Morphology and Time Evolution of Dark Facular Regions in Cycle 23 and 24

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This is a study of the contrast of plage and facular regions in the 607nm red continuum spectral region using images produced by the ground-based Precision Solar Photometric Telescope (PSPT) at Mauna Loa Observatory. Additional information is derived from space-based observations from the Helioseismic and Magnetic Imager (HMI) as well as the Atmospheric Imaging Assembly (AIA) on the Solar Dynamics Observatory (SDO) at 617.3 and 1700nm, respectively. PSPT analysis over the time frame of January 2005 to February 2015 permits the solar cycle characterization of the time evolution of facular regions. Facular regions darker than the center-to-limb variation (CLV) in PSPT exhibit a distinct solar cycle dependence with about 15-30 percent of facula darker than the CLV during times of high solar activity. These dark facular regions have the greatest contrast at disk center and fall off toward the solar limb where they become predominantly bright. Cospatial magnetic field strength dependence can be associated with image contrast using HMI images and co-aligned and cotemporal high contrast AIA images can be used for the identification of bright solar features. Analysis of HMI contrast employing masking of magnetic field strength and AIA brightness provides greater insight into evolution of these dark features. HMI images indicates bright and dark image pixels are highly interleaved in solar regions that can be identified as facular structures. HMI pixels in the $200<|B|<600$ Gauss range show a distinct brightening near the limb resembling the CLV enhancement seen in facula identified in PSPT. This field range is predominately bright relative to the CLV, but for $600<|B|<1200$ Gauss, it is predominately dark. In HMI images, dark facular regions exhibit a higher population than seen in PSPT images. HMI images masked according to AIA brightness indicate a broad range contrast and a similarly broad range of magnetic field strengths.