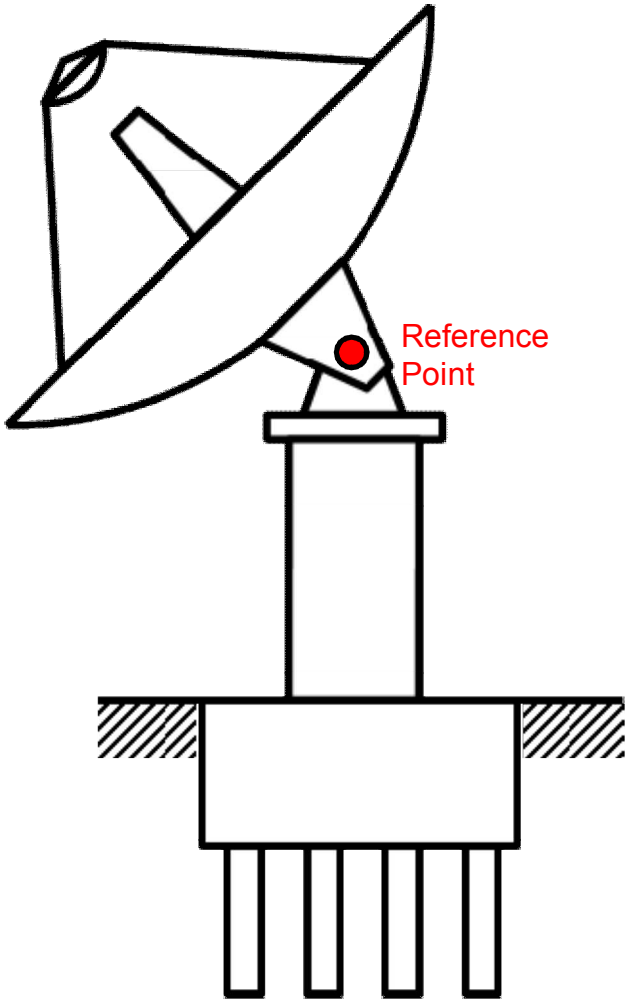
5. Precise Frequency Standard (H-maser)

4. Data Processing & Acquiring System

(6. Operation Building)

Photo of the antenna (1)

1. Antenna (Single type)



Diameter : 13.2m

Optics : Ring Focus

Frequency: 2-14GHz

Aperture Efficiency: ≥ 50%

Antenna Noise Temperature: ≤ 10K
(Excl. Atmosphere Contribution)

Reference Point Stability : ≤ 0.3mm (rms)

Path Length Stability : ≤ 0.3mm (rms)

Reference Point can be measured directly from the ground for Co-location!

Driving Speed

Az slew rate: 12 deg/sec

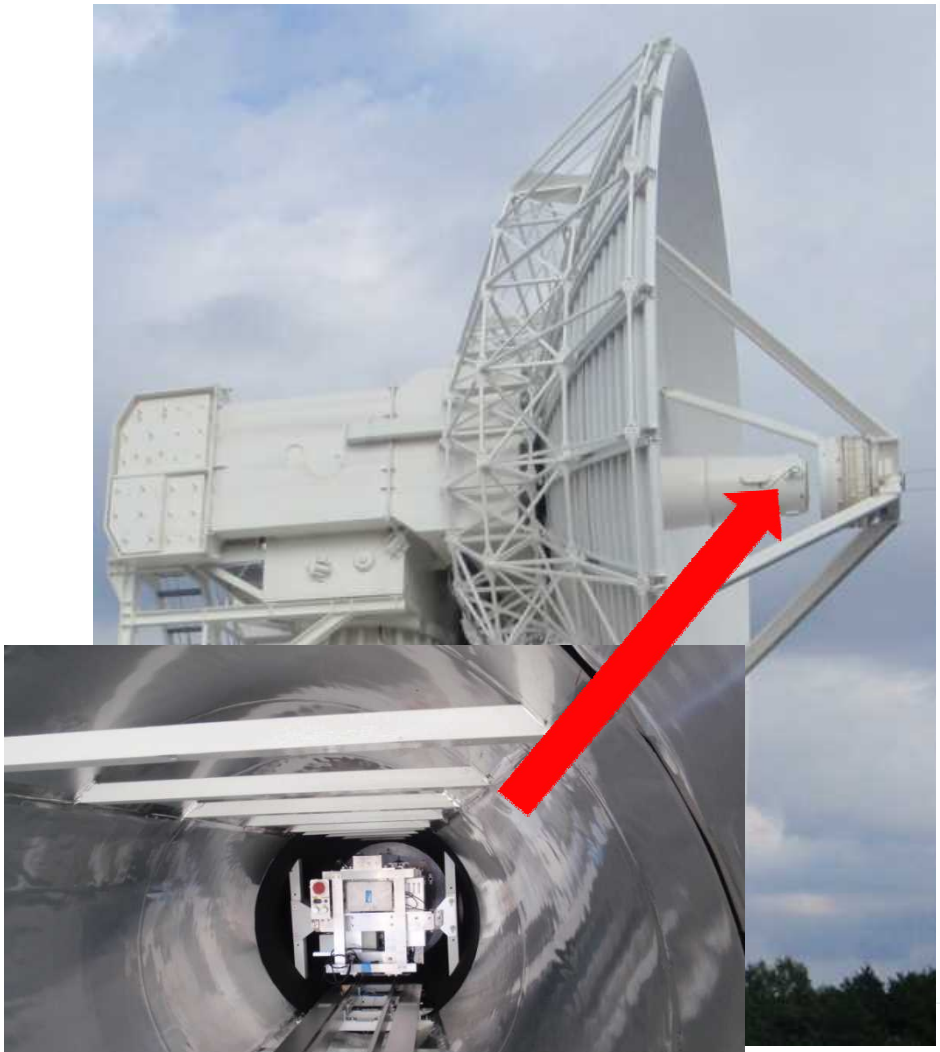
El slew rate: 6 deg/sec

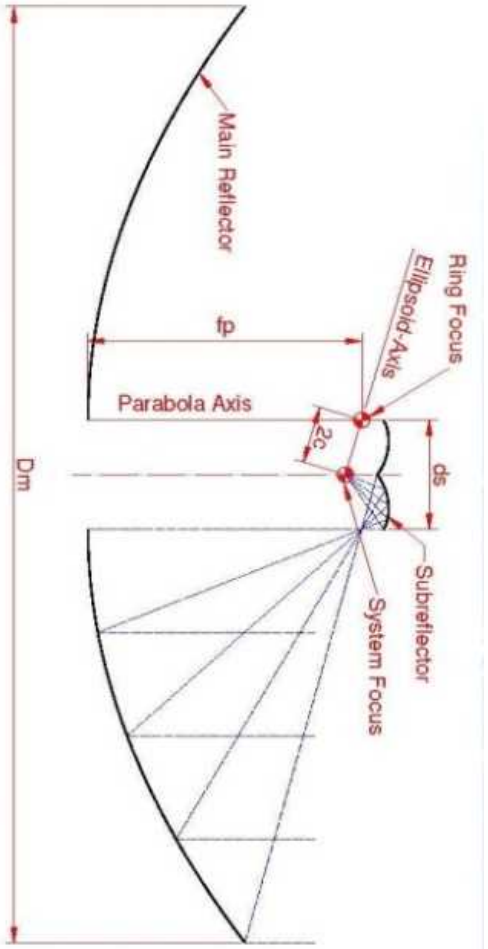
Az acceleration: 3 deg/sec^2

El: acceleration: 3 deg/sec^2

Optical Fiber cable: from Antenna to Building

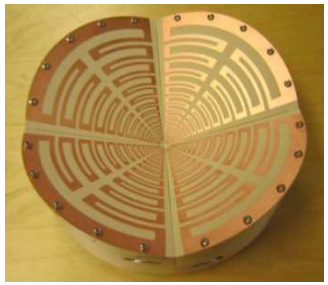
Antenna Optics & Front-end





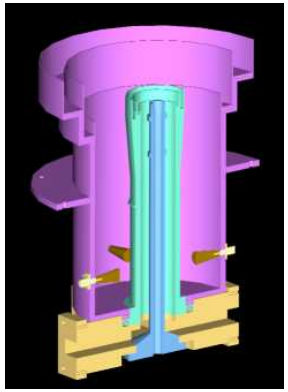
Ring Focus optics

2. Front-end



Developed by Chalmars University of Technology

Developed by Caltech



Developed by Spanish IGN (Yebes Observatory)

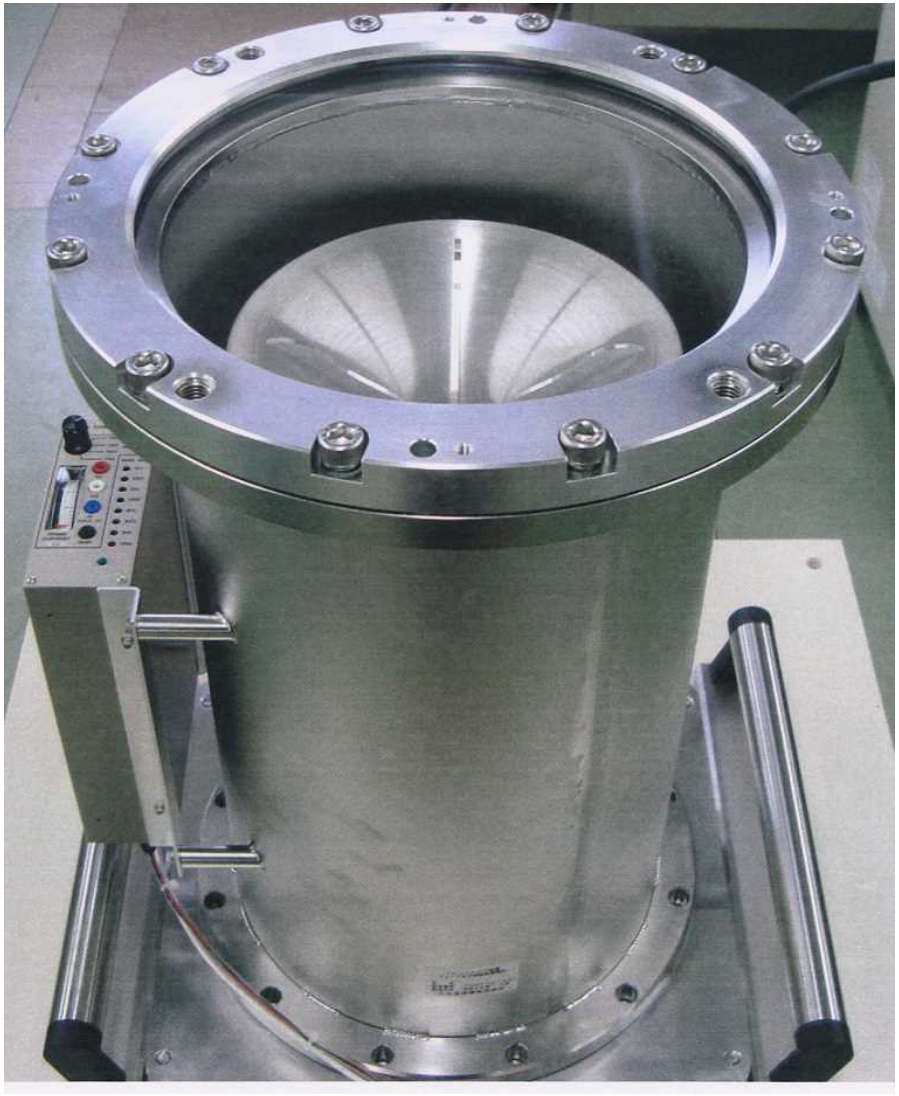
Frequency: 2-14GHz
(Eleven feed was assumed for antenna design.)

2 types of broadband feed purchased.
1) Eleven feed
2) Quadruple-Ridged Flared Horn (QRFH)

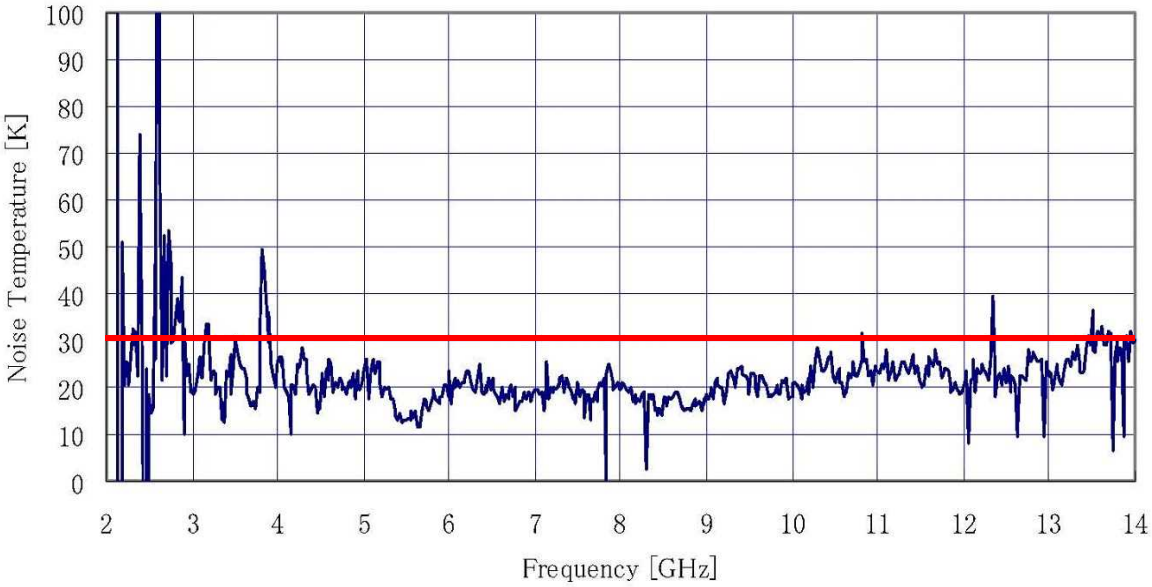
Receiver Noise Temperature: ≤ 30K
System Noise Temperature: ≤ 40K
(Excl. Atmosphere Contribution)

For compatibility with legacy system,
Tri-band (S/X/Ka) feed system purchased

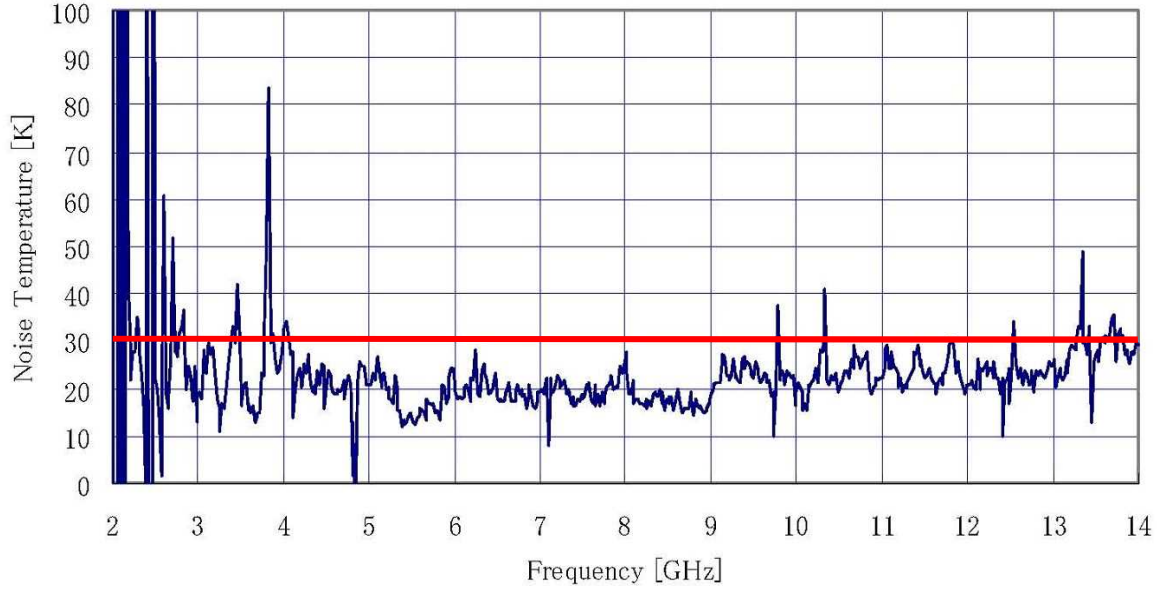
Cryogenic Dewar containing QRFH



Receiver Noise Temperature of QRFH system



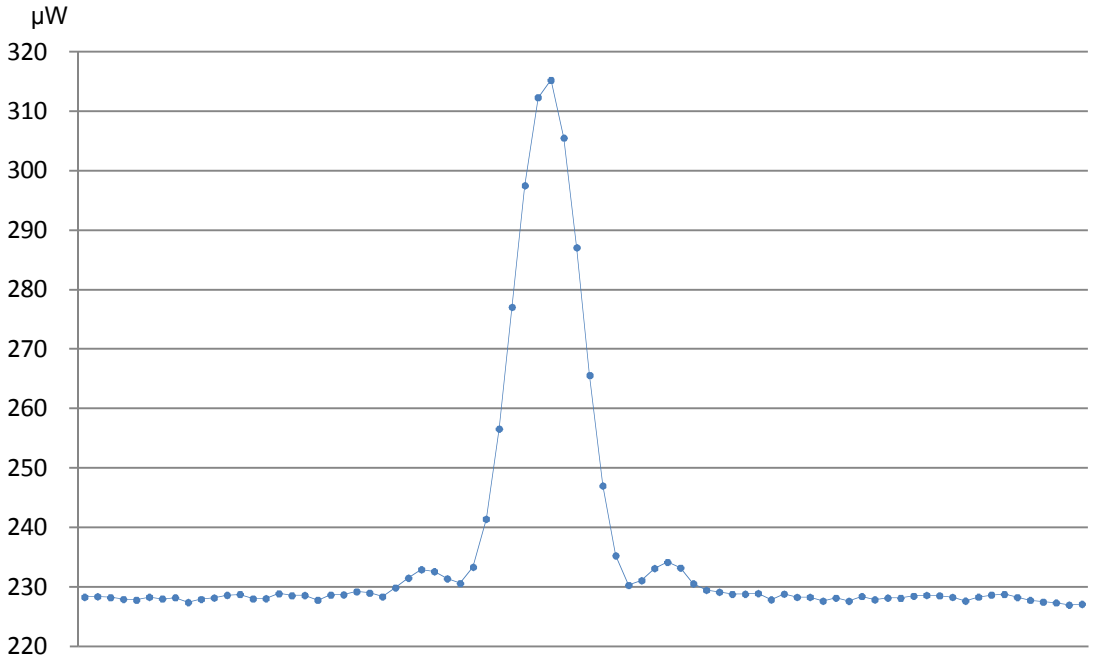
Horizontal Polarization port



Vertical Polarization port

Physical temperature:
LNA : 9.7K
Feed : 21.5K

First Light！



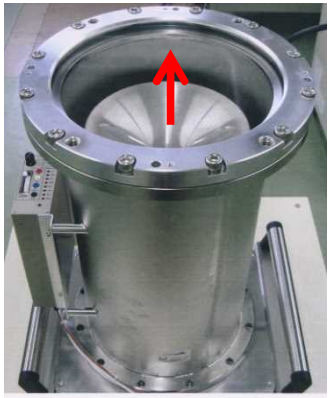
Cross scan data of Taurus-A
with Tri-band feed
at X band（BW：900MHz）

According to Y factor, the SEFD is calculated as 1,250Jy.
Assuming that System Noise Temperature is 50K, the aperture efficiency is 77%!

Summary list of receiving performance

- Tri-band feed : 1,250Jy (X-band)
  1,700Jy (S-band)
  (Ka-band not measured yet)

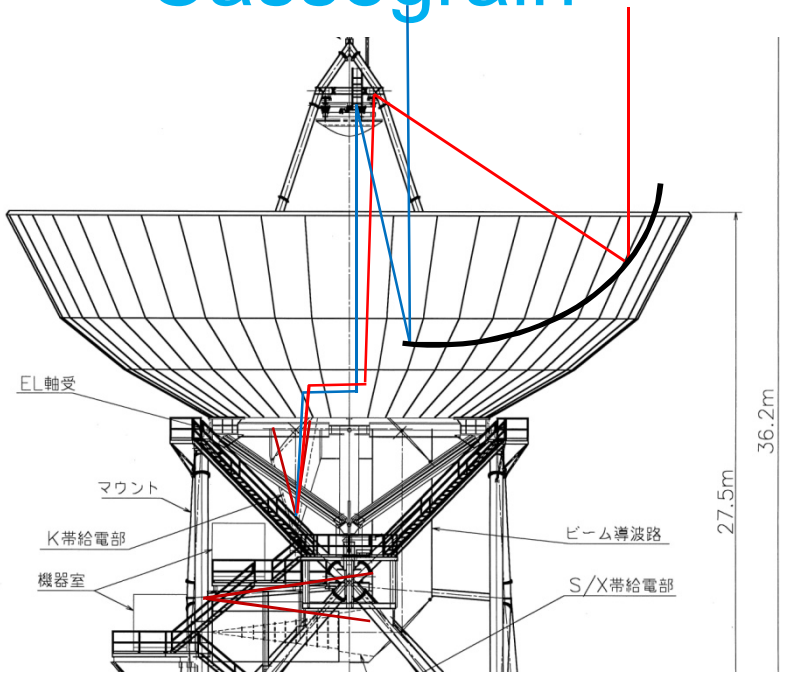
- QRFH : Only Sun detected
  ⇒ Improvement will be done!



- Eleven feed : 1,250Jy (X-band)
  - Lower sensitivity at higher freq.
  - How to inject P-cal/Noise-source?

Comparison of antenna optics （Cassegrain vs. Ring Focus）

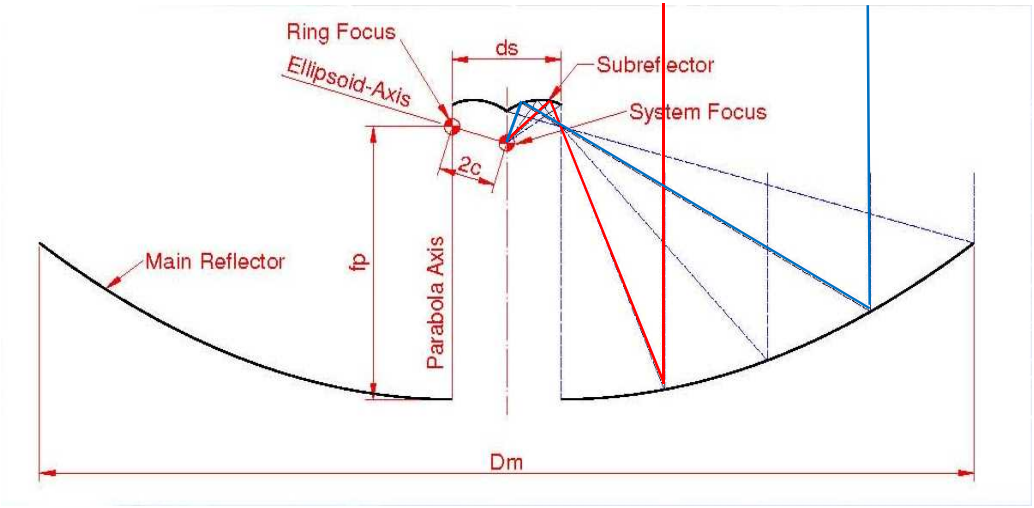
Cassegrain



feature：

- normal efficiency：50～70%
- Much less RFIs

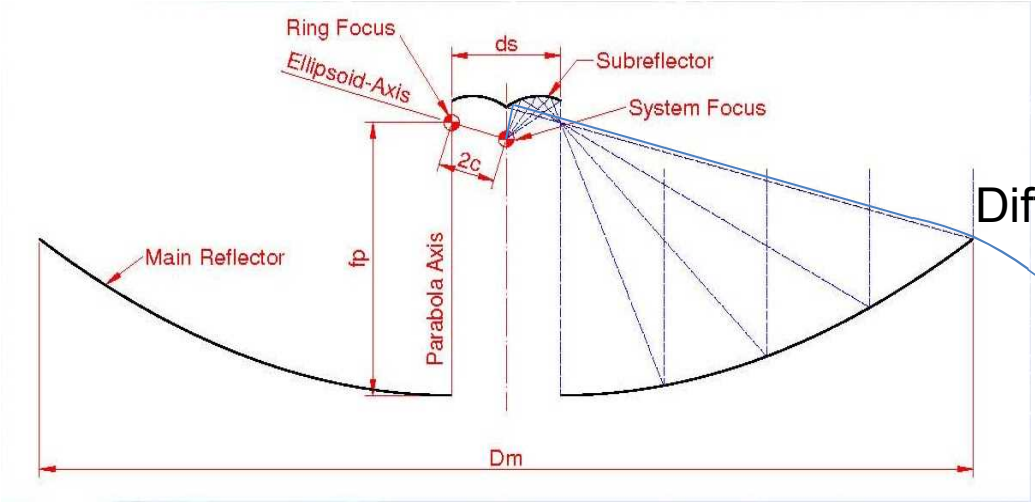
Ring Focus



feature：

- better efficiency：～80%
- Artificial signals easily reach the feed

Artificial signals easily reach the feed!



Diffraction!

Artificial radio signal

Ground

Summary

- New project for constructing new VGOS Station started in Japan.
- New VLBI observing facilities are installed, fully compliant with VLBI2010 (VGOS) concept.
- Construction of the antenna was completed, and the receiving performance was measured.
- In 2014, set-up & test observation will be done, and domestic local-tie observations with old antennas (Tsukuba & other stations) will start in legacy S/X band mode from February, 2015.

Thank you very much
for your attention!