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ESTUDO COMPARATIVO DE FRENTES DE CHOQUES PLANETÁRIAS

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INTRODUCTION

The study of Planetary Bow Shocks provide us a class of very different space plasma environments. Planetary atmosphere and magnetic field, the presence of satellites and rings, and the distance from the sun constitute factors that influence the shape and characteristics of magnetospheres.

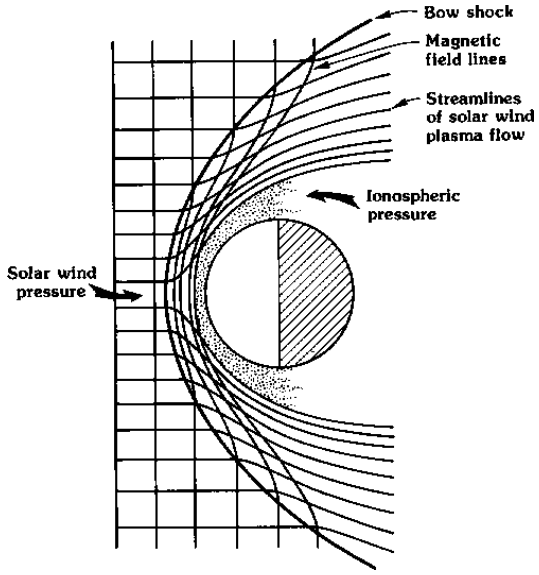
Bow shocks ahead magnetospheres occur because solar wind is moving supersonically in relation to the planets. The electromagnetic interaction between planetary and solar wind plasmas and fields gives the mechanism that make possible the formation of shocks even in the very low density space environment.

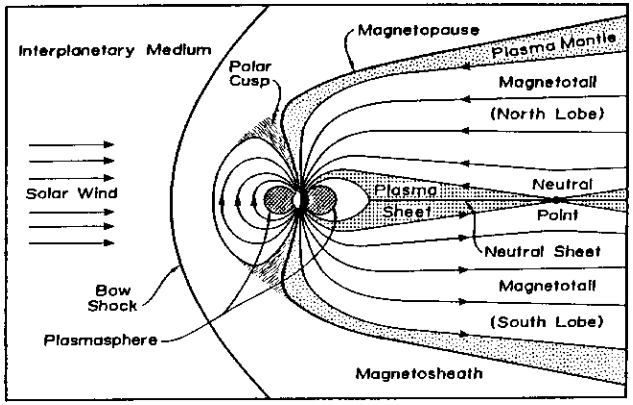
We present here a comparative study of planetary magnetospheres and their bow shocks.

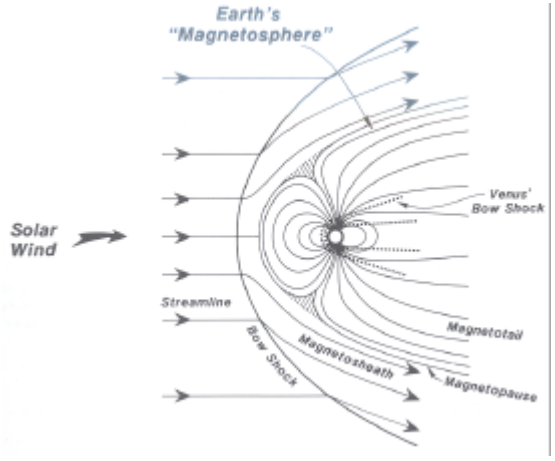
METHODOLOGY OF ANALYSIS

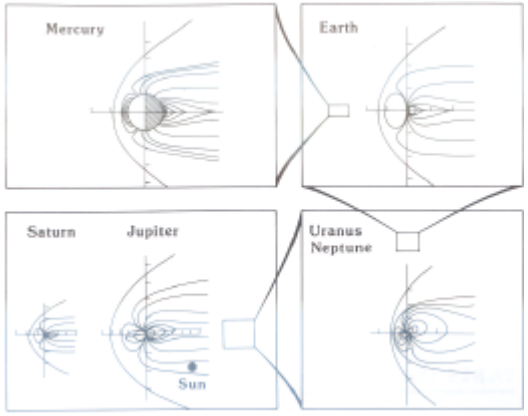
The present work has as objective an analysis of the planetary bow shocks in the solar system. We present here a review of our present knowledge about the different kinds of magnetospheres.

Planet	Global Magnetic Field (nT)	Relative strength at surface	Heliocentric distance (1 AU)	Magnetopausa distance	Surface Temperature (°C)
Mercúrio	250	0.0007	0.387	1.5 R_M	260
Vênus	10^{-5} B_E	<0.0004	0.723		480
Terra	31000	1	1	10-15 R_E	15
Marte		<0.0002	1.52		-60
Júpiter	Mais do que 10 B_E	20.000	5.20	70 R_J	-110
Saturno	B_E	600	9.54	21 R_S	-190
Urânio	Menos do que B_E	50	19.19	27 R_U	-215
Netune	Menos do que B_E	25	30.07	26 R_N	-225
Plutão	Desconhecido		39.48		-235

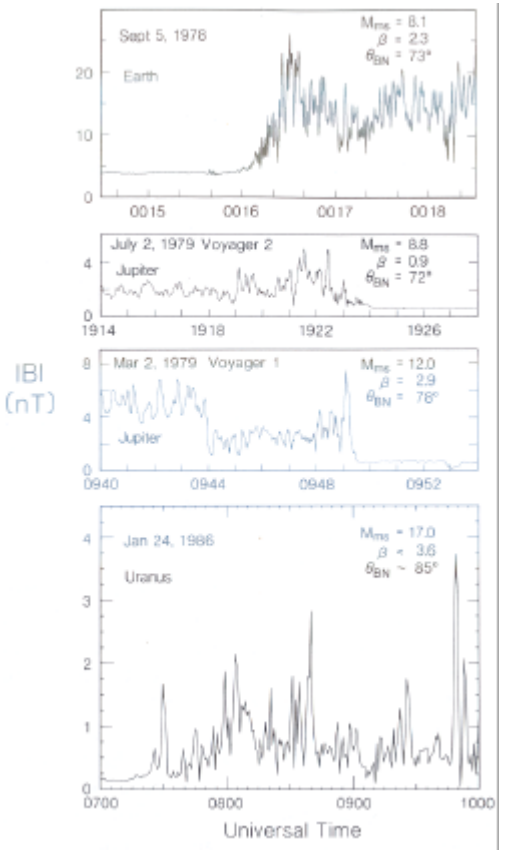

Bow shock
Magnetic field lines
Streamlines of solar wind plasma flow
Ionospheric pressure
Solar wind pressure

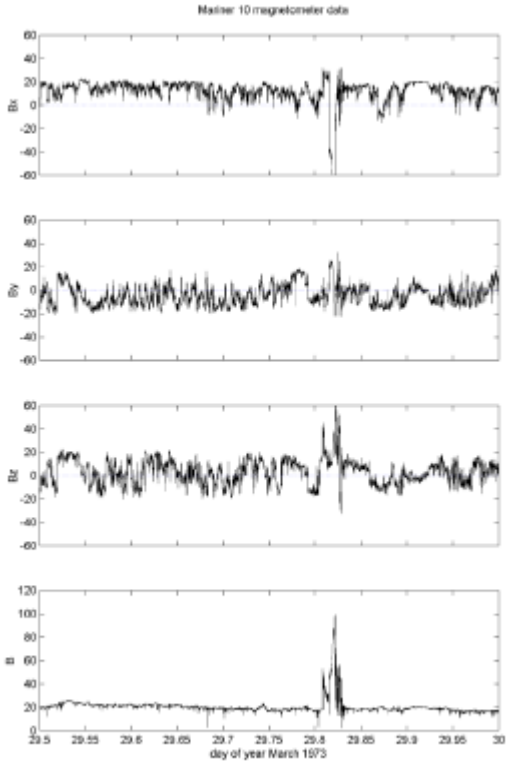

Interplanetary Medium
Magnetopause
Plasma Mantle
Polar Cusp
Magnetotail
(North Lobe)
Solar Wind
Plasma Sheet
Neutral Point
Neutral Sheet
Magnetotail
(South Lobe)
Bow Shock
Plasmasphere
Magnetosheath

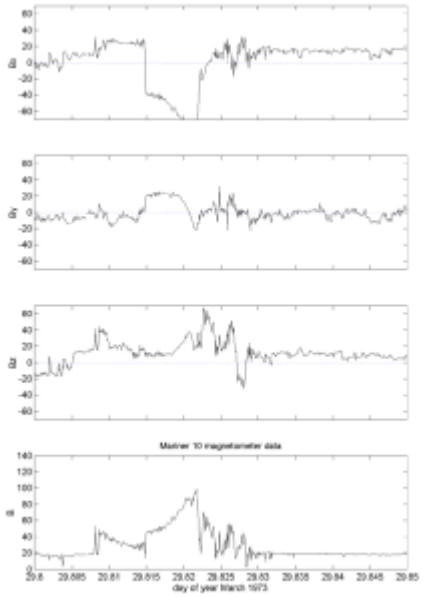

Earth's
"Magnetosphere"
Solar
Wind
Venus'
Bow Shock
Streamline
Bow Shock
Magnetosheath
Magnetotail
Magnetopause


Mercury
Earth
Saturn
Jupiter
Uranus
Neptune
Sun

It is presented a comparison of the magnetic field strengths measured through the bow shocks on the Earth, Jupiter and Uranus. The overshoot in magnetic field just downstream of the shock ramp is a signature of the strengths of these shocks.




Mariner 10 magnetometer data
Bx
By
Bz
B
day of year March 1973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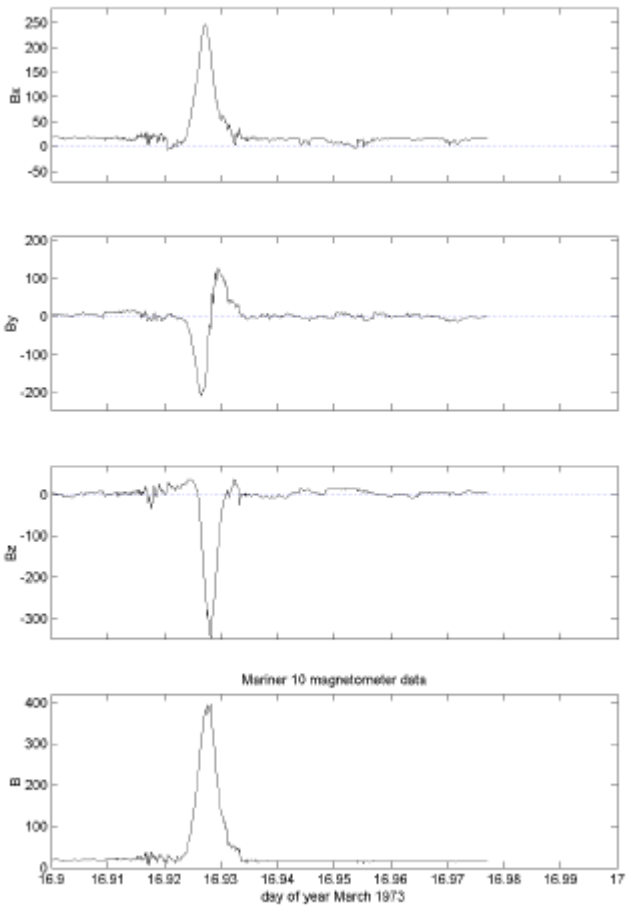
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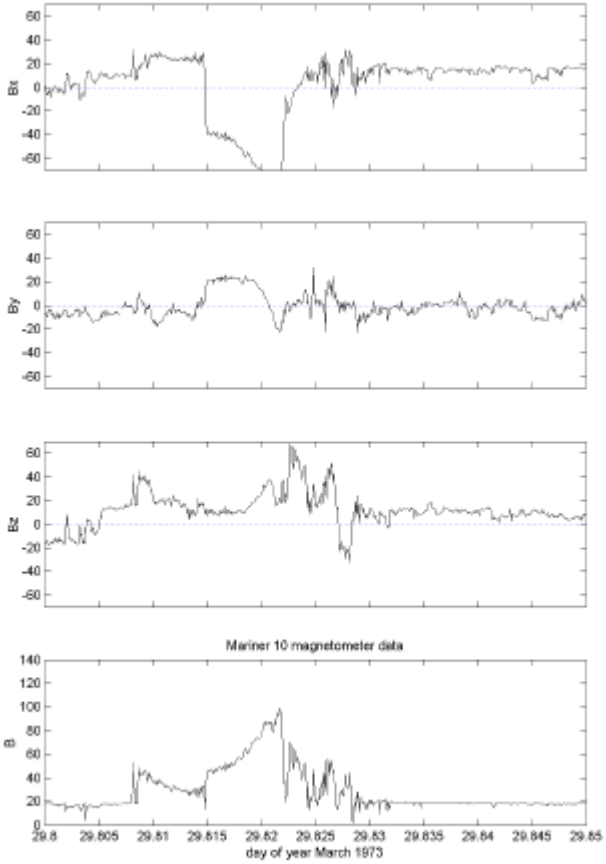
day of year March 1973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Mariner 10 magnetometer data
day of year March 1973

RESULTS AND DISCUSSION

It was observed:

when magnetic field and heliocentric distance increase, the magnetosphere of the planet also increase, thus, the distance of the bow shock-planet also increases;

when the temperatures at the surface of the planet is above the Curie point, the effects of the fields do not persist in rocky materials;

the strength of a planetary bow shock depends on solar wind strength and then on the planet distance; this is because when the plasma is flowing stronger, the relative speed between planet and solar wind is higher and the shock is stronger. It also depends on the planetary plasma and magnetic field environment, because its combined pressure acts to deflect the solar wind ahead of the planet.

CONCLUSIONS

Planetary environments found in our solar system are quite diverse. This provides us rich examples of a variety of conditions to study space plasmas. Magnetic field and planetary atmospheres, besides the distance from the Sun, determines the characteristic of each planetary magnetosphere. With recent missions (Galileo, Cassini) and future programmed space missions (Venus Express, Mercury Messenger and Bepi-Colombo, various Mars missions), we expect to improve our knowledge of these fascinating environments in the next years.

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