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# A Milky Way-like barred spiral galaxy at a redshift of 3

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# Abstract

The majority of massive disk galaxies in the local Universe show a stellar barred structure in their central regions, including our Milky Way. Bars are supposed to develop in dynamically cold stellar disks at low redshift, as the strong gas turbulence typical of disk galaxies at high redshift suppresses or delays bar formation. Moreover, simulations predict bars to be almost absent beyond  $z = 1.5$  in the progenitors of Milky Way-like galaxies. Here we report observations of ceers-2112, a barred spiral galaxy at redshift  $z_{\text{phot}} \approx 3$ , which was already mature when the Universe was only 2 Gyr old. The stellar mass ( $M_{\star} = 3.9 \times 10^9 M_{\odot}$ ) and barred morphology mean that ceers-2112 can be considered a progenitor of the Milky Way, in terms of both structure and mass-assembly history in the first 2 Gyr of the Universe, and was the closest in mass in the first 4 Gyr. We infer that baryons in galaxies could have already dominated over dark matter at  $z \approx 3$ , that high-redshift bars could form in approximately 400 Myr and that dynamically cold stellar disks could have been in place by redshift  $z = 4-5$  (more than 12 Gyrs ago).

