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От Сильченко О.К.

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Uncovering the stellar structure of the dusty star-forming galaxy GN20 at z=4.055 with MIRI/JWST

L. Colina[1], A. Crespo Gómez[1], J. Álvarez-Márquez[1], A. Bik[2], F. Walter[3], L. Boogaard[3], A. Labiano[1,4], F. Peissker[5], P. Pérez-González[1], G. Östlin[2], T.R. Greve[6,7,8], H.U. Nørgaard-Nielsen[6], G. Wright[9], A. Alonso-Herrero[10], R. Azollini[1,11], K.I. Caputi[12,7], D. Dicken[9], M. García-Marín[13], J. Hjorth[14], O. Ilbert[15], S. Kendrew[13], J.P. Pye[16], T. Tikkanen[16], P. van der Werf[17], L. Costantin[1], E. Iani[12], S. Gillman[6,7], I. Jermann[6,7], D. Langeroodi[14], T. Moutard[15], P. Rinaldi[12], M. Topinka[11], E.F. van Dishoeck[17], M. Güdel[19,3,20], Th. Henning[3], P.O. Lagage[21], T. Ray[11], and B. Vandenbussche[22]

(Affiliations can be found after the references)

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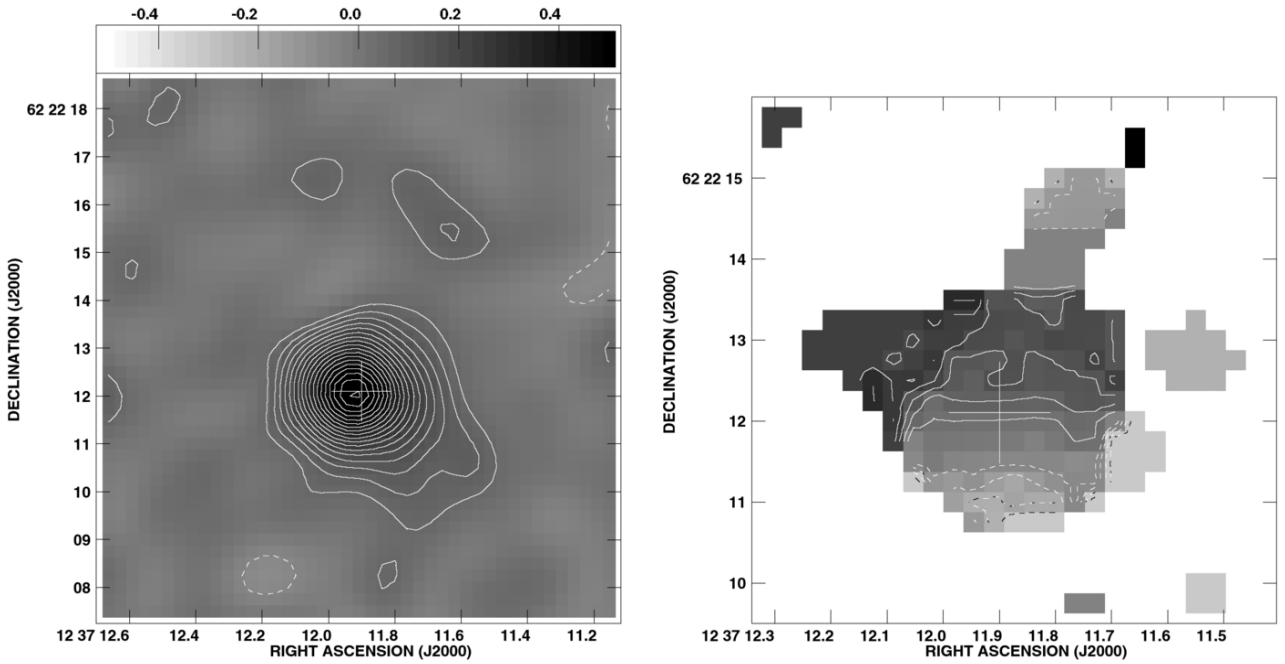
ABSTRACT

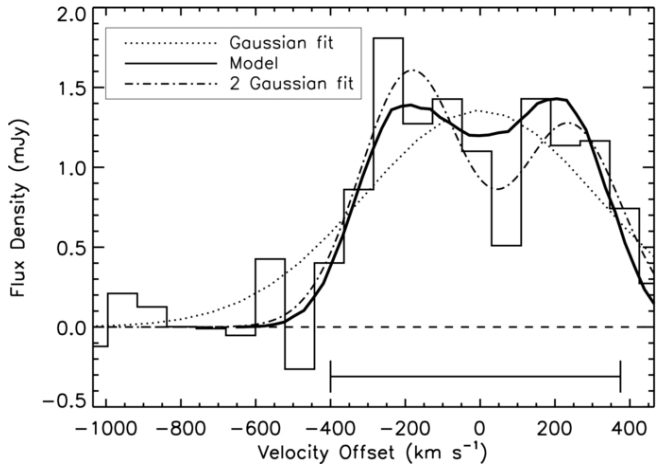
Luminous infrared galaxies at high redshifts ($z > 4$) include extreme starbursts that build their stellar mass over short periods of time, that is, of 100 Myr or less. These galaxies are considered to be the progenitors of massive quiescent galaxies at intermediate redshifts ($z \sim 2$) but their stellar structure and buildup is unknown. Here, we present the first spatially resolved near-infrared (rest-frame 1.1 μm) imaging of GN20, one of the most luminous dusty star-forming galaxies known to date, observed at an epoch when the Universe was only 1.5 Gyr old. The 5.6 μm image taken with the JWST Mid-Infrared Instrument (MIRI/JWST) shows that GN20 is a very luminous galaxy ($M_{1.1\,\mu m,\,AB} = -25.01$, uncorrected for internal extinction), with a stellar structure composed of a conspicuous central source and an extended envelope. The central source is an unresolved nucleus that carries 9% of the total flux. The nucleus is co-aligned with the peak of the cold dust emission, and offset by 3.9 kpc from the ultraviolet stellar emission. The diffuse stellar envelope is similar in size (3.6 kpc effective radius) to the clumpy CO molecular gas distribution.

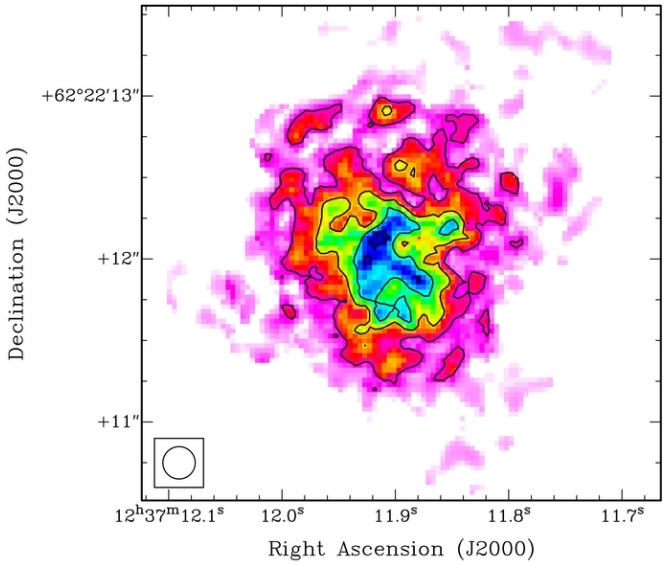
Давно открытое (прото-)скопление галактик на z=4.05…

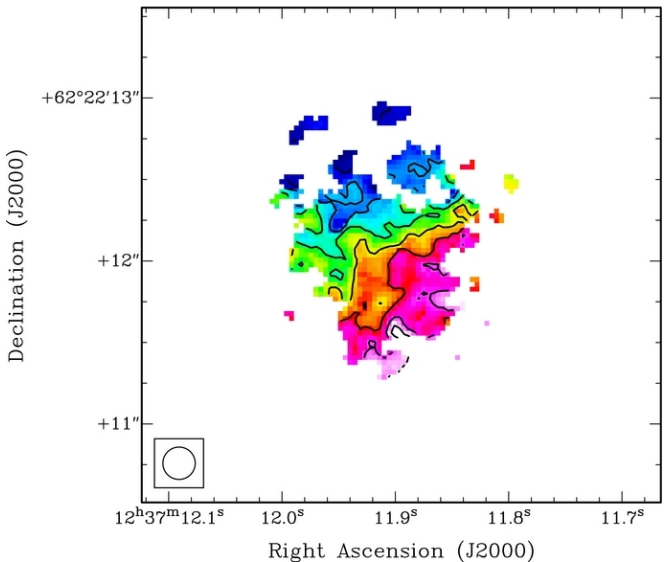


Carilli+(2011): CO 2→1

… разрешили диск молекулярного газа на VLA

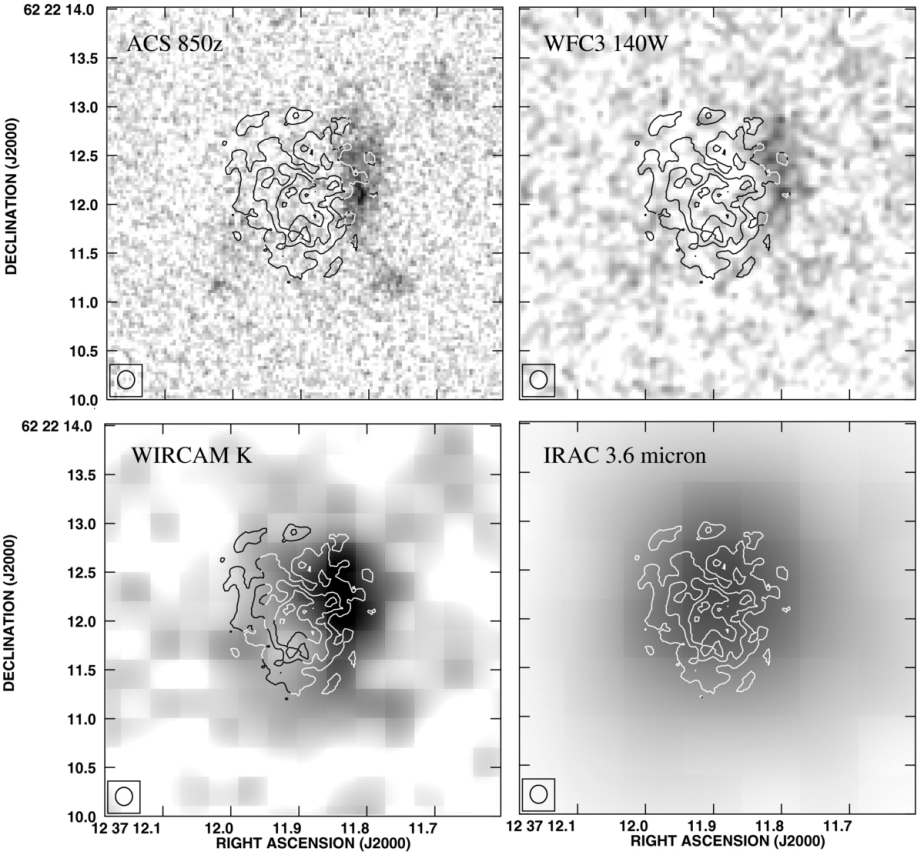


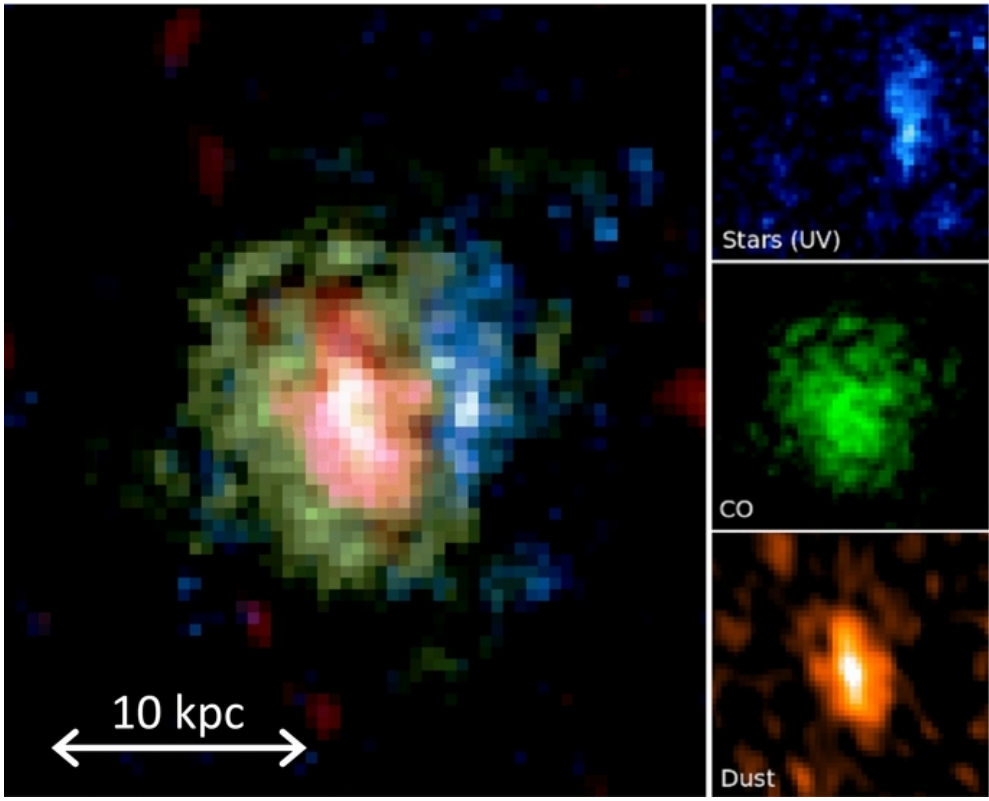




Hodge+ 2012

Многоволновой анализ





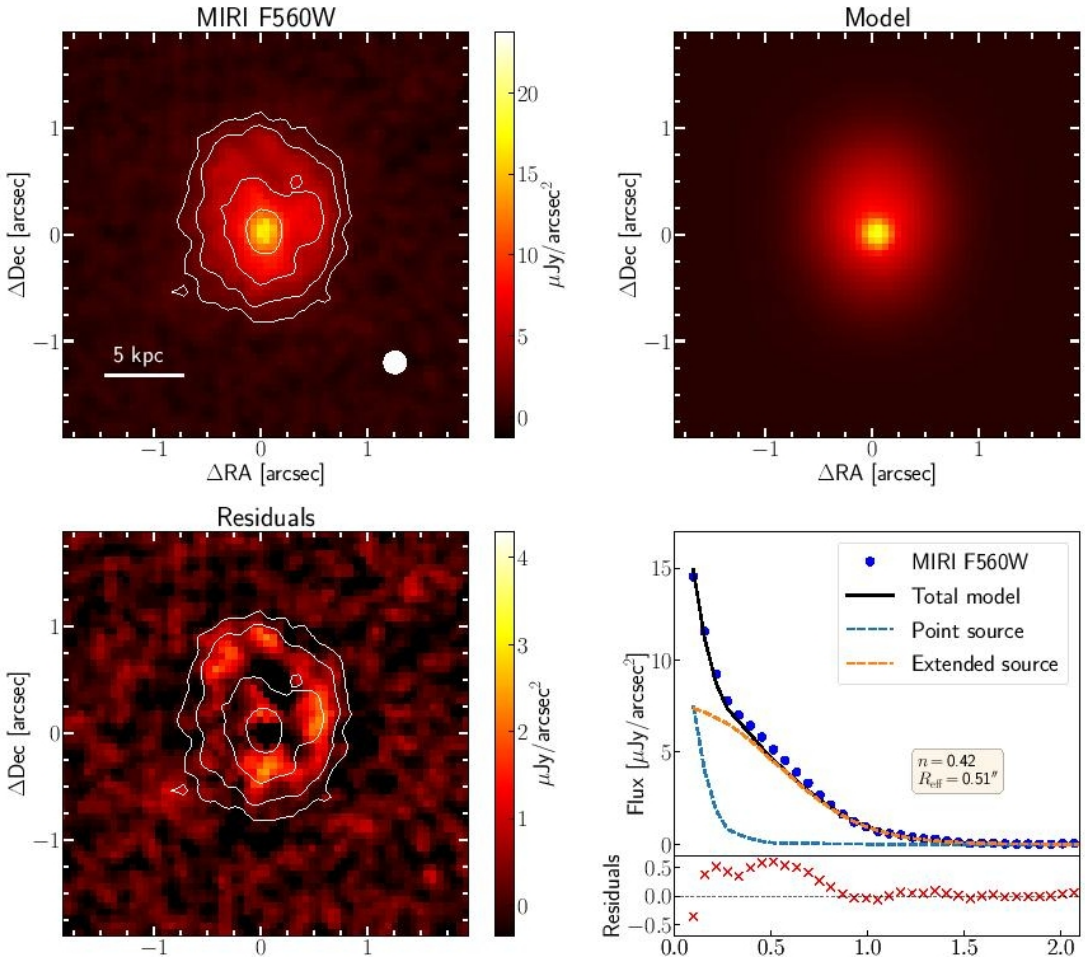
Hodge+ 2012, 2015

Новые наблюдения JWST – 5.6 мкм (1.1 мкм в собственной системе)

2.1. JWST MIRI data and calibration

GN20 JWST imaging was obtained on November 23-24, 2022 using the MIRI imager (MIRIM, Bouchet et al. 2015) in the F560W filter as part of the European Consortium MIRI Guaranteed Time (program ID 1264). The observation has a total integration time of 1498.5 seconds using the FASTR1 read-out mode and a five-dither medium-size cycling pattern, with one integration of 108 groups per dither. The MIRIM F560W image has been calibrated using version 1.9.5 of the JWST pipeline and context 1077 of the Calibration Reference Data System (CRDS). The process follows the same steps applied in the calibration of the SPT0311-58 image (Álvarez-Márquez et al. 2023). A final image with a scale of 0.06″ per pixel and 0.24″ FWHM is used throughout the analysis. At the redshift of GN20, the MIRI F560W image traces the rest-frame 1.1μm emission.

Балдж+диск, эффективный радиус больше 3 кпк



Асимметрия=признаки взаимодействия

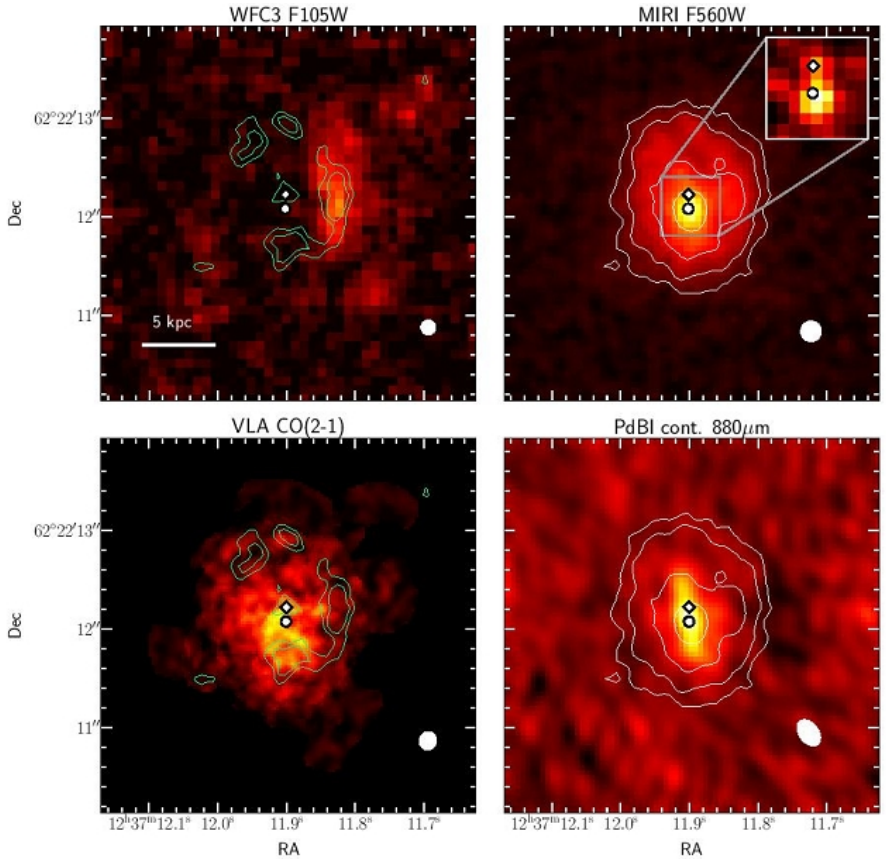


Fig. 2. Multi-wavelength morphology of GN20. Top panels display the WFC3 F105W (left) and MIRI F560W (right) images of GN20, tracing the rest-frame UV (0.2μm) and near-IR (1.1μm) light, respectively. Bottom left panel shows the CO(2-1) flux map, obtained with the VLA. Bottom right panel displays the rest-frame 170μm continuum map from PdBI observations. Black-edged white diamond and circle mark the position of the centre for the nuclear point-source and extended components derived from the 2D brightness decomposition (see Sect. 3.1). White circles and ellipses at the bottom right corner of the panels represent the PSF or beam size for the different images. White contours on the right panels represent the F560W isophotes at 5σ, 10σ, 20σ, and 35σ levels. Green contours in the left panels mark the residuals of the near-IR light distribution fit (see Fig. 1) at 3σ and 5σ levels. The inset in the F560W image represents the central 0.6″ × 0.6″ region with the presence of the secondary nucleus as obtained from the deconvolution of the F560W image (see Sect. 3.1)