Extra-Galactic Science with Subaru GLAO

Based on the Subaru ngAO workshop@Osaka on 2011/9/8-9
Tadayuki Kodama (Subaru) on behalf of the ngAO Science Workshop
The 1st Subaru Conference (Dec. 2007, Hayama) Panoramic Views of Galaxy Formation and Evolution based on the results with wide field instruments
The X-th Subaru Conference:

“Narrow” Views of Galaxy Formation and Evolution based on the results with Classical Adaptive Optics ??

Venue…

Accommodation…
The X-th Subaru Conference:

“Panoramic” AND “Sharp” Views of Galaxy Formation and Evolution based on the results with GLAO!

The Mt. Fuji (3776m) on the Fuji river viewed from Shinkan-sen
Advantages of GLAO on Subaru

Diffraction Limit: 0.06" @2μm ⇔ ~0.5kpc @z>1
Ground Layer AO: 0.2" @2μm ⇔ ~1.5kpc @z>1

Stars and gas within galaxies can be “just” resolved.

Field of View can be as large as 10-15 arcmin with GLAO

At the same time, statistical studies are possible.

• Imaging (+NB filters?)
  galaxy morphologies (Hubble types, mergers, size)
  distribution of star formation within galaxies

• Spectroscopy (multi-IFU):
  internal kinematics (rotation/random, inflow/outflow)
  metallicity distribution
Red emitters are found in the outskirts and in groups!

Koyama et al. (2011)

 nb921 imaging of ha emitters

"Octopus cluster" (cl0939@z=0.41)

Koyama’s talk

- red HAEs
- blue HAEs

SFR > 0.75M☉/yr

What are they?
- Dusty SF? or
- Passive+AGN?

What is their origin?

NB921 imaging of Hα emitters
i z=0.4 cluster
Ha emitters in two high-z proto-clusters at z>2

“Red emitters” tend to favor high density regions!

What’s the origin of “red” Hα emitters? Dusty+SF (SF mode)? or Passive+AGN (AGN activity)?

Hayashi et al. (2012), See Hayashi’s talk

Koyama et al. (in prep)
Koyama’s talk

What are the morphologies of these red emitters?

HST morphologies are available only in the cluster core...

Any signature of galaxy-galaxy interaction?
Koyama’s talk

Science with AO + NB imaging

Spatially resolved SF distribution

- 銀河内のどこで星形成が起こっているか？
  (nuclear starburst か、extended disk SF か)
- S0銀河の形成とも関係
  (bulge growth?)

Tunable filter 検討の可能性は？

- HSC や FMOS などによって今後見つかるあらゆる redshift の大規模構造を NB サーベイするイメージ。
  (サンプル数の圧倒的な向上 + multi-line survey)
- 参考: SPICA も広視野を目指す。
Importance of IFU

- 銀河内のどこで星形成が起こっているか？
  (nuclear starburst か、extended disk SF か)
  ただしこれはAO+NB撮像で観測視野全体で行える。

- kinematics の情報
  (merger の兆候はあるか、普通の disk rotation か)

- Spatially resolved line ratios
  (AGN, Hα/Hβ, metallicity)

KMOS type multi-IFU with assistance of GLAO will be unique!
(24 units in 7.2’ Φ FoV)
SF and chemical evolution in merging galaxies

N-body/SPH (GADGET-2) Simulation
Torrey et al. (2011)

Gas which lost angular momentum through merger fall into galaxy center and decreases the central metallicity. Initially, but the subsequent starburst increases metallicity later on.

Direct comparison with numerical simulation!
Outflows from distant galaxies

2. QSO absorption lines

3. Dijkstra+2009

Ryan-Weber+2010

_outflow velocity [km/s]

escaped fraction

redshift

銀河間の金属量変化にも関係？アウトフローによりLyα脱出率が増大→宇宙再電離への正確な制限

他にも、銀河LF, ULIRG→QSO進化などにも重要な役割を果たす
Velocity structure (bi-polar like outflow by AGN feedback?) or Velocity offsets between Lyα and Hα/[OIII]/Hβ as a function of positions
Shibuya’s talk

Outflows at $z \sim 3$ with ngAO

- 2.5 < $z$ < 4 LAE
- R < 19 TTGS

Subaru Deep Field

GLAO FoV

MOAO FoR

グリッド間隔 = 1'
Lower metallicity in the center → cold streams (pristine) may have decreased it
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