

Scaling Relations of Spiral Galaxies: Theory versus Observations

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We use (semi) analytical models of disk galaxy formation within the CDM scenario to investigate the origin of the slope, zero point and scatter in the luminosity-rotation speed (or Tully Fisher; TF) and size-luminosity (SL) relations. The main drivers of scatter in our model relations are due to scatter in the halo concentration parameter, halo spin parameter, and disk mass fraction. We find that scatter in the TF relation is dominated by scatter in halo concentration, while the scatter in the SL relation is dominated by scatter in halo spin parameter. Observations show that the residuals of the TF and SL relations at constant luminosity are only weakly correlated. In order to explain this weak correlation, and at the same time match the zero points of the TF and SL relations, our models favor low mean values of disk mass fraction and halo spin parameter. We discuss implications of these findings for galaxy formation, and the maximum disk hypothesis.

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