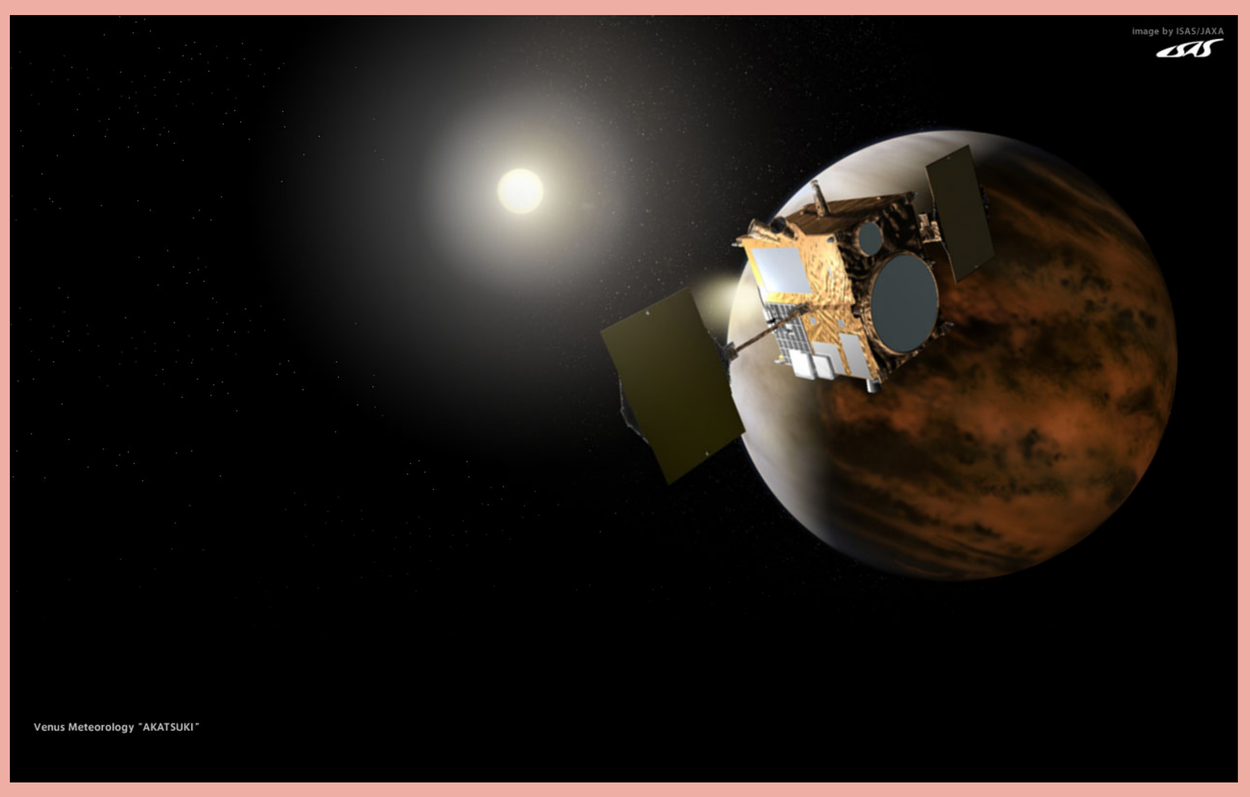
PHYSICS SEMINAR

Wednesday, 26th March, 2025 14–15h Room C1.4.14

By: Dr. Masahiro Takagi (Kyoto Sangyo University, Kyoto, Japan)

"Dynamics of the Venusian atmospheric superrotation"



Abstract: Venus rotates very slowly with a period of 243 Earth days. However, its entire atmosphere rotates much faster than and in the same direction as Venus. Spacecraft observations revealed that the zonal (east-west) wind velocity, which is almost 0 m/s near the surface, increases with altitude and reaches about 100 m/s at about 70 km altitude in the equatorial region. Namely, the Venusian upper atmosphere rotates 60 times faster than the planet's rotation. This fast zonal wind is called "superrotation" (SR), being one of the greatest mysteries in the planetary science.

Although the generation mechanism of SR remains unclear, several important hypotheses have been proposed in studies so far made. Gierasch (1975) and Matsuda (1980) showed that the SR could be generated by the zonal-mean meridional circulation like the Hadley circulation in the Earth atmosphere with the help of the equatorward angular momentum (AM) transport produced by waves and/or disturbances. Fels and Lindzen (1973) and Plumb (1975) showed that the SR could be generated by the thermal tide, which is a planetary-scale atmospheric wave produced by the solar heating. In recent years, the SR has been reproduced by atmospheric general circulation models (GCMs) and these theories have been verified, but the generation mechanism of SR remains unclear.

In this talk, I will briefly review the studies on the dynamics of SR and introduce our recent results, including observations by the Venus climate orbiter, Akatsuki.