Discovery of a Possibly Quenched Low-mass Galaxy in the Field

Tehreem Hai[1], Kristen McQuinn[1,2], Yao-Yuan Mao[3], Erik Tollerud[2] , Matthew Buckley[1], David Shih[1], Roger Cohen[1], Andrew Eugene Dolphin[4]
[1]Rutgers, The State University of New Jersey, Piscataway, NJ, [2]Space Telescope Science Institute, Baltimore, MD, [3]University of Utah, Salt Lake City, UT, [4]Raytheon Technologies, Tuscon, AZ

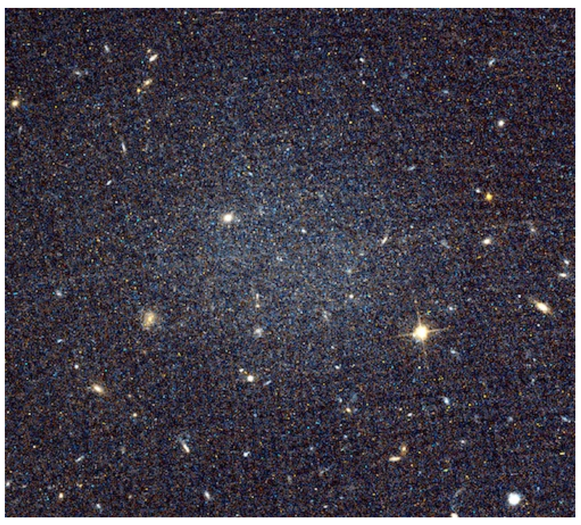
Isolated, Early-type Dwarf Galaxies Challenge the Role of Environment in Galaxy Quenching

Early-type dwarfs are quenched low mass galaxies with little to no gas. The mechanisms by which they lost their gas and ceased star formation are debated; **environment is considered to play a large role in dwarf galaxy quenching, but the growing sample of low mass, isolated quenched galaxies hint that other factors besides environment may need to be considered** (e.g. McQuinn et al. 2024; Greene et al. 2024). Yet, the current sample of known low-mass galaxies in the field that are quenched is still small, which limits our understanding of how quenching can occur. Here, **we report the discovery of Canes Venatici C, a possibly quenched dwarf galaxy in the field, and characterize its properties.**

Properties of Canes Venatici C: A Possibly Quenched Low-Mass Galaxy

Canes Venatici C (CVnC) was discovered in DESI Legacy Survey DR9 data, while searching for nearby ultra-faint dwarf galaxies. Using follow-up observations from the Hubble Space Telescope in the ACS/WFC F606W and F814W bands, we constructed a Color-Magnitude Diagram (CMD) and found a preliminary Tip of the Red Giant Branch (TRGB) distance of **9.8 ± 0.3 Mpc**. Based on stellar isochrones from the PARSEC evolutionary library (Bressan et al. 2012), the CMD is consistent with **little recent star formation.** Figure 1 shows the three-color image of CVnC made using HST follow-up observations, while Figure 2 shows the CMD overplotted with 10 Gyr, 1 Gyr, and 100 Myr isochrones. While the 10 Gyr isochrone fits the RGB well (and the 1 Gyr isochrone less so), the 100 Myr isochrone mostly sits outside of the distribution of stars, indicating a lack of recent star formation.

Figure 1: Cutout of HST three-color image of CVnC [Red: F814W, Blue: F606W, Green: average of F814W and F606W].



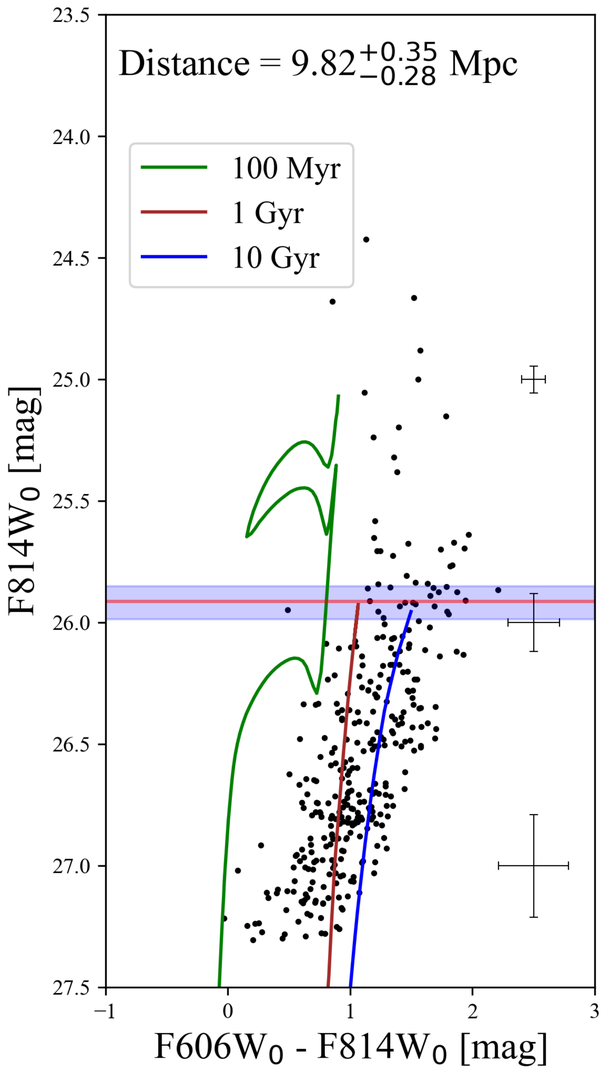
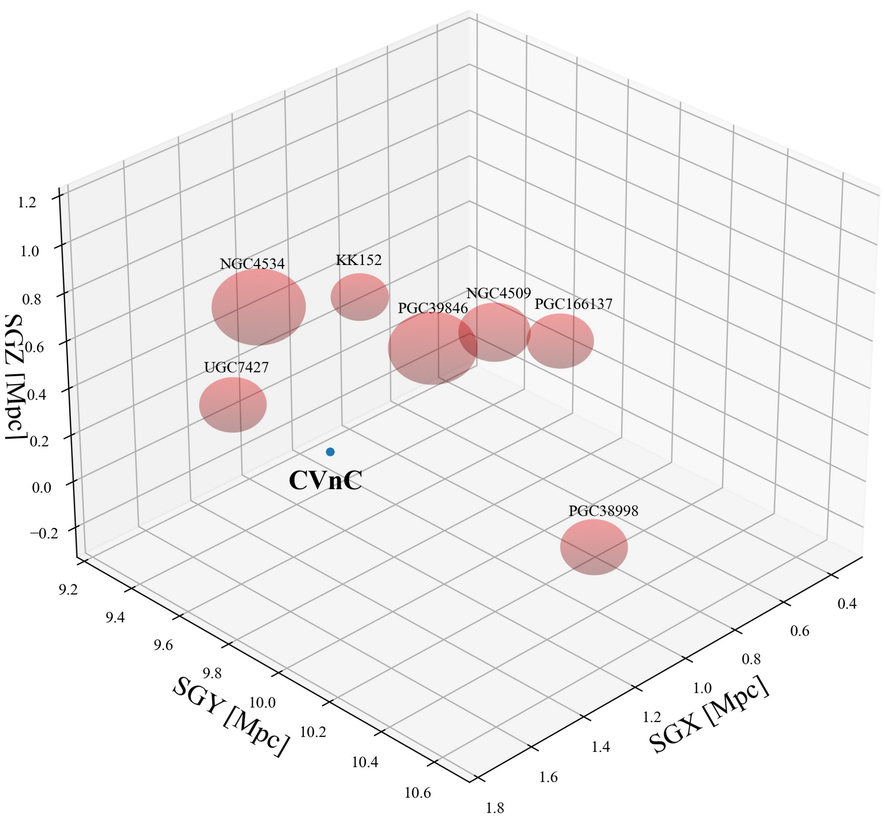
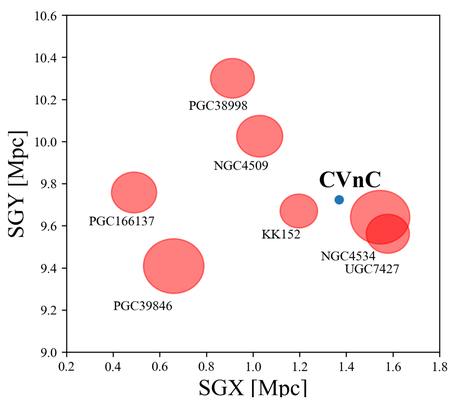


Figure 2: Extinction-corrected color-magnitude diagram of stars in CVnC. The red line shows the location of the Tip of the Red Giant Branch (TRGB), and the purple band represents statistical errors from the fit to the TRGB. Green, red, and blue lines show 100 Myr, 1 Gyr, and 10 Gyr PARSEC (Bressan et al. 2012) isochrones, respectively. All isochrones have a metallicty of log[M/H]=-0.75. Error bars show mean uncertainties in four magnitude bins.

The Relatively Isolated Environment Around CVnC

Using the TRGB distance to CVnC and existing distance catalogs, we found 7 galaxies within 1 Mpc of CVnC. We also used SDSS photometry for the neighboring galaxies to estimate stellar masses; we found that **CVnC's neighbors consist of five low-mass dwarf galaxies ($M_* \leq 10^8 M_\odot$) and two more massive galaxies ($M_* \geq 10^8 M_\odot$)**. Using virial radii estimated from the Behroozi et. al (2019) stellar mass to halo mass relation, we found that **the nearest galaxy to CVnC is located at more than 3 times its virial radius.**





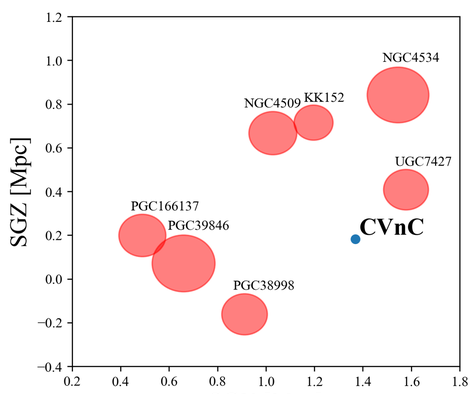


Figure 3: Left: 3D representation of the neighboring galaxies within 1 Mpc of CVnC, in terms of Supergalactic X, Y, and Z coordinates. Right: 2D representations of the environment around CVnC, in terms of Supergalactic X and Y (center) and Supergalactic X and Z (right). Red circles/spheres indicate the virial radii of the neighboring galaxies. The virial radius of CVnC is not shown, since we are currently in the process of estimating its stellar mass.

Conclusions and Future Work

We have found a **relatively isolated and possibly quenched low-mass galaxy**, Canes Venatici C. To strengthen our preliminary results, we plan to:

- Fit for the structural parameters of the galaxy and **obtain robust stellar mass and virial radius estimates for CVnC.**
- Use a CMD-fitting technique to **quantify the recent star formation history of the galaxy and put constraints on quenching timescales.**

These steps will allow us to confirm the properties of CVnC and its environment. If CVnC is indeed an isolated, early-type dwarf galaxy, **it will enable an exploration of factors other than environment in the quenching of these low-mass systems.**

References

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Acknowledgements

Support for this work was provided by NASA through Grant no. HST-GO-17481. T.H. was also supported by the National Science Foundation Graduate Research Fellowship.

tnh57@physics.rutgers.edu