

# Mass Spectrometric study of planetary atmospheres in future missions: a case study: Venus Neutral and Ion Mass Analyser (VENIMA)



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## Introduction

- ❑ Venus is formed in the same part of our solar system as Earth, apparently from similar precursor materials.
- ❑ Although both planets (Venus & Earth) of inner solar system are of the same size and near to each other, their differences are profound.
- ❑ The inner solar system planets: Venus, Mars and Earth experienced vastly different evolutionary pathways resulting in unexplained differences in their atmospheric composition and dynamics.
- ❑ Understanding when and why the evolutionary pathways of planets Venus, Mars and Earth diverged is the key to understand how terrestrial planets form and how their atmospheres and surfaces evolved.
- ❑ A Neutral & Ion mass spectrometer is under development.

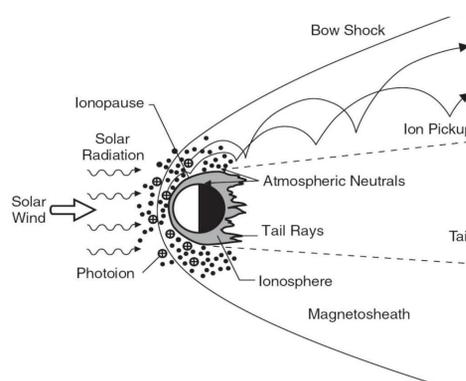
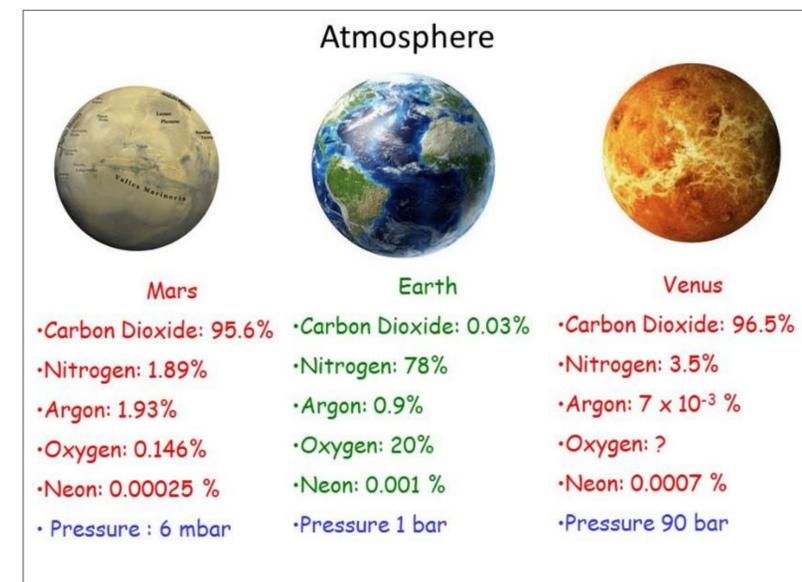


Fig. 1: Since Venus does not possess an intrinsic magnetic field, the solar wind interacts directly with the ionosphere and hence, leads to atmospheric escape by means of photoionization, charge exchange and electron impact ionization. (Russell et. al., 2006)

## Science objective

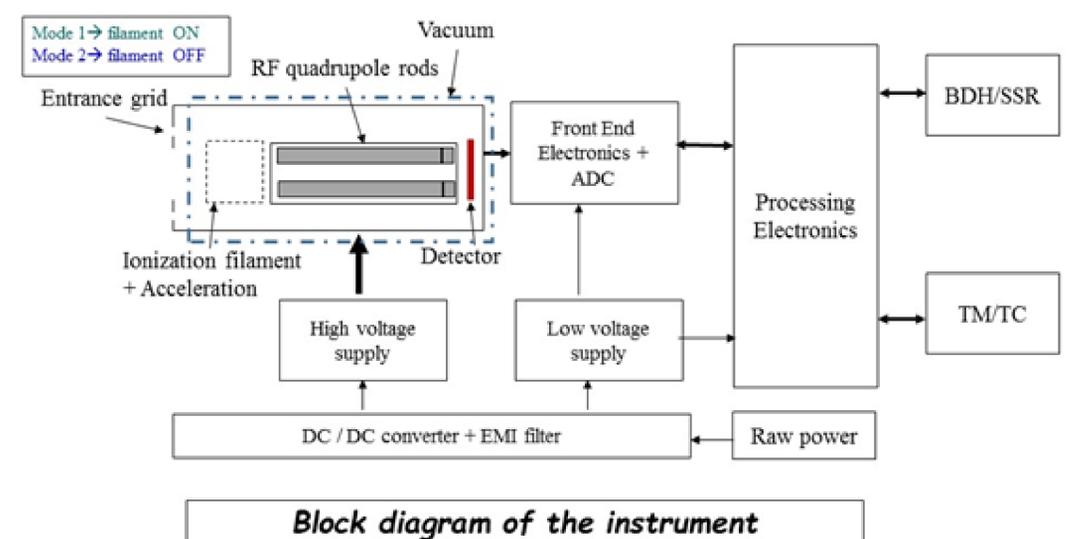
The primary science objective of the VENIMA experiment is:

- ❑ To determine the abundances of neutral species (atoms and molecules) and ambient ions of the Venus upper atmosphere via in-situ measurement.
- ❑ Measurement of isotopes of the different atoms and molecules in the Venus upper atmosphere and ionosphere.
- ❑ To study the interaction of Venus atmosphere with solar wind.

## Expected Results :

- ❖ Measurements with high mass resolution to resolve the mass discrepancies in the measurement of the similar masses like  $N_2/CO$  etc. from the earlier findings.
- ❖ Isotopic ratio measurements of different molecules in the upper atmosphere of the Venus.
- ❖ Systematic investigation of the all possible neutral species and positive charged ions.

## Venus Neutral and Ion Mass Analyzer (VENIMA)



Block diagram of the instrument

## Instrument specifications

Sr. No.	Parameter	Specifications
1	Species to be measured	Ambient neutral & ion species
2	Number of modes	Neutral mode, ion mode
3	Mass range	2 - 200 amu
4	Mass resolution	0.1 amu
5	Ionization filament	Thoria coated Iridium filament (redundant)
6	Total mass	~3 kg
7	Total power	~20 W (regulated power)
8	Volume	Detector package: 130 mm (dia.) x 350 mm + Electronics package: 126 mm x 126 mm x 80 mm

## References:

- > Russell, C. T. et. al., (1980) "On the search for an intrinsic magnetic fields at Venus", Proceedings of 11<sup>th</sup> Lunar and Planetary Science Conference, p. 1897-1906.