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2020 Coordinated Venus Observations of BepiColombo (ESA and JAXA), Akatsuki (JAXA), and Ground-based Telescopes

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Abstract

We report the 2020 coordinated Venus observation plan of four instruments on board two spacecraft: MERTIS and PHEBUS of BepiColombo, during its Venus flyby, and LIR and UVI of Akatsuki, which is orbiting the planet. These coordinated observations will make better understanding on physical properties and chemical compositions of the Venusian atmosphere above the cloud top level, and provide an excellent cross comparison opportunity. In addition, coordinated ground-based observations can provide unique complimentary spatial coverage from the spacecraft, and can expand the spectral ranges of the four instruments. We will also introduce more instruments that will perform Venus observations from BepiColombo and Akatsuki, but independently. We would like to encourage your participants to this exciting event of Venus observations.

1. Introduction

Recent Venus observations revealed the 10 μm global scale mountain-induced wave [1] and the intense decadal UV albedo variations [2] around the cloud top level (~60–70 km altitudes). These features can be better understood with spectral information, which are missed by Akatsuki, and requires more cross comparison data for quantitative albedo studies. BepiColombo's Venus flybys will provide unique opportunities to accomplish such analysis, and we would like to compare spectral observations by BepiColombo and global images by Akatsuki, acquired simultaneously.

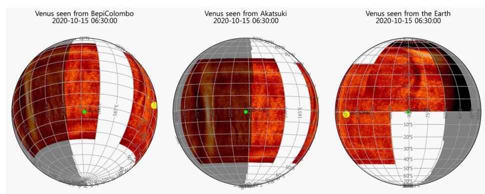

Figure 1: Viewing geometries of Venus, as seen from BepiColombo (left), Akatsuki (center), and the Earth (right) around the time of the closest approach to Venus of BepiColombo on 15 Oct 2020. LIR image [12] is shown on the globe. Green and yellow dots are sub-observer and sub-solar points, respectively.

2. Coordinated Venus observations

2.1 Mid-IR observations by BepiColombo and Akatsuki (Oct 2020)

The MErcury Radiometer and Thermal infrared Imaging Spectrometer (MERTIS) on board BepiColombo covers the 7–14 μm range [3], suitable to understand atmospheric thermal and cloud top structures, and trace gaseous abundance above the cloud top level [4, 5]. The Longwave Infrared Camera (LIR) on board Akatsuki detect thermal distributions on Venus at 10 μm (8–12μm bandpass) [6]. These two instruments will observe Venus in different spatial scales; MERTIS will have close-up observations from noon to afternoon local time, while LIR will have global view from the apocenter of Akatsuki (Fig. 1).

2.2 UV observations by BepiColombo and Akatsuki (TBD, Aug-Sep 2020)

The Probing of Hermean Exosphere By Ultraviolet Spectroscopy (PHEBUS) on board BepiColombo can measure the 55–315 nm range [7], which can detect emission [8] and absorption [9] by the atmospheric molecules of Venus. The UltraViolet Imager (UVI) on board Akatsuki has two channels at 283 and 365 nm [10], where are maximum absorptions by SO_2 gas and an unidentified absorber, respectively. During BepiColombo's approaching phase (Fig. 2), simultaneous observations between PHEBUS and UVI will provide valuable cross comparison data, and using these data we can better characterize spectral features and variabilities of Venus atmosphere in UV. The PHEBUS observations are yet under examination, and will be confirmed later.

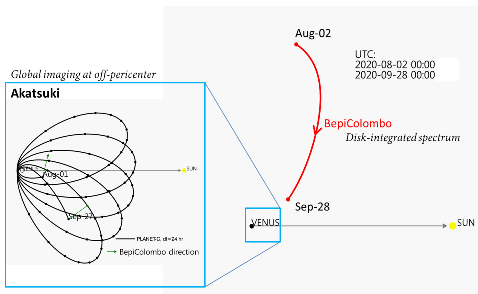

Figure 2: Trajectories of BepiColombo (red) and Akatsuki (black) in Aug-Sep 2020. The +X axis is the direction of the Sun. While BepiColombo is approaching to Venus, Akatsuki can monitor dayside continously. PHEBUS observations are under examination for its possibility.

2.3 Ground-based observations

Ground-based telescopes can provide important complimentary observations. As shown in Fig. 1, the view from the Earth covers mostly the morning side of Venus. Therefore, simultaneous ground-based observations at mid-infrared range (for example, [5]) can make a complete Venus globe analysis from morning terminator to early night local time. Observations at other spectral ranges can provide valuable comparison data, such as wind fields using morphology tracking and Doppler shift measurements, as compared during MESSENGER's Venus flyby observations [11]. Overall collaborative observations will help diagnose the status of Venus cloud top level at the time of Venus flyby of BepiColombo. We would like to encourage Venus observers to contact T. Widemann (Envision), V. Mangano (BepiColombo), M. Imai (Akatsuki), J. Peralta (amateur) for better coordination.

3. Conclusions

In 2020, coordinated Venus observations are planned among four instruments; MERTIS/BepiColombo and LIR/Akatsuki, and PHEBUS/BepiColombo (TBD) and UVI/Akatsuki. The coordinated observations will be repeated during the 2nd Venus flyby of BepiColombo (11 Aug 2021). We welcome ground-based observers.

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