SDSS-IV MaNGA: Stellar Population Gradients Within Barred Galaxies.

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ABSTRACT

Bars in galaxies are thought to stimulate both inflow of material and radial mixing along them. Observational evidence for this mixing has been inconclusive so far however, limiting the evaluation of the impact of bars on galaxy evolution. We now use results from the MaNGA integral field spectroscopic survey to characterise radial stellar age and metallicity gradients along the bar and outside the bar in 128 strongly barred galaxies. We find that age and metallicity gradients are flatter in the barred regions of almost all barred galaxies when compared to corresponding disk regions at the same radii. Our results re-emphasize the key fact that by azimuthally averaging integral field spectroscopic data one loses important information from non-axisymmetric galaxy components such as bars and spiral arms. We interpret our results as observational evidence that bars are radially mixing material in galaxies of all stellar masses, and for all bar morphologies and evolutionary stages.

Bar構造は銀河内の物質分布や銀河進化にどのような影響を及ぼすのか？

- 銀河のbar構造は物質を内側へ落とし、その結果radial gradientを薄めると予想される (“radial mixing”)。
- これまでの観測では
  - 空間分解出来ておらず、barの影響が(あったとしても)disk部分と平均化されてしまう。
  - bar/diskを適切に含んでおらず、正しくgradientが見積もられない。
- 空間分解した大規模bar銀河サンプル=MaNGA + Galaxy Zoo:3Dで検証する。

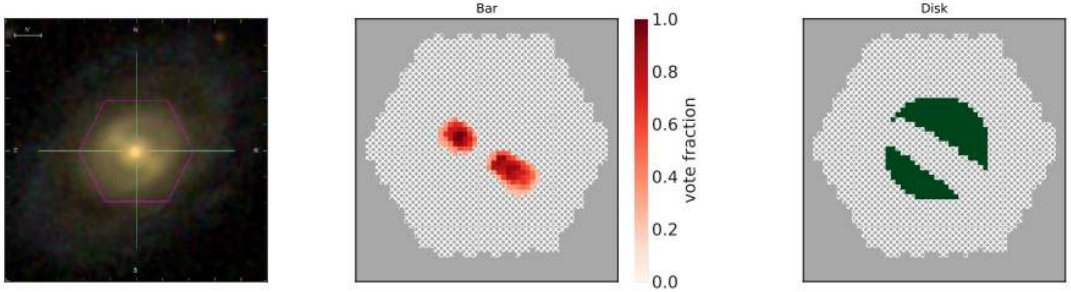

Figure 1. The barred galaxy 8451-6101 (left, with MaNGA field of view as the pink hexagon), and its Galaxy Zoo:3D bar (red, centre) and disk (green, right) masks. The bar mask is scaled by the total vote fraction of respondents. Only spaxels with a vote fraction greater than 0.2 are included in the bar region for analysis. We exclude the central region of the galaxy in our gradient determination in order to compare bar and disk gradients at the same radii. The disk is defined as any spaxel within the IFU field of view that is not included in the bar region.

Fig 1. Galaxy Zoo:3Dによるbar領域、disk領域の分類例

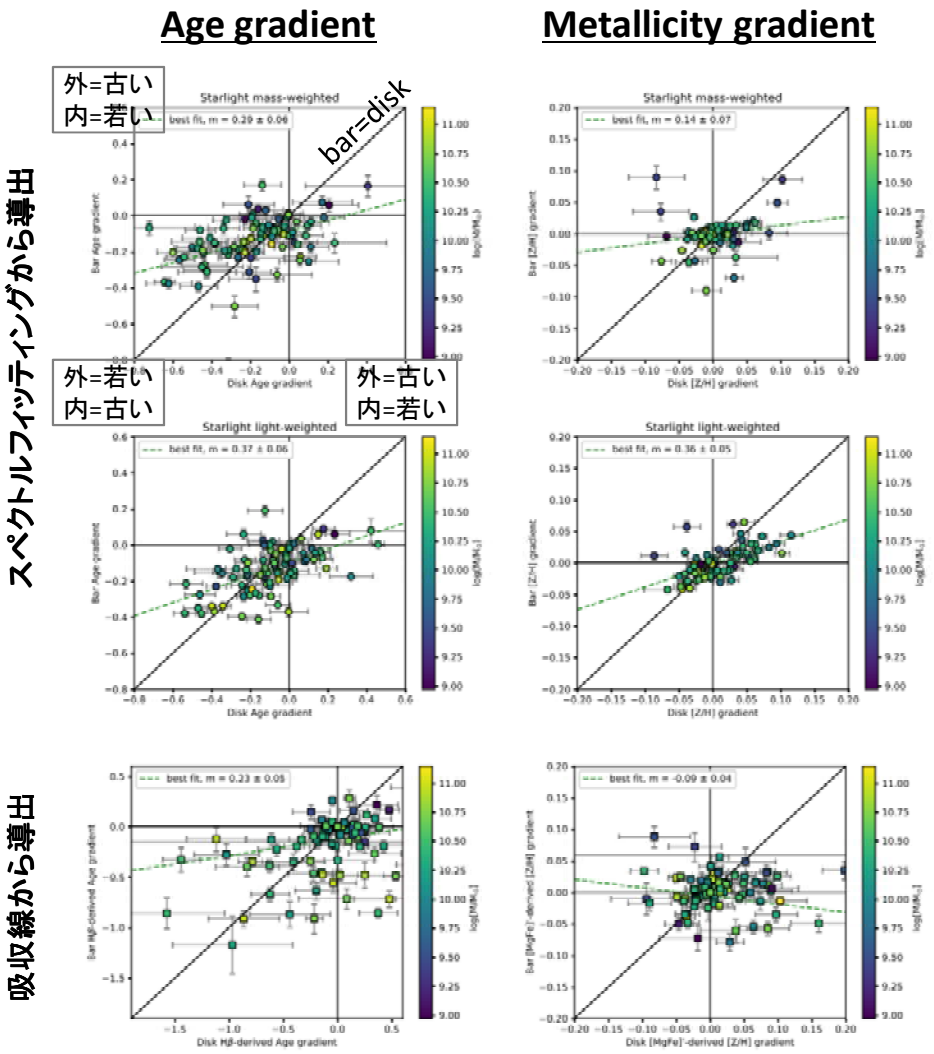

Figure 2. Bar and disk age (left column) and metallicity (right column) gradient comparisons for Starlight mass-weighted (top row), light-weighted (middle row) full spectral fits, and the derived ages and metallicity gradients from index measurements (bottom row, square markers, note different scale on Hβ-derived age plot). Black 1:1 lines denote where the bar and disk gradient is the same for a given galaxy, and a green dashed line indicates the best fit to the data points on each plot. In all cases, stellar population gradients are flatter within the bar than within the disk, indicating that bars are radially mixing stars.

Fig 2. bar, disk領域でのage, metallicity gradient

- Disk領域と比べてbar領域のgradientは小さい (flatter)
  → radial mixingの観測的証拠であり、IFU dataの重要性を示す。

今後:

- barの規模や銀河の環境によって”radial mixing”がどう異なるか？
- Age/metallicity分布の絶対値がbarの有無によってどう異なるか？