Probing environmental quenching in the Fornax cluster through a population-orbital superposition method

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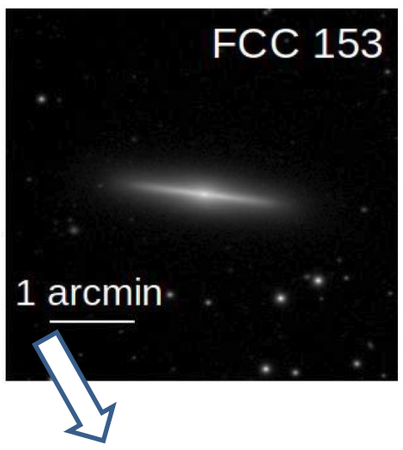
We probe the effect of cluster environment to the star formation quenching in galactic thin disks for 18 galaxies (17 early-type, 1 late-type) in the Fornax cluster. High quality data resolving the kinematical and chemical information across the observational plane are obtained through IFU observations with MUSE/VLT. We create population-orbit superposition models to each galaxy, the model fit the surface brightness, kinematics, age and metallicity maps simultaneously. Based on the model, we can dynamically separate the thin disk from other component of the galaxy and obtain its age distributions across the disk plane. We find 9 of the 18 galaxies show positive age gradient on the cold disk. With the help of our model and infall time classification based on the cluster phase-space, we find recent infallers are mostly with higher cold disk fraction, younger cold disk and positive age gradient while ancient infallers have older and smaller disks which show negative age gradient. By comparing with simulation, we find that positive age gradient is strong evidence of environmental quenching.



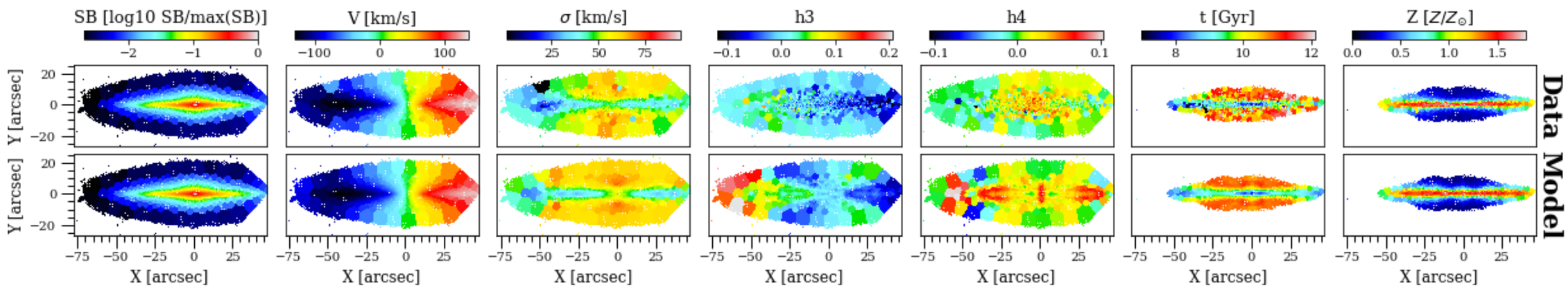


Fig1. Best-fitting model of FCC153. First row: observational ; second row: best-fitting from our population-orbital superposition model. From left to right, they are surface brightness (SB), line-of-sight velocity, velocity dispersion, h3, h4, age and metallicity maps. The model fits all data well.

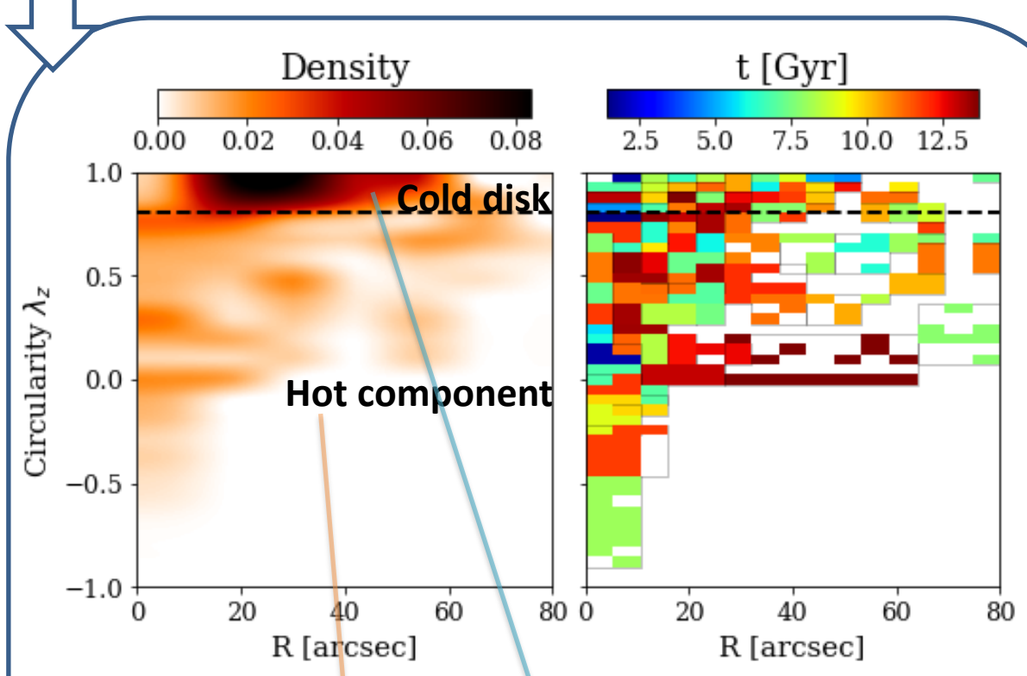


Fig2. Orbital distribution in λ_z—r phase space. Left panel: orbital density; left panel is the phase space colored by age. We separate the galaxy into 2 parts: cold disk and hot component. We can see a young cold thin disk and an old bulge.

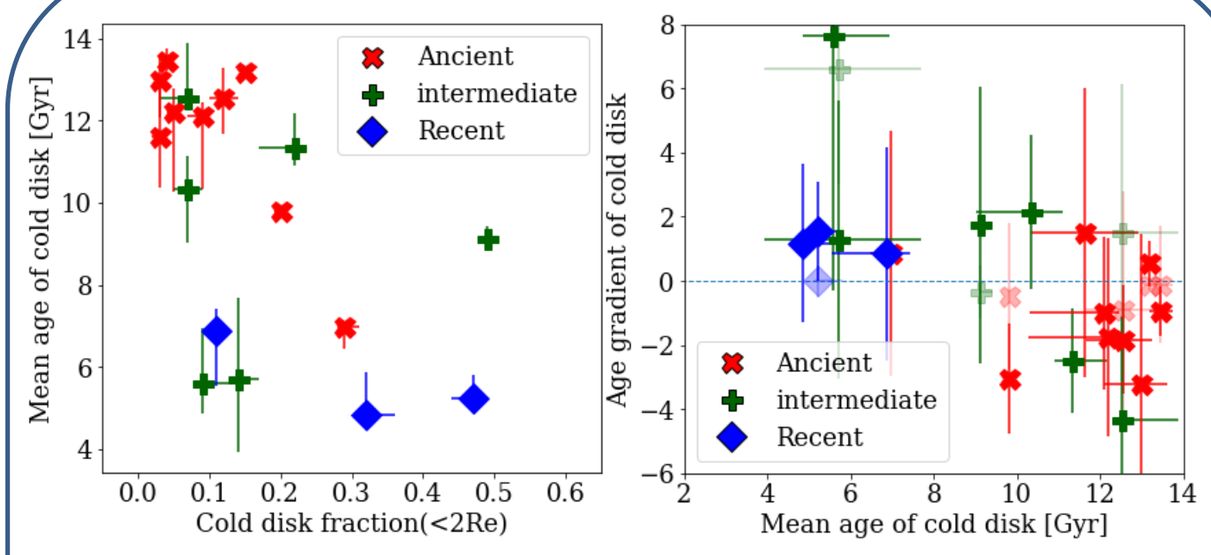


Fig3. Left panel: cold disk fraction vs. mean age of cold disk; right panel: mean age of cold disk vs. age gradient of cold disk. Ancient infallers tend to have lower disk fraction, older disks that show negative age gradient. Recent infallers tend to have higher cold disk fraction and younger disks that show positive age gradient.

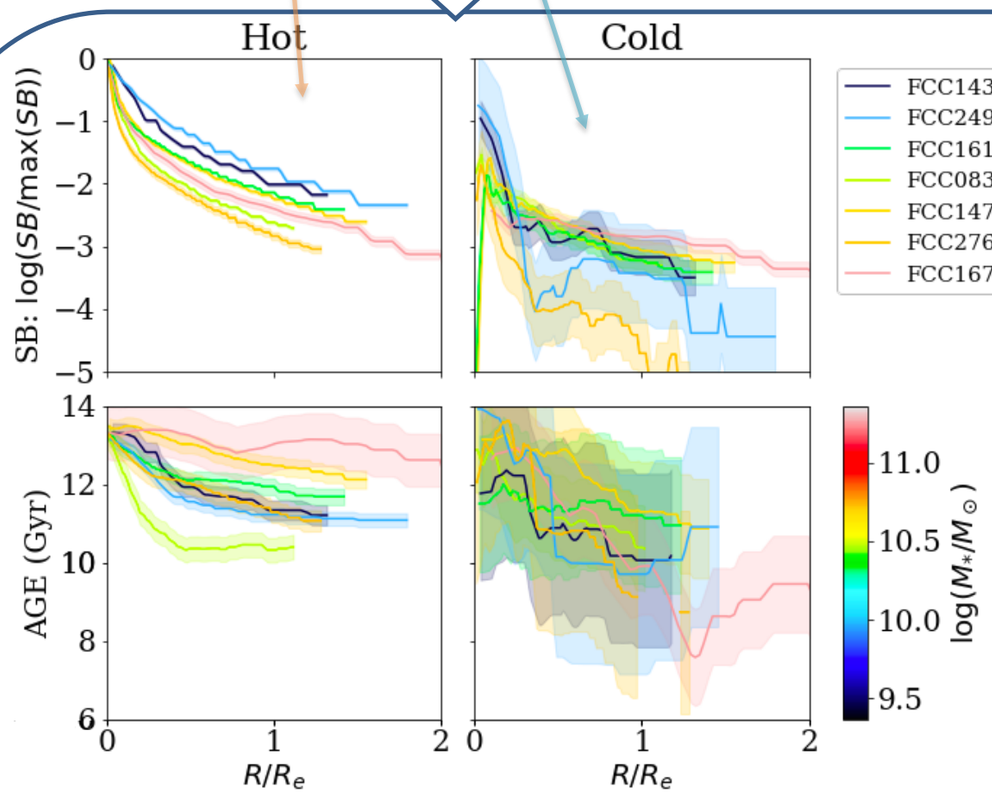


Fig4. Main-axis profiles of Fornax galaxies. From top to bottom: SB, age profile; from left to right: hot and cold disk component. We find non-exponential disk in Fornax cluster. Nine in eighteen (50%) of the Fornax galaxies show negative age gradient on the cold disk.

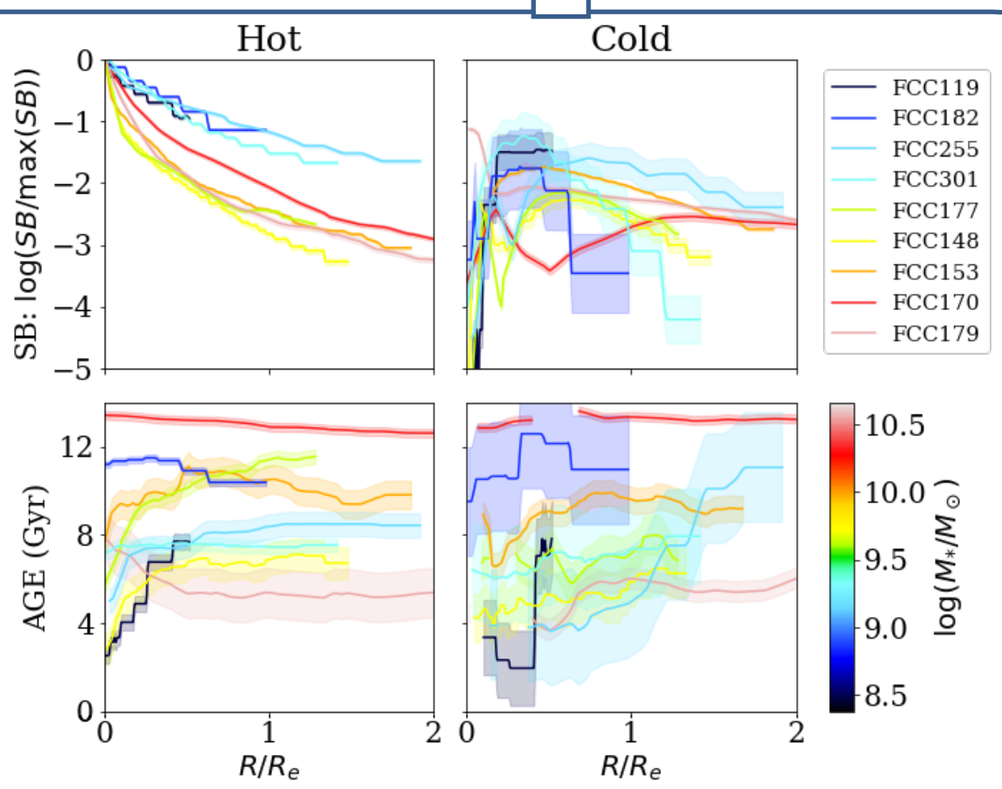


Fig5. Same as Fig.4, but here we demonstrate another half of the Fornax galaxies which show positive age gradient on the cold disk. From simulation, we find that this could be caused by the star-formation enhancement in galaxies' inner stellar region after they fall into a cluster.