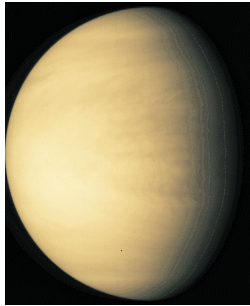


## The atmosphere and surface conditions of Venus



Why is the surface temperature of Venus 730 K?

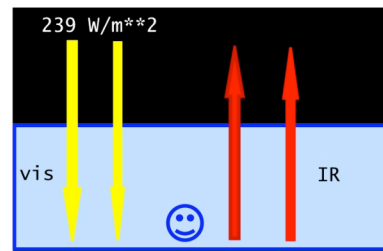


First question: how many have seen Venus in the evening sky?

## Let's start with the atmosphere of Venus. What do we know about it?

- Pressure at surface is 90 atmospheres (90 times pressure in this room)
- Question: what is the composition of the Earth's atmosphere?
- On Venus 96.5% of atmosphere is carbon dioxide (on Earth it is 0.038 %)

## Why CO<sub>2</sub> has a big effect on climate

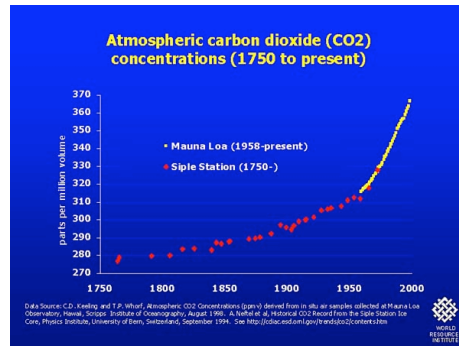


Energy Balance on Earth

Carbon dioxide has an important role because it absorbs radiation that Venus is emitting in an “attempt” to cool itself

Carbon dioxide has absorption “bands” in the part of the infrared spectrum where Venus is emitting the most radiation.

### CO2 and the Earth: Venus has a disturbing lesson



Over the past 200 years, the CO2 content of the Earth’s atmosphere has increased from about 280 to over 380 parts per million. Most of this increase has occurred in the last few decades, and is clearly due to human activity, primarily fossil fuel burning.

It is clear that the CO2 content of the Earth’s atmosphere will double (prior to pre-industrial) in the next couple of decades. What will be the effect on the climate of Earth (global warming problem)

An interesting (an ominous) fact. The total mass of CO2 on the surface of the Earth and the surface of Venus is about the same. On Venus it is in the atmosphere, on Earth, it is locked in carbonate rocks.



Formation of carbonate rocks occurs in the oceans, where dissolved CO2 is “fixed” in carbonate minerals. The oceans play a huge role in making the Earth habitable

### Did Venus ever have oceans, and a more benign atmosphere?

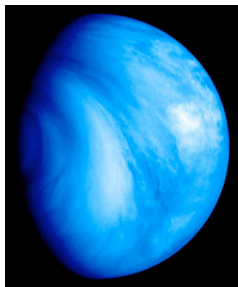


### Ancient oceans on Venus?

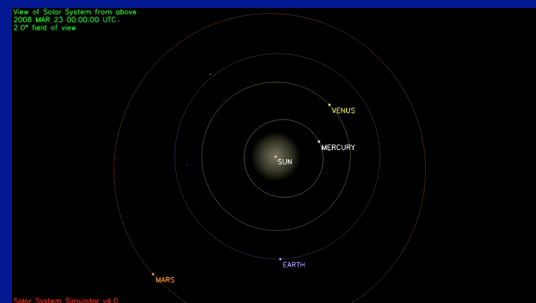
- We don't know
- It is possible Venus has always been the way it is now; way too hot for liquid water
- Alternative possibility, early in the history of the solar system (when was that?) temperature may have been lower, allowing water to fill the present day "basins" on the surface of Venus
- This would have been aided by the "faint young Sun", which would have allowed a cooler Venus
- Stay tuned

### A final word on Venus

- Venus is highly similar to the Earth in size and mass
- The atmosphere, however, is vastly different, and produces a dead planet
- This raises the question of how "fine tuned" a planet has to be to host life

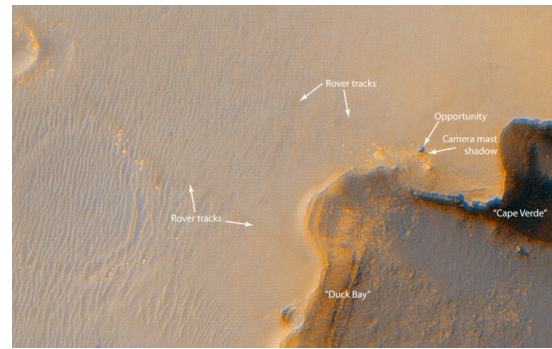


### Exploration of Mars

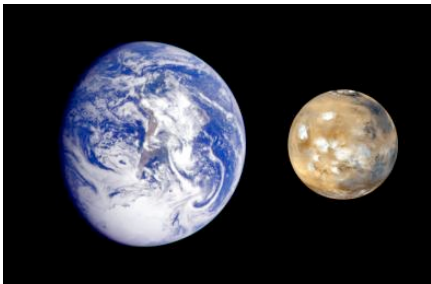


Mars: see it tonight!

### The study of Mars today

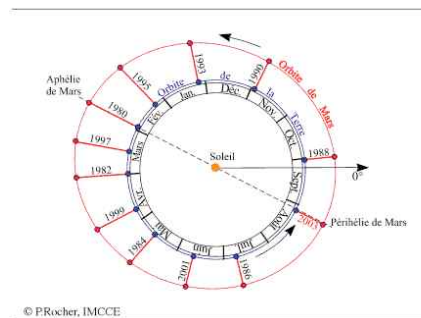


### Physical characteristics of Mars

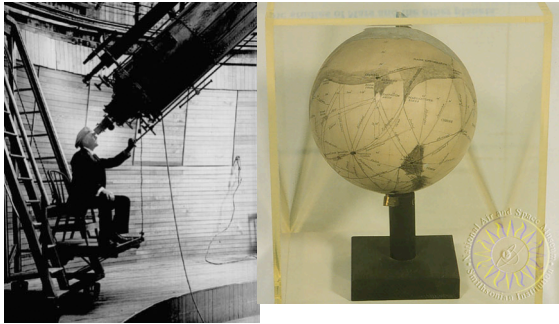


About half the diameter, about 11 percent of mass

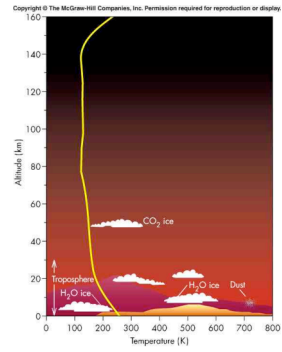
### The varying distance of Mars at opposition



## Percival Lowell and the Canals of Mars



## The atmosphere of Mars: 95% CO<sub>2</sub>



## Next time: spacecraft exploration of Mars

