

# High Contrast Vacuum Nuller Testbed (VNT) Contrast, Performance and Null Control

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## 100 WORD ABSTRACT

Herein we report on our contrast assessment and the development, sensing and control of the Vacuum Nuller Testbed to realize a Visible Nulling Coronagraph (VNC) for exoplanet detection and characterization. The VNC is one of the few approaches that works with filled, segmented and sparse or diluted-aperture telescope systems. It thus spans a range of potential future NASA telescopes and could be flown as a separate instrument on such a future mission. NASA/Goddard Space Flight Center has an established effort to develop VNC technologies, and an incremental sequence of testbeds to advance this approach and its critical technologies.

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Herein we report on our contrast assessment and the development, sensing and control of the Vacuum Nuller Testbed to realize a Visible Nulling Coronagraph (VNC) for exoplanet detection and characterization. The VNC is one of the few approaches that works with filled, segmented and sparse or diluted-aperture telescope systems. It thus spans a range of potential future NASA telescopes and could be flown as a separate instrument on such a future mission. NASA/Goddard Space Flight Center has an established effort to develop VNC technologies, and an incremental sequence of testbeds to advance this approach and its critical technologies. We discuss the development of the vacuum Visible Nulling Coronagraph testbed (VNT). The VNT is an ultra-stable vibration isolated testbed that operates under closed-loop control within a vacuum chamber. It will be used to achieve an incremental sequence of three visible-light nulling milestones with sequentially higher contrasts of  $10^8$ ,  $10^9$  and ideally  $10^{10}$  at an inner working angle of  $2\lambda/D$ . The VNT is based on a modified Mach-Zehnder nulling interferometer, with a "W" configuration to accommodate a hex-packed MEMS based deformable mirror, a coherent fiber bundle and achromatic phase shifters. We discuss the laboratory results, optical configuration, critical technologies and the null sensing and control approach.

**Keywords:** Exosolar planets, visible nulling coronagraph, visible nulling interferometer, coronagraph, wavefront control, null control, interferometry