Introduction
The majority of the 5500+ confirmed exoplanets orbit stars that will eventually become white dwarfs (WDs). Very few planets have been discovered around WDs, and none have been directly imaged, which leaves gaps in our knowledge of how planetary systems evolve as stars evolve (Fig 1). Constraining the survival rate and characteristics of post main sequence planets will address these open questions and lend insight into the inevitable fate of systems such as our own Solar System.

Direct Imaging Searches for WDs: HST can offer good image quality, but there is still a limit to detecting planets around WDs at solar system scales (<7AU) due to their small telescope diameters. We can get around these challenges with kernel phase interferometry (KPI), which is a data processing technique that improves the achievable resolution of a telescope by a factor of several. This enables us to extract information lost in standard detection techniques (as depicted in Fig 2). We are currently applying KPI to archival HST data of seven WDs in the Hyades cluster to search for planets that have survived the death of their host star (data from Brandner et al. 2020).

Kernel Phase Interferometry: KPI treats a conventional telescope as an interferometric array. It enables us to achieve angular resolution close-to or within the diffraction limit by eliminating instrumental errors, as long as image quality is high. The procedure for KPI is shown in Figures 3 and 4.

Achievable Contrast
With the Hyades cluster ~47pc away, those angular resolution boosts provided by KPI access orbital separations much tighter than what HST standard imaging can provide (Fig 5). As shown in Figure 5, if a planet with a contrast relative to its host star of ~6.5 mag was present, the standard technique of angular differential imaging (ADI) would detect it in the NICMOS data at ~8 AU, but KPI would detect it at ~4 AU.

Next Steps
We are in the final stages of determining if any planets are present around these seven WDs. Planets radiate in thermal emission, and the contrast sensitivity can be converted to mass sensitivity. We will be converting contrast limits (as seen in Fig 5) into mass limits by using the WD’s flux and age and planetary atmosphere models. We expect to reach planets with $M \sim 5$–$10M_\oplus$ for this sample. Applying KPI to this dataset will result in the highest resolution planet search around WDs to date, and it will provide new constraints on post main sequence planetary evolution.

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