

# Environmental effects on the star formation activity in galaxies at $z \sim 1.2$ in the COSMOS field

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## Abstract

We investigate the relation between the star-formation activity in galaxies and environment at  $z \sim 1.2$  in the COSMOS field, using the fraction of [OII] emitters and the local galaxy density. The fraction of [OII] emitters appears to be almost constant over the surface density of galaxies between 0.2 and 10  $\text{Mpc}^{-2}$ . This trend is different from that seen in the local universe where the star-formation activity is weaker in higher galaxy density regions. To understand this difference between  $z \sim 1$  and  $z \sim 0$ , we study the fraction of non-isolated galaxies as a function of local galaxy density. We find that the fraction of non-isolated galaxies increases with increasing density. Our results suggest that the star formation in galaxies at  $z \sim 1$  is triggered by galaxy interaction and/or mergers.

## 1. Introduction

The formation and evolution of galaxies

⇒ "when" and "where" stars formed in the history of the universe

The current picture of star formation history (SFH)

Star formation rate density

$z > 3$  increases with decreasing  $z$   
 $1 < z < 3$  peak  
 $z < 1$  decreases with decreasing  $z$

⇒ This gives us only the "averaged" picture of the SFH. There are structures like high- and low- density regions in the universe.

⇒ It is essential to study the star formation in galaxies as a function of both the redshift (when) and the environment (where).

We study the relation between the star formation activity and the environment at  $z \sim 1$  in the COSMOS field, indicating rapid change of the star formation rate density.

In order to study this...

We estimate star formation activity by focusing "emitter fraction", and environment by using surface galaxy density.

Thanks to the very large survey area ( $2 \text{deg}^2$ ) of the COSMOS field, we are able to obtain a typical picture of the star-formation activity in galaxies, avoiding the cosmic variance.

## 2. Sample

[OII] emitter sample ( $z=1.17-1.20$ )

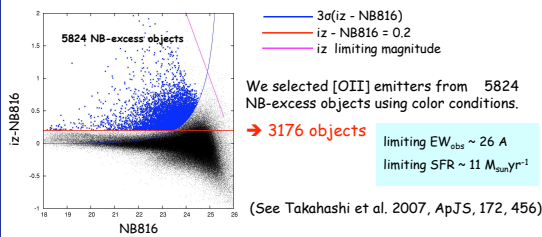
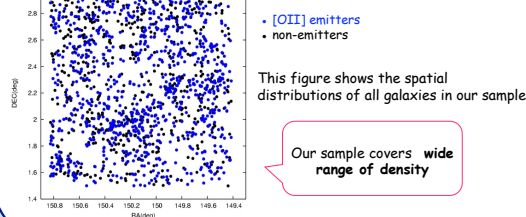


Photo-z sample ( $z=1.17-1.20$ )

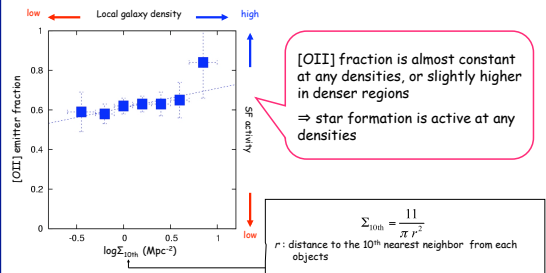
We selected galaxies with  $z=1.17-1.20$  and  $i' < 24$  using photo-z catalog (Ilbert et al. 2009, ApJ, 690, 1236)

⇒ Total: 1553 objects  
 [OII] emitters: 965 objects  
 Non-emitters: 588 objects

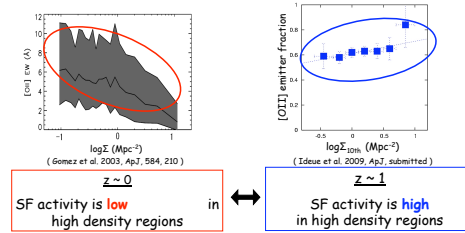


## 3. Results and Discussion

Density dependence on star formation activity



Comparison between  $z \sim 0$  and  $z \sim 1$



What is the origin of this difference?

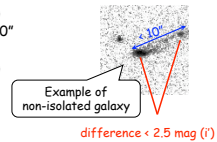
⇒ since gas fraction is higher @  $z \sim 1$  than @  $z \sim 0$ , interactions trigger star formation @  $z \sim 1$ ?

⇒ we investigate environmental dependence on the interaction fraction

Analysis of "galaxy interaction"

We classified our sample into isolated galaxies and non-isolated galaxies

- Isolated galaxies (likely non-interactions) do not have the nearest neighbors within  $10''$
- Non-isolated galaxies (likely interactions) have the nearest neighbors within  $10''$

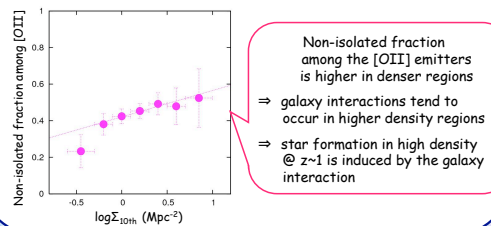


⇒ We find that the non-isolated galaxies is 37% over the whole sample and 71% of all non-isolated galaxies in the sample are [OII] emitters.

Non-isolated fraction  
 [OII] emitter sample : 43 %  
 Non-emitter sample : 28 %

⇒ interactions tend to be star-forming galaxies

Density dependence on the galaxy interaction



## 4. Summary

- The relation between the fraction of [OII] emitters and the local galaxy density @  $z \sim 1.2$  is flat, suggesting a different trend from the local universe.
  - We find that the fraction of non-isolated galaxies is 37% over the whole sample, including both 43% [OII] emitters and 28% non-emitters.
  - The fraction of non-isolated galaxies among the [OII] emitters increases with increasing density.
- ⇒ These suggest that the origin of that difference between  $z \sim 0$  and  $z \sim 1$  is the influence of "wet" galaxy interactions.