

Here be Substructures

A VLT/PIONIER View of the Inner Rims of Dusty Post-AGB Discs

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1 MOTIVATION

- Crucial to planet formation and star-disc interaction, **the inner rims of dusty discs and their substructures remain unresolved [1]**.
- Post-Asymptotic-Giant-Branch (post-AGB) binaries** consist of an evolved primary & jet-launching main sequence companion, **surrounded by massive dusty circumbinary discs [2, 3]**. They are a unique laboratory, as the **inner disc sublimation rims are resolvable via optical interferometry (> 1 mas)**.
- Subject to much of the same physics [2,4,5], **it is natural to ask:**

Do post-AGB inner disc rims harbour substructures similar to those predicted for PPDs?

2 SAMPLE & METHODOLOGY

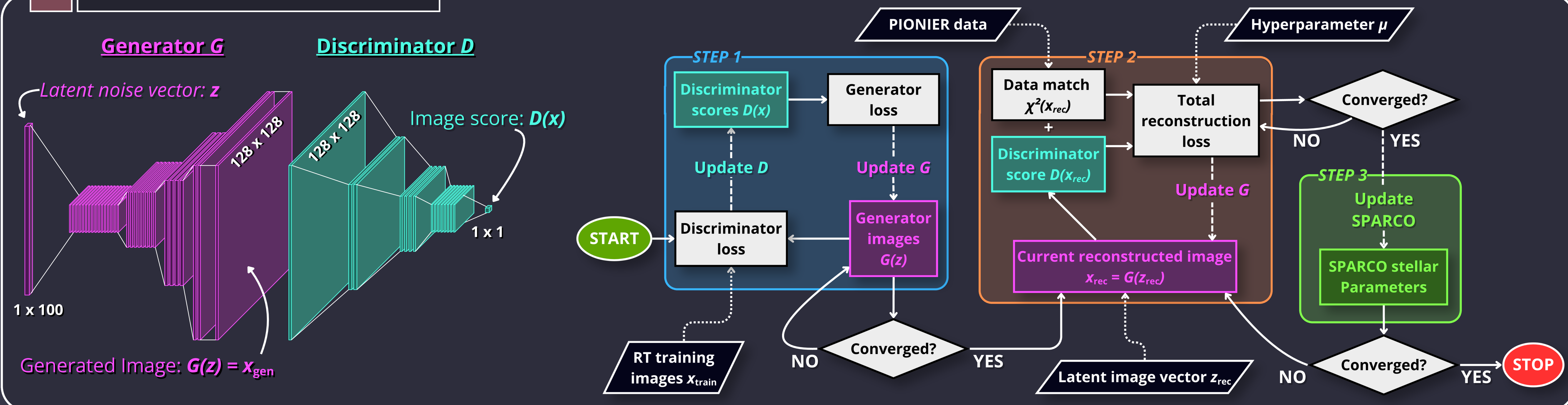
In our paper [6], we **reconstruct thermal emission H-band PIONIER images of 8 post-AGB disc inner rims**. We develop a workflow with **ORGANIC [7]**, an algorithm based on a Generative Adversarial neural Network (GAN; [8]):

STEP 1 PRE-TRAINING: The **Generator (G)** creates images **x** from latent noise **z**. The **Discriminator (D)** judges similarity to a training set of smooth-disc radiative transfer (RT) images. The **Generator is trained using the Discriminator's similarity score D(x)** as feedback to create RT-like images.

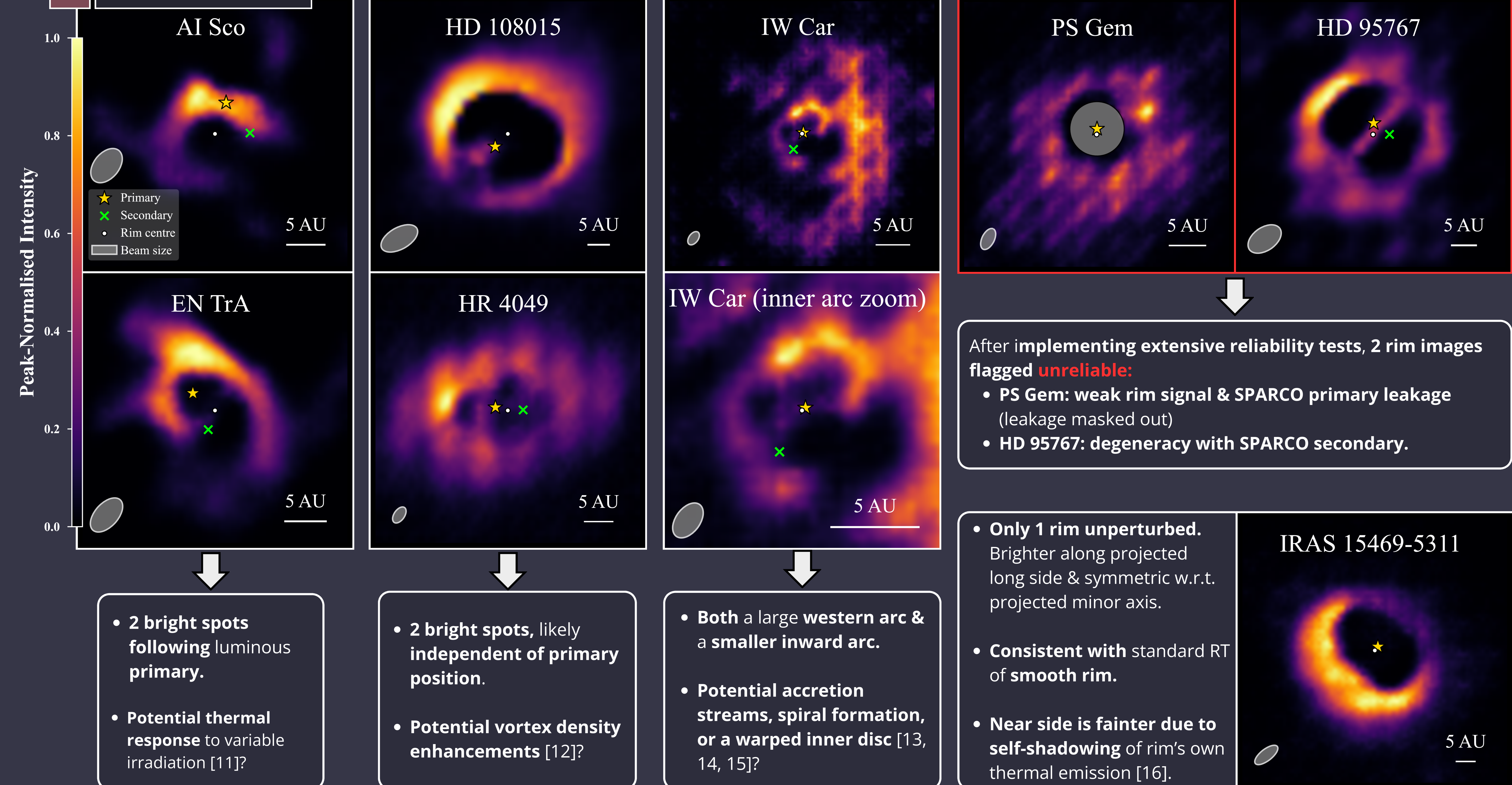
STEP 2 IMAGE RECONSTRUCTION: To match observations, the **Generator is optimised further**, creating an image from a fixed latent vector. We **minimise a weighted reconstruction loss consisting of a data match (χ^2), and a Discriminator term ($-\mu \log D(x)$)** punishing dissimilarity to training data. Hyperparameter **μ** sets their weighting.

STEP 3 SPARCO OPTIMISATION: To remove their glare, the central stars are **parametrised as chromatic point-like sources and subtracted** (a.k.a. the SPARCO approach; [9]). We optimise over these stellar parameters using the BADS Bayesian Optimisation algorithm [10] until the total reconstruction loss is minimised.

3 ORGANIC IMAGING FLOWCHART



4 INNER RIM IMAGES



5 SUMMARY & FUTURE PROSPECTS

- We present the **first homogeneous imaging survey of post-AGB circumbinary disc inner rims [6]**. Robust image reconstructions indicate that **smooth, axisymmetric rims are likely uncommon**, suggesting that dynamical or radiative **perturbations are widespread**.
- Multi-epoch imaging will constrain** whether detected substructure **features co-rotate with the binary or present separate motion**. **Multi-band imaging (H/K/L/M/N bands) will probe their temperature, optical-depth and density effects**. Together this will **elucidate their formation**.

Check out our A&A preprint!



Or the ORGANIC algorithm!



REFERENCES: [1] Dullemond & Monnier 2010; [2] Van Winckel 2025; [3] De Prins et al. 2024; [4] Corporaal et al. 2023a; [5] Corporaal et al. 2023b; [6] De Prins et al. 2026; [7] Claes et al. 2020; [8] Goodfellow et al. 2014; [9] Kluska et al. 2014; [10] Acerbi & Ma 2017; [11] Nagel et al. 2010; [12] Flock et al. 2017; [13] Kraus et al. 2008; [14] Facchini et al. 2013; [15] Dong et al. 2015; [16] Hofmann et al. 2022; Background art courtesy of my lovely girlfriend, Zoë Frans.

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