

A study of the central stellar populations of galaxies in SDSS-IV MaNGA: identification of a sub-sample with unusually young and massive stars

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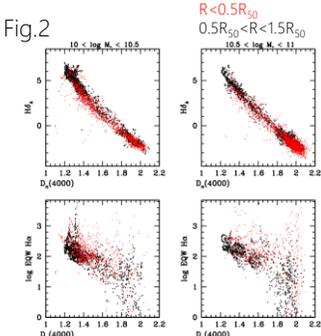
This paper describes a search for galaxy centers with clear indications of unusual stellar populations with an initial mass function flatter than Salpeter at high stellar masses. Out of a sample of 668 face-on galaxies with stellar masses in the range $10^{10} - 10^{11} M_{\odot}$, I identify 15 galaxies with young to intermediate age central stellar populations with unusual stellar population gradients in the inner regions of the galaxy. In these galaxies, the 4000 Å break is either flat or rising towards the center of the galaxy, indicating that the central regions host evolved stars, but the H α equivalent width also rises steeply in the central regions. The ionization parameter [OIII]/[OII] is typically low in these galactic centers, indicating that ionizing sources are stellar rather than AGN. Wolf Rayet features characteristic of hot young stars are often found in the spectra and these also get progressively stronger at smaller galactocentric radii. These outliers are compared to a control sample of galaxies of similar mass with young inner stellar populations, but where the gradients in H α equivalent width and 4000 Å break follow each other more closely. The outliers exhibit central Wolf Rayet red bump excesses much more frequently, they have higher central stellar and ionized gas metallicities, and they are also more frequently detected at 20 cm radio wavelengths. I highlight one outlier where the ionized gas is clearly being strongly perturbed and blown out either by massive stars after they explode as supernovae, or by energy injection from matter falling onto a black hole.

Nuclear Stellar Cluster (NSC)

- Late-type銀河の中心部(バルジ内)にある大質量で若いW-R, O, B星を含む星団
- MWのNSCのK-band光度関数からSalpeterよりフラットなIMFが推定されている
- NSCでstellar mass BHとその衝突成長は中心BH成長に関連?
- MaNGAからバルジ部分で特異な(massive, young)な特徴を持つものを探す

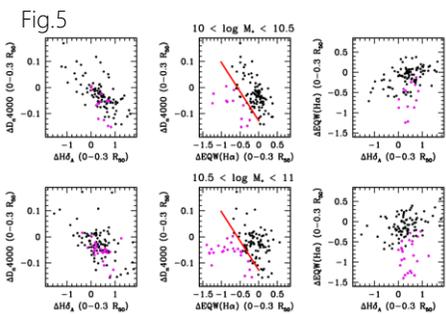
Sample & indices

- MaNGAよりface-on($b/a > 0.7$), half-light radii $> 5'' \sim 2 \times \text{PSF}$, $M_* = 10^{10} - 10^{11} M_{\odot}$ のサンプルを選出 → 668 galaxies
- stellar population ageの指標
 - EQW H α : O, B type star
 - H δ_A index: A, F type star
 - $D_n(4000)$: よりlateな恒星



中心が特に若い天体探し

- 中心の $\Delta \text{EQW}(\text{H}\alpha)$ ($\text{EQW}(\text{H}\alpha)$ の勾配)と $\Delta D_n(4000)$ で選定
- $\Delta \text{EQW}(\text{H}\alpha) < 0$ (中心で若い) & $\Delta D_n(4000)$ が小さい (old stellar ageの変動が小さい)
- $D_n(4000)$ vs $\text{EQW}(\text{H}\alpha)$ で中心部分は主に二つ(?)に分離
 - $D_n(4000) > 1.65$ はAGN
 - $D_n(4000) < 1.65$ のみ議論 (15天体)



色々なRadial profile

- Control sampleと比較する
- まとめてと...
- i. EQW(H α), Dn(4000), H α /H β はより中心上昇 → H α が中心集中し、ダストに覆われている
- ii. 中心で[OIII]/[OII]がわずかに高い → 中心のstellar populationが特殊
- iii. red (~5700Å) & blue (~4600Å) W-R featureがより高い頻度で確認、特にred → UV-selected W-R galaxiesとは異なる
- iv. 中心でstellar, gas-phase metallicityが中心で高い
- v. VLA 20cm radio emissionで検出頻度が高い

Fig.8より抜粋: outlier

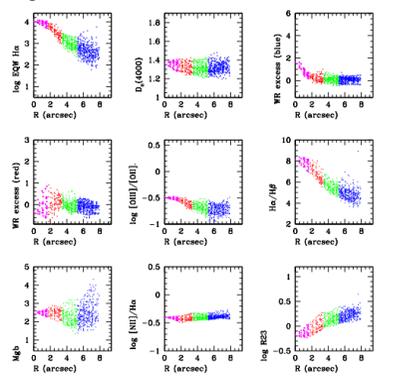
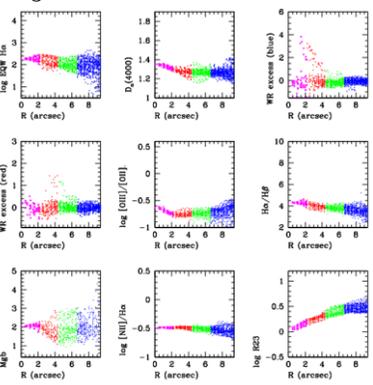


Fig.9より抜粋: control



SSP modelでDn(4000) vs EQW(Ha)を再現

- STARBURST99, BC03, SFR=Ceyt ($\gamma = -2.0 \sim 0.0$)
- Kroup IMFでcontinuous SF and continuous SF+recent SB (strong: 0.1-50%, weak: 0.005-0.1%)を検証 → EQW(H α)のoutlierを再現できない
- IMFを変更してみる: $dN/dm = m^{-\alpha}$ (Salpeter $\alpha = 2.35$)
 - $\alpha = 0.5$ above 7M \odot
 - $\alpha = 0.8$ above 10M \odot
 - EQW(H α)が4-7倍大きくなる
- 中心はダスト減光が強いため、massive starのfeatureがopticalでは隠されているのでは? → H α /H β の分散がちいさいので、dustはそこまでclumpyではない(1天体を除く, Fig.12)

Fig.10

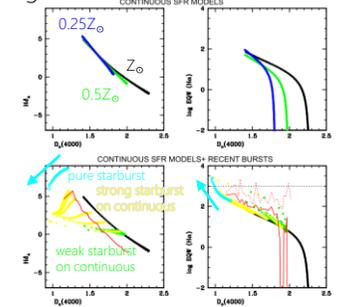


Fig.11

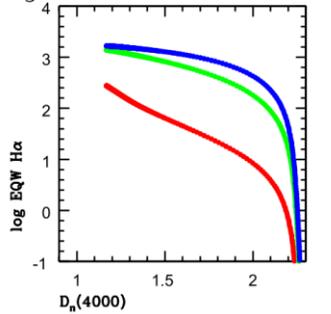


Fig.12

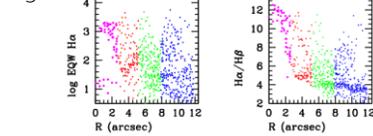
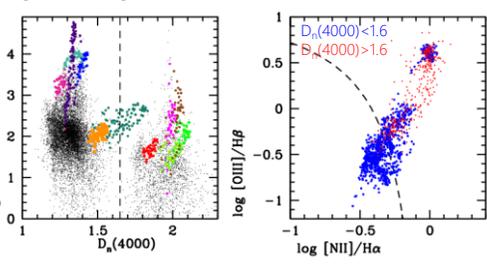


Fig.6, 10 < log M* < 10.5の10/13天体のみプロット



Transition object: central starburst → AGN

- $D_n(4000) < 1.65$ だが、AGNに分類されるようなもの IC910 (LINER: Veron-Cetty & Veron 1996)
- red & blue W-R featureや H α のnon-Gaussian成分が中心で強く検出
- ガスの速度分散が中心で卓越する

