Can simulations quench enough early massive galaxies by boosting high-redshift black hole growth?

The James Webb Space telescope has increased the number of reported massive quenched galaxies at z>2, further increasing tensions with simulations. Typically, simulations require the growth of massive black holes (>% of galaxy mass) to quench galaxies with kinetic feedback. This reinforced tension suggests faster and more widespread black hole growth in the first few billion years than imagined. At the same time, numerous AGN candidates have been found out to high redshifts, including in lower galaxy masses that previously thought possible. In this talk, I use zoom simulations of massive Horizon-AGN galaxies to investigate physical model changes that favor early black hole growth and quenching. In particular, I find that going to higher resolutions tends to inhibit black hole growth at high redshifts, leading to fewer massive quenched galaxies than in HAGN, and increasing the tension with observations.
Lowering the star formation efficiency can favor the formation of such structures and promote earlier black hole growth. Tweaking the sub grid-modeling for dynamical and hydrodynamical friction experienced by the black holes can also contribute. However, overall it appears that Super-Eddington growth periods may be required in order to quench enough galaxies. At the same time, I investigate the definition of quenching in simulations and observations thanks to realistic NIRCAM mocks and comparisons with the COSMOS-Webb survey.