# Akatsuki mission update

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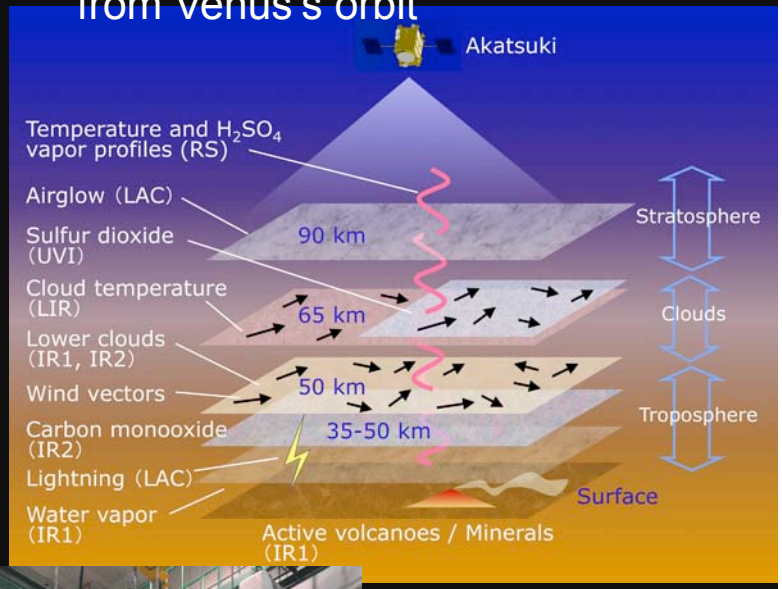
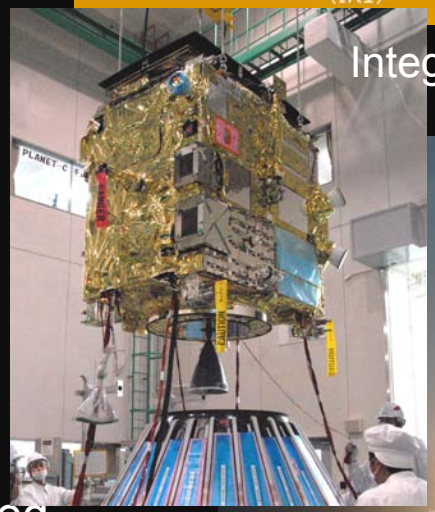
# Development and launch

- Objective: Understanding the atmospheric dynamics and cloud physics of Venus
- Spacecraft
  - Venus orbiter designed for remote sensing from an equatorial, elliptical orbit
  - Mass: 500 kg (incl. fuel)  Payload: 35 kg
  - Three-axis attitude control
- Science instruments
  - 1μm Camera (IR1)
  - 2μm Camera (IR2)
  - Longwave IR Camera (LIR)
  - Ultraviolet Imager (UVI)
  - Lightning and Airglow Camera (LAC)
  - Ultra-stable oscillator (USO)
- Akatsuki was proposed in 2001 and approved as an ISAS mission soon after the proposal.
- Akatsuki was launched in May 2010.

3-D observation of the atmosphere from Venus's orbit



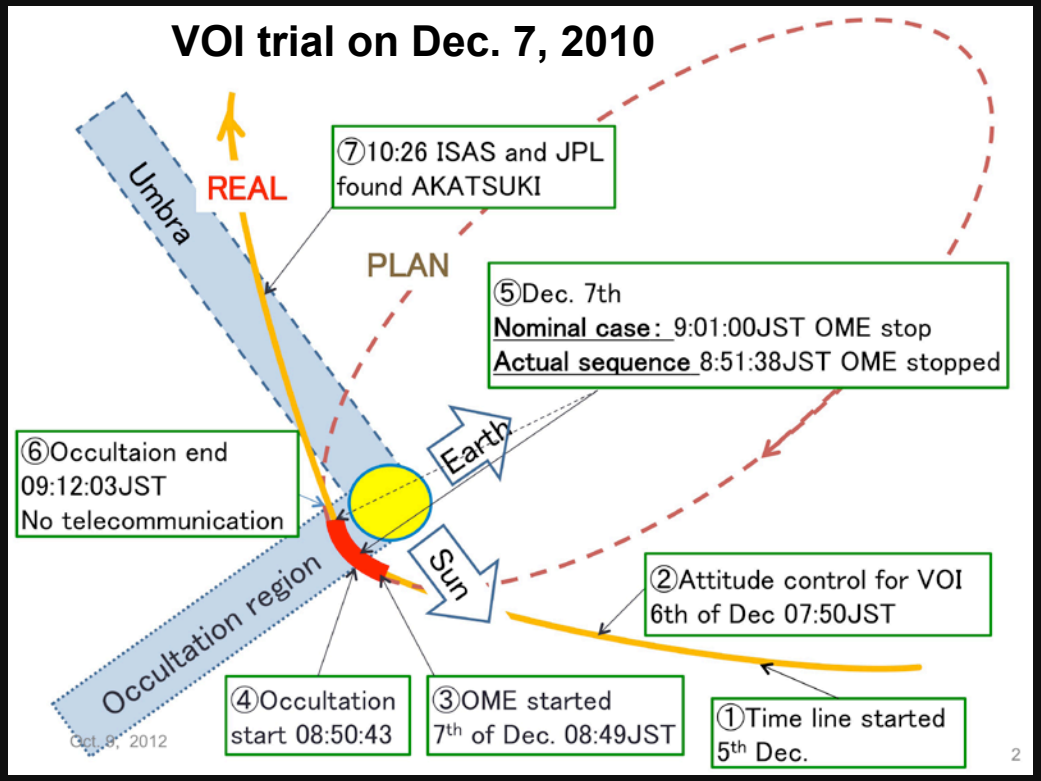



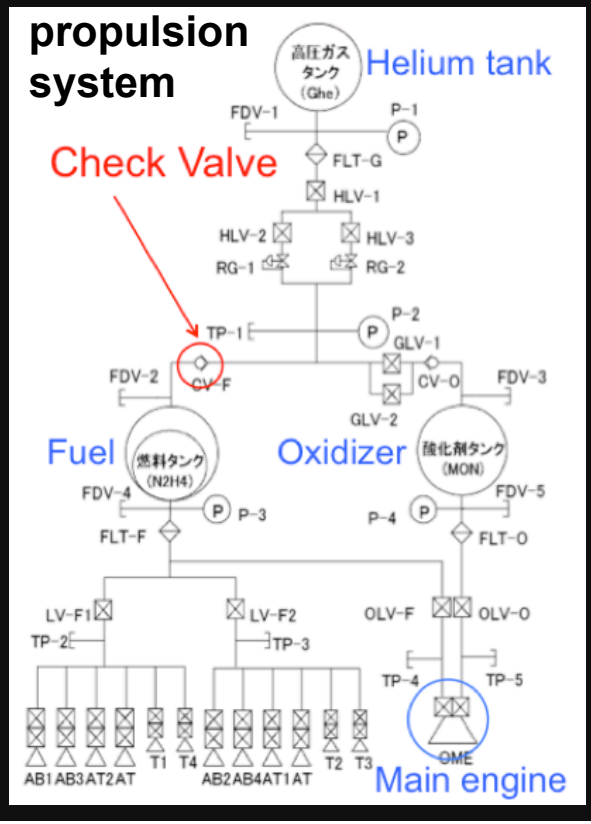
Integration at ISAS

Launch by H2A in May, 2010

# Failure of Venus orbit insertion

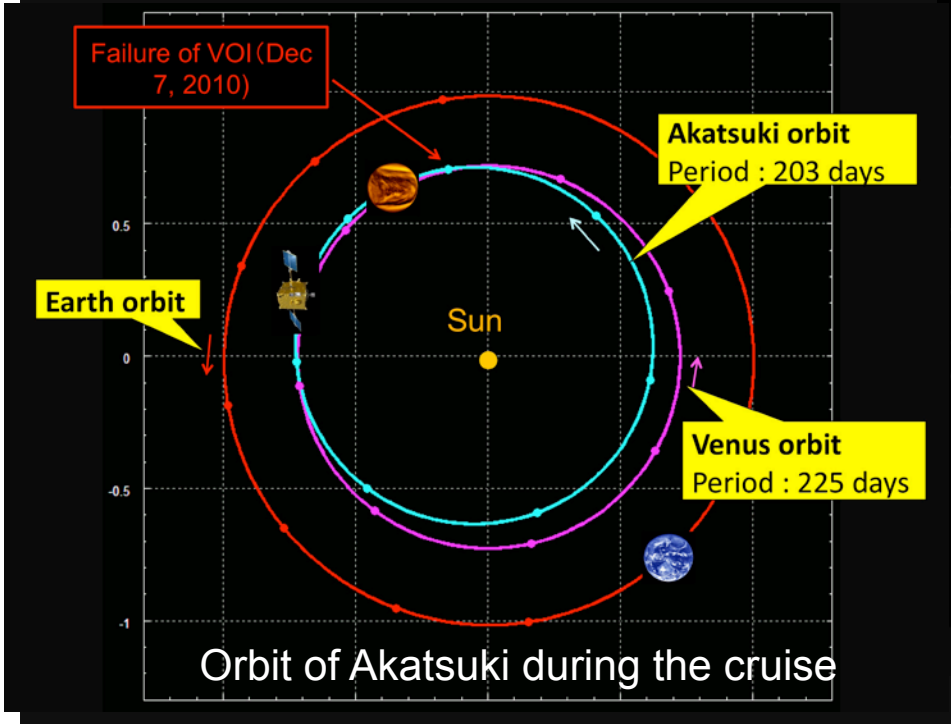
- The Venus orbit insertion (VOI) scheduled for Dec 7, 2010 has failed due to a malfunction of the propulsion system.
- The check valve between the helium tank and the fuel tank was blocked by an unexpected salt formation during the cruising from the Earth to Venus. As a result the orbital maneuvering engine (OME) became oxidizer-rich and fuel-poor condition, which led to an abnormal combustion in the engine with high temperature, and finally the engine was broken.



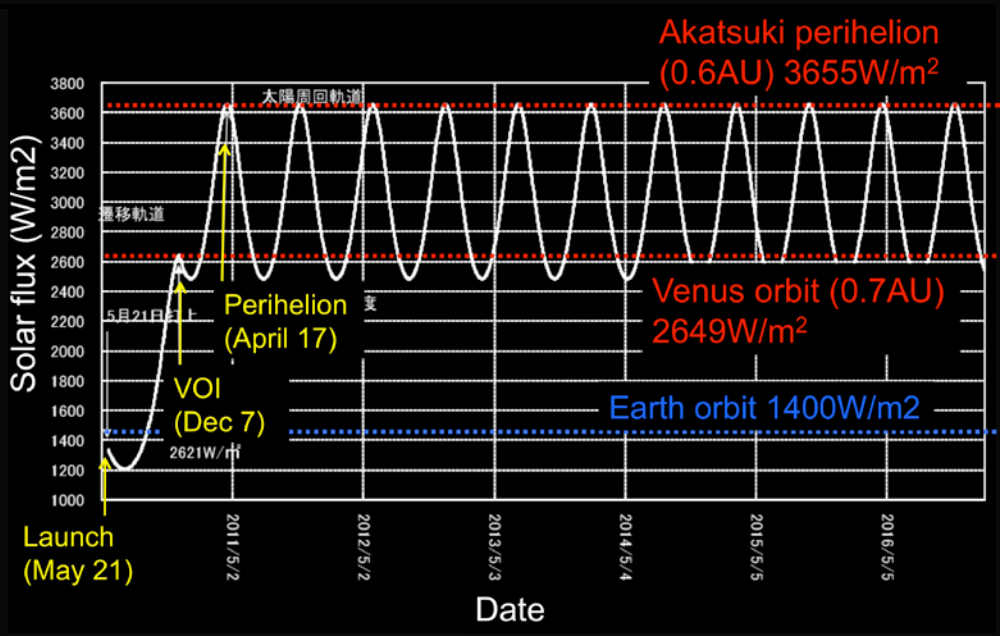



# Toward the next VOI trial

- All the subsystems, except the main thruster, are normal.
- Since OME was destroyed, we decided to use the attitude control thrusters (or reaction control system, RCS) for further orbit maneuver. RCS does not require oxidizer, and we disposed the oxidizer of 65 kg in Oct 2011 to reduce the weight.
- An orbit control maneuver was conducted using RCS in Nov 2011. This operation enables a Venus encounter in Nov 2015.
- The main concern is the high temperature conditions during the perihelion passages.

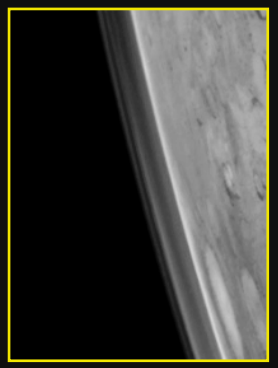



Orbit of Akatsuki during the cruise



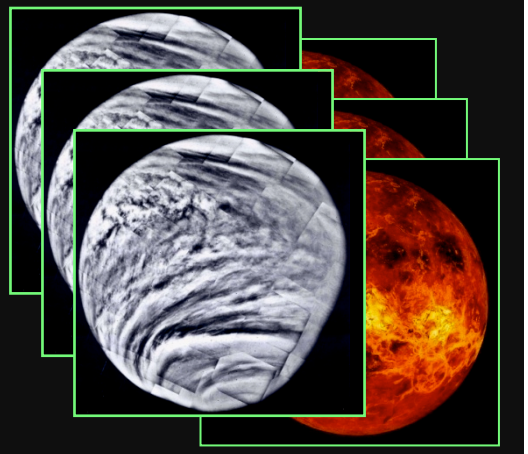

Expected thermal condition during the cruise

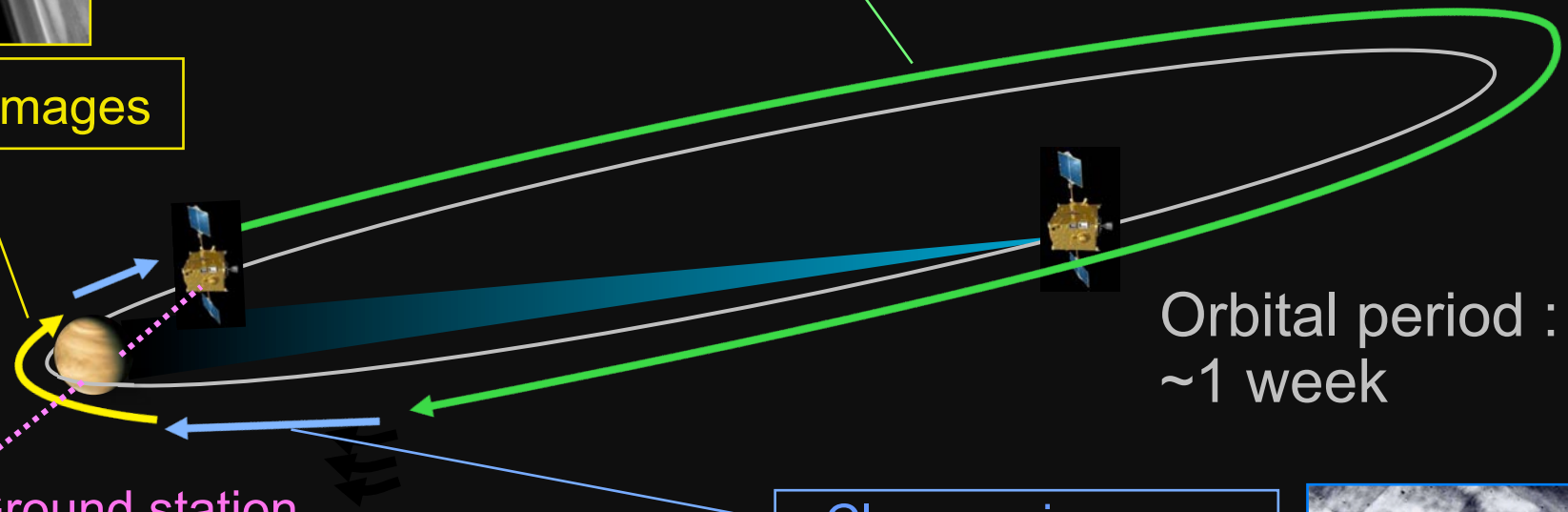
# Observation plan based on the new orbit



Limb images

Successive Global images of atmosphere and ground surface (~6 days)



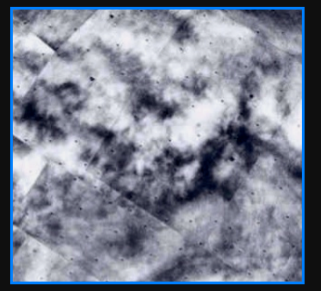


Orbital period : ~1 week

Ground station

Temperature / $H_2SO_4$ vapor / Ionosphere by radio occultation

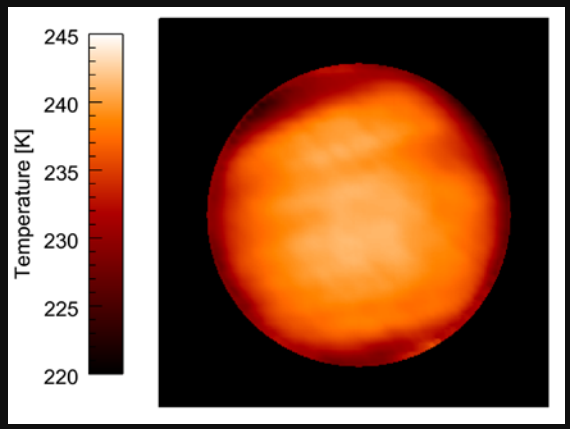
- Close-up images
- Stereo viewing
- Lightning
- Airglow



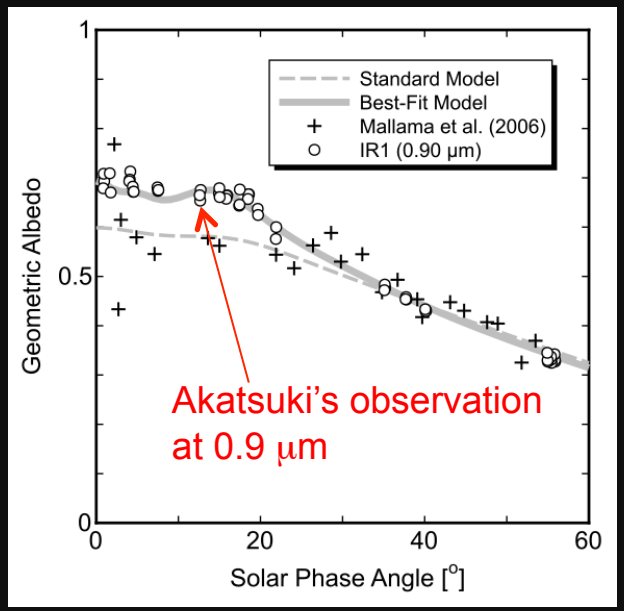
# Scientific observations during the cruise

- Mid-infrared images of Venus obtained two days after the failure of VOI revealed previously unknown structures in the cloud temperature distribution.
- Photometric observations of Venus from distances of ~$10^6$ km conducted in March and May 2011 revealed the existence of anomalously large particles near the cloud top during this period, and quasi-periodic variations of ultraviolet brightness suggesting roles of planetary-scale waves transporting chemical species.
- Radio occultation observations of the solar corona conducted in June 2011 revealed the radial variations of the solar wind velocity and wave activity.

Radio occultation



Temperature map obtained two days after the failure of VOI



Scattering angle dependence of cloud albedo obtained from far distances

# Summary

- We decided to use the attitude control thrusters instead of the main thruster to reach Venus again in 2015.
- The condition of the spacecraft is normal. We are carefully monitoring the change of the temperature of the spacecraft.
- The expected new orbit about Venus is a long elliptical one with the orbital period of approximately one week. The spatial resolution achieved around the apoapsis becomes worth (~50km) as compared to the original orbit with the period of 30 hours. We are considering optimization of the observation plan to this new orbit. (for example, more data allocation to near-periapsis region)
- Several scientific observations have been conducted during the cruise.