

The puzzle of unbarred galaxies

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Abstract. Nearly two thirds of spiral galaxies are either strongly or weakly barred, yet a significant fraction of disc galaxies do not have a bar. Now we understand that there are at least three ways of making bars, i.e., bar instability, tidal interaction, and secular bar growth by orbit trapping of a seed bar. However, the reverse problem of avoiding bar formation in unbarred galaxies may be more challenging than we thought. It is shocking that we still do not understand how the bar instability is avoided in real galaxies such as M33, and this puzzle may be central to the outstanding issue of what determines the distribution of bar strengths in galaxies.

Keywords. galaxies: evolution, galaxies: kinematics and dynamics, galaxies: spiral

This 20-minute talk summarized the main results and discussions from [Sellwood, Shen & Li \(2019\)](#). We highlight the puzzle of unbarred galaxies with the well-observed bulgeless unbarred spiral M33. We create and evolve a dynamical model that is as close a match as possible to the observed constraints and find that the currently-observed state of M33 is prone to bar formation in a short time period. The formation of a bar in M33 is unaffected by how the gas component is modelled, by increasing the mass of the nuclear star cluster, or by making the dark matter halo counter-rotate, but it can be prevented by either reducing the mass-to-light ratio of the stars significantly or by increasing the random motions of the stars. More details can be found in [Sellwood, Shen & Li \(2019\)](#).

We are currently studying more well-observed unbarred galaxies to confirm whether some of them present a similar challenge as M33.

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Reference

Sellwood, J. A., Shen, J., & Li, Z. 2019, *MNRAS*, 486, 4710