Sune Toft (Dark Cosmology Centre , faculty/staff)

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Presentation Requested: oral
Category: Assembly of Galaxies / Mass & Structure Evolution
Question: How do galaxies grow over time? How does its mass (stellar, gas and dark matter) and structure change over cosmic time? What can ALMA in conjunction with other telescopes tell us about the assembly of galaxy disks and spheroids?

Sub-mm galaxies as progenitors of compact quiescent galaxies

Three billion years after the big bang (at redshift z=2), half of the most massive galaxies were already old, quiescent systems with little to no residual star formation and extremely compact with stellar mass densities at least an order of magnitude larger than in low redshift ellipticals, their descendants. Little is known about how they formed, but their evolved, dense stellar populations suggest formation within intense, compact starbursts 1-2 Gyr earlier (at $3 < z < 6$). Simulations show that gas-rich major mergers can give rise to such starbursts which produce dense remnants. Sub-millimeter selected galaxies (SMGs) are prime examples of intense, gas-rich, starbursts. With a new, mass-complete spectroscopic sample of compact quiescent galaxies at z=2 and a statistically well-understood sample of SMGs, we show that $z = 3 - 6$ SMGs are consistent with being the progenitors of $z = 2$ quiescent galaxies, matching their formation redshifts and their distributions of sizes, stellar masses and internal velocities. Assuming an evolutionary connection, their space densities also match if the mean duty cycle of SMG starbursts is 42^{+40}_{-29} Myr (consistent with independent estimates), indicating that the bulk of stars in these massive galaxies were formed in a major, early surge of star-formation. These results suggests a coherent picture of the formation history of the most massive galaxies in the universe, from their initial burst of violent star-formation through their appearance as high stellar-density galaxy cores and to their ultimate fate as giant ellipticals. The above conclusions were derived from multi-wavelength analysis of data from a range of facilities, operating optical, NIR, MIR, FIR and Sub-mm and radio wavelengths. At the time of the meeting we will in addition have high resolution ALMA data which will be taken over the next months. With these we will be able to derive restframe FIR morphologies and sizes of the star forming regions in the z¿3 SMGs and derive dynamical information, from the spatially resolved CII and NII lines.