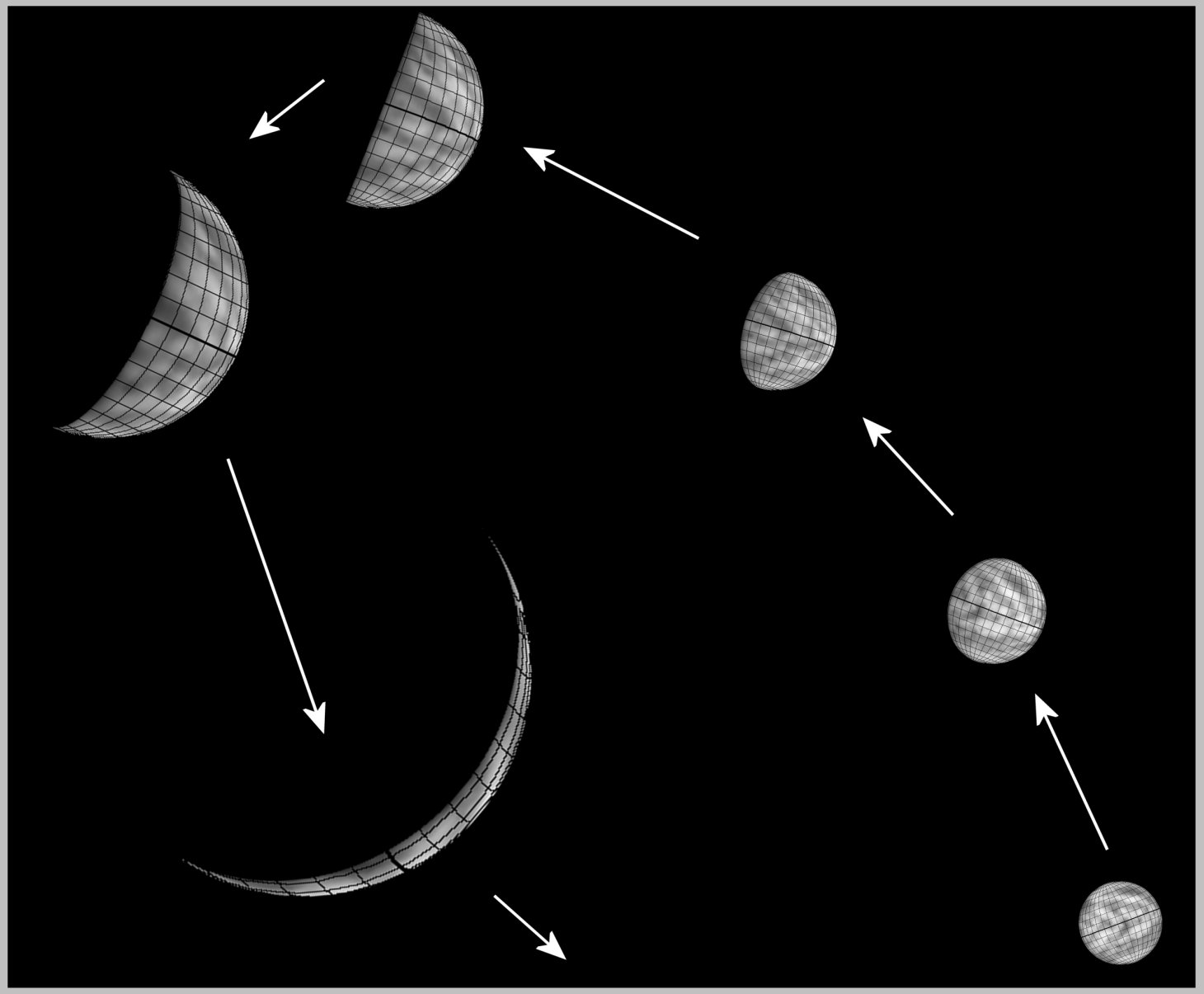
OBSERVING THE PLANET VENUS

Christophe Pellier

RENCONTRES DU CIEL ET DE L'ESPACE 2014

I – AN INTRODUCTION TO VENUS



Venus is an « interior » planet.

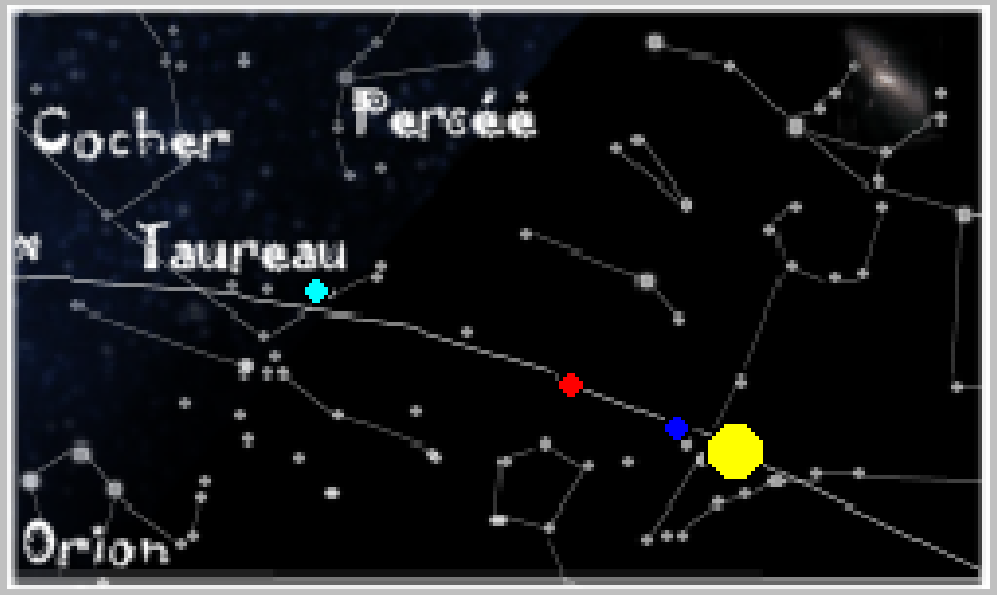
It shows well defined phases just like the Moon does.

Its visibility from Earth is described as an « elongation » (angular distance in the sky from the Sun).

Simulation above western horizon, evening elongation

I – AN INTRODUCTION TO VENUS

April 15th, 2007



April 15th, 2015

Simulations AstroCalc

The venusian elongations repeat in an identical way following an 8 eight years cycle.

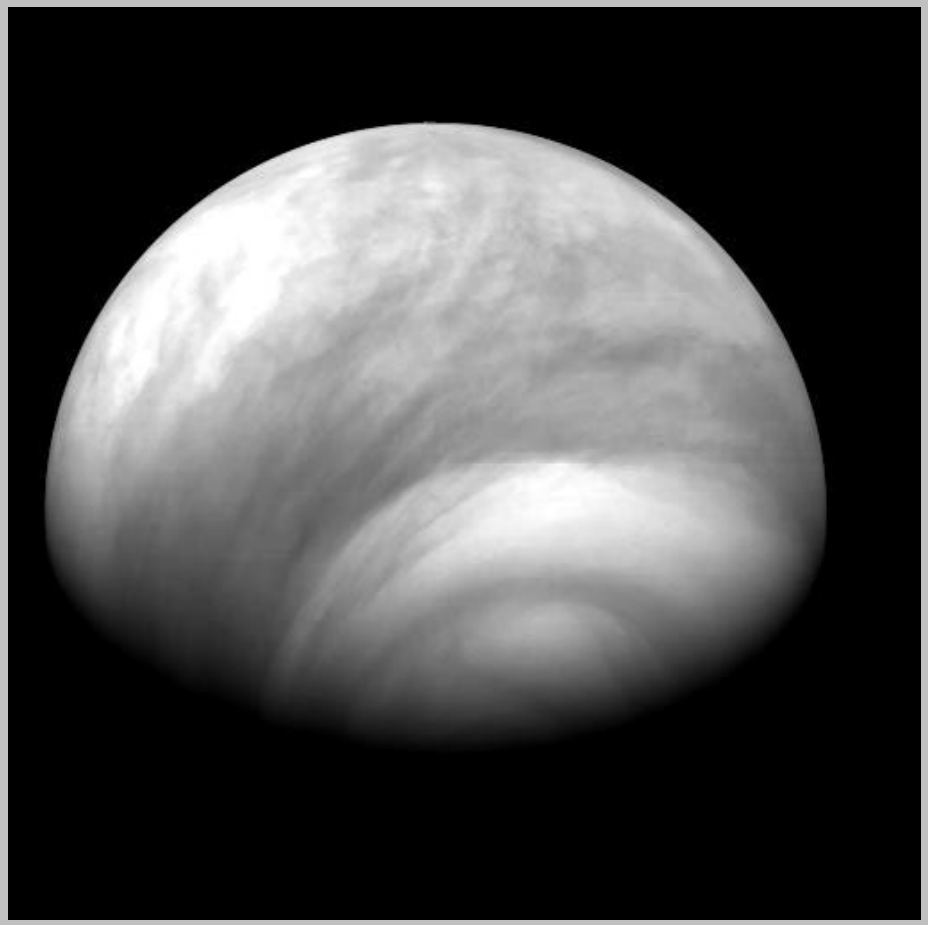
For northern hemisphere observers, in one cycle, two years separated by three are especially good, for the current one 2012 and 2015.

2015 will be equivalent to 2007.

II – THE ATMOSPHERE OF VENUS

Venus spins backward on its axis (from East to West), in around four days at equatorial latitudes, which is rather slow.

Wind pattern is largely governed by the presence of powerful vortices found on each pole. This pattern can be more easily observed in Ultraviolet light.

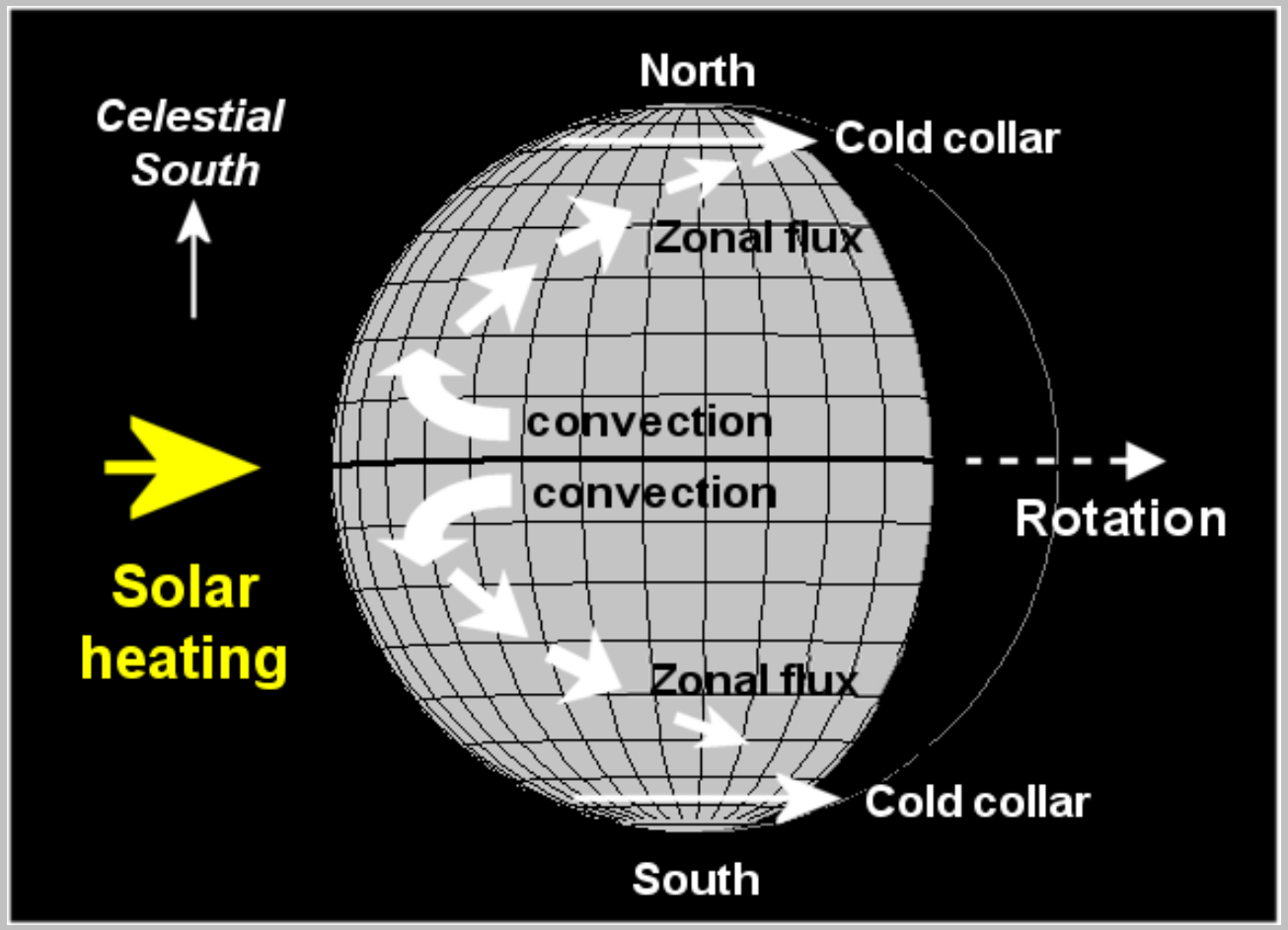


UV image of the South pole taken by Venus Express, showing the southern vortex as a white cap

II – THE ATMOSPHERE OF VENUS

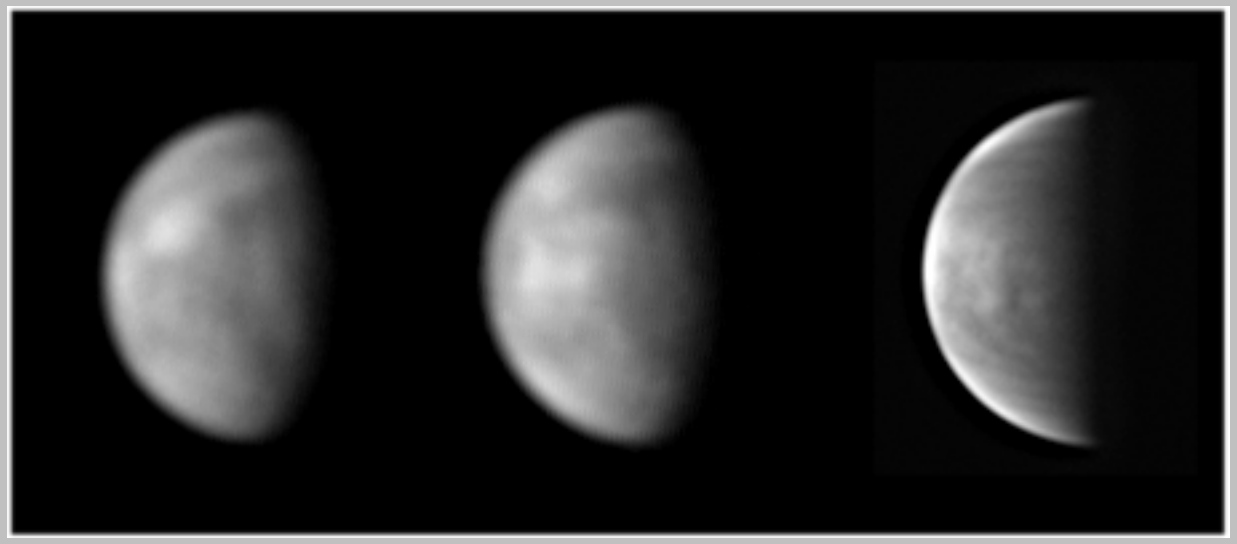
Around the equator, zonal winds (those following the parrallels) are almost absent due the to very slow rotation. Circulation is dominated by convection, due to strong solar heating.

Wind speed gradually increases toward polar vortices if latitude increases as well, and zonal flux progressively becomes dominant against convection.



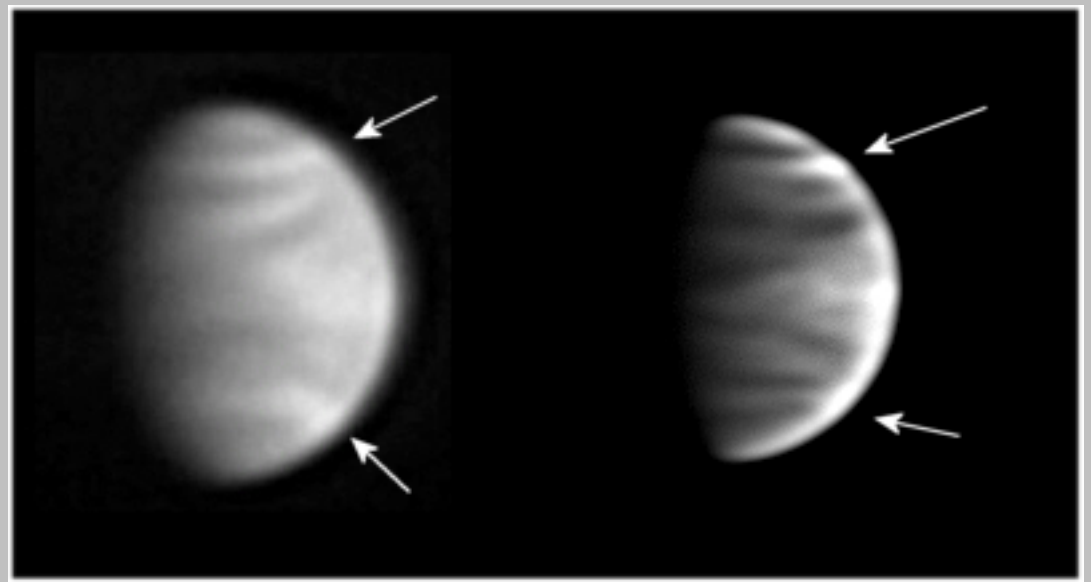
II – THE ATMOSPHERE OF VENUS : IN UV

The high atmosphere contains an unidentified chemical component that absorbs ultraviolet light. Its distribution follows atmospheric movements and allow us to see the wind patterns.



Equatorial puffy clouds, bright and dark, revealing convection near equator.

Images : C.Pellier and C. Viladrich



« Cold collars » bordering the polar vortices, contain very few UV absorber and look bright.

Images : G.Monachino / Association AstroQueyras

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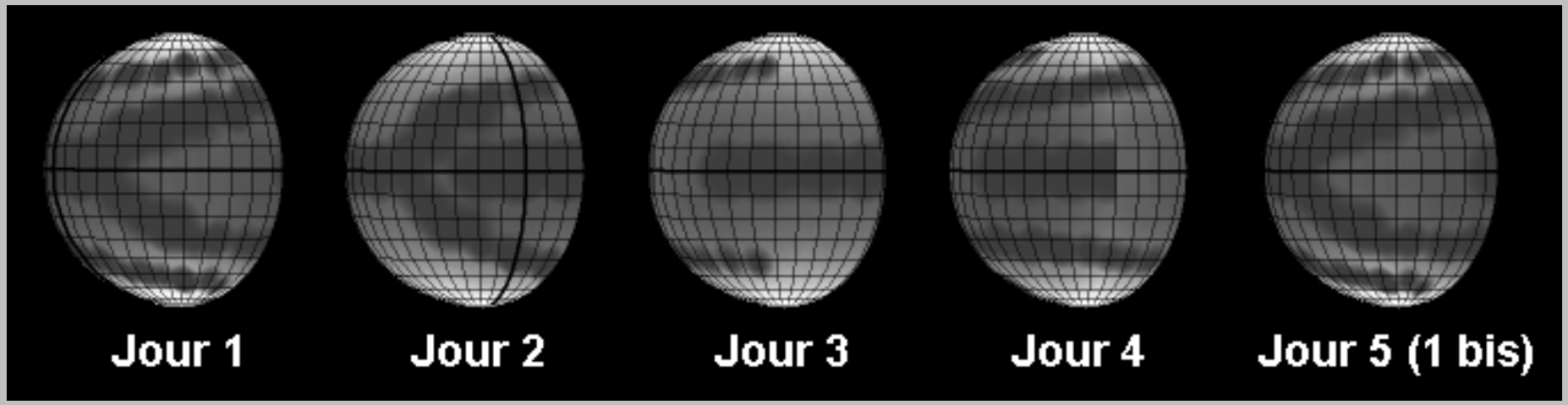

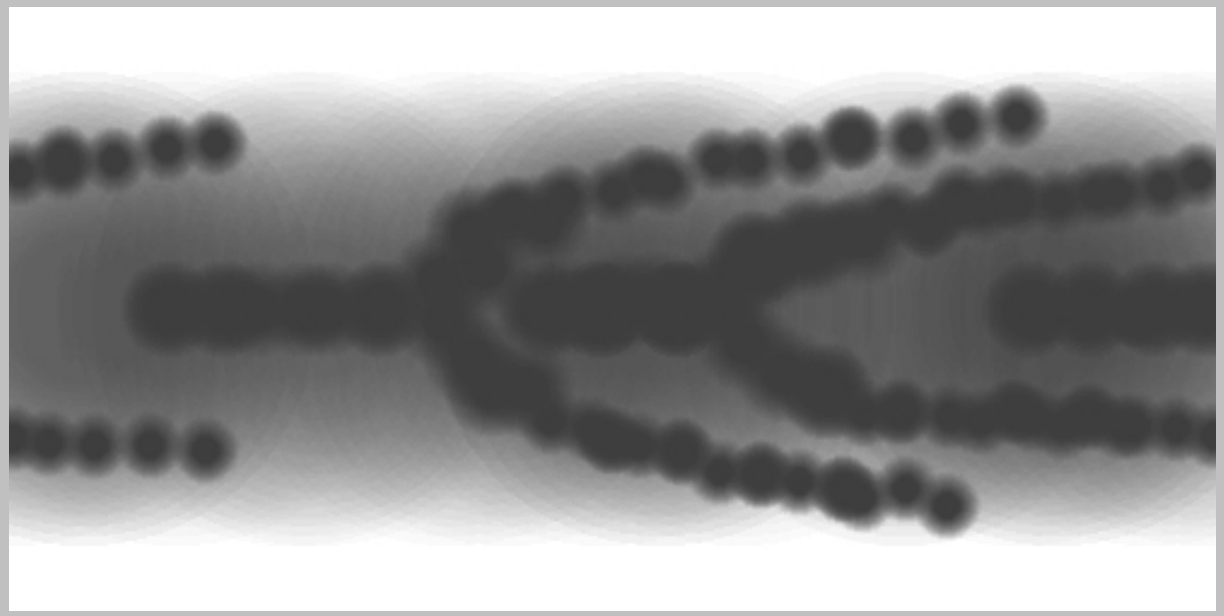

UV simulation of the whole globe, showing that the famous Y or Ψ pattern are the ascending branches of the polar vortices

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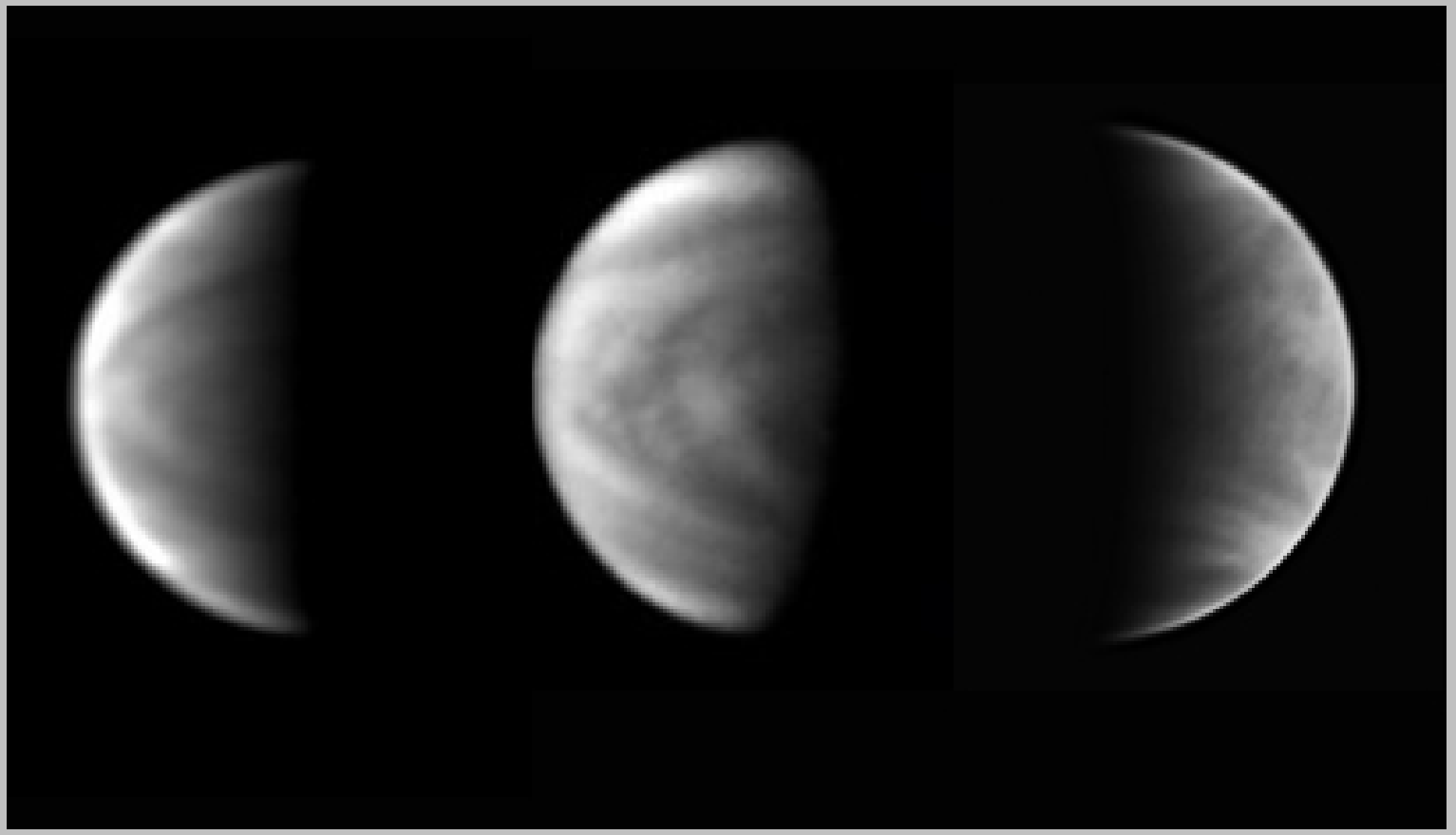
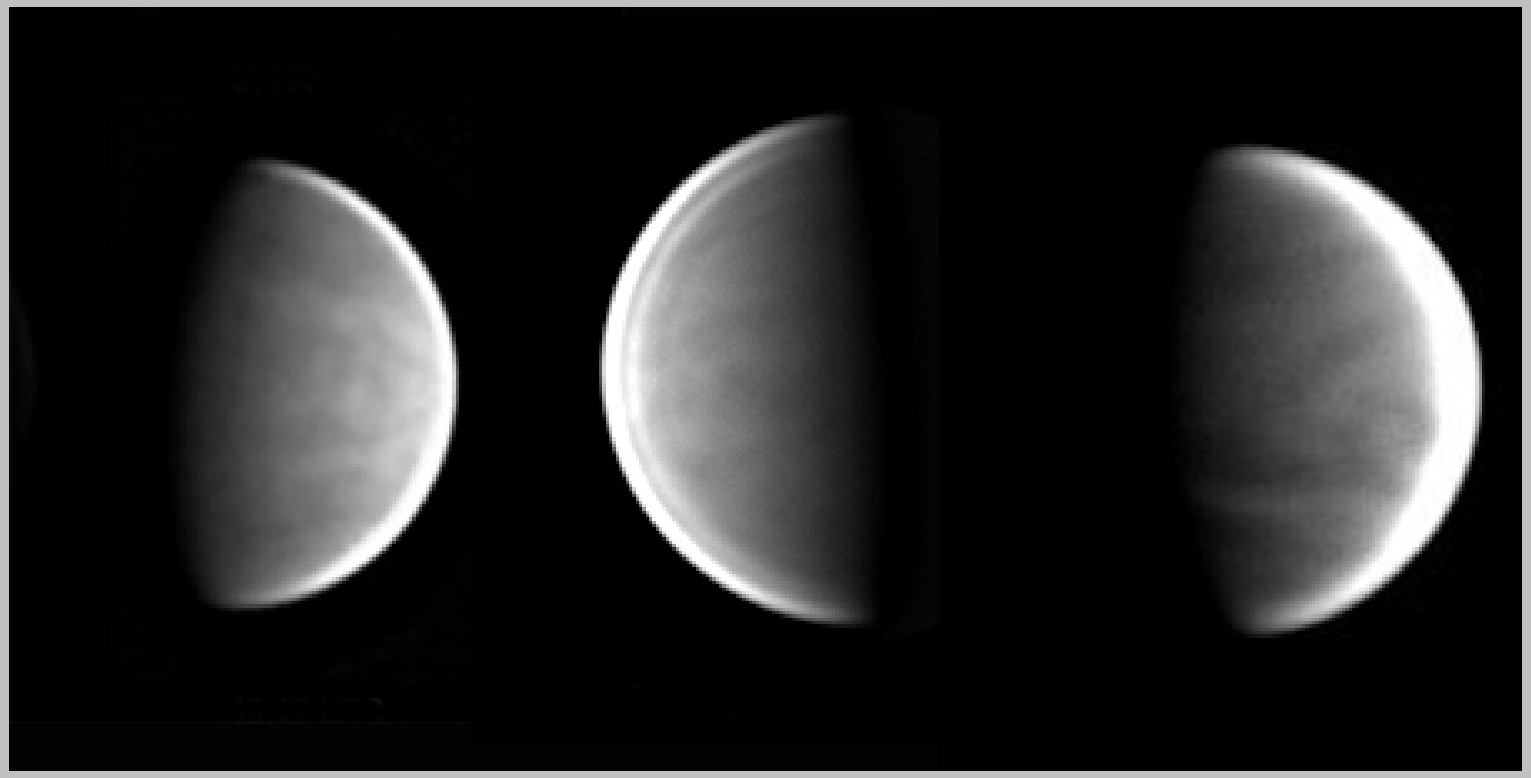


Classical patterns observed in UV.

Images A.Wesley, D.Peach, Observatoire Pic du Midi
S2P/IMCCE/OMP/Colas/Dauvergne/Delcroix/Legault/Viladrich

II – THE ATMOSPHERE OF VENUS : IN IR

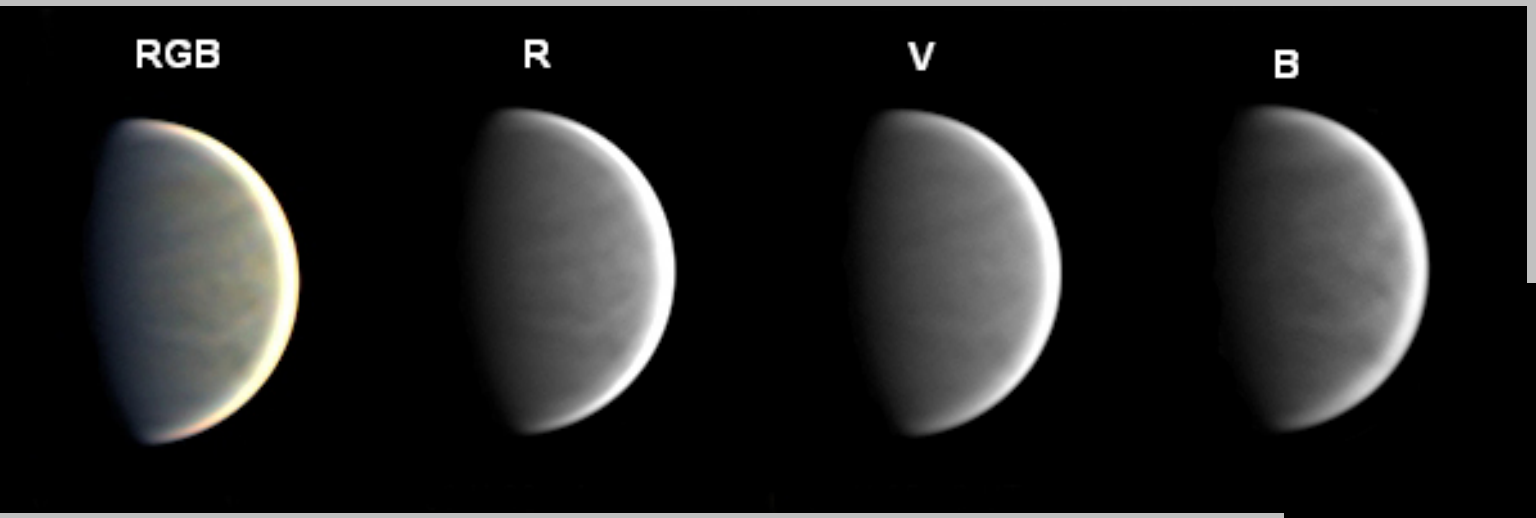
The near infrared reveals more deeper cloud layers, found some ten kilometers lower than the UV clouds (altitude = 60 km). IR images show details as well, mostly dark bands weakly contrasted. Details are in general different than those seen in UV.

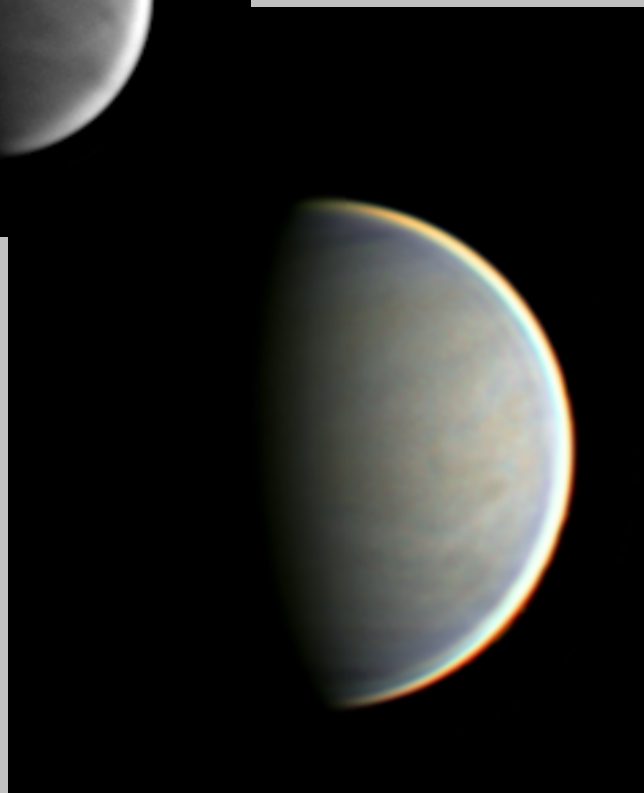


Images D.Peach, C.Pellier, G.Monachino/AstroQueyras

II – THE ATMOSPHERE OF VENUS : IN VISIBLE LIGHT

Now even visible color bands (red, green, blue) show details on Venus. The blue filter reveal the same details as in UV, but with a very weak contrast. Red and green filters show different things, maybe particular, that would deserved to be more closely followed

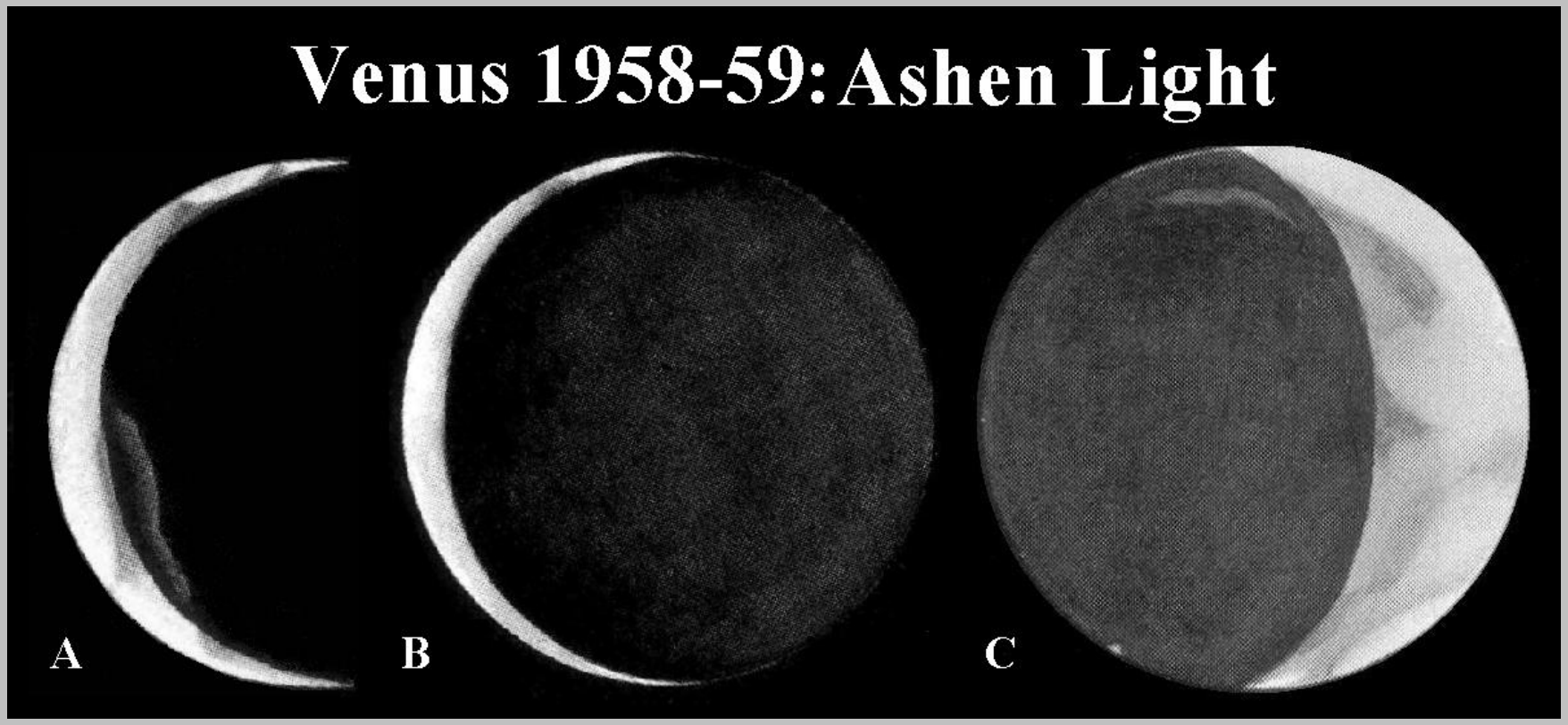




RGB images taken by C.Pellier & R.de Benedictis on the same day (September 16th, 2012) . Details and color are identicals.

II – THE VENUSIAN NIGHT SIDE : THE « ASHEN LIGHT »

The « Ashen light of Venus » is a light emission observed on the night side, during the crescent phase. Its existence is still not proven ; only visual testimonies exist, some of them coming from serious observers.



Observations V.A. Firsoff – doc. R.McKim

II – THE VENUSIAN NIGHT SIDE : THERMAL EMISSION FROM THE SURFACE

Another curious phenomenon to observe during the crescent phase, but now its existence is proven. Heated to more than 400°C, the ground of the planet emits a near-IR light that can be recorded with a b&w camera and and a filter transmitting around a wavelength of 1 micron.

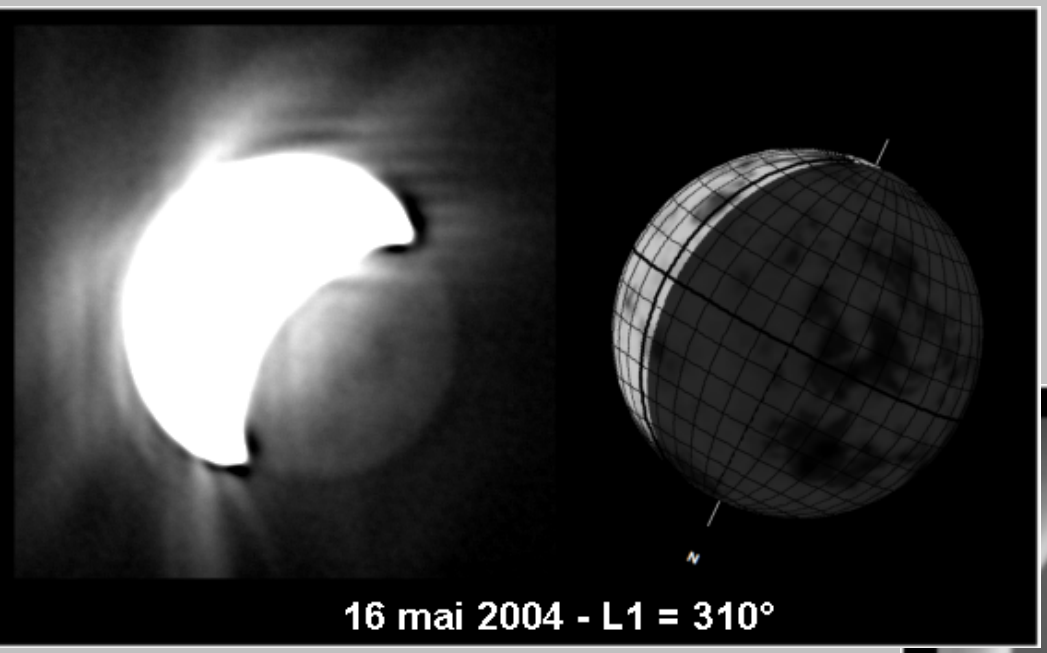
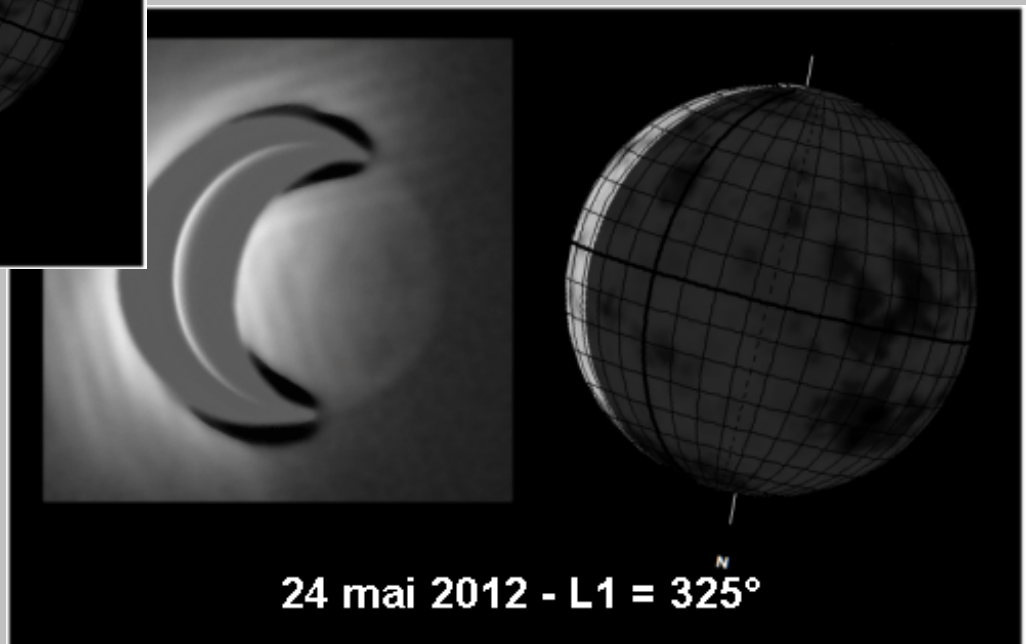


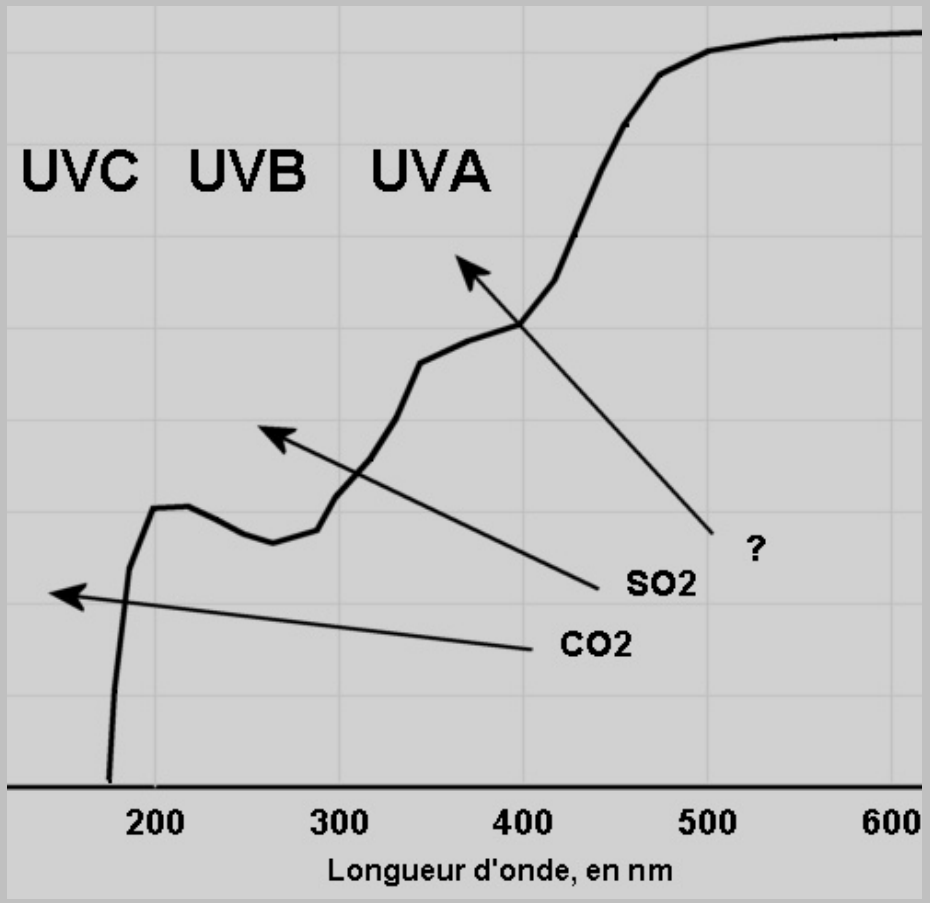
Image : C.Pellier, with WinJupos simulation at right. Dark patches are mountains on the ground, higher, colder and then darker.

Image : John Boudreau



III – HOW TO OBSERVE VENUS ?

The visual observation of Venus is possible, but difficult, and the eye can not see everything



The albedo of Venus shows several light absorptions in short wavelengths.

The absorption responsible for the details seen in UV is still active, although much weaker, in blue light accessible to the human eye.

This shows that it is possible to detect the UV markings directly at the eyepiece.

III – HOW TO OBSERVE VENUS ?

The strong luminosity of the planet and the impossibility to observe it in full night asks for a different approach.

To observe the sunlit part of the planet, a daytime observation is strongly adviced, if possible : before sunset, after sunrise, and even in full daytime : the glare of Venus is more acceptable and it's higher in the sky

To observe the night side (Ashen light or thermal signal) we still need to wait for a dark sky as usual : the available time of observation is then reduced.

Finding the planet during the day is quite easy thanks to its very important apparent magnitude :

- With a well aligned equatorial mount, scanning the sky with the longitude of the planet already set is generally enough to detect it with the finder. We can also start from the coordinates of the Sun (beware of accidents), or the Moon if visible.

- In any case binoculars will make the search more easy. If the sky is transparent enough and if the observer is protected from the Sun, Venus can be spotted with naked eye even far from sunset or sunrise.

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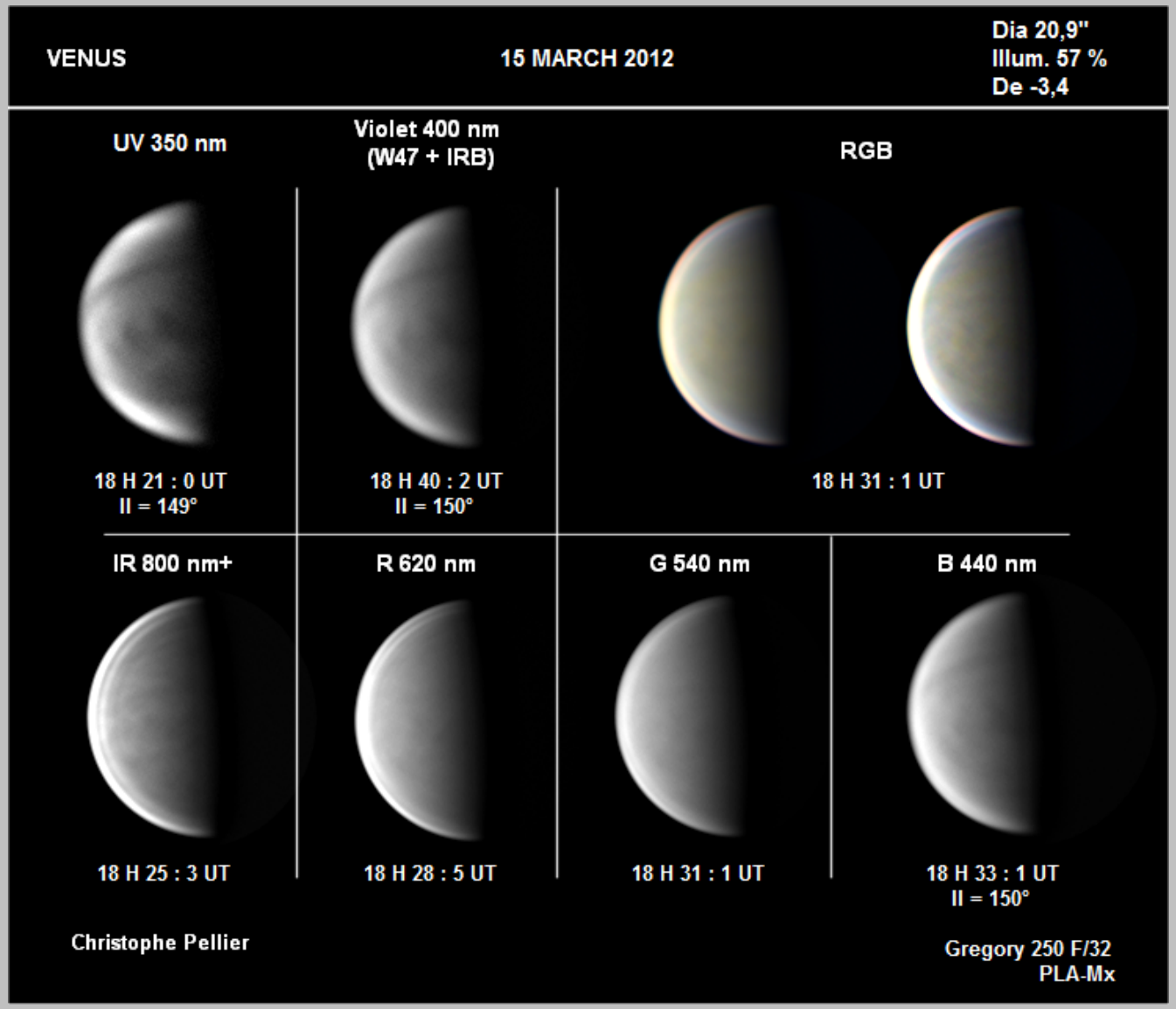

The tool to be used for visual observing is the Wratten 47 violet filter. It gives access to the same details as in UV, but with lower contrast.

III – HOW TO OBSERVE VENUS ?

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Drawing made by Frédéric Burgeot at the eyepiece of a 400 mm newtonian, a binoviewer and a W47 filter.

Aspect is typical of what can be expected from visual observing, in particular the bright « cusps » that are in reality the famous polar vortices.

III – HOW TO OBSERVE VENUS ?

CCD imaging gives access to every kind of observation, with details in infrared but as well in visible ligth (green/red) apart of ultraviolet

Imaging techniques :

- **Very short exposures, thanks to the high luminosity of the planet, with high frame rates and a very low gain. <u>The aim is to get an excellent signal to noise ratio</u>**

- **Video lengths will be short as well, because we get thousand of frames in a very short time**

- **About maximum time of video recording : in theory it is very long (from 15 to 40 mn following the telescope diameter in UV – more in IR). In practice however frame rates are so high that 5 mn are enough in general, 10 in UV.**

►<u>Globe rotation is perceptible from 20-30 mn of spacing between two images</u>

- **The techniques of de-rotation with WinJupos are maybe not reliable, because of possible errors of timing in the system of longitudes implemented (read on next slides), but they do not appear as very useful anyway.**

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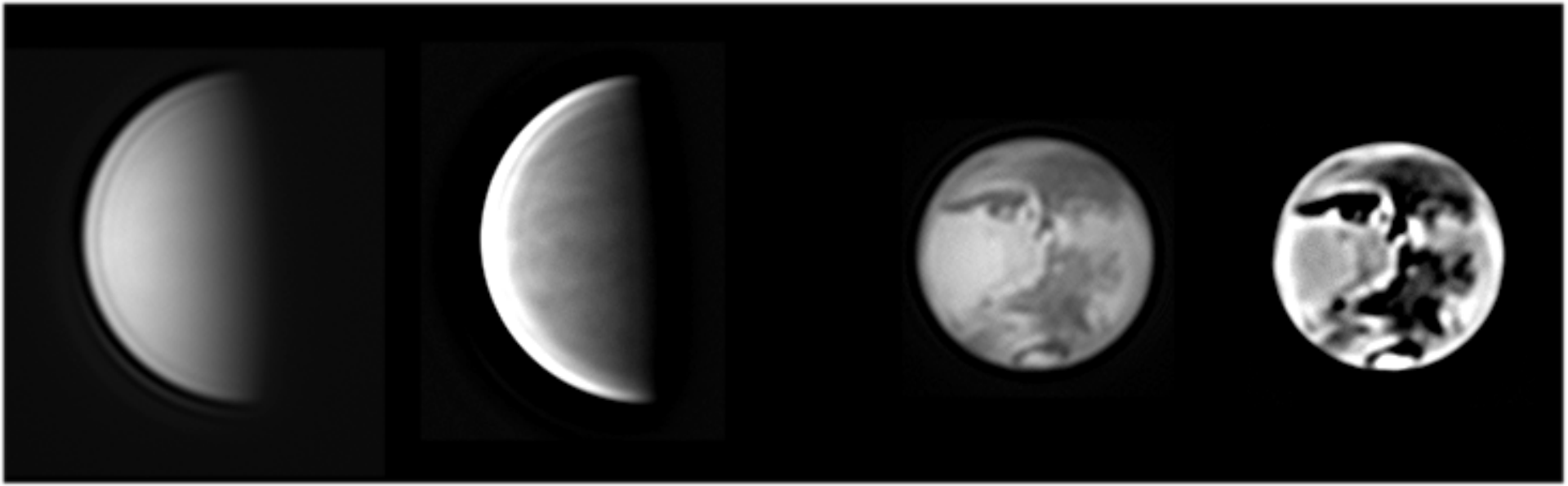
Processing techniques

In UV or violet, the level of contrast of the details is enough to adopt commonly used coefficients of wavelets.

In green, red and infrared, details'contrast is extremely weak and requires very strong enhancement, at unusal levels, that would be unacceptable for Mars, for example.

We then get a very strong limb artefact, which is unavoidable.



IV – OBSERVING PROJECTS

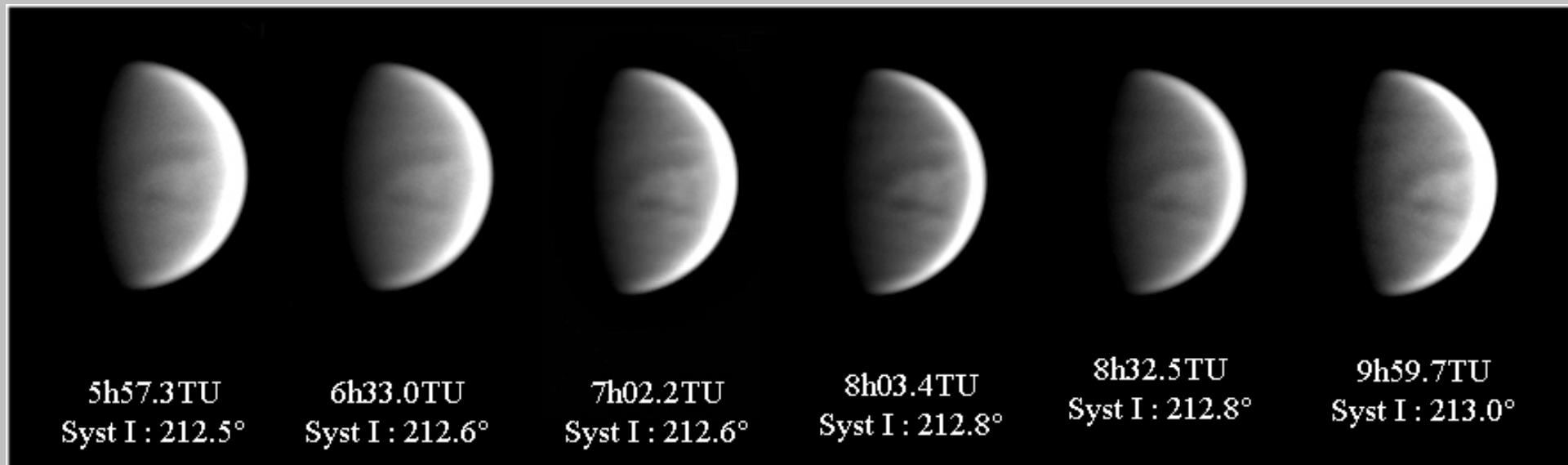
1 – Refine the rotation time of the globe, in different color bands

Rotation in UV is currently accepted for 4,2 terrestrial days (value implemented in WinJupos). But recent measurements (Monachino/Pellier/Gasperi) find a lower value of around 3,9 days. In IR : around 5 days

In UV and IR, it's fine to take images on a regular spacing of 30 to 45 mn (best done if we follow the planet during daytime).

The clouds change in a matter of a few days, this is why trying to make measurements with images taken from various Earth longitudes looks more hasardous.

Contact me and Giuseppe Monachino to participate:)



IV – OBSERVING PROJECTS

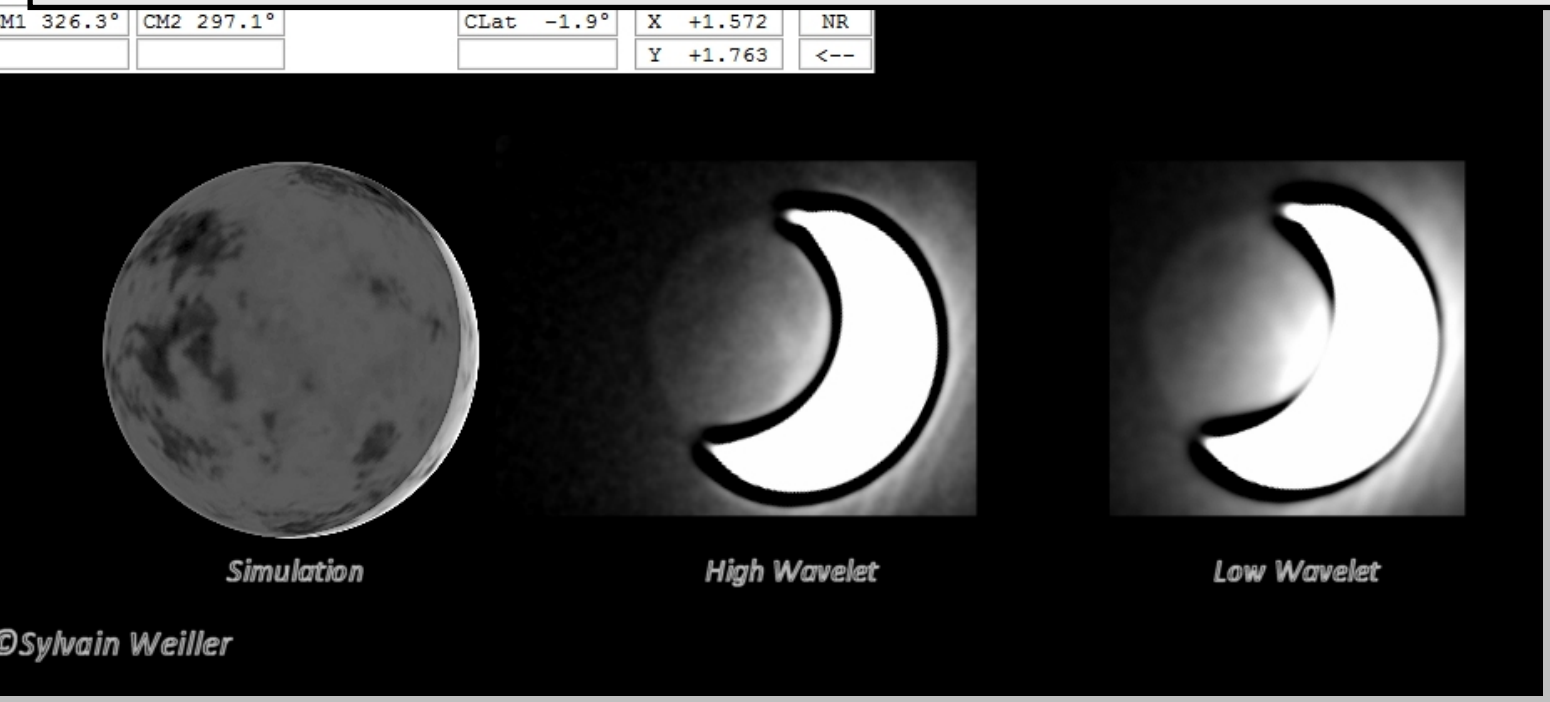
2 – Refine mapping of the thermal signal of the surface in IR

Thermal emission shows the topography of the venusian ground. We can try to get a more precise view.

Get a 1 micron filter (very cheap)

Take images of the best possible quality and try to make comparisons with WinJupos simulation and Magellan radar map

Contact me and Giuseppe



Images Sylvain Weiller in december 2013

IV – OBSERVING PROJECTS

3 – Hunt for possible light emission in the night side (apart of thermal signal)

To try solving the « Ashen light mistery » ? and more...

- **Find acceptable compromise between the strong glare of the dayside crescent and the night side (hard to find...)**
- **Test different light bands : a priori green (OIII), red ? And other possible emissions in the near infrared**
- **Contact me and Giuseppe !**