

# VeGASO (Venus Gravity Assist Science Opportunities)

## Science Priority Matrices

- (1) BepiColombo
- (2) Solar Orbiter
- (3) Solar Probe Plus

April 2015

INSTRUMENT	ACRONYM	Purpose	Potential Venus Science Value	Operable at Venus?	VEXAG GOI	Remarks	Questions
			<i>MPO</i>				How soon before the VGAs can the instruments be turned on? Two to four weeks?
Radio Science (Telemetry)	RO	Engineering system for communication	Cloud opacity at Ka,X thermal structure	YES during occulting fly-bys	YES	Ka-Band radio occultations, because of their short wavelength, provide higher vertical resolution than the longer wavelength occultation experiments, and are also sensitive to cloud condensates. This makes possible the vertical profiling of cloud bulk density (Fahd and Steffes, 1991), with vertical resolutions on the order of 100 meters. These missions provide more equatorial sampling than what we have had to date.	Can Ka provide any information about the ionosphere? Different latitude coverage. Need EIRP
Solar Intensity X-ray and particle spectrometer	SIXS	Monitor solar-xray intensity and solar particles	X-ray production processes	YES	NR	Add to the single observation from Chandra	
BepiColombo Laser Altimeter	BELA	Topographic mapping	Cloud Topography	NO	YES	Cloud structure	
Italian Spring Accelerometer	ISA	Non gravitational accelerations of the spacecraft	Limited	YES	YES	Can measure atmospheric drag, so can help connect it with the other measurements of the neutrals	Unique- distribution of neutrals in 3-D space not sampled by Venus Express. Complementary measurement. Spatial and temporal distribution valuable. Energy range 100 eV - 15 KeV; Mass resolution M/dM ~ 40; FoV: 2pi max Solar wind-Venus interaction, plasma regimes interaction, planetary ion species detection
Search for Exospheric Refilling and Emitted Natural Abundances (Elena, MIPA, PICAM, Strofio)	SERENA	In-situ study of composition, vertical structure and source and disk processes of the exosphere	Venus thermosphere / extended atmosphere	MIPA, PICAM		Maximal extent of the exosphere. Can operate simultaneously with the neutrals measurements and EUV	
Probing of Hermean Exosphere by Ultraviolet Spectroscopy	PHEBUS	UV spectral mapping of the exosphere	UV spectral mapping of the exosphere	YES	1b, 3a	Coupling with EUV, Thermal and SERENA, PHEBUS and MERTIS simultaneous provides coupling of Venus atmosphere with the larger environment and magnetic field. Atm temp retrieval using part of 15 micron band, retrieval on dayside possible, soundign at the 55-70 km range; SO2 abundance; Measurements at different phase angles; Atmospheric energy balance (Radiometer)	
Mercury Radiometer and Thermal Imaging Spectrometer	MERTIS	Global mineralogical mapping (7-14 μm)	Cloud top temperature structure, and beyond the disk of Venus	YES	1b,3a		
Solar Imaging X-ray Spectrometer	SIXS	Elemental surface composition, global mapping and composition of surface features	?	NO		Can we learn something from the X-ray fluorescence at Venus?	Can it be pointed at Venus? Would X-ray fluorescence from Venus be useful?
Magnetic Field Investigation	MPO/MAG	Detailed description of planetary magnetic field, its source and interaction with the solar wind	Limited	YES			
Mercury Gamma-Ray and Spectrometer	MGNS	Elemental surface and sub-surface composition, volatile deposits on surface	Limited	NO			
Mercury Orbiter Radio Science Experiment	MORE	Core and mantle structure, Mercury orbit, fundamental science, gravity field	Venus cloud and thermal structure	YES			
Magnetic Field Investigations	MGF	Magnetic field from the planet, magnetosphere, and interplanetary solar wind		NO			
Mercury Plasma Particle Experiment	MPPE	Plasma and neutral particles from the planet, magnetosphere and interplanetary solar wind		NO			
Plasma Wave Investigation	PWI	Electric field, EM waves, radio waves from magnetosphere and solar wind		NO			
Mercury Sodium Atmosphere Spectral Imager	MSASI	Sodium atmosphere		NO			
Mercury Dust Monitor	MDM	Dust from the planet and interplanetary and interstellar space		NO			

Solar Orbiter

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<i>Nominally, the s/c will remain Sun -pointed during the encounter, but</i>						How soon before the VGAs can the instruments be turned on? Two to four weeks?
Radio Science (Telemetry)	RO	Engineering system for communication	Cloud opacity at X-band thermal structure	YES during occulting fly-bys	YES	"Free" science at Venus
Solar Wind Analyzer (SWA)	SWA	Solar wind and electron bulk properties	Venus Magnetosphere structure			Bow-shock and foreshock crossings
Energetic Particle Detector	EPD	Composition, timing, and distribution of ion and energetic particles (8keV - 200 MeV/electrons)	Venus Magnetosphere structure		No recommendation	
Magnetometer (MAG)	MAG	DC Vector magnetic fields (0-64 Hz)	Venus Magnetosphere structure		No recommendation	
Radio & Plasma Waves (RPW)	RPW	AC electron and magnetic fields (~ DC - 20 Hz)	Venus Magnetosphere structure		No recommendation	
Polarimetric & Heliospheric Imager	PHI	Vector magnetic fields and line-of-sight velocity of photosphere	?		No recommendation	
EUV Imager	EUI	Full-disk EUV and high-resolution EUV and the solar atmosphere	May shed new light on Venus atmospheric composition		No recommendation	Never been imaged
Spectral Imaging of Coronal Environment	SPICE	EUV spectroscopy of the solar disk and corona	?		No recommendation	
X-Ray Spectrometer Telescope	STIX	Solar thermal and non-thermal X-ray emission	?		No recommendation	Attempted only by Chandra
Coronagraph	METIS/COR	Visible, UV and EUV imaging of the solar corona	May detect escaping atmosphere from Venus		No recommendation	
Heliospheric Imager	SoloHI	White-light imaging of the extended corona	May detect escaping atmosphere from Venus		No recommendation	

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<b><i>Nominally, the s/c will remain Sun -pointed during the encounter, but it may have to roll to align the thrusters for the maneuver. The baseline is that instruments will be powered off.</i></b>							
Radio Science (Telemetry)	RO	Engineering system for communication (Ka/X)	Cloud opacity at Ka/X, thermal structure	YES during occulting fly-bys	YES	"Free" science at Venus. Ka occultations are unique, and first time at Venus. SPP is nominally transmitting data during VGAs (except #3 and #6) Ka-Band radio occultations , because of their short wavelength, provide higher vertical resolution than the longer wavelengths. Measurements during VGAs will be useful	Which VGAs will have occultations? Can the S/C Power be managed to turn on the EM Suite during VGAs (occultations)? Can X and Ka downlinks be used simultaneously during VGAs?
	FIELDS			YES			
	ISIS			YES			
	SWEAP			YES			
Wide Field Imager for Solar Probe	WISPR		Escape of atmosphere from Venus	YES		Imaging of the atmosphere from Venus would be unique and very valuable at any VGAs. Imaging some time before and after VGAs will enable escaping atmosphere and correlate it with solar wind/CMEs and with concurrent FIELDS, SWEAP and other instrument observations. Will tell us about maximum extent of the Venus ionosphere. None of the Venus missions likely to be launched in the near future will be able to capture the escaping atmosphere and none of the past Venus missions were able to observe it as well as WISPR and the similar instrument on SO can observe it.	Will it be possible to point WISPR near Venus before, during and after VGA 7 ? Will WISPR be able to capture escaping atmosphere from Venus?

**Note: Atmosphere solar-wind interaction is not explicitly addressed by VEXAG (GOI)**