ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DIPARTIMENTO DI FISICA E ASTRONOMIA
Department of Physics and Astronomy - DIFA

PhD project in ASTROPHYSICS

Title of the Project: Rapid Quenching by Major Mergers

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Scientific Case: Galaxy mergers are powerful events that have the potential for dramatically changing the physical properties of galaxies. However, it is still unclear whether mergers are actually driving some of the observed transformations that take place during galaxy evolution. One transformation that is particularly important is galaxy "quenching", i.e. the process that turns star-forming galaxies into gas-poor, quiescent galaxies. A decade of observational and theoretical research has concluded that mergers are probably not the main cause for galaxy quenching *in the local universe*. However, recent observations have suggested that major mergers may play a dominant role during the key epoch of "Cosmic Noon", around redshift $z\sim2$, when quenching is both rapid and common among the most massive galaxies.

Outline of the Project: The goal of the project is to use data from the newly launched James Webb Space Telescope (JWST) to assess the connection between major mergers and rapid quenching of massive galaxies at $z\sim2$. The project consists of three inter-related parts, and includes both theoretical and observational work:

1. In the first part of the project the student will develop idealized numerical simulations of galaxy interactions that reproduce the JWST/NIRCam images of observed major mergers. These simulations will represent a key tool for the correct interpretation of the observations.

2. The student will then analyze multi-band JWST/NIRCam imaging and, if available, JWST/NIRSpec spectroscopy to extract the physical properties of the merging galaxies. The main result of this analysis will be a comparison between the time of pericentric passage obtained from the numerical simulations and the time of quenching measured from the observations. A coincidence in the timing would strongly suggest a causal connection between mergers and quenching.

3. The results of detailed studies of mergers, including their timescale and their effect on star formation and stellar populations, will then be applied to a statistical sample obtained from large public surveys with JWST/NIRCam. The student will compare the merger rate to the quenching rate, both derived from JWST data. This comparison will allow us to finally assess the role played by major mergers in galaxy quenching.

The student will be part of the Bologna-based, ERC-funded *Red Cardinal* project, starting in 2023.

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