

# Preliminary Design of Retroreflector Array for ASTRO-G in Highly Elliptic Orbit

**Hiroo Kunimori**

National Institute of Information  
and Communications Technology

**Toshimichi Otsubo**

Hitotsubashi University

**Shinichi Nakamura**

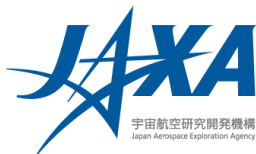
**Hiroshi Takeuchi**

**Yoshiharu Asaki**

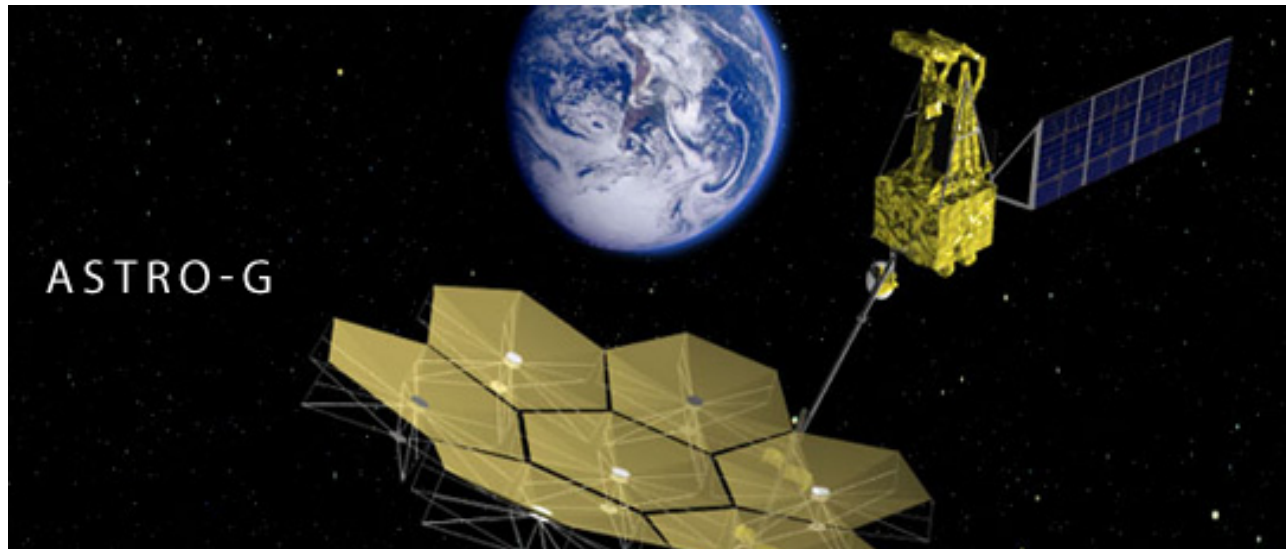
Japan Aerospace Exploration  
Agency



**NICT**

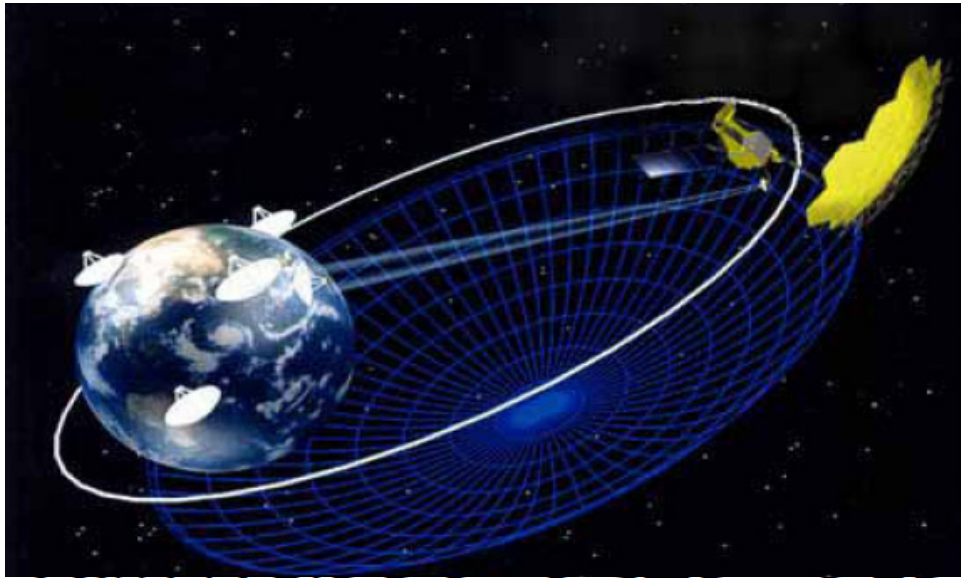


# VSOP2 Mission



- Follow on Space VLBI mission to the former called VSOP (1997-2006) : Imaging astrophysical objects with 10 times higher resolution/sensitivity than those of VSOP. Launch scheduled in early 2010's.
- Requirement of POD : 3cm the best science achieved by during observation mode using technique switching objects phase compensated.
- POD by GPS and SLR (SLR approved recently)

# Characteristic of Orbit and Range / Incident angle



Orbit: Height of perigee : 1,000 km

Height of apogee : 25,000 km ,

$i=31\text{deg}$

Simulation Range vs. Incident angle to LRA

using 30 ILRA stations for various Phas of orbit parameter Omega

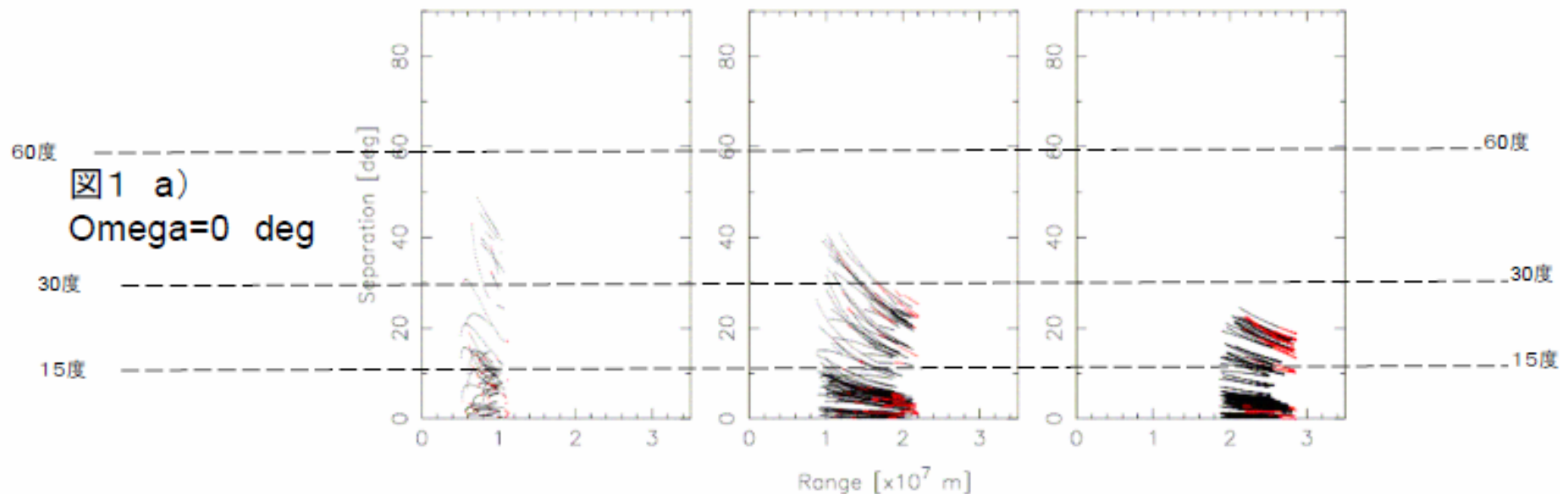
Importance of medium height

performace in terms of dynamic feature in orbit determination.

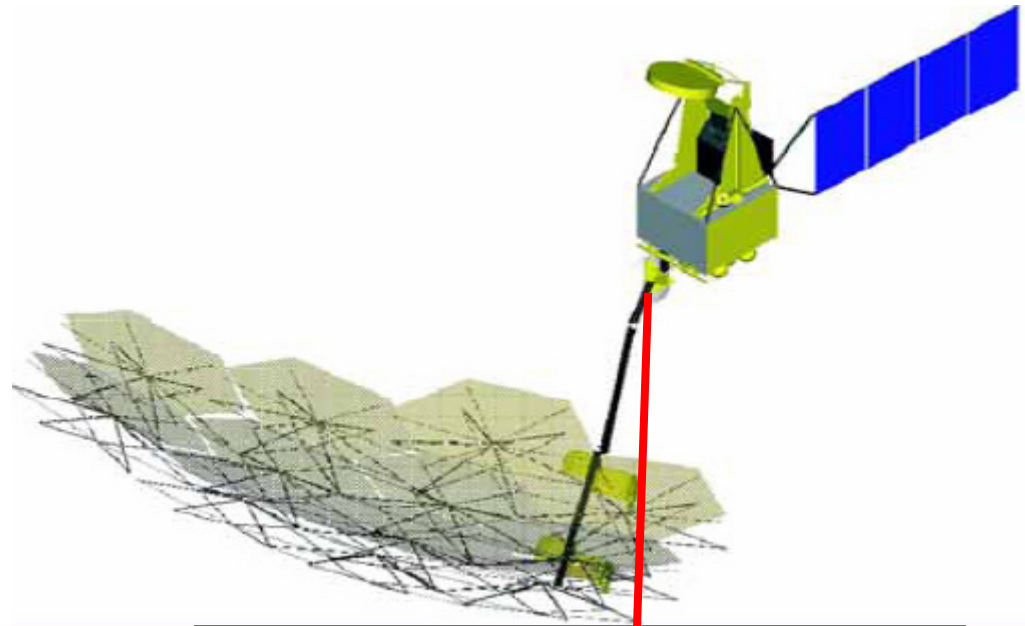
$R \leq 15000$  [km]

$15000 < R \leq 25000$  [km]

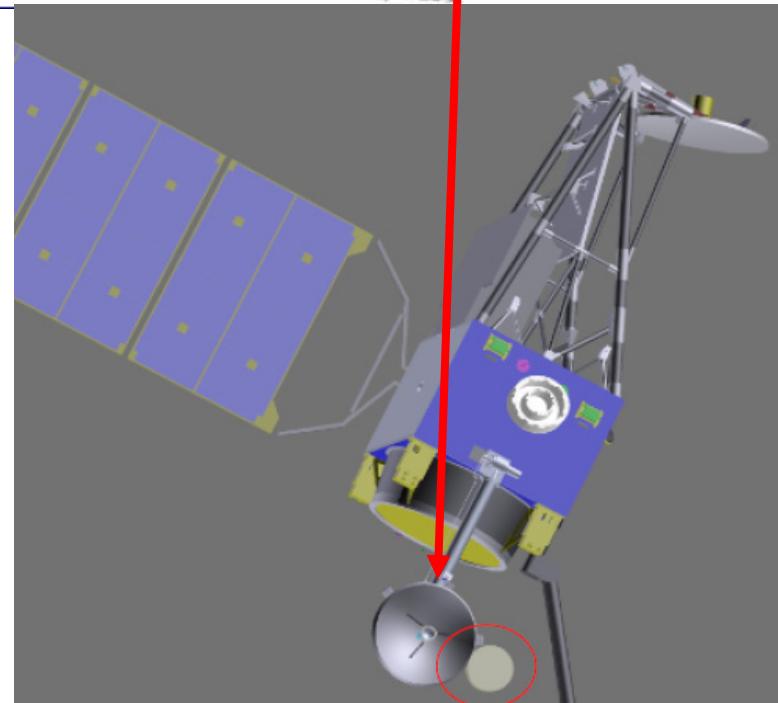
$R > 25000$  [km]



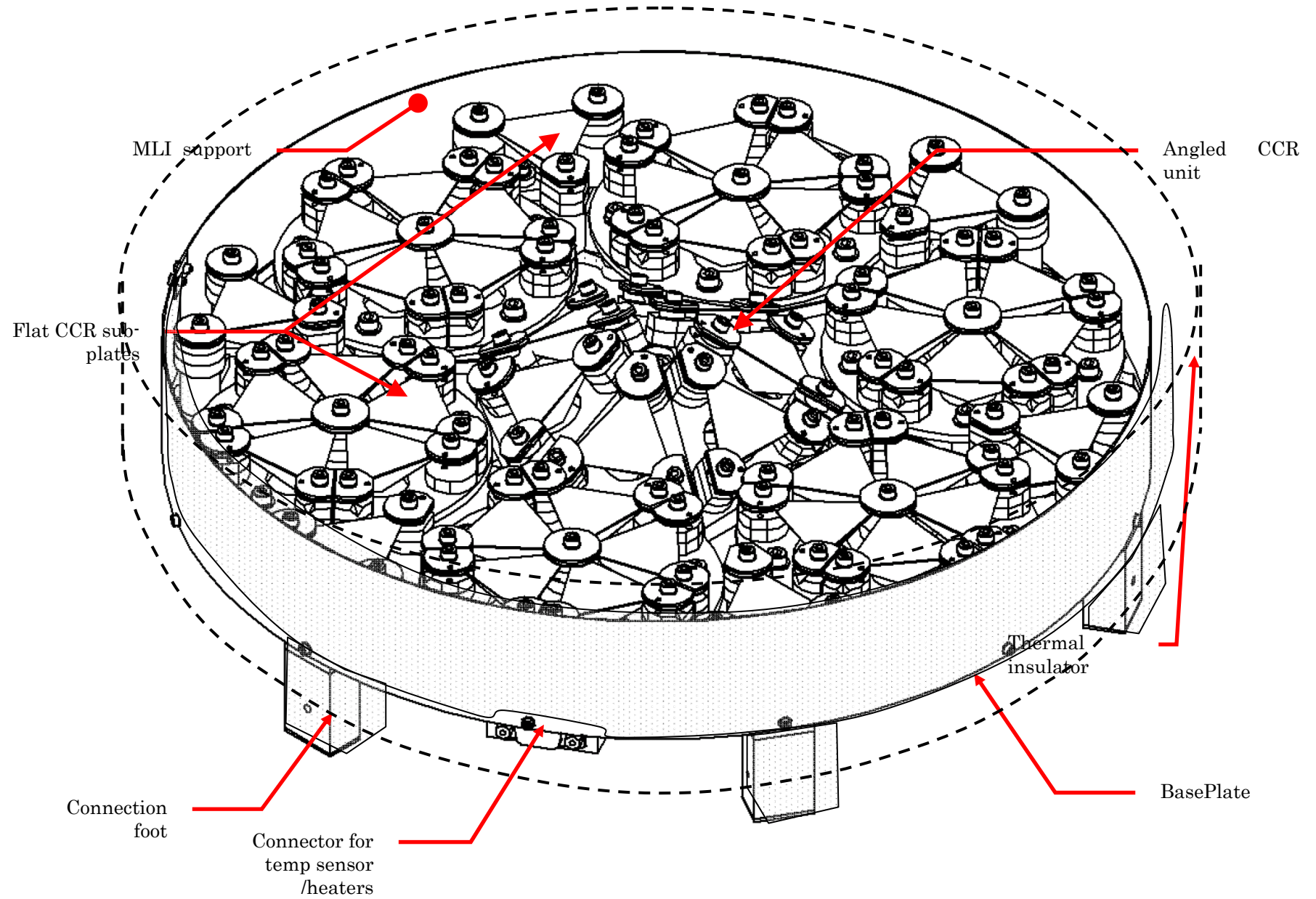
## VIEW of Astro-G



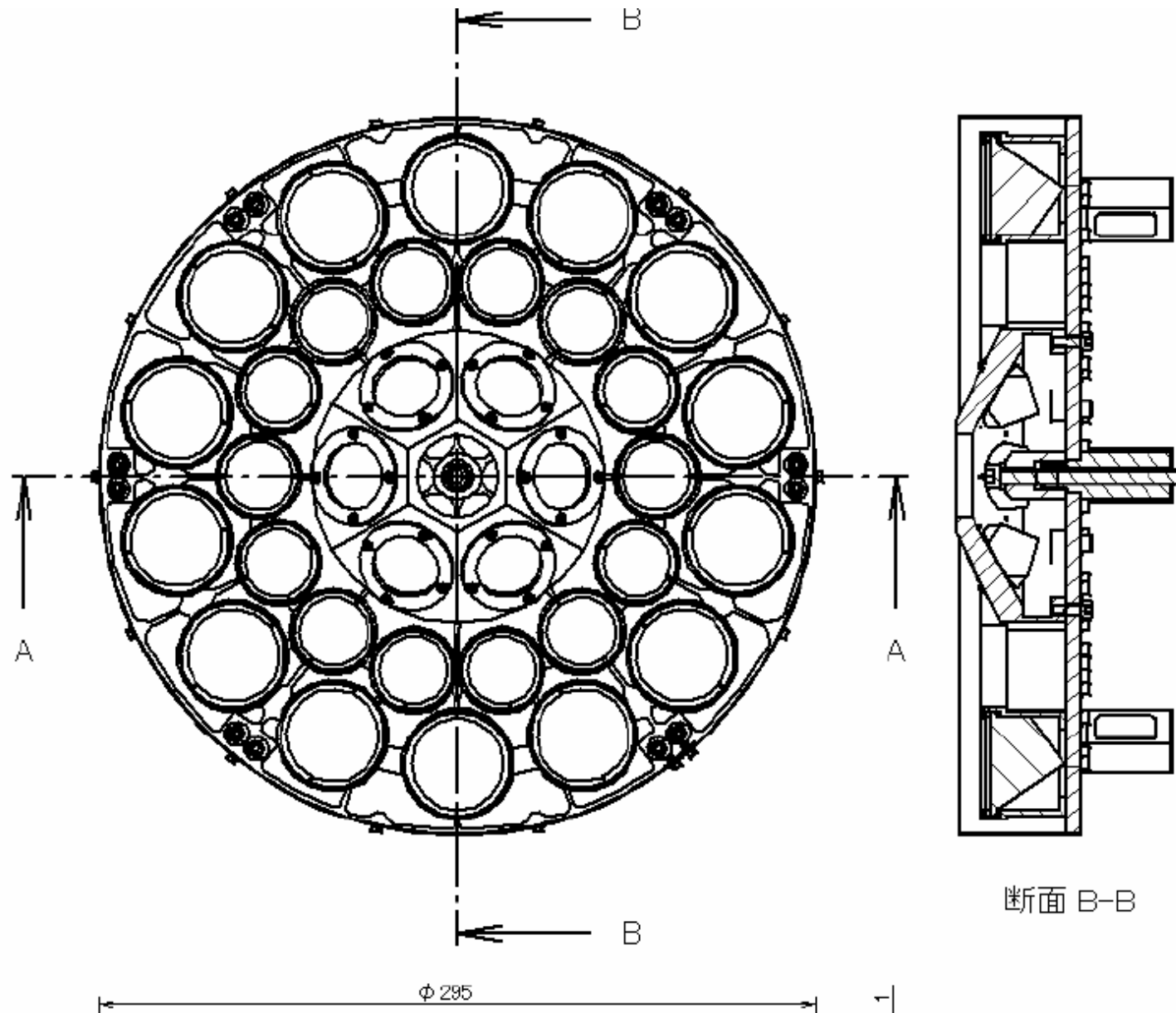
## Location of SLRA



# SLRA Type1

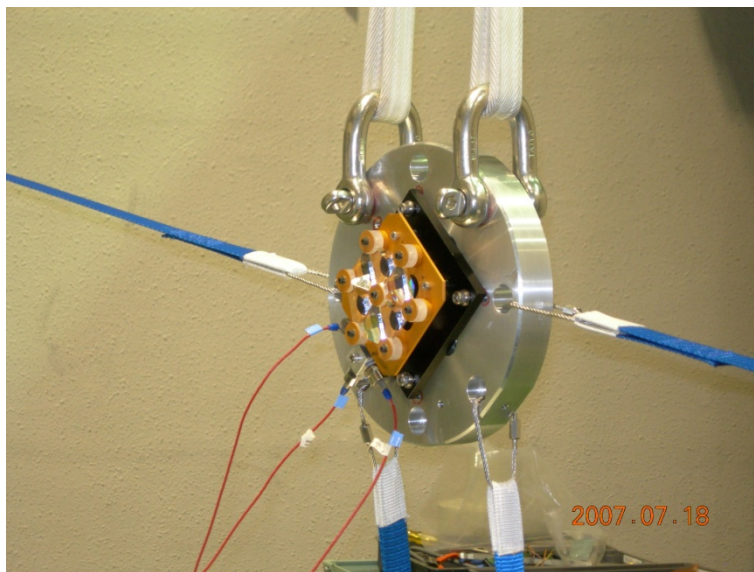


# SLRA Type2





Angled CCRs Unit (Type1)



Preliminary Shock test CCR on holder design

## The present activities :at

Design Phase for Engineering Model Including

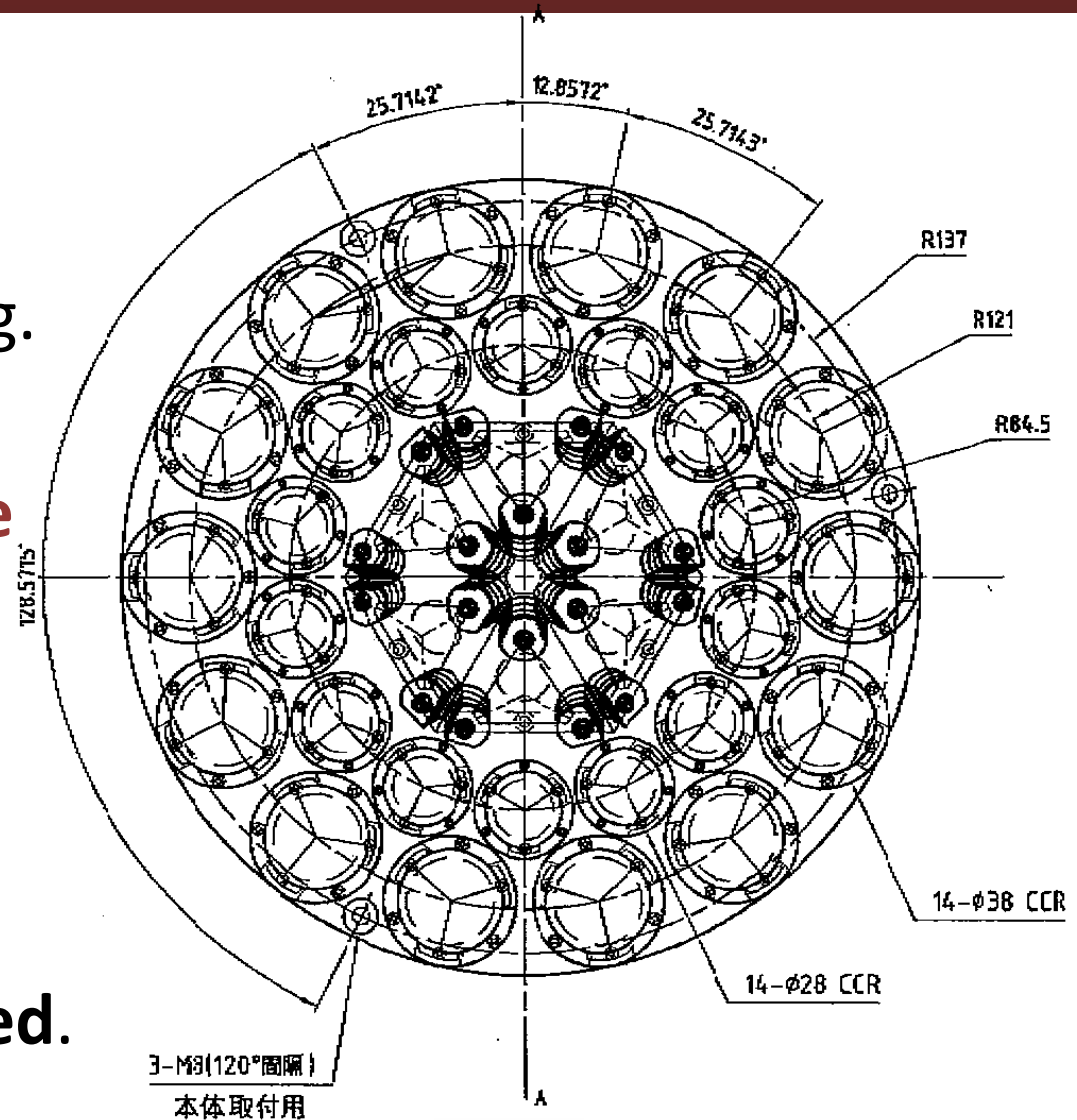
- Prototyping sub-parts for various holder design mechanical resistance e.g. by shock test
- Scrutinizing candidate fused silica of various grades for radio active resistance
- Optical coating candidates investigation
- Developing detail thermal model
- Test instruments and facility
- Should finalizing LRA optical and mechanical design in this year.



Prototype holder type2

# LRA Design: "Type 2"

- Centre
  - 6 reflectors.
  - **Inclined** by 30 deg.
  - Back face **coated**.
  - For **SHORT** range
- Ring
  - 28 reflectors.
  - Inner and outer.
  - Back face **uncoated**.
  - For **LONG** range



NICT

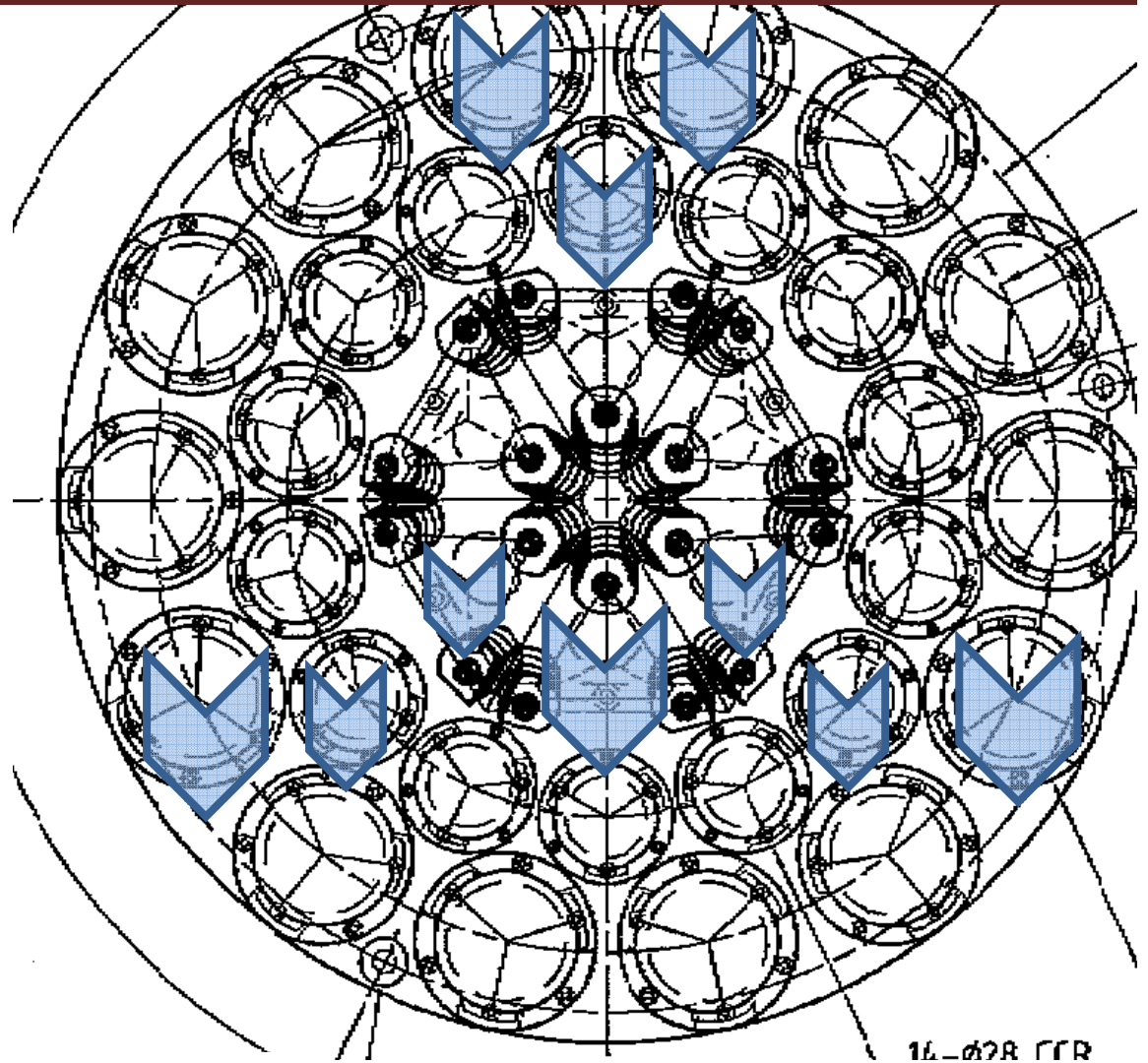
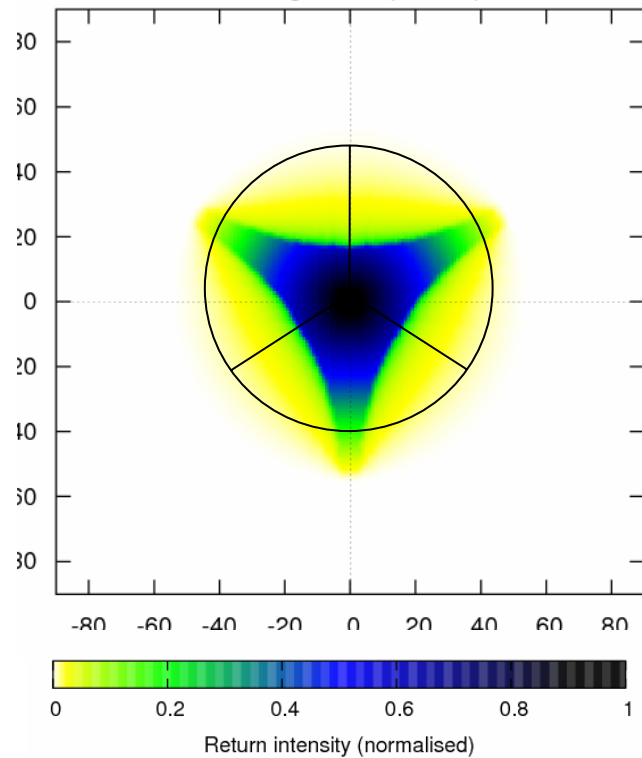




# Orientation is a Key

## Single Reflector

Lageos LR (Normal)

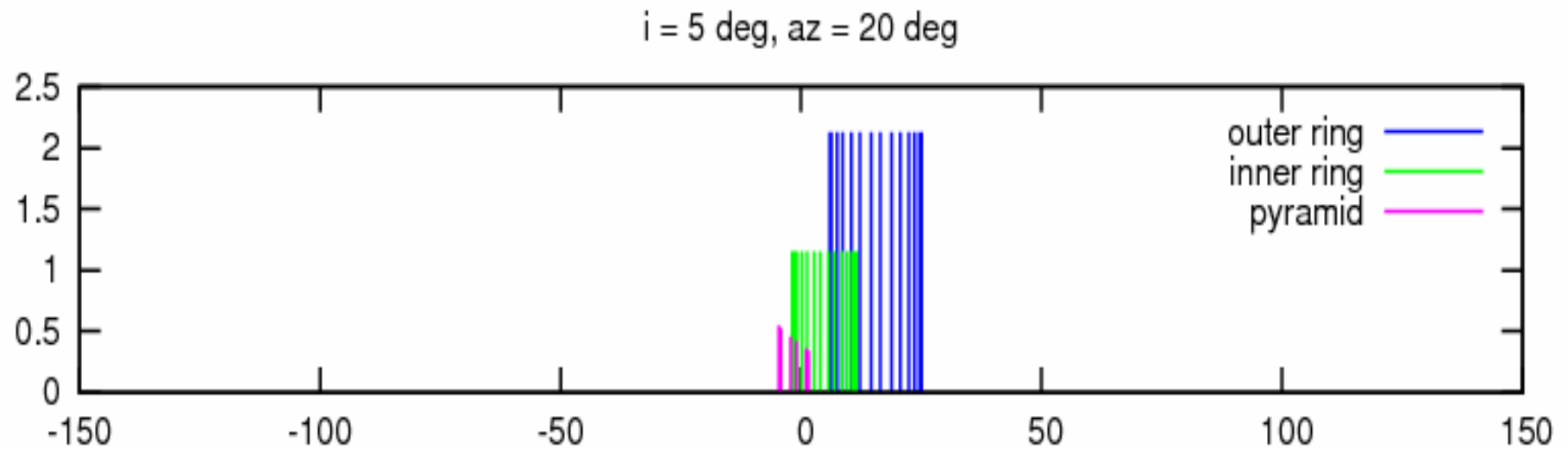


Reflection when  
angle of incidence  $> 20$  deg



# Simulation Results

0-ps-width pulse of incidence assumed.

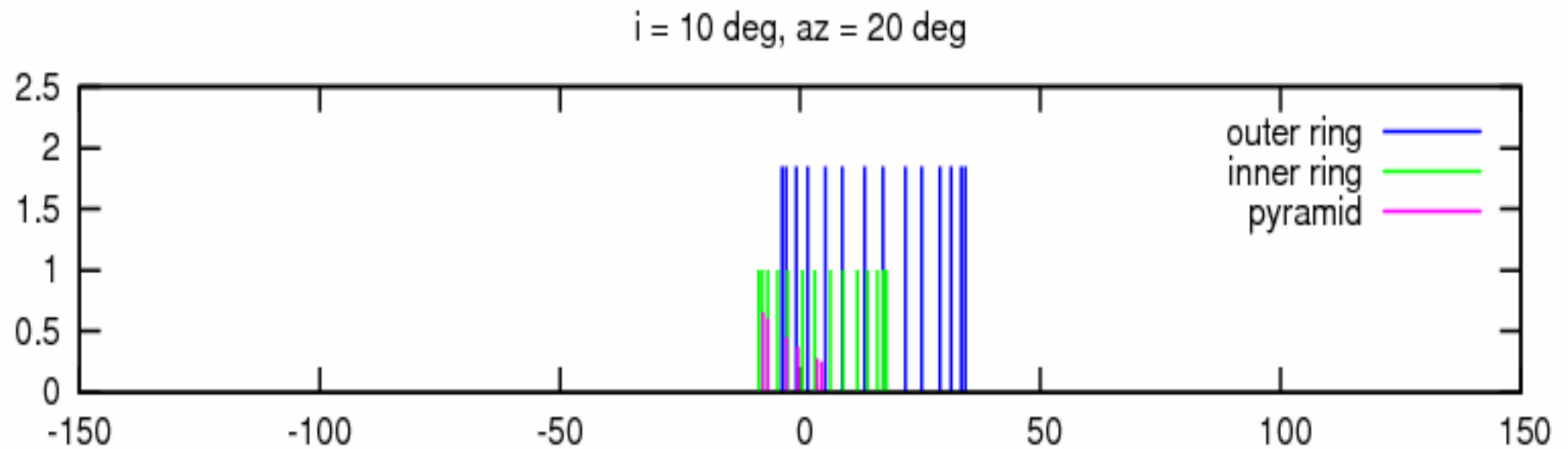


**NICT**

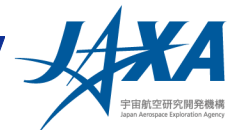


# Simulation Results

0-ps-width pulse of incidence assumed.

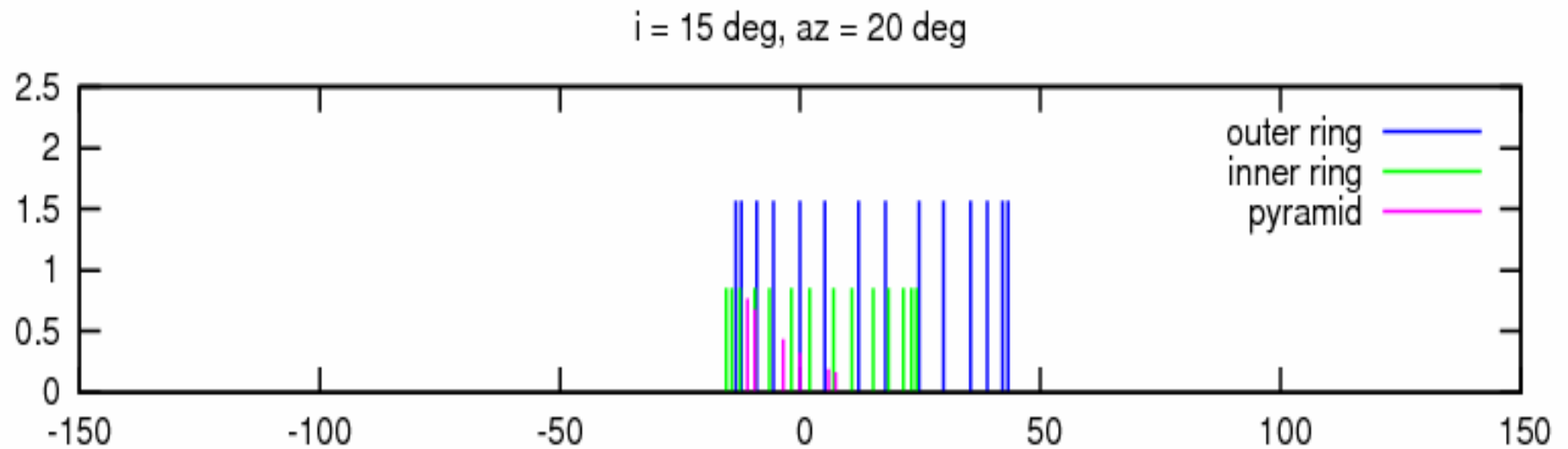


**NICT**



# Simulation Results

0-ps-width pulse of incidence assumed.

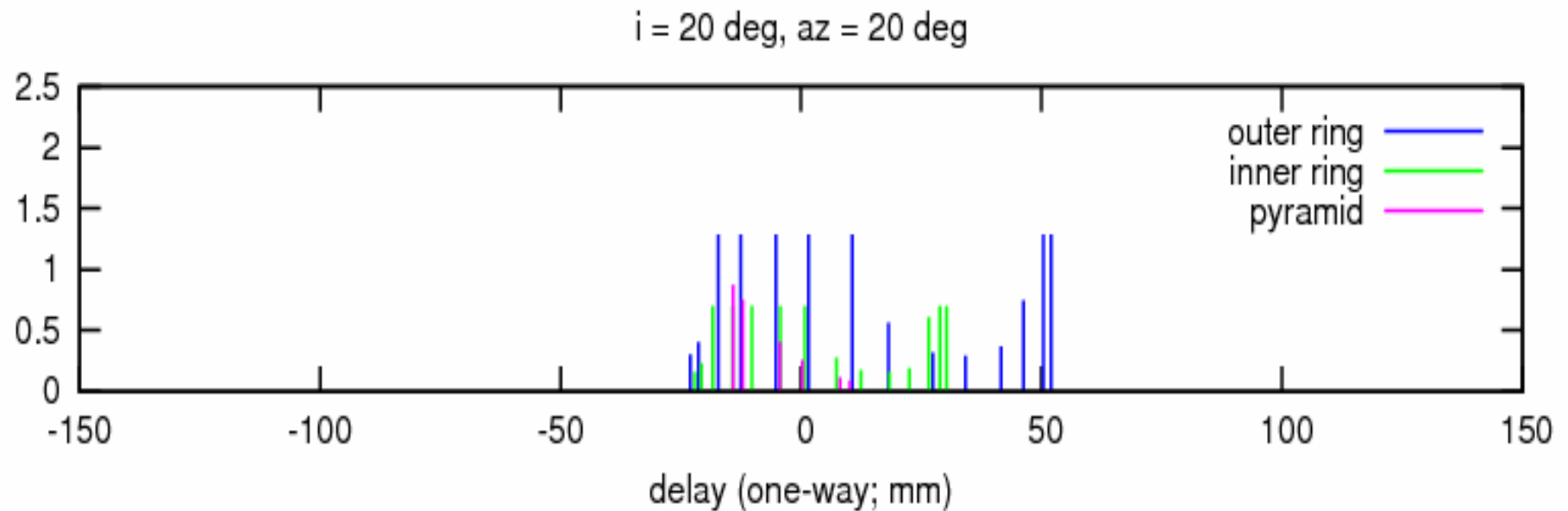


**NICT**



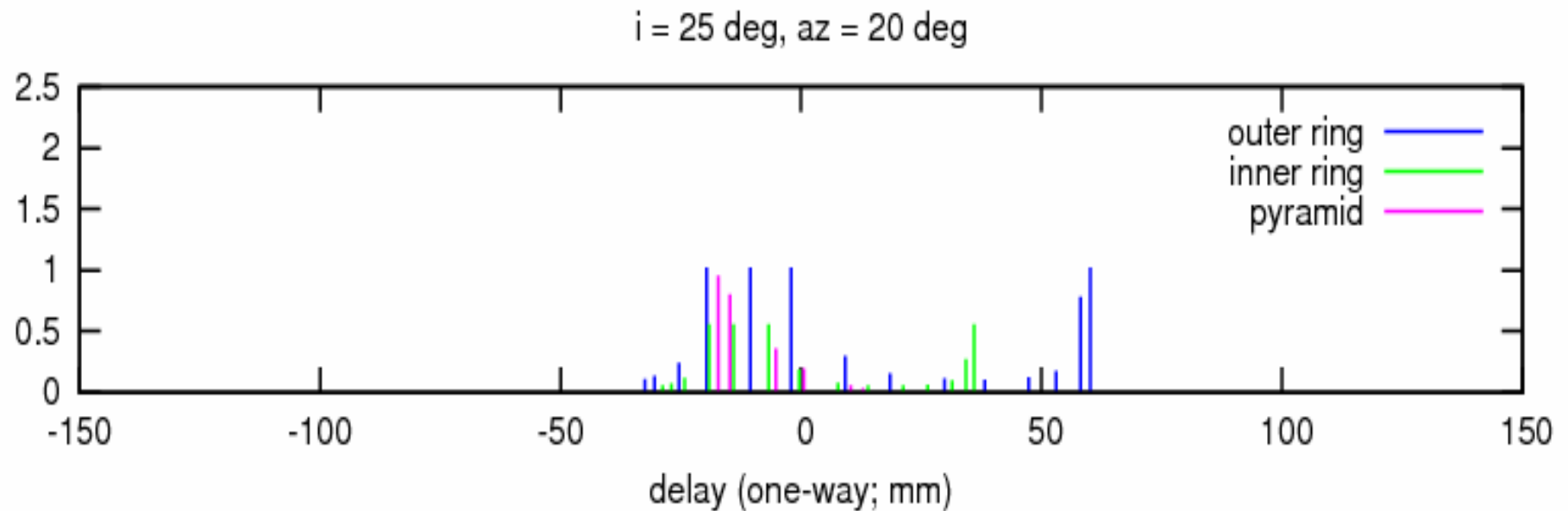
# Simulation Results

0-ps-width pulse of incidence assumed.



# Simulation Results

0-ps-width pulse of incidence assumed.

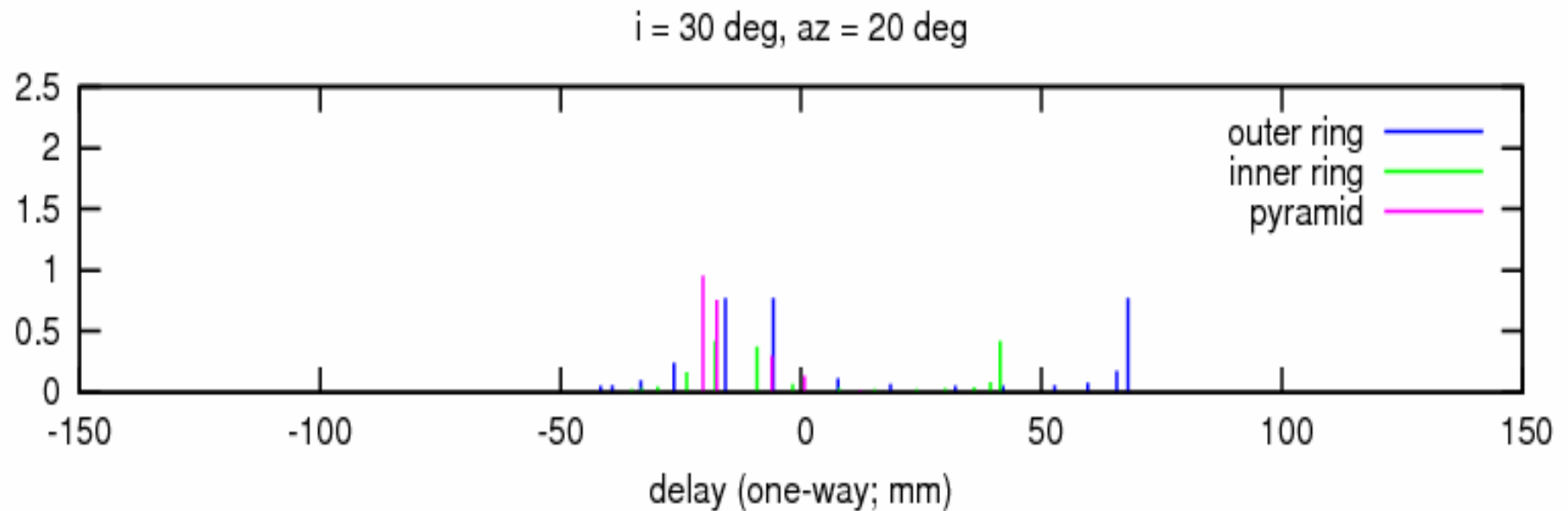


**NICT**



# Simulation Results

0-ps-width pulse of incidence assumed.

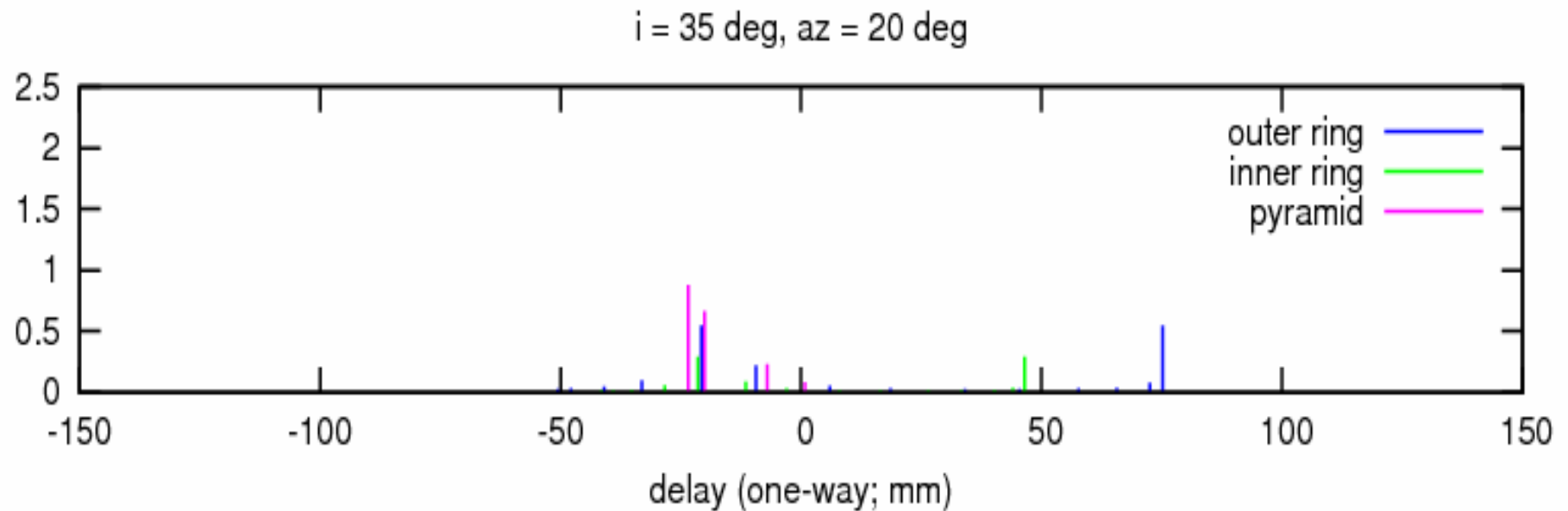


**NICT**



# Simulation Results

0-ps-width pulse of incidence assumed.



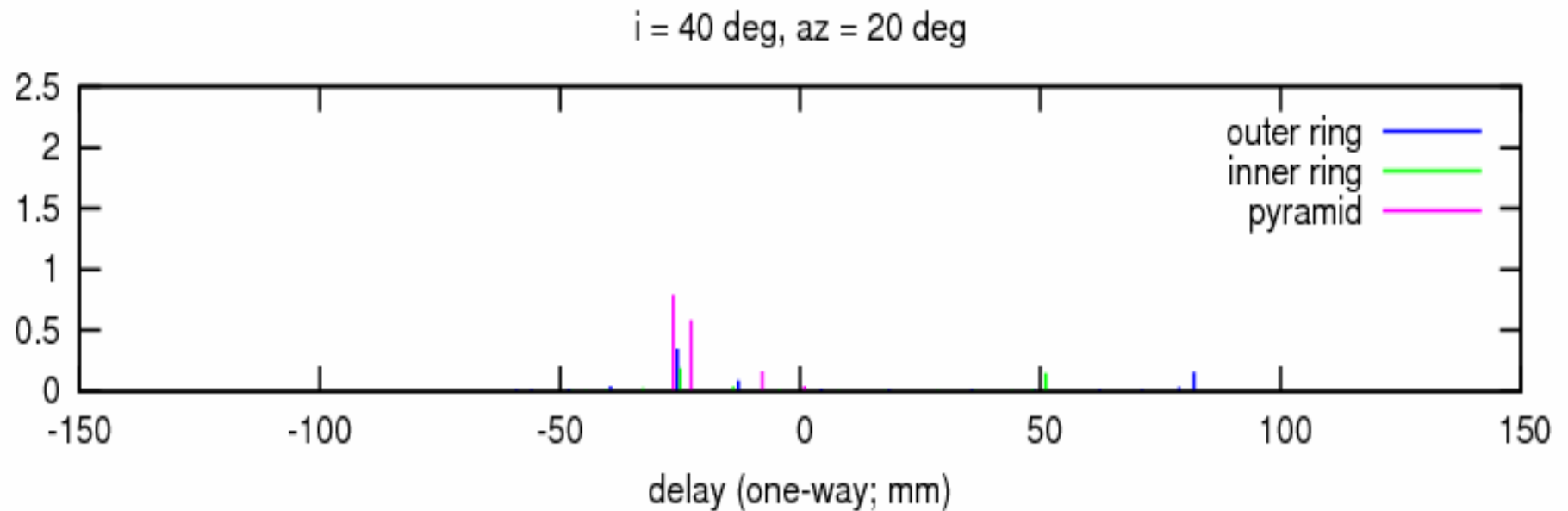
**NICT**





# Simulation Results

0-ps-width pulse of incidence assumed.



**NICT**



# More To Do

- Signature problem: solve the 'double pulses'
  - Curb the reflection from farther reflectors.
- Velocity Aberration
  - Re-design the reflector size and dihedral angle.
- Launch: 2012