Title:

Resolving star formation regions at 10s pc resolution within magnified distant galaxies with the ELT instruments.

Abstract:

Distant galaxies present an irregular morphology dominated by compact sub-structures called “clumps”. Thanks to JWST observations of magnified galaxies (which is so far the only way to resolve individual clumps (<300 pc) and star clusters (<20 pc)), the physical properties of these systems and their role in galaxy evolution can now be explored. The first works indicate that these clumps are a major mode of star formation and morphological evolution of galaxies.

I will present the properties of the first statistical sample of thousands distant JWST clumps (at 1<z<10) obtained from NIRCam observations of strongly lensed galaxies in multiple galaxy cluster fields. Exploring the redshift evolution of the clumps properties, we can investigate on the evolution of galaxies stellar substructures from the reionisation era (z=5-10) to the cosmic noon (z=1-4). Clumps are on average more star-forming, denser and younger at higher redshift and represent a significant fraction of their host galaxy stellar mass and star formation activity. At cosmic noon, the distributions indicate proto-bulge growth, in-situ formation from disk fragmentation and active star cluster formation. Individual clumps exhibit very high emission lines EW (probed thanks to NIRCam medium-band filters) indicating a complex propagation of star formation and bursty star formation histories within these distant galaxies. Clumps show also high ionising photon production efficiency, suggesting that they could have played a significant role in the reionisation of the Universe.

While JWST observations dramatically increased the statistics and then opened a new window on resolved star formation and stellar regions within distant galaxies, we are still limited by both the spatial resolution for the smallest objects (i.e., individual star clusters and very small structures) and by the lack of spatially resolved spectroscopic observations (to constrain clumps recent SFR, metallicity, kinematics…).

The combination of JWST observations with future ELT instruments (especially MICADO/ MORFEO for and HARMONI), will enable us to build a coherent picture of star formation processes in the early Universe.