Why high temperature laboratory spectroscopy is key to exploring Mercury and Venus - and why it is much harder than it sounds

Mercury and Venus are competing for the title of the most extreme planetary surface in our solar system. While Venus has the highest peak temperatures on the surface, Mercury has the highest temperature extremes. From the perspective of a spectroscopist that wants to to fly instruments to the planets to use remote sensing to study the surface composition that is good and bad news. The good news is that high temperatures mean that we should get a lot of signal for emission spectroscopy - the bad news is that a lot of things happen to spectral features at high temperatures.

For a spectroscopist working and developing laboratory facilities this is a dream come true, With the selection of the Mercury Radiometer and Thermal Infrared imaging Spectrometer (MERTIS) for the payload of the ESA-JAXA BepiColombo mission we started in Berlin to develop a spectral facility that would allow to measure the emissivity of Mercury analog materials under vacuum at temperature of at least 450°C. This proved to be an interesting challenge in many aspects. Starting from the seemingly simple technical question to interesting (material) science questions that required quantum mechanics to address them.

In 2007 we started to embarking on an even more challenging voyage to retrieve information of the surface composition of Venus from orbit. With the ESA Venus Express mission we could show a proof of concept by showing variability of the surface emissivity from orbital measurements. However it also raised the interesting question of how much information can actually be retrieved from emissivity measurements of just five narrow spectral windows around 1 micron. This started a 10 years journey to develop the currently only spectral facility in the world that allows emissivity measurements of Venus analogs around 1 micron. Those measurements can be obtained routinely and help to support the selection of the NASA VERITAS and ESA EnVision. Getting to that point was a very bumpy road.