

NASDA Planning for GPM

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Background

- **TRMM**

Launched in November 1997. Nominal mission life : 3yr 2mo.
First spaceborne Precipitation Radar (PR) in the world.
Demonstrated the usefulness of PR for global rain observation

- **Expectation of TRMM Follow-on (F/O)**

Extension of observation area.

Observation of global rain/snow.

Successive observation to TRMM.

Launch target FY 2007 (earliest).

More frequent observation.

Application for weather forecasting.

Plans for TRMM F/O

ATMOS-A (JAPAN) ---- DPR, TMI, VIRS

GPM (USA) --- DPR, TMI (Core), 8 small satellites

ATMOS-A1 Mission Concept

Follow-on mission to TRMM

Observing precipitation, including solid precipitation (snow/ice) and high-latitude regions

Dual frequency precipitation radar to increase sensitivities

Orbit:

- Altitude: 412.6 km

- Inclination: 55 deg

Total mass: approx. 2.5 ton

Lifetime: 5 years

Launch period: 2006

Sensor:

- Precipitation Radar

Frequency: 14/35 GHz

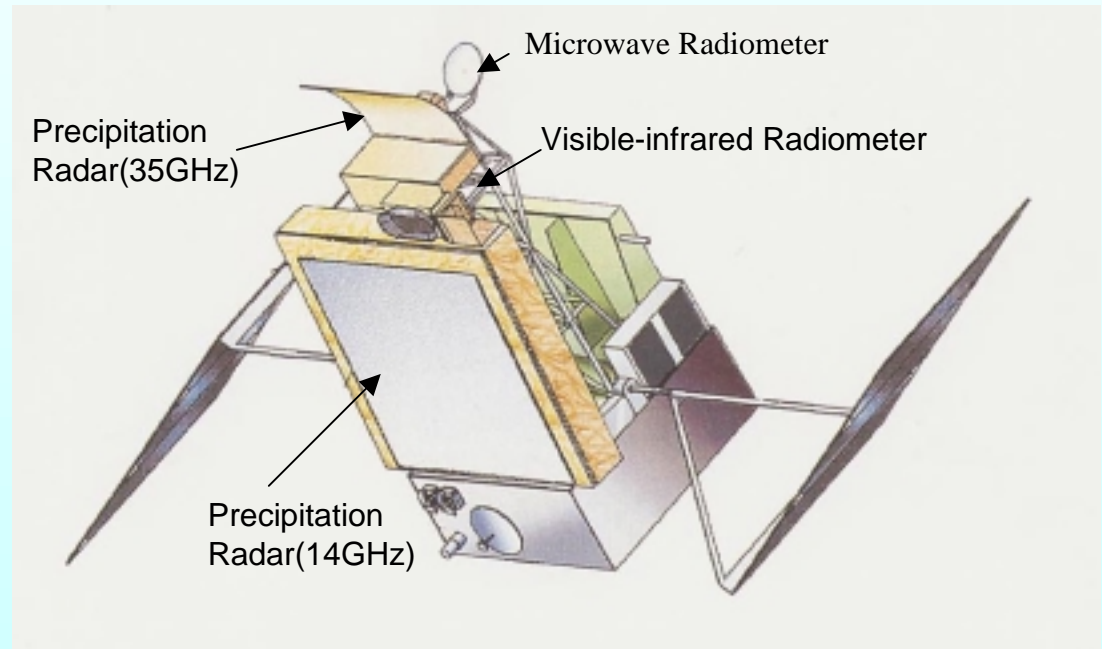
- Microwave Radiometer

similar to TRMM TMI

- Visible-infrared radiometer,

Lightning sensor

desirable



GPM/ATMOS-A1 → GPM

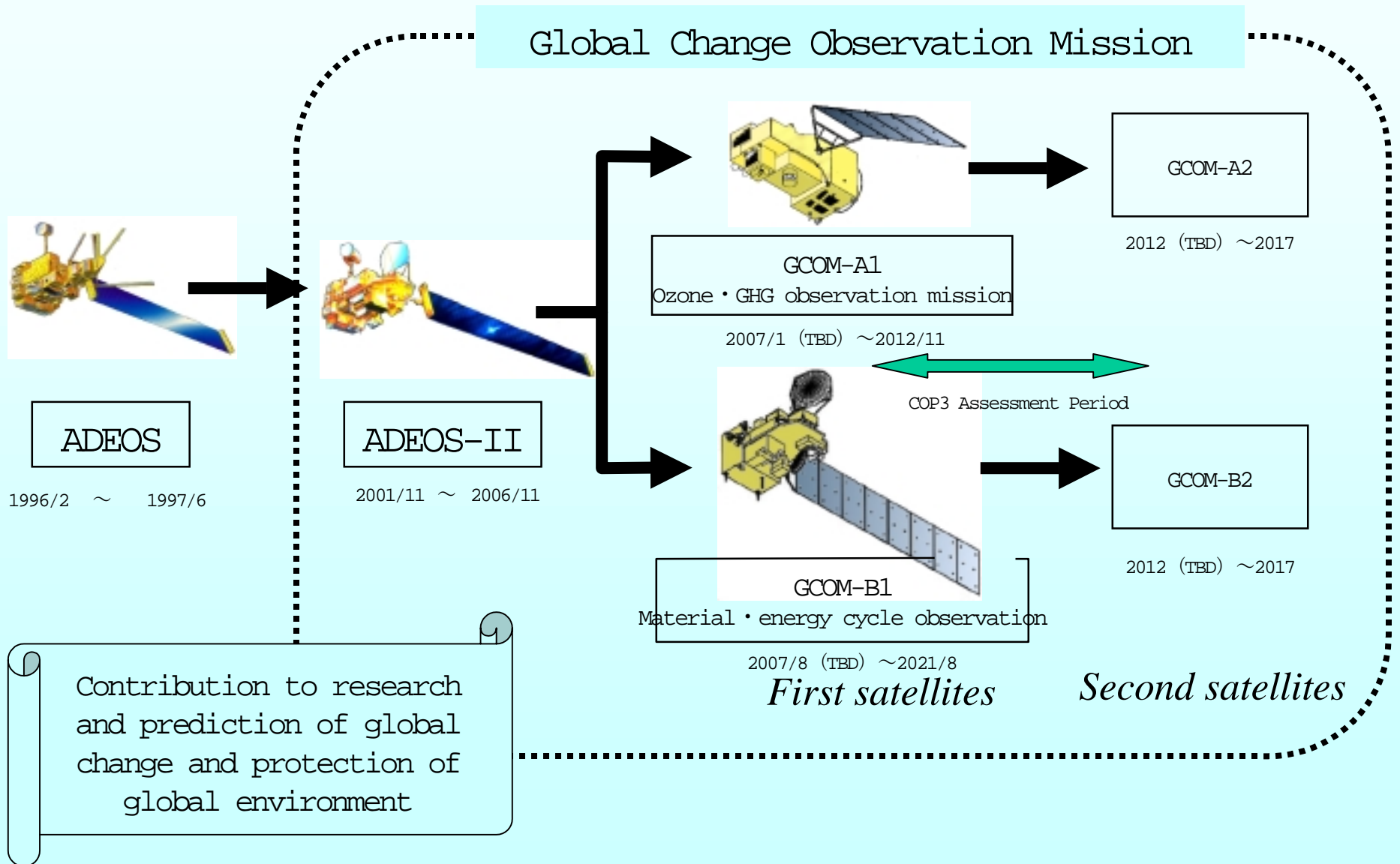
Current scenario of Earth Observation (2002~2017)

Obs. target	2002~2007	2007~2012	2012~2017	Objectives
Atmospheric composition Ozone aerosol, NOX, SOX GHGs	ADEOS-II ILAS-II GLI SeaWinds DCS AMSR POLDER	GCOM-A1 ODUS SOFIS SWIFT	GCOM-A2 CO ₂ observation, From Stratosphere to Troposphere	Monitoring of the ozone layer Monitoring of air pollution Estimation of CO ₂ source and sink
Climate Change Air-Sea interactions Water cycle Cloud Radiation		TRMM PR	GCOM-B1 SGLI, AMSR, AlphaSCAT GPM DPR, TMI	GCOM-B2 More accurate observation Operational System
Others Forest observation	ALOS PALSAR	ALOS-F/O		Estimation of CO ₂ absorption
Expected results	Monitoring Ozone layer in polar region Aerosol Ocean variability Forest map Combined data set	Model improvements Chemical transport model Hydrological model Ocean circulation model Cloud · Radiation model Climate model	Prediction Variability of atmospheric composition Global warming Hydrological cycle Oceanic variability Climate change	

GCOM and GPM/ATMOS-A1

- GCOM: global change observation mission.
 - GCOM is a mission concept of NASDA's Earth Observation programs extending over more than 15 years, not a single satellite program
 - GPM/ATMOS-A1 is also considered under 'GCOM' umbrella

GCOM Configuration (Proposal)



GPM Concept and NASDA's participation

Core Satellite

OBJECTIVE: *Understand the Horizontal and Vertical Structure of Rainfall and Its Microphysical Element. Provide Training for Constellation Radiometers.*

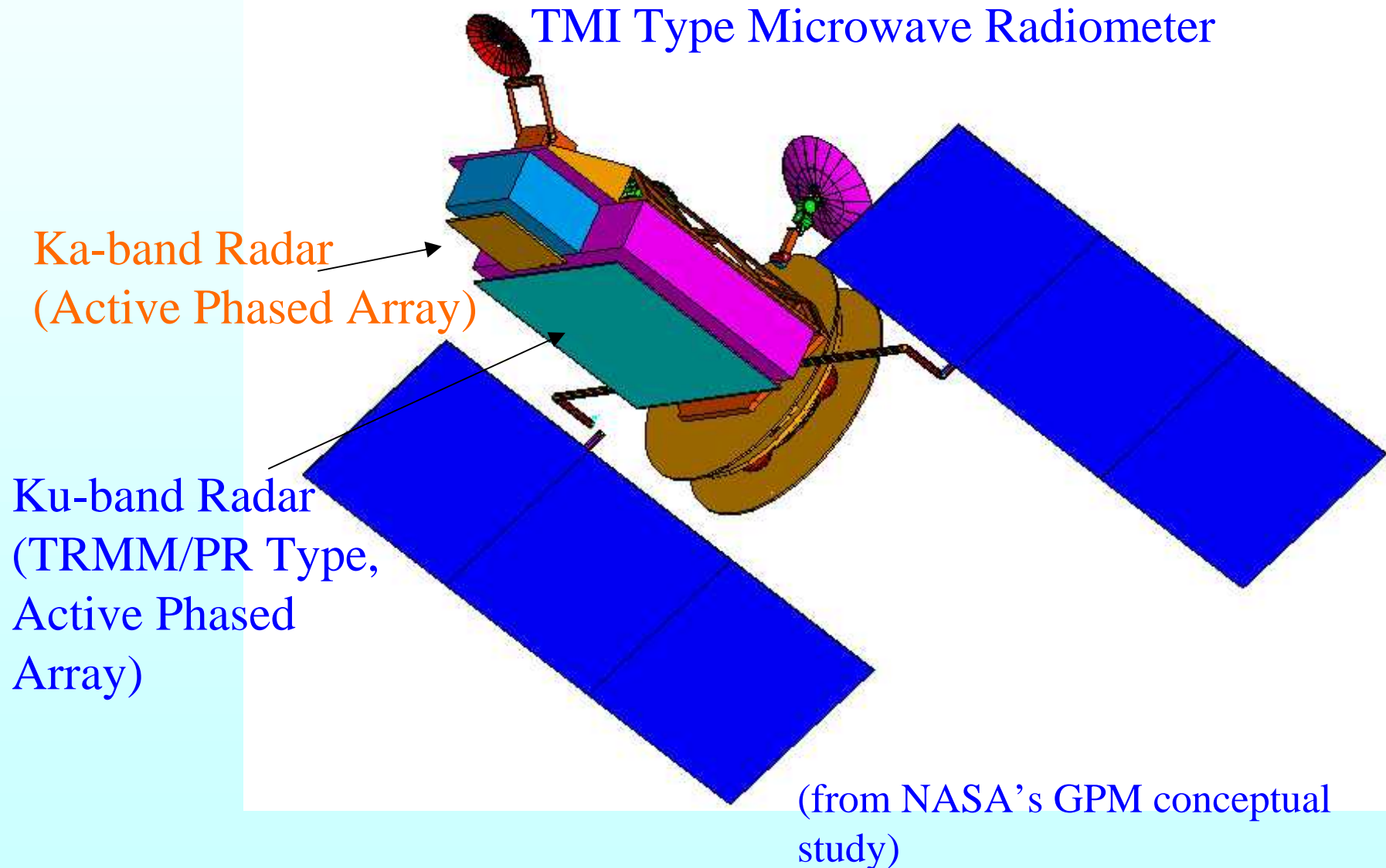
- **Dual Frequency Radar**
- **Multi-frequency Radiometer**
- **H2-A Launch**
- **TRMM-like Spacecraft**
- **Non-Sun Synchronous Orbit**
- **~70° Inclination**
- **~400 - 500 km Altitude**
- **~4 km Horizontal Resolution**
- **250 m Vertical Resolution**

Constellation Satellites

OBJECTIVE: *Provide Enough Sampling to Reduce Uncertainty in Short-term Rainfall Accumulations. Extend Scientific and Societal Applications.*

- **Small Satellites with Microwave Radiometers**
- **Aggregate Revisit Time, 3 Hour goal**
- **Sun-Synchronous Polar Orbits**
- **~600 km Altitude**

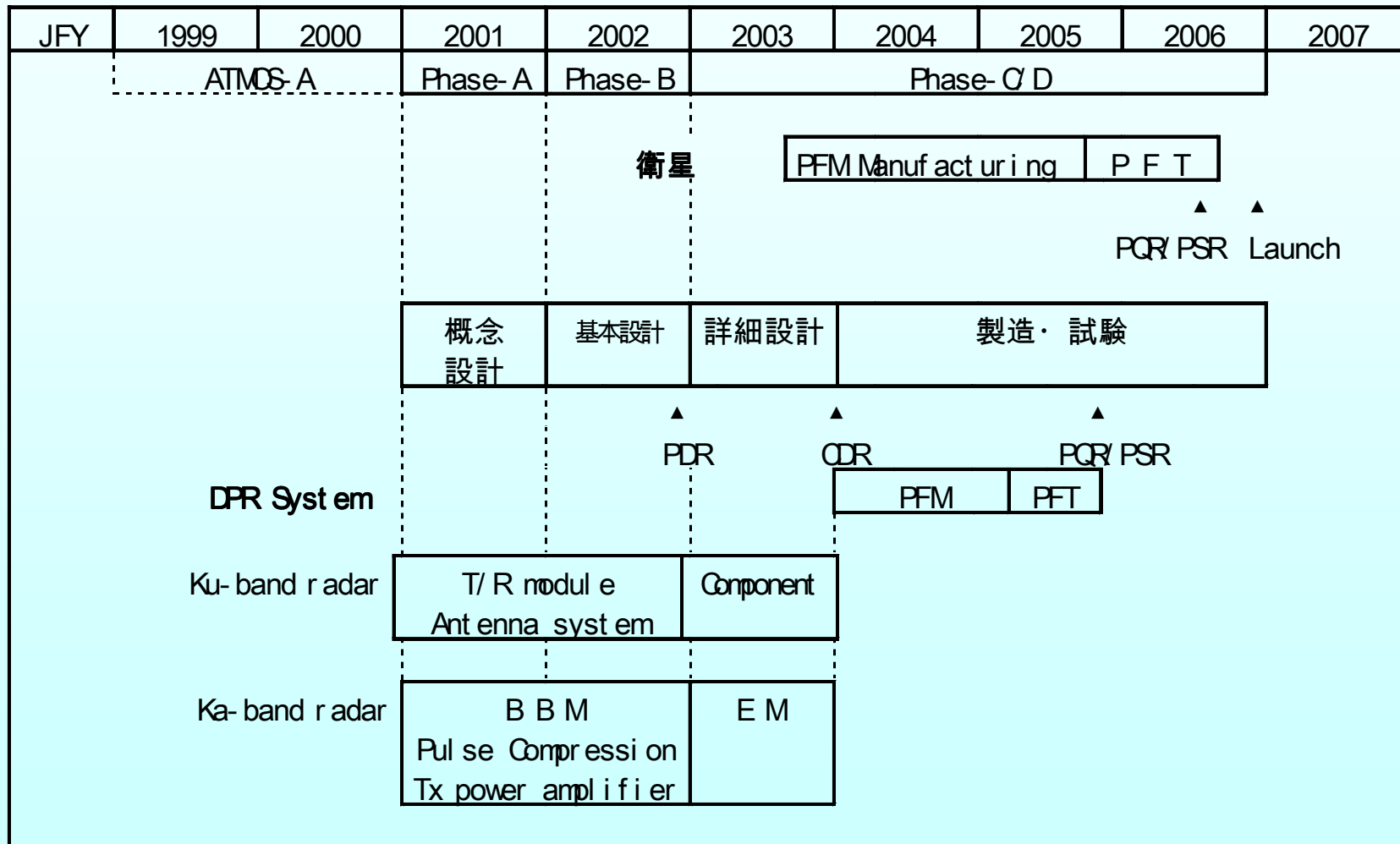
Conceptual Image of GPM Core (ATMOS-A1)



Dual-Frequency Precipitation Radar (DPR)

- 1. Ka-band radar: sensitive measurement of weak rainfall and snowfall.**
- 2. Dual-frequency analysis: accurate quantitative measurement.**
 - **Combination of reflectivity and attenuation.**
 - **Estimation of drop size distribution.**
 - **Discrimination of rain and ice**
- 3. Improvement of radiometer algorithms**

GPM/DPR Development Schedule



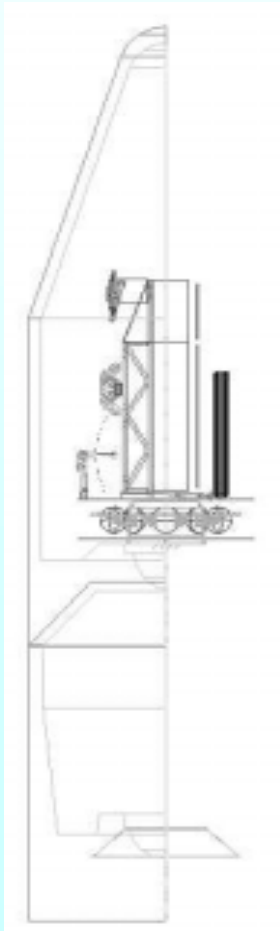
DPR study status

- Ku-band radar: phase A study by NASDA. NASDA would like to start phase B study in JFY2002. PRR#1 in 2001(?)
- Ka-band radar: CRL started phase A DPR study in JFY2000.

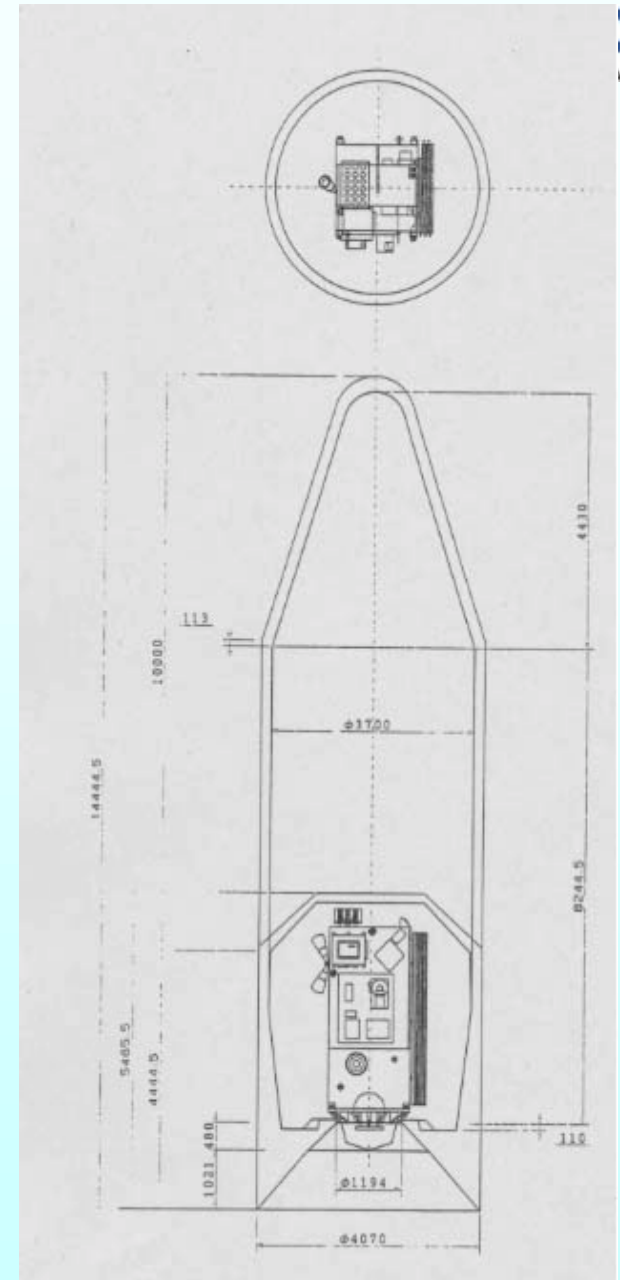
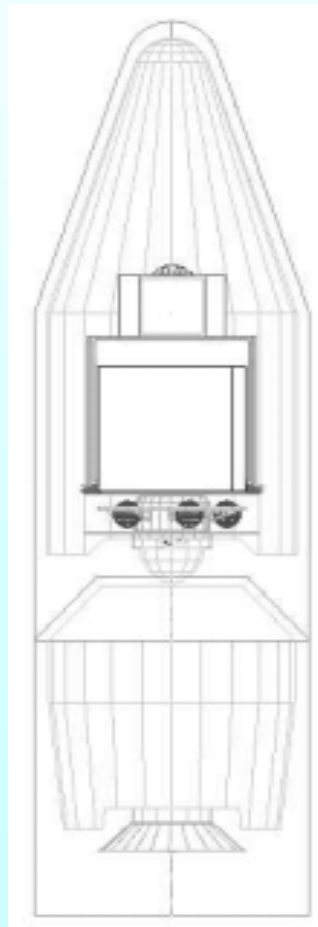
Launch Option by H-IIA

- H-IIA Dual Launch
 - GCOM-A1 : 650Km / GPM core : 400Km
 - NASDA wants to avoid multiple 2nd stage engine ignition to inject GCOM-A1 in a certain altitude after injecting GPM core satellite. (Too risky)
- Option 1 : Inject both GCOM-A1 and GPM core to about 400 km circular orbit and then transfer GCOM-A1 to 650 km
- Option 2 : Inject both GCOM-A1 and GPM core to 650 km circular orbit and then transfer GPM to 400km
- Option 3: Inject both GCOM-A1 and GPM core to 400 x 650 km elliptic orbit and then transfer GPM core to 400 km and GCOM-A1 to 650 km

H2-A Dual launch Configuration



GPM Core (H-IIA upper)



GCOM-A1 (H-IIA lower)

Summary

- NASDA's ATMOS-A1 and NASA's GPM are complementary missions and should be merged.
- NASDA intends to provide NASA with the DPR and a launcher (H-IIA).
- Targeted date of launch in Feb. 2007.
(Dual launch with GCOM-A1)
- NASDA and CRL are jointly developing DPR for sensitive and accurate measurement of global precipitation.
- Currently in Phase A. Mission requirements have to pass PRR#1 to move into the development phase (Phase B).