

The effect of environment on the fundamental plane of elliptical galaxies

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Abstract. We study the effect of environment to fundamental relation of elliptical galaxies. We find that superclusters, filaments and groups give noticeable effect to slope of velocity dispersions while little to luminosity slope.

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1. Introduction and method

Fundamental plane (FP) is a plane that ties independent parameters of elliptical galaxies: surface brightness inside half-light radius (μ), half light radius (R) and central velocity dispersions (σ):

$$R \sim \sigma^a \mu^b. \quad (1.1)$$

The parameters of FP can be derived from virial theorem, from observations and from simulations. Each of these methods give slightly different values. Taranu *et al.* (2014) simulated spiral galaxy mergers and found $a = 1.7$ and $b = 0.3$. Virial theorem gives $a = 2$ and $b = 0.4$. Observations indicate that a and b values are 1...1.5, 0.25...0.35 respectively depending on observed filter, radius definition and fiber size.

We study FP dependence on three environment classes: superclusters (as large scale luminosity density field), filaments and groups/clusters. Supercluster environment is derived by kernel density distribution (see appendix of Tempel *et al.* 2014b). Data is smoothed with kernel size 8 Mpc/h with the idea it is being close to the average size of supercluster. Filaments are derived using Bisous point process method. This method is implemented on SDSS galaxy structure by Tempel *et al.* (2014a). The volume limited group environment dependence is found with friend of friends method in Tempel *et al.* (2014b). We cleaned the sample by selecting only galaxies that have high probability of being elliptical and can be described by one component.

All the input data can be downloaded from Tartu Observatory cosmology department database: <http://cosmodb.to.ee>.

2. Results

From the Fig. 1 can be seen that the effect of different scale environment (group, filament and large scale density) on the fundamental plane. Dependence is more clear when looking at a parameter, the velocity dispersion slope. In figure is also seen that the effect is similar, therefore it is possible that they describe hierarchical effect: dispersions slope is higher in larger groups and groups are mostly in supercluster or filament regions.

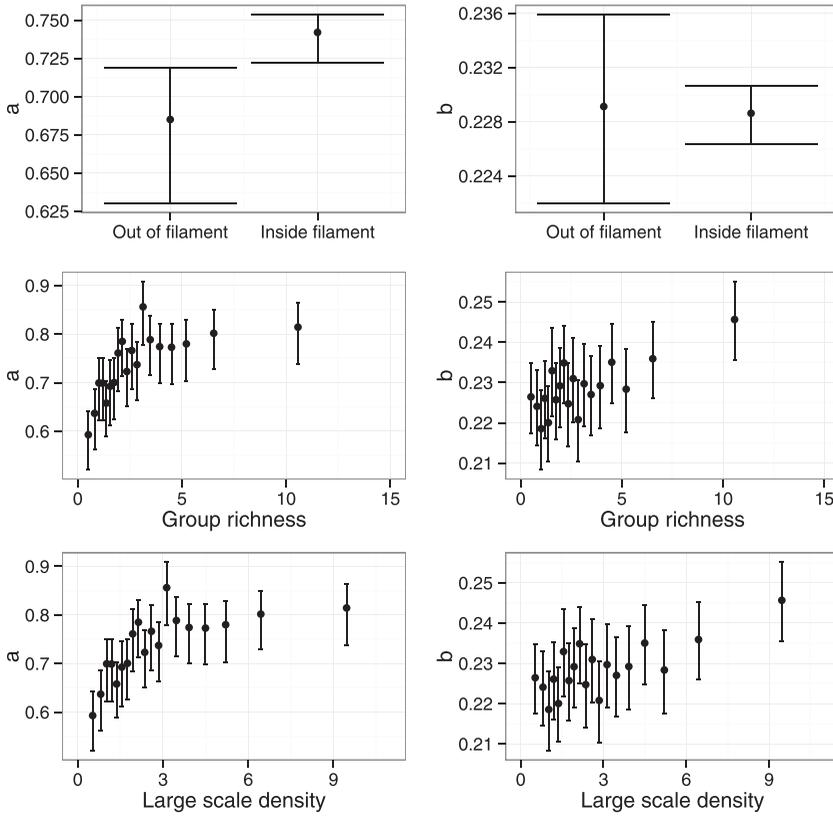


Figure 1. Fundamental plane parameters in filament environment (top panel), group environment (middle panel) and supercluster environment (bottom panel). The errors are 95% confidence intervals.

References

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