Investigating circular patterns in linear polarization observations of Venus

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ESA's Venus Express mission has revealed our neighbouring planet to be a highly dynamic world, with ever-changing cloud properties and structures, wind speeds that increase in time, and variable concentrations of atmospheric trace gases such as SO_2. The SPICAV-IR instrument on Venus Express has provided us with close-up linear polarization data of sunlight reflected by Venus's clouds and hazes, that allows a characterisation of their composition and particle sizes. Here, we analyse linear polarization data of the planet at a distance, obtained with the Extreme Polarimeter (ExPo) on the William Herschel Telescope on La Palma. These spatially resolved, high-accuracy polarization observations of Venus show faint circular patterns centered on the sub-solar point that are absent in the flux observations. So far, careful analyses have ruled out instrumental effects which leaves us to wonder about atmospheric properties as the cause of the circular patterns. Using numerical simulations of the flux and polarization of sunlight that is reflected by Venus, we have investigated the relation between the observed patterns and several atmospheric properties, such as variations in particle sizes, composition, density and altitude. We discuss the plausibility of the possible causes in the view of the current knowledge of the composition and dynamical processes in Venus's atmosphere.