Formazione ed evoluzione delle Galassie e delle strutture cosmiche

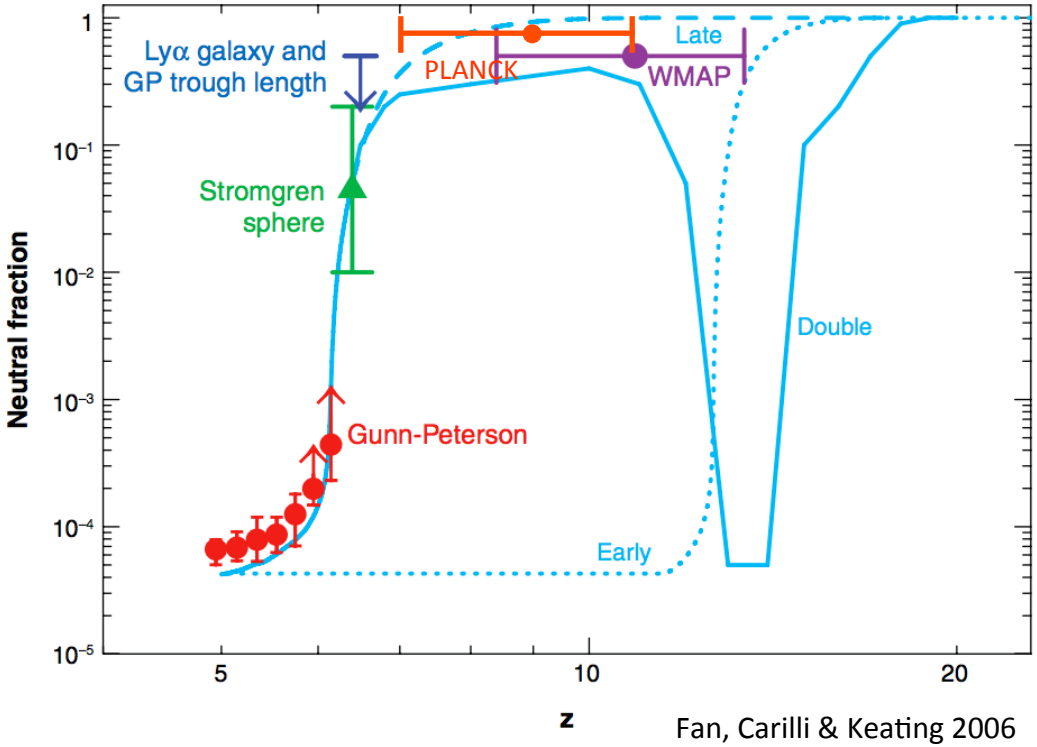
Valentina D'Odorico (OATs), Carlotta Gruppioni (OABo) e Stefano Andreon (OABrera) per il gruppo di lavoro sul DVS

Meeting MA1, SAIt 2017 – Padova

When and how did reionization occur?

From the optical depth of Thomson scattering (measured from CMB), evolution of LAEs and Gunn Peterson trough in the Lyman-alpha forest we know that reionization occurred between redshift ~9-10 and 6.

➔➔ Now we want to understand the details of the process



Fan, Carilli & Keating 2006

When and how did reionization occur?

Main probe ➔ intensity mapping of redshifted 21cm radiation measured with radio interferometers ➔ SKA and precursors

Independent and complementary probes of the amount of HI are needed ➔ Ly-alpha emitters and QSOs at z>>6 ➔ JWST, ELT

Are we ready (or are we preparing) to tackle this science?

Are we building the expertise to deal with radio observations (intensity mapping)?

Observations + Simulations

Which sources caused reionization?

Galaxies or QSOs, or both?

Methods:

- Direct observations of the objects at high redshift (JWST, WFIRST)
- Indirect evidences from the patchiness of HI, from the chemical abundances of metal poor objects, etc (SKA, ELT)

More questions

- Will we ever be able to measure the escape fraction of ionizing photons from high-z galaxies?
- Will simulations help us in this sense?

How, when and where did the first SMBHs form?

The presence of luminous QSOs at z>6 is difficult to explain because there is not much time to form the central SMBH.

Method

- Use deep X-ray observations of high-z QSOs to reveal the physics of accretion of early SMBHs and their environment (presence of other, obscured AGNs?)
- Use deep X-ray blank sky fields to discover the typical population of accreting BH at z>6

Chandra, XMM ➔ Athena

Which strategy to optimize results?

- Organize Task Forces within (or even across) MA to tackle identified questions?
The idea would be to put together people approaching the same topic from different point of views to boost collaborations and new results.

- ….

Key Questions (DVS)

1 - Origin and fate of galaxies, the galaxy stellar mass function and morphological differentiation.

2 - Feedback processes among the different components of galaxies (stars, gas, dust) and AGN. Role of DM halos.

The origin and Evolution of Galaxies

Understanding galaxy evolution requires the knowledge of the main galaxy properties and their dependence on environment and cosmic time.

Many physical processes may shape galaxies:

1. AGN activity is partly regulating and partly being regulated by star formation.

2. Stellar mass and environment govern the processes that lead to the quenching of star formation and the emergence of the passively evolving sequence.

3. Galaxy assembly is connected to dark matter growth.

Methods

- Observe the properties of nearby galaxies in great details
- Look at the distant Universe to examine the properties of galaxies at different epochs
- Continuously compare the empirical picture derived from observations and theoretical models

Basic Questions:

1. Were primordial galaxies different? Which is the IMF of the very low metallicity stellar populations at high-z? What is the dust content of high-z primordial galaxies?

2. How does the baryon cycle between gas/metals in galaxies and gas/metal 'outside' (in the interior circum-galactic medium) work? Chemical enrichment history…

3. Are black holes and galaxies co-evolving or is this just a consequence of the mechanisms driving black hole formation? Are nuclear activity and star formation in causal or incidental relation?

Basic Questions:

4. Which physical processes drive the cosmic star formation history, and in particular the quenching of star forming galaxies?

5. What physical processes shape and transform the structural parameters of galaxies? What drives the size evolution of massive early-type galaxies?

6. Which is the interplay of enviroment and galaxy evolution? What is the enviroment that matters and how does this change with cosmic time?

Methods/Projects (from DVS):

- Detailed observation of gas kinematics, inflows/outflows, connections with ICG, ICM

➔ ALMA, JWST, VLT-MUSE, SKA, ELT, WEAVE

- Observation of molecular gas

➔ ALMA, IRAM/PdB&NOEMA, JVLA

- H I content of gas

➔ SKA

- ISM and dust properties in galaxies and AGN

➔ ALMA, SPICA

- Statistical studies at different epochs linking galaxy evolution with the driving mechanisms of galaxy growth

➔ Euclid, LSST, VST, VISTA, MOONS

ARE WE MISSING ANY CRUCIAL QUESTIONS?

ARE WE MISSING ANY CLEVER METHODS?

ARE WE REALLY PROMOTING THE RIGHT/BEST RESEARCH PROJECTS?