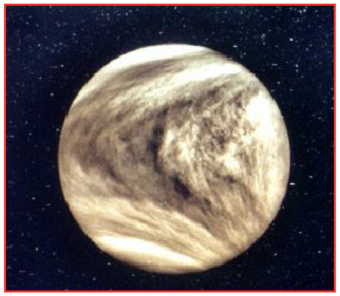
Homework, Section 1

- A sample return Probe is being sent on a 1-year mission from Earth to Mars Via Venus Using "aero-gravity" assist *(both both gravity And aerodynamics at Venus used to turn the corner to Mars)*



- The aero-assist maneuver at Venus is performed at An altitude of *110 km* above the Surface at a peak Atmospheric velocity of *13.09 km/sec*

- *At 110 km altitude, the ambient temperature is* 147.63°K **(-125.52 deg. C)**

- Assume that the Venusian atmospheric Composition by volume is {97% CO_2, 3% N_2}

- Calculate the Probe Mach number at the Venus aero-assist interface

c_p At -100 °C

CO_2 ~ 0.845kJ/kg °K

N_2 ~ 0.995kJ/kg °K

Note Units!

Assume that these properties are constant between -100 C and -125.52 C)

Homework, Section 1 (cont'd)

- Show that for a reversible process

$$s_2 - s_1 = c_v \ln\left[\frac{T_2}{T_1}\right] + R_g \ln\left[\frac{\rho_1}{\rho_2}\right]$$

- and that for a reversible, adiabatic process

$$\left[\frac{T_2}{T_1}\right] = \left[\frac{\rho_2}{\rho_1}\right]^{\gamma-1}$$

Homework, Section 1 (cont'd)

• Show that for an ideal gas the following
Useful relationships *hold*

$$\boxed{\begin{aligned} c_p &= \frac{\gamma}{\gamma - 1} R_g \\ c_v &= \frac{1}{\gamma - 1} R_g \end{aligned}}$$