# Probing Stellar Populations in the Virgo and Fornax Clusters with Infrared Surface Brightness Fluctuations

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## ABSTRACT:
Surface brightness fluctuations (SBF) are a useful tool for measuring extragalactic distances. At infrared wavelengths, SBF break the age-metallicity degeneracy and are useful for probing the properties of the most luminous stars in a galaxy, even when individual stars are not resolved. We present a detailed comparison of F110W and F160W SBF measurements made using the Hubble Space Telescope WFC3/IR camera to a variety of stellar population models, including those with solar-scaled and alpha-enhanced compositions and models incorporating convective core overshoot for younger populations. We use these model comparisons to assess the star formation histories of Fornax galaxies spanning a wide range in color and luminosity in the Virgo and Fornax clusters, measured as a function of distance from the galaxy center in elliptical apertures. We discuss the implications of population variations on the fluctuation magnitudes and distance measurements.

## Procedure:
- We fitted elliptical isophotes to each galaxy from those fits, we constructed elliptical apertures where previously circular apertures were used.
- Edited the residual $g$, $r$, and $z$ band images by masking defects, subtracting sky values, scaling for exposure time, and accounting for extinction.
- SBF amplitude was measured by fitting the PSF power spectrum in each elliptical annulus.
- $i$- and $g$- and $z$- color maps were made by subtracting the images, respectively.
- The colors were extracted from each color map for each annulus, giving the internal color gradient for each galaxy.
- Absolute SBF magnitudes were computed using optical SBF distances.
- SBF magnitudes and colors were compared to four new stellar population models.

## Conclusion:
Both Teramo BaSTI and Padova stellar population models lead to the conclusion that most SBFs are sensitive to the brightest stars in a galaxy, and SBFs provide a powerful tool to test the models. Most of the galaxies follow lines of constant metallicity, with SBF and color gradients arising from age variations (younger populations toward the center). NCG 1380 is the exception: the population models imply nearly constant age for this galaxy. While the galaxies have similar internal trends with age and metallicity, variations between galaxies are large.

## Comparison to Stellar Population Models:
- The plots below show the internal gradients in fluctuation magnitude and color for each galaxy. The near-IR SBF measurements help break the age-metallicity degeneracy present at optical wavelengths and reveal the presence of young stars in galaxies with known distances. We compare our SBF measurements (all in AB magnitudes) to four new stellar population models, one based on Padova isochrones and three variations on the Teramo BaSTI isochrones (α-enhanced, convective core overshoot, and solar scaled).
- Since SBFs are sensitive to the brightest stars in a galaxy, SBFs provide a powerful tool to test the models. Most of the galaxies follow lines of constant metallicity, with SBF and color gradients arising from age variations (younger populations toward the center). NCG 1380 is the exception: the population models imply nearly constant age for this galaxy. While the galaxies have similar internal trends with age and metallicity, variations between galaxies are large.

## References:

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