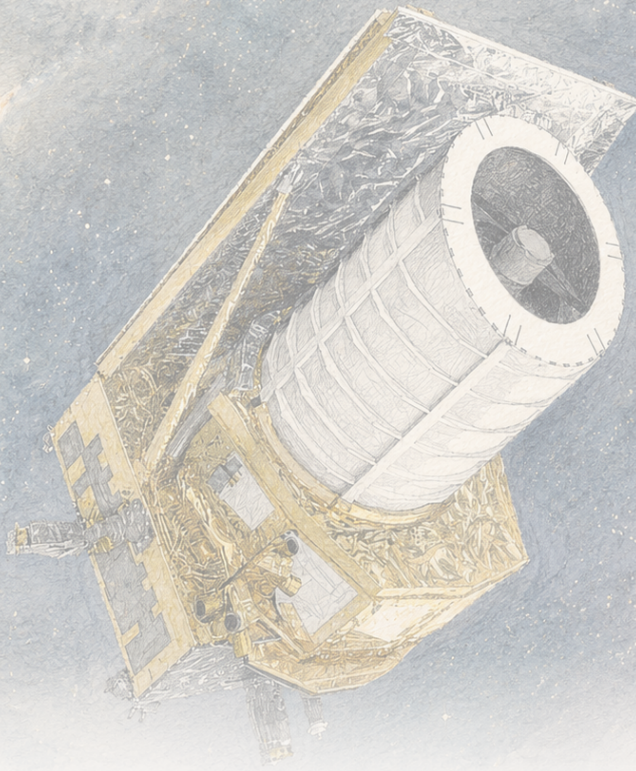




The CLEAN PAPER

WHAT THE PAPER SAYS · WHAT IT DOESN'T · WHY IT MATTERS

Euclid more than doubles small sample of quasars beyond redshift 7

Nínú first year and a half Euclid Wide Survey, search over roughly 3000 square degrees found 31 new quasars between redshift 6.6 and 7.8. Twelve lie at redshift 7 or higher, more than doubling handful known there before Euclid, one at 7.77 is now most distant quasar on record. Real advance kà í ʒe single record yèn, which only nudges frontier; ó jé survey power to find rare, mostly faint objects in bulk, making them useful probes of young Universe. Èyí jé initial result, full statistical analysis àti much spectroscopic confirmation still to come.

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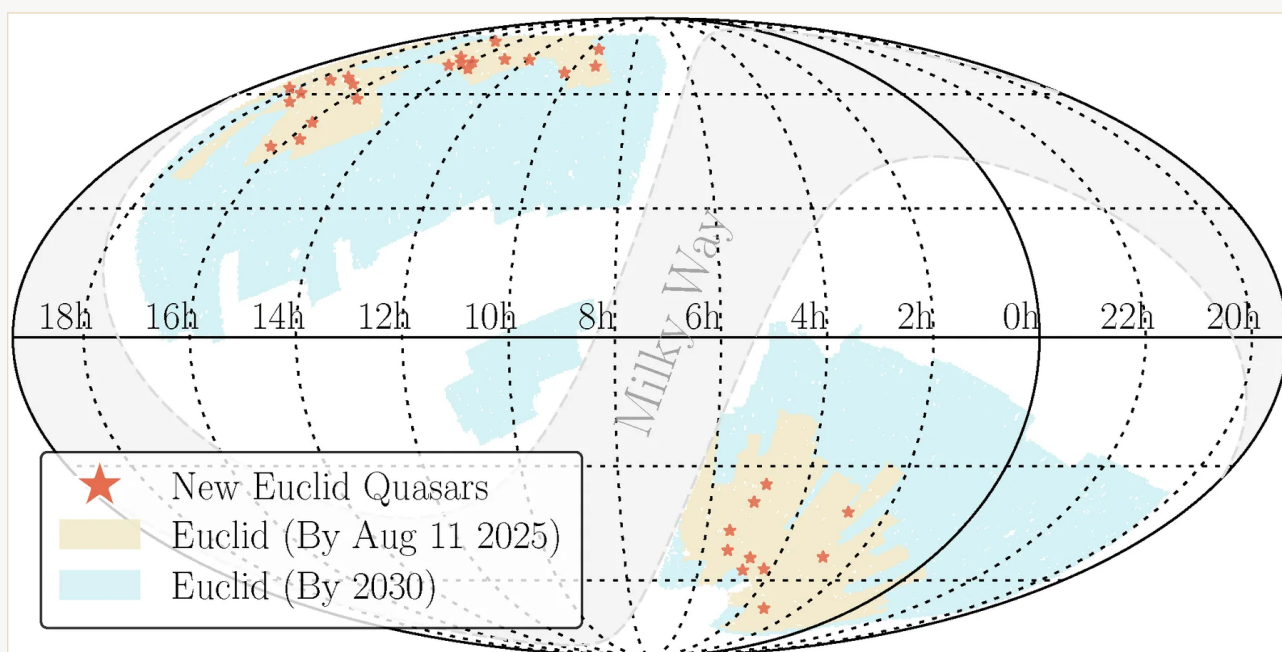
Paper: *Euclid: Discovery of 31 new quasars at $6.6 < z < 7.8$* , D. Yang, J. F. Hennawi, F. Guarneri et al. (Euclid Collaboration), *Astronomy & Astrophysics* · DOI: 10.1051/0004-6361/202658883

Survey tí a kọ fún rare things sèṣè rí batch kan nínú wọn

Quasar ni supermassive black hole tí a mu nígbà tò ní feed, tò ní blaze tò bẹ̀ẹ́ bí ó ẹ̀ ní swallow gas tí ó lè brighter ju entire host ìṣùpò ìràwò rẹ̀. Nítorí wọn jẹ ọkan lára most luminous steady orísun nínú Universe, quasars ṣiṣẹ́ gégé bí beacons: rí ọkan tò jìn tò, light rẹ̀ di lamp tí a gbe sí èyìn billions of years tí intervening space.

Most distant quasars — àwọn tí light wọn start journey nígbà tí Universe kò tū pé billion year — ni rarest. Šáájú Euclid space telescope pàtàkì survey, nípa nine nìkan ni confirmed beyond redshift 7, tally tí a kọ slowly láti first discovery irú yí ní 2011.

Nínú tuntun ìwé ìwádíí nínú *Astronomy & Astrophysics*, Euclid Collaboration report 31 tuntun quasars láàárín redshift 6.6 àti 7.8, rí nínú first year àti a half survey. Twelve wà ní redshift 7 tàbí ga sí i. Run kan yí sí i than doubled known population ní redshifts wònyí. Èyí jẹ survey-power ìtàn, ó sì yẹ ká precise nípa ohun tí ó mean àti ohun tí kò mean.



Euclid Wide Survey area tí a cover títí di báyii (beige) against full footprint planned by 2030 (cyan), pèlú 31 newly discovered high-redshift quasars marked in red. Wọn wá láti first slice nìkan tí survey designed láti eventually map nípa 14,000 square degrees — survey-power ìtàn nínú picture kan.

D. Yang et al. / Euclid Collaboration / *Astronomy & Astrophysics* CC BY 4.0

Euclid made the small $z \geq 7$ sample visibly larger

The point is not 'the first quasars'; it is a sparse high-redshift census getting less sparse.



Boundary: a bigger census of rare high-redshift quasars, not a claim about the first objects in the Universe.

Sáájú Euclid, nípa nine quasars ní a mò beyond redshift 7 (2011–2024). Early run yíi fi 12 mî kún un — “doubling” made concrete, lóri àpẹẹrẹ tó sì kéré.

Original diagram — The Clean Paper CC BY 4.0

Kí ló dé tí quasars tó jìn báyyí fi yẹ wahala?

Redshift measure bí expansion Universe ẹ stretch light orísun sí longer wavelength ní journey sí wa; higher redshift mean older light àti earlier Universe. Ní redshift 7, a ní wo back sí less than a billion years lẹyìn Big Bang, sí tail end tí epoch of reionization, nígbà tí first luminous objects ní burn off fog of neutral hydrogen tí kún early space.

Kí ni redshift, kí ló sì dé tí ó fi jẹ distance àti clock ní akoko kan náà?

Tí vocabulary tuntun: *redshift* ni iye tí light orísun ti stretch sí longer, redder wavelengths nígbà tí ó dé ọdọ wa. Nìkan méjì mú number kan yíi useful. Àkókó, light travel ní fixed speed, nítorí náà nìkan tó jìn ni a tún rí gégẹ bí ó ti wà ní igba pípẹ sẹyìn — looking deep sínú space ni looking back in àkókò. Ẹlẹ̀ẹ̀kejì, nítorí Universe ní expand jálẹ̀ journey light, journey tó gùn sí i mean sí i stretching. Nítorí náà larger redshift mean light tí set out earlier, láti farther away, nígbà cosmos younger. Redshift 7 níbí jẹ light láti lábẹ a billion years lẹyìn Big Bang — well lábẹ a tenth of present age Universe.

Quasars era yíi useful fún reasons méjì. Àkókó, each ọkan already hosts black hole pẹ̀lú hundreds of millions sí billions solar masses. Growing something that heavy that early hard: lábẹ usual ààlà on accretion speed, nìkan fairly massive “seeds” ní enough àkókò láti reach masses wònyí nínú few hundred million years available. Nítorí náà mere existence àti census objects wònyí constrain bí first supermassive black holes form àti grow. Ẹlẹ̀ẹ̀kejì,

quasar light passing nípasẹ surrounding intergalactic medium carries imprint tí how neutral gas náà was, making each quasar a probe of reionization.

Catch ní pé wọn extraordinarily rare àti hard to rí. Ní redshift wònyí, strongest àbùdá quasar, Lyman-alpha break, stretch out of optical sínú near-infrared, nítorí náà o need deep near-infrared imaging over large area — roughly ọkan quasar per hundred square degrees down to relevant brightness. Deep + wide nínú near-infrared láti ground ni exact combination tó prohibitively difficult. Gap yí ni Euclid built to close.

Ohun tí Euclid ẹ gidi

Euclid jẹ 1.2-metre space telescope tó ní run six-year survey designed láti map nípa 14,000 square degrees sky nínú optical àti near-infrared light. Being above atmosphere jẹ kí ó reach depths over wide field tí ground-based near-infrared surveys kò match. ìwé ìwádíí yí lò dátà láti first roughly year àti a half — nípa 3000 square degrees observed láàárín February 2024 àti August 2025.



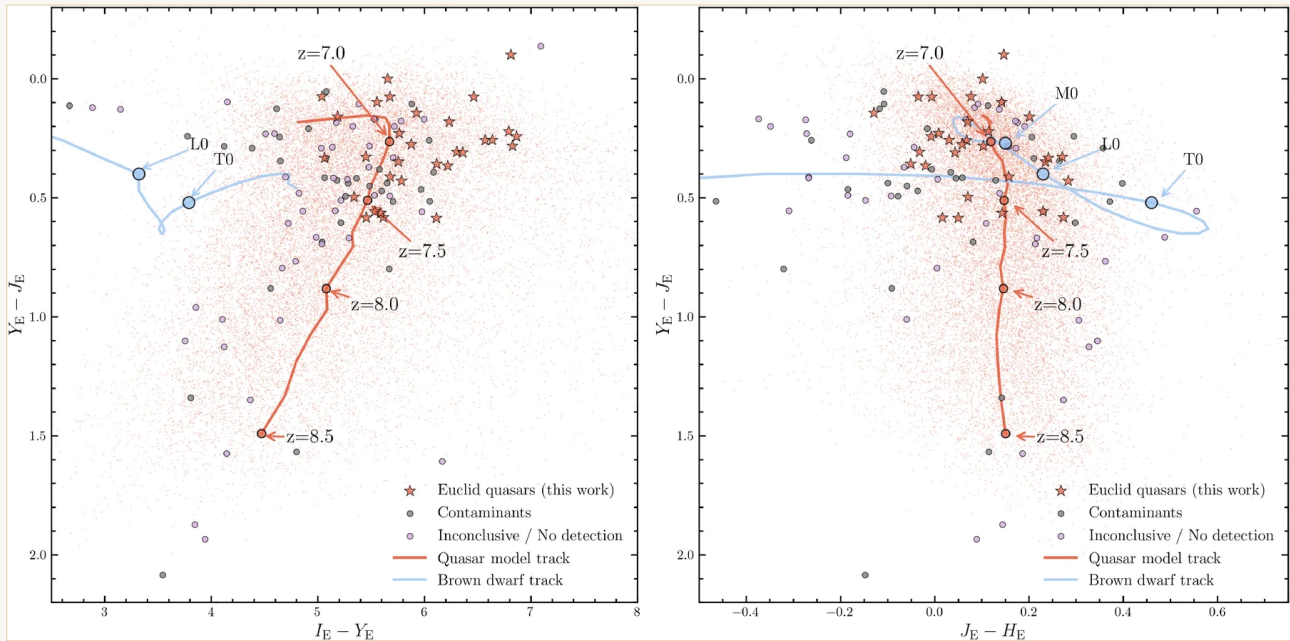
Euclid spacecraft nínú cleanroom ńjẹ launch. 1.2-metre telescope wo sky nípasẹ top of white cylinder; láti above atmosphere, wide-field near-infrared camera rẹ reaches depths over large area tí ground-based searches kò match.

ESA / NASA Science fair-use

Finding 31 needles nínú haystack kì í ẹ matter of looking. ẹgbẹ build custom photometry, run several machine-learning àti probabilistic classifiers — extreme-deconvolution density àwòṣe, gradient-boosted classifier, template-

based fits — láti ịsírò àfojúsùn fún faint point-like orísun kọkọkan probability pé ó jé high-redshift quasar dípò far sí i numerous contaminants, especially cool brown dwarfs tí colours mimic distant quasar. Candidates cross-checked láàárín ọ̀nà, inspected by eye, prioritized fún follow-up. Euclid images select candidates; confirmations come láti spectra on large ground-based telescopes — including Magellan àti Large Binocular Telescope — tó split light finely enough láti see tell-tale break àti emission lines.

Confirmation step yíi jé honest ịsẹ in progress. Spectroscopic follow-up ongoing, ịwé ịwádíí fúnra rẹ sọ pé full completeness kò tū dé, especially southern sky. Fún candidates followed up tí kò become ọ̀kan of 31 confirmed quasars, ịwé ịwádíí account plainly: many contaminants (large share likely brown dwarfs), some inconclusive, some no detectable àmì. Batch confirmed quasars ní àkọlẹ́; full bookkeeping of what selection catches/misses deferred to later ịwé ịwádíí.



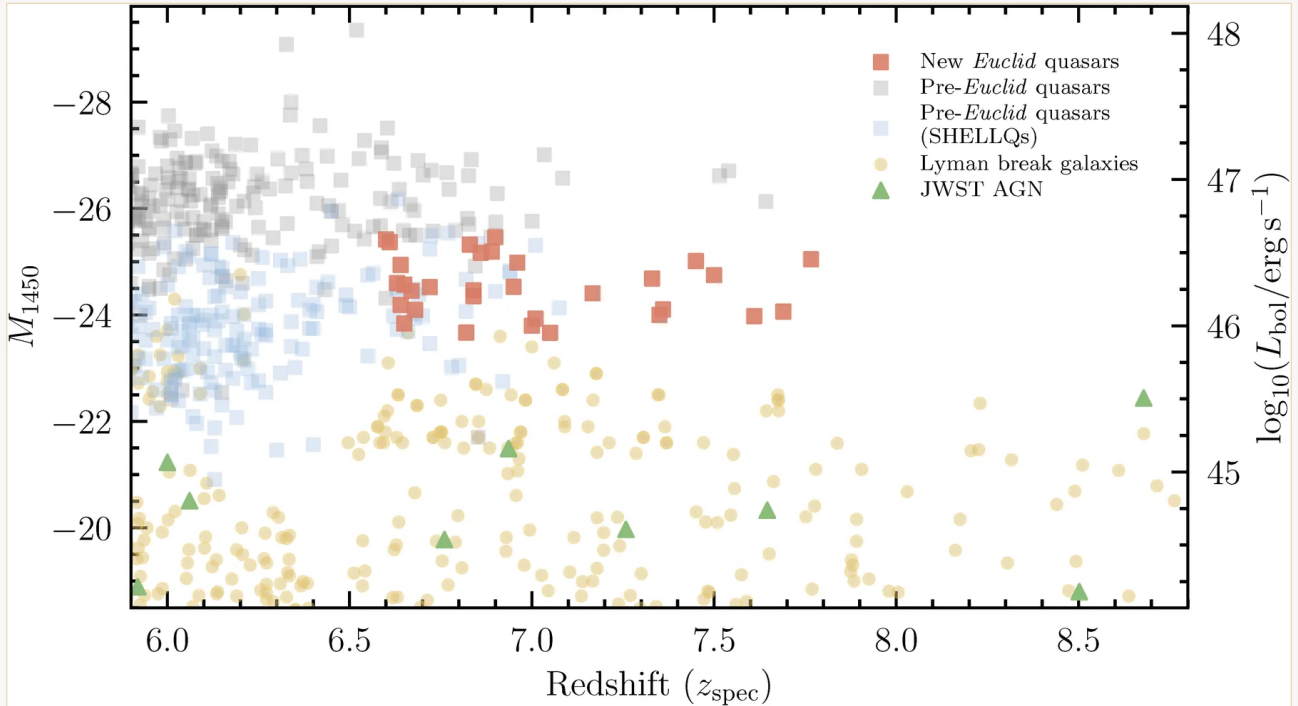
Colour-colour diagram: bí Euclid ịe distinguish distant quasar láti nearby brown dwarf. Axis kọkọkan fi hàn difference láàárín brightness in méjì Euclid filters, capturing colour rather than brightness. Red curve traces predicted high-redshift quasar track (labels redshift 7.0–8.5); light-blue curve traces cool brown dwarfs — pàtàkì impostors — labeled M0 to T0. 31 tuntun quasars (red iràwọ̀) line up along quasar track; confirmed contaminants (grey) àti inconclusive/undetected candidates (violet) fall away. Níbi tracks méjèjèjì sún mọ̀ra, colour alone kò decide — every quasar still need spectroscopic confirmation.

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Record náà, ní proportion tó yẹ

Ọ̀kan nínú 31, EUCL J1729+6410, wà ní redshift nípa 7.77, ó sì jé most distant quasar known. Real àkọsílẹ̀ ní, sùgbọ̀n ó yẹ ká ipò ịwọ̀n step. Over méjì decades dedicated searching, frontier pushed sí around redshift 7.5, previous record-holder nípa 7.64. Moving to 7.77 genuine advance, sùgbọ̀n incremental — ịwé ịwádíí puts increment nípa 0.13 redshift, roughly fifteen million years cosmic àkókò. Nudge, kì í ịe leap.

More consequential number ni other òkan: doubling àpẹẹrẹ above redshift 7 nínú single early run. Record-holder jẹ object kan, dátà kókó kan. Doubled growing population ni ohun tó jẹ kí statistics ẹeé ẹe — measure how common black holes were, how bright, how clustered — statistics ni ibi science of early Universe lives. Most tuntun quasars tún comparatively faint, òkan to méjì magnitudes fainter than luminous quasars rí ẹ́áájú Euclid. Faint end harder to reach, sí i valuable fún reionization ìwádíí: fainter quasars carve smaller ionised bubbles around themselves, so light wọn àpẹẹrẹ sí i still-neutral gas.



Ibi tuntun quasars fall: brightness against cosmic ijinnà. Horizontal axis redshift — farther right mean earlier cosmic history. Vertical axis intrinsic ultraviolet brightness, M_{1450} ; old magnitude convention runs backwards, so higher up means brighter (right-hand scale restates as bolometric luminosity). Read that way, plot is census. Bright previously known quasars (grey) crowd lower redshifts; deeper survey SHELLQs (light blue) reached fainter objects ẹ̀gbẹ̀n not much further back. 31 tuntun Euclid quasars (red) extend luminous population to highest redshifts — rightmost record-holder at 7.77 — while sitting 1–2 magnitudes fainter than classic bright quasars. Below them are Lyman-break ìṣùpò iràwò (yellow) àti very faint accreting black holes JWST rí (green triangles). Euclid contribution is distinct ẹgbẹ: relatively bright quasars, very early, over wide area.

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Ohun tí ẹ̀sì uncertain

Caveats mẹtá travel pẹ̀lú ẹ̀sì, ìwé ìwádíí ipò each.

Àkọ́kọ́, initial ẹ̀sì ni, kì í ẹ ẹ final measurement. ònńkòwé explicitly hold back comprehensive statistical ìtúpàlẹ̀ of selection function àti quasar population fún forthcoming publications. Luminosity-function constraints níbí first look.

Ẹ̀lẹ̀ẹ̀kejì, not every faint “quasar” guaranteed to be òkan. At faint end, some objects identified as quasars lè instead

be compact early λ Lyman- α , especially if they lack strongly broadened Lyman- α line. λ Lyman- α gives preliminary check that objects consistent λ Lyman- α rather than extended λ Lyman- α , λ Lyman- α calls it preliminary: deep near-infrared spectroscopy, λ Lyman- α JWST λ Lyman- α similar, λ Lyman- α settle faintest ones.

Euclid, objects themselves faint near λ Lyman- α of ground-based spectroscopy. Pinning down black-hole masses, surroundings, place in reionization λ Lyman- α λ Lyman- α take JWST, ALMA, NOEMA. Euclid very good at λ Lyman- α them; it largely hands them to other instruments to λ Lyman- α .

Kí nìdí tí ó fi λ Lyman- α pàtàkì?

Value of λ Lyman- α is demographic. For decade, first billion years Universe offered astronomers bare handful quasars to reason λ Lyman- α . Euclid, in λ Lyman- α early slice, added enough to change list λ Lyman- α λ Lyman- α — on track consistent λ Lyman- α pre-launch forecasts to keep going.

That matters λ Lyman- α open λ Lyman- α are population λ Lyman- α . How did black holes get so big so fast? How patchy λ Lyman- α how neutral was intergalactic gas at λ Lyman- α times? Not answered by single spectacular object; answered by counting, comparing, mapping many. Euclid demonstrated capability to build census — including faint end connecting to puzzling population accreting black holes JWST turning up in λ Lyman- α era. λ Lyman- α λ Lyman- α does not resolve first black-hole formation, does not by itself measure reionization. It supplies raw λ Lyman- α , in bulk, those measurements need, λ Lyman- α sets frontier λ Lyman- α follow-up campaigns underway.

Àkótán kedere

Using first roughly 3000 square degrees of Euclid Wide Survey, Euclid Collaboration discovered 31 λ Lyman- α quasars λ Lyman- α redshift 6.6 λ Lyman- α 7.8, twelve at redshift 7 λ Lyman- α higher — λ Lyman- α λ Lyman- α than doubling known population there — including λ Lyman- α at 7.77 now most distant quasar on λ Lyman- α . Importance is survey demonstrated power to λ Lyman- α rare, mostly faint objects in bulk, not incremental redshift λ Lyman- α . λ Lyman- α are initial λ Lyman- α release: full statistical λ Lyman- α , much spectroscopic confirmation, detailed characterisation still to come.

Àyèwò láisí àṣejù

Ohun tí λ Lyman- α λ Lyman- α fi hàn: Euclid Wide Survey, in first ~ 1.5 years over ~ 3000 square degrees, λ Lyman- α λ Lyman- α high-redshift quasars in numbers no previous survey λ Lyman- α — 31 confirmed λ Lyman- α 6.6 λ Lyman- α 7.8, twelve at 7 λ Lyman- α above, roughly doubling known count, most distant at ~ 7.77 .

Ohun tó λ Lyman- α λ Lyman- α not the λ Lyman- α : Redshift λ Lyman- α itself. Genuine, λ Lyman- α moves frontier λ Lyman- α ~ 0.13 — λ Lyman- α previous ~ 7.64 to 7.77, ~ 15 million years cosmic λ Lyman- α . λ Lyman- α that ages well is doubled, growing, unusually faint λ Lyman- α , not λ Lyman- α record-holder.

Ohun tí λ Lyman- α fi hàn: How first supermassive black holes formed, λ Lyman- α measurement of reionization. Quasars are

irinṣẹ́ fún those ìbéèrè, not answers. Nor final population census — full statistical ìtupalẹ́ left to later ìwé ìwádíí.

Main limitations: Spectroscopic follow-up incomplete, especially south; luminosity-function èsì preliminary; some faintest objects labelled quasars lè be early ìṣùpò ìràwò until JWST-class spectroscopy confirms.

Confidence wo ni gbogbogbò reader yẹ kí ó ní? High that Euclid changed what is findable at these redshifts, high on peer-reviewed confirmations brighter objects. Lower, by ònkòwé’ framing, on precise faint-end population numbers àti nature of faintest candidates — first èsì, not settled.

Àwọn orísun

D. Yang, J. F. Hennawi, F. Guarneri et al. (Euclid Collaboration), *Astronomy & Astrophysics* 711, A104 (2026), DOI 10.1051/0004-6361/202658883
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