Imaging Venus with a Scientific SWIR camera

More astronomers are looking into the SWIR bands these days. A German researcher, Dr. Sebastian Voltmer, has been looking at the inner planet Venus as a Ring next to the sun and how the crescent is getting bigger. He investigated slight irregularities in the atmospheric layers, as shown in Figure 1.

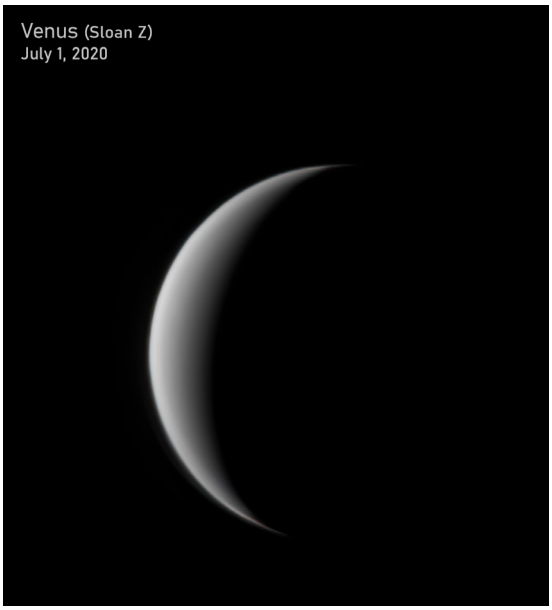

Figure 1: A short exposured result of the crescent Venus from July 1, 2020.

The challenge was to reveal the ground structures of Venus in NIR. For surface observations (night side) through the clouds of Venus require a spectral window around 1000 nm.

Observations at wavelengths beyond 1.0 micron are very interesting to observe the lower clouds of Venus through the infrared radiation that escapes from the planet through holes of lower cloud content at an altitude of about 50 km above the surface. The Ninox 640 II SWIR camera was able to reveal the surface and the lower clouds in one image.

In late June and early July 2020, the crescent morning star Venus was narrow enough and the planet was positioned far enough from the sun. This meant that the sky was dark enough to capture the night side in SWIR. The seeing conditions (less turbulence in the atmosphere) before sunrirse are much better than those after sunset.

On July 1st 2020, Dr. Voltmer was able to capture an unique image of Crescent Venus and the infrared radiation of the hot planet.

Figure 2: Ninox 640 II in telescope set-up

Figures 2 and 3 show the set up on his scope in Spicheren, France.

Figure 3: Tracking mount with the attached Ninox 640 II to the telescope

He was able to capture the very faint radiation beyond 1000 nm of the surface of Venus, as displayed on Figure 4. The image was captured with a prototype Sloan Z filter from Baader Planetarium (820-1500 nm) and a Ninox 640 II IR camera. He aligned it with a circle congruent with the night side of Venus.

Figure 4: July 1, 2020: Crescent Venus and the thermal radiation of the hot planet, captured in short exposure.

12,000 video frames were necessary for the recording and a significant amount of post processing work.

Images courtesy of Dr. Sebastian Voltmer.

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Summary of set-up

Start time: 2:40 UT (duration 20 min), crescent

start time: 03:17 UT

Telescope: Celestron 11 EdgeHD + Baader Fluorite Flatfield Converter (FFC)

Camera: Ninox 640 II SWIR camera

Filter: Baader prototype Sloan-Z

Camera settings:

• Surface & nocturnal deeper clouds: 12,000 frames at 90,000msec, 10 FPS, sensor temp. -31.7C + Dark Frame of 12,000 frames

• Crescent: 12,000 short exp. frames, 30 FPS

According to Dr. Voltmer, “In my previous images of Venus from May 2020 I only used planetary CCD cameras with NIR sensitivity. It was hard to get any signal of Venus’s surface. But with the cooled Ninox 640 II SWIR camera I got a much better signal-to-noise-ratio.

With the Ninox 640 II SWIR camera I was able to reveal the surface and the lower clouds in one image”.

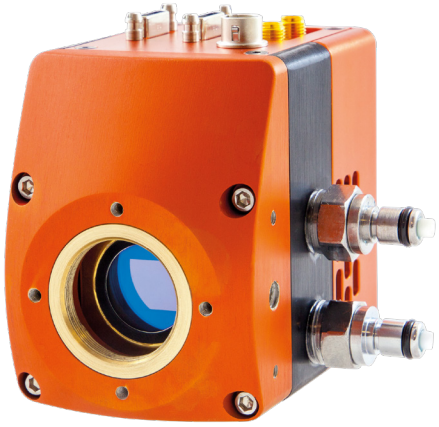

Figure 4: Ninox 640 II

- **VIS-SWIR InGaAs technology** | Enables imaging from 0.6µm to 1.7µm
- **Cooled to -15°C** | Allows longer integration avoiding dark current build-up
- **Ultra-Low Noise Sensor: 18e- in High Gain** | Enables ultimate low light Vis-SWIR image
- **15µm x 15µm pixel pitch** | Enables the highest resolution SWIR image
- **Ultra high intrascene dynamic range** | Enables simultaneous capture of bright & dark portions of a scene
- **Onboard Automated Gain Control (AGC)** | Enables clear video in all light conditions
- **Ultra compact, Low power** | Ideal for hand-held, mobile or airborne systems

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