Spatially resolved star formation and metallicity profiles in post-merger galaxies from MaNGA

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ABSTRACT

Large galaxy surveys have demonstrated that galaxy-galaxy mergers can dramatically change the morphologies, star formation rates (SFRs) and metallicities of their constituents. However, most statistical studies have been limited to the measurement of global quantities, through large fibres or integrated colours. In this work, we present the first statistically significant study of spatially resolved star formation and metallicity profiles using integral field spectroscopy, using a sample of ~20,000 spaxels in 36 visually selected post-merger galaxies from the Mapping Nearby Galaxies with Apache Point Observatory (MaNGA) survey. By measuring offsets from SFR and metallicity scaling relations on a spaxel-by-spaxel basis, we are able to quantify where in the galaxy these properties are most affected by the interaction. We find that the SFR enhancements are generally centrally peaked, by a factor of 2.5 on average, in agreement with predictions from simulations. However, there is considerable variation in the SFR behaviour in the galactic outskirts, where both enhancement and suppression are seen. The median SFR remains enhanced by 0.1 dex out to at least 1.9 Re. The metallicity is also affected out to these large radii, typically showing a suppression of ~ −0.04 dex.

arXiv.1810.00897

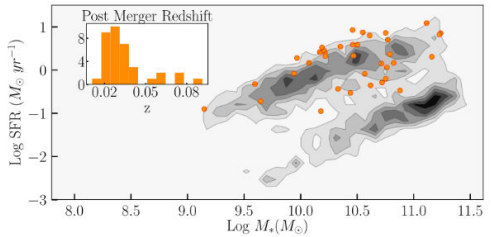

Figure 1. SFR-mass distribution of the full DR14 MaNGA data set (grey contours), with our post-merger sample overlaid as orange points. The inset shows the redshift distribution of the post-merger sample.

Fig1.
post-merger samples on MS

Interactionによって銀河のどこがどう影響を受けるのか？

- SDSS MaNGAから見た目でpost-mergerを選び、SFRと金属量分布（のMS銀河からのズレ）をradial profileで（統計的に）見てみる。

Fig2. post-merger 例

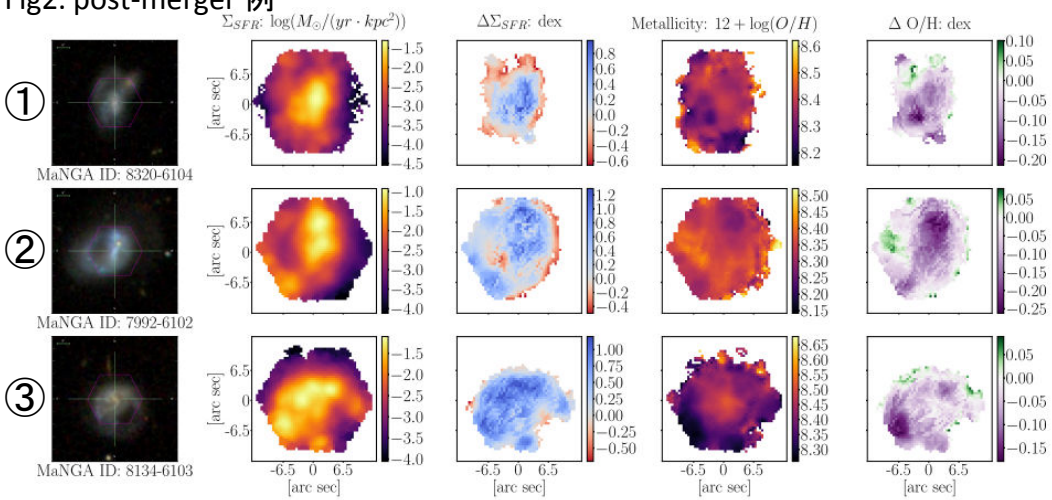

Figure 2. MaNGA data products and offset maps for 3 example post-merger galaxies. 1st column: SDSS *gri* image with MaNGA IFU footprint overlaid in magenta. 2nd column: Map of Σ_{SFR} as determined by PIPE3D. 3rd column: Offset in Σ_{SFR} ($\Delta\Sigma_{SFR}$) from the resolved main sequence; enhancements are shown in blue and deficits in red. 4th column: Map of O3N2 metallicity measurements from PIPE3D. 5th column: Offset in metallicity from the resolved mass-metallicity relation (ΔO/H); enhancements are shown in green and deficits in purple. Some spaxels are lost in the matching process for offset maps.

- ✓ 星形成：中心部でenhanceしているが、外側に行くにつれて落ち着き、suppressが見られるものも。
  - Interactionによって銀河外縁部のgasが中心に落ち込むことで、中心でenhance、外縁部ではsuppress。
- ✓ 金属量：中心付近で特に薄まり、外縁部まで続いている。
  - （metal poorな）gasの落ち込みによって特に中心付近で薄まる。
  - 中心部で薄まりが弱いのはnuclear SF feedbackか、分解能のせいか。

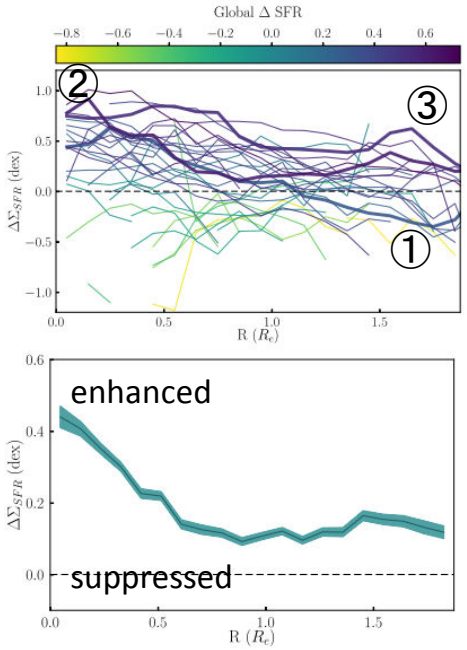

Figure 3. SFR enhancement in post-mergers as a function of radius. **Top panel:** All $\Delta\Sigma_{SFR}$ profiles as a function of effective radius, coloured according to the global ΔSFR of the host galaxy. Bold lines represent galaxies from Fig.2. **Bottom panel:** Median profiles for all galaxies, the width representing the error on the mean. Note that the top panel has a different y-scale.

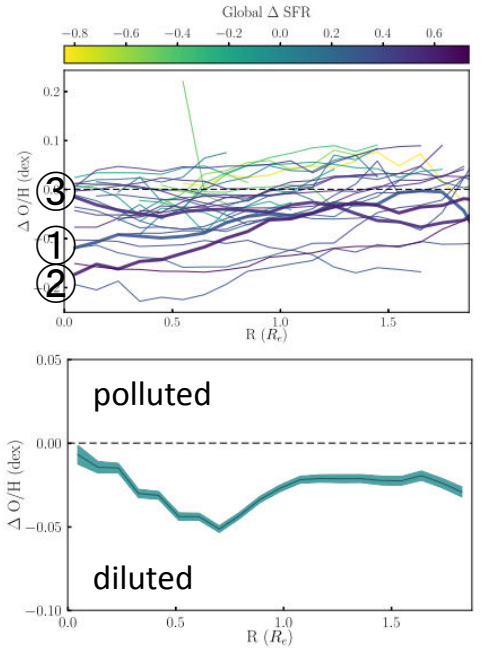

Figure 4. Metallicity suppression in post-mergers as a function of radius. **Top panel:** All ΔO/H profiles plotted against effective radius, coloured according to the global ΔSFR of the host galaxy. Bold lines represent galaxies from Fig.2. **Bottom panel:** Median profile for all galaxies, the width representing the error on the mean. Note that the top panel has a different y-scale.

- Enhance/suppress、dilutionどれも非一様なので、1次元ではなく2次元分布で見る必要がある（今後）。
- （Merger stageによる違いも見るべき。）