

Žijeme ďalšiu revolúciu v astrofyzike?



Norbert Werner

Revolúcia pred 101 rokmi

8

THE NEW YORK TIMES, SUNDAY, NOVEMBER 23, 1924.

FINDS SPIRAL NEBULAE ARE STELLAR SYSTEMS

**Dr. Hubbell Confirms View That
They Are 'Island Universes'
Similar to Our Own.**

WASHINGTON, Nov. 22.—Confirmation of the view that the spiral nebulae, which appear in the heavens as whirling clouds, are in reality distant stellar systems, or "island universes," has been obtained by Dr. Edwin Hubbell of the Carnegie Institution's Mount Wilson observatory, through investigations carried out with the observatory's powerful telescopes.

The number of spiral nebulae, the observatory officials have reported to the institution, is very great, amounting to hundreds of thousands, and their apparent sizes range from small objects, almost star-like in character, to the great nebulae in Andromeda, which extends across an angle some 3 degrees in the heavens, about six times the diameter of the full moon.

"The investigations of Dr. Hubbell

were made photographically with the 60-inch and 100-inch reflectors of the Mount Wilson observatory," the report said, "the extreme faintness of the stars under examination making necessary the use of these great telescopes. The revolving power of these instruments breaks up the outer portions of the nebulae into swarms of stars, which may be studied individually and compared with those in our own system.

"From an investigation of the photographs thirty-six variable stars of the type referred to, known as Cepheid variables, were discovered in the two spirals, Andromeda and No. 33, of Messier's great catalogue of nebulae. The study of the periods of these stars and the application of the relationship between length of period and intrinsic brightness at once provided the means of determining the distances of these objects.

"The results are striking in their confirmation of the view that these spiral nebulae are distant stellar systems. They are found to be about ten times as far away as the small Magellanic cloud, or at a distance of the order of 1,000,000 light years. This means that light traveling at the rate of 186,000 miles a second has required a million years to reach us from these nebulae and that we are observing them by light which left them in the Pliocene age upon the earth.

"With a knowledge of the distances of these nebulae we find for their diameters 45,000 light years for the Andromeda nebulae and 15,000 light

years for Messier 33. These quantities, as well as the masses and densities of the systems, are quite comparable with the corresponding values for our local system of stars."

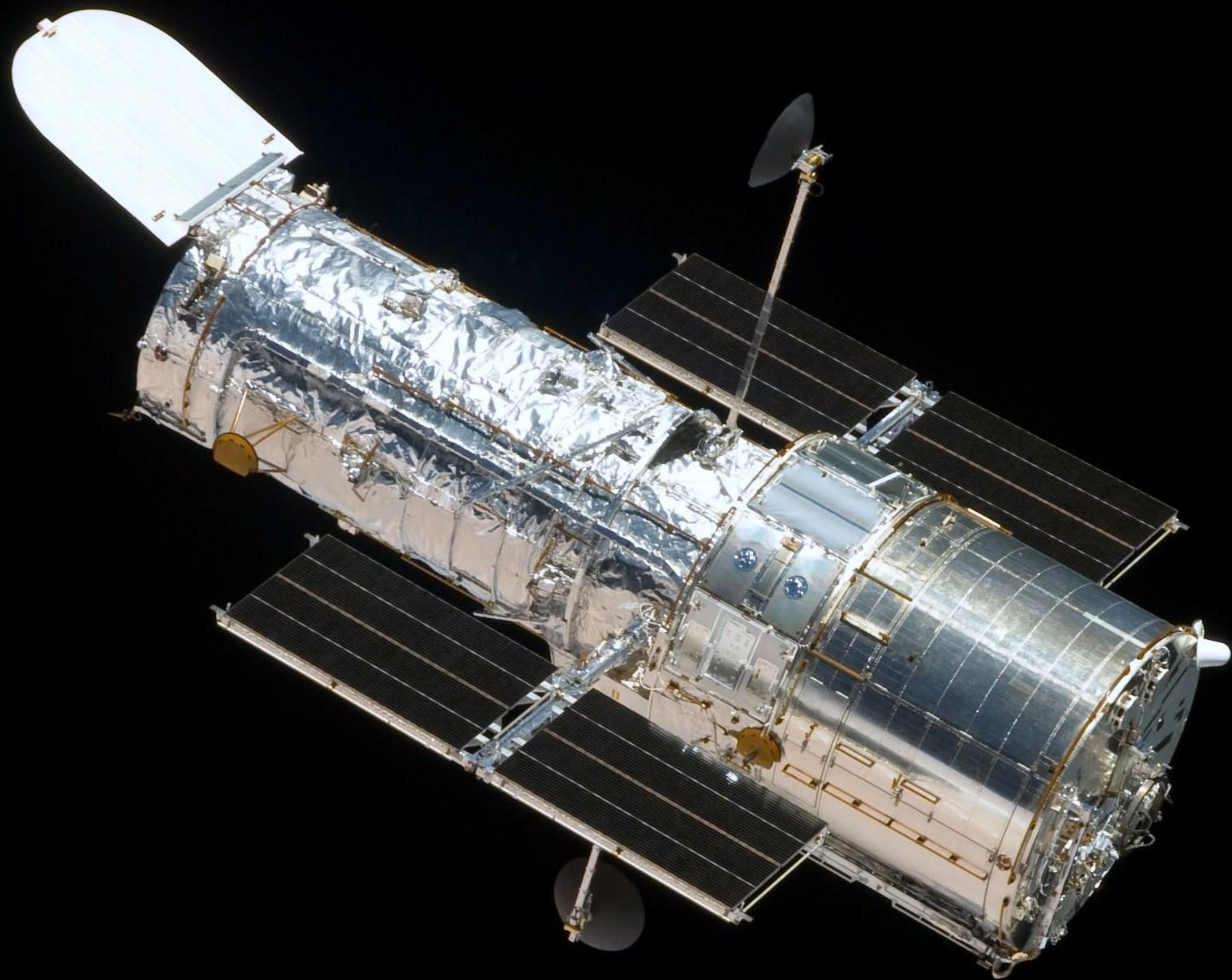
FUNDS FOR SCHENCK HOUSE

**William C. Redfield Says It
Built of Timbers of Old Ship.**

William C. Redfield, formerly Secretary of Commerce and now the President of the Netherland-America Foundation, 17 East Forty-second Street, was one of the many who were interested in the news printed in yesterday's TIMES that an offer had been submitted to Murray Hulbert, President of the Board of Aldermen, to sell to the city for \$10,000 the old Schenck homestead at Mill Basin, Brooklyn, which is believed to be the oldest house in New York City.

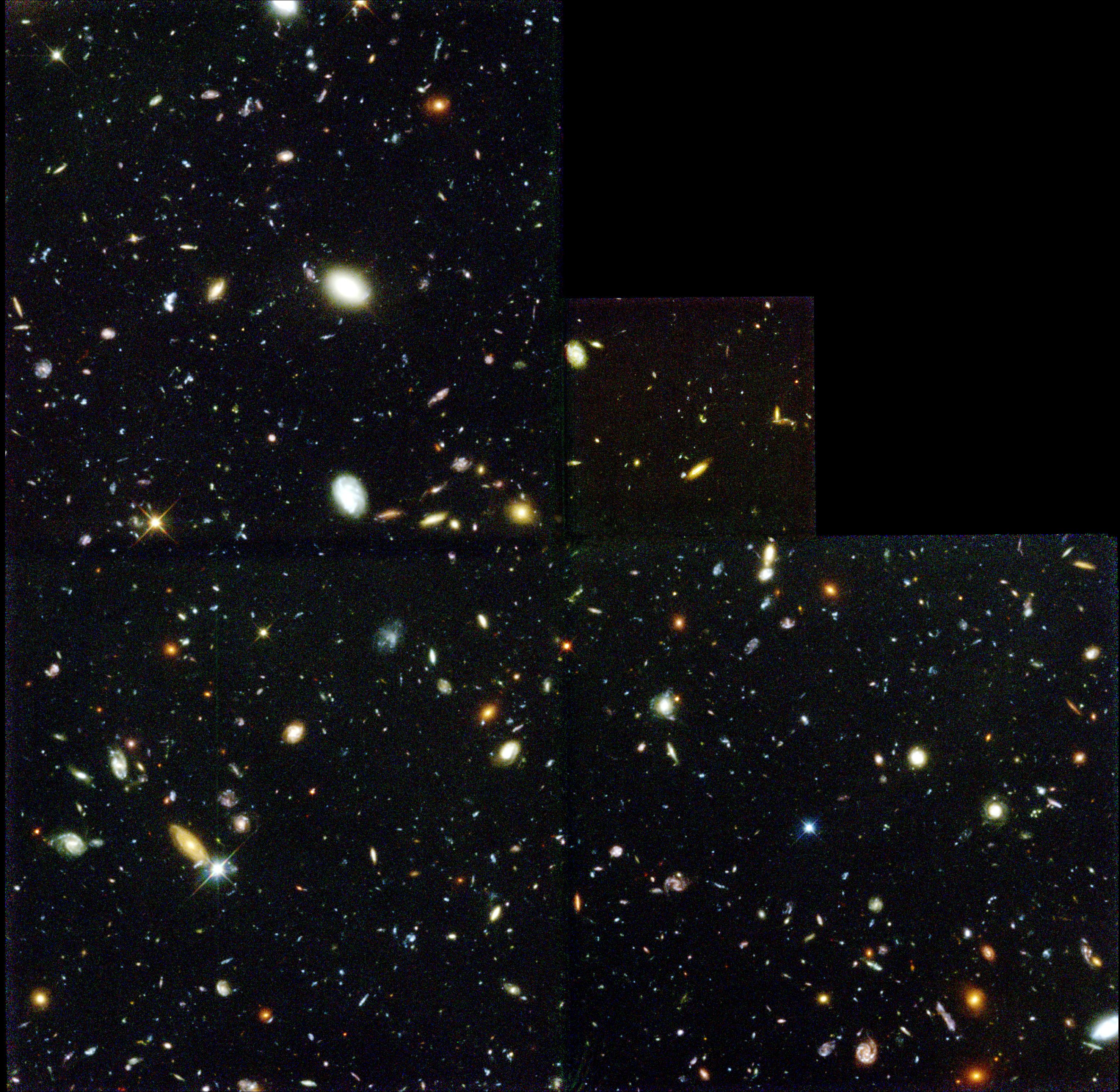
Mr. Redfield, in a letter to Mr. Hulbert yesterday, said that the Schenck house was built out of the timbers of an ancient ship. The old beams are visible and the knees of the old vessel still support the upper floors.

"I earnestly hope that funds may be made available, in order that this exceptional landmark of our city's history may be preserved," wrote Mr. Redfield. Mrs. Redfield is connected by marriage with the Schenck family.



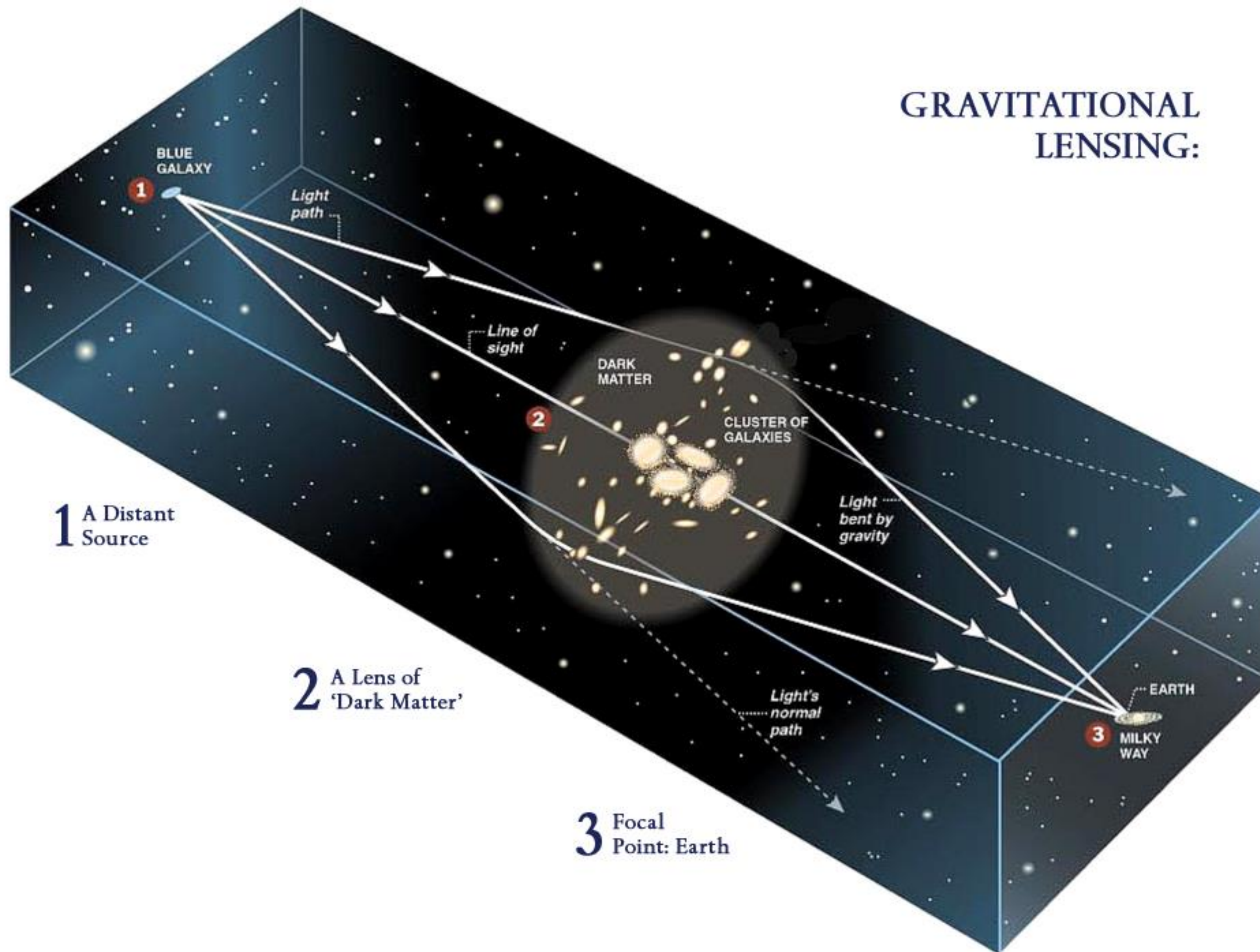
Prelom 20. a 21. storočia

- Práve objavené zrýchlené rozpínanie vesmíru
- Najhlbšie pozorovanie vesmíru bol Hubble Deep Field a najvzdialenejšia galaxia mala červený posun $z = 5.6$
- Hubblova konštanta zmeraná s presnosťou lepšou ako 10% ($H_0 = 71 \pm 7 \text{ km s}^{-1} \text{ Mpc}^{-1}$)
- Objav prvých exoplanét
- Vypustené revolučné röntgenové vesmírne ďalekohľady *Chandra* a *XMM-Newton*

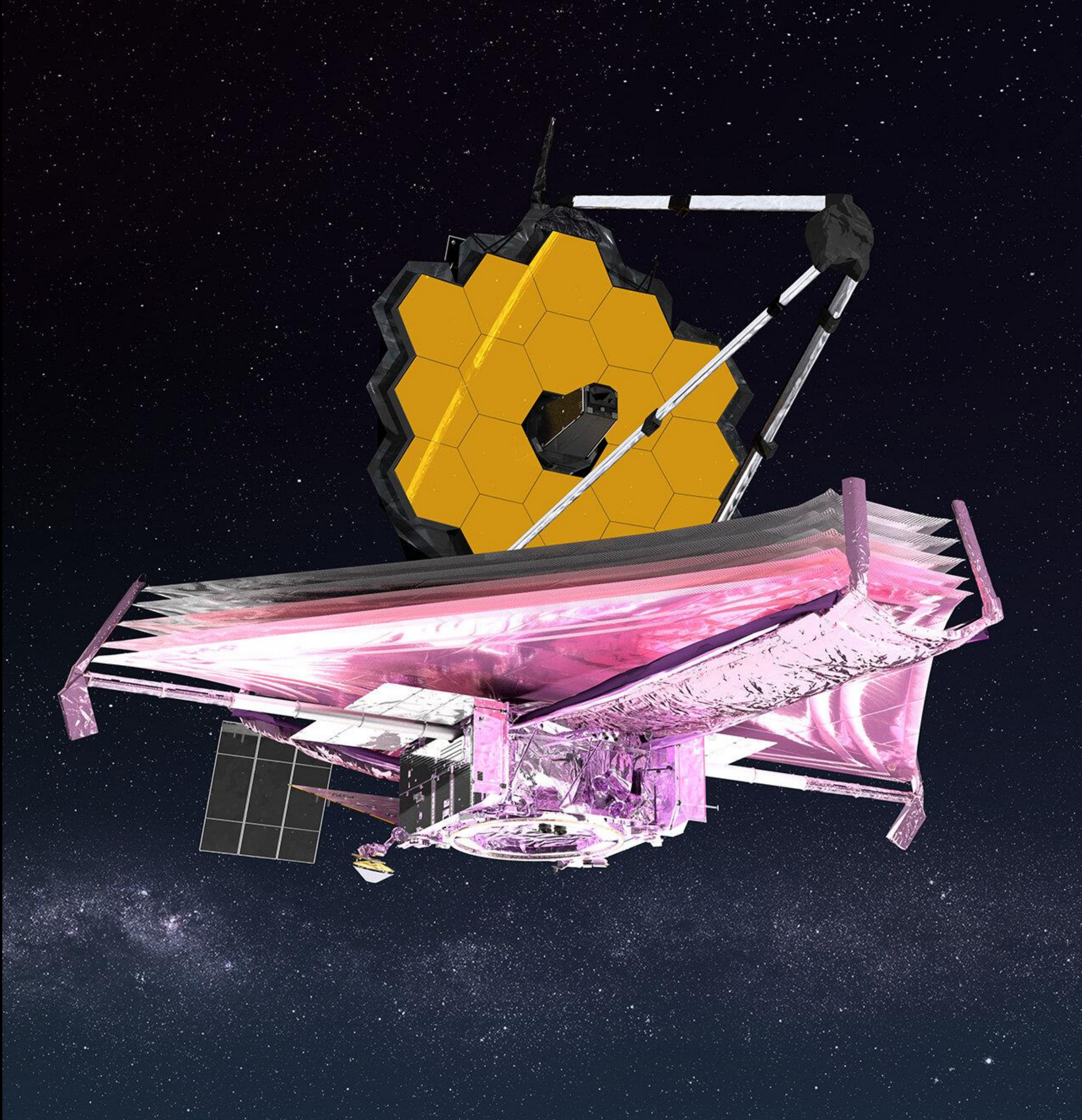




GRAVITATIONAL LENSING:



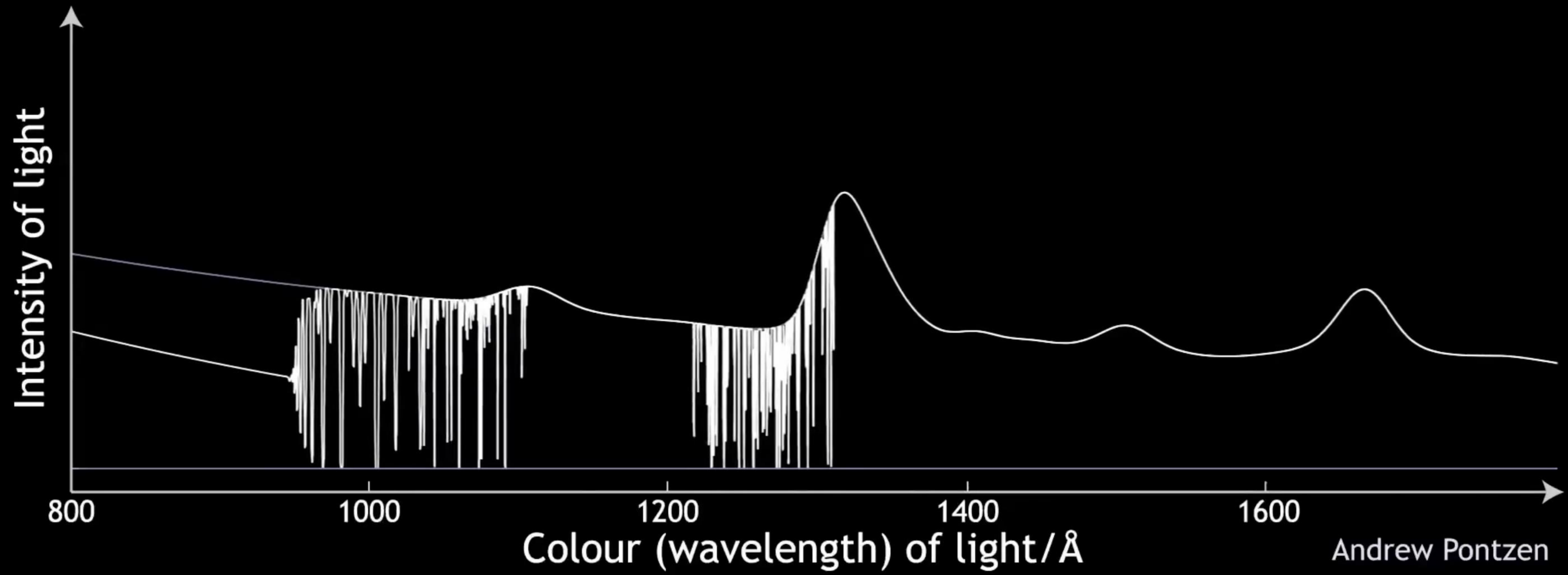
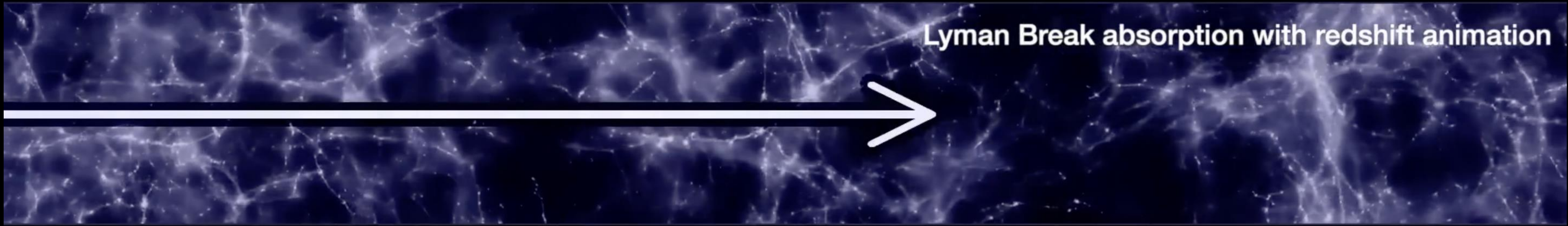


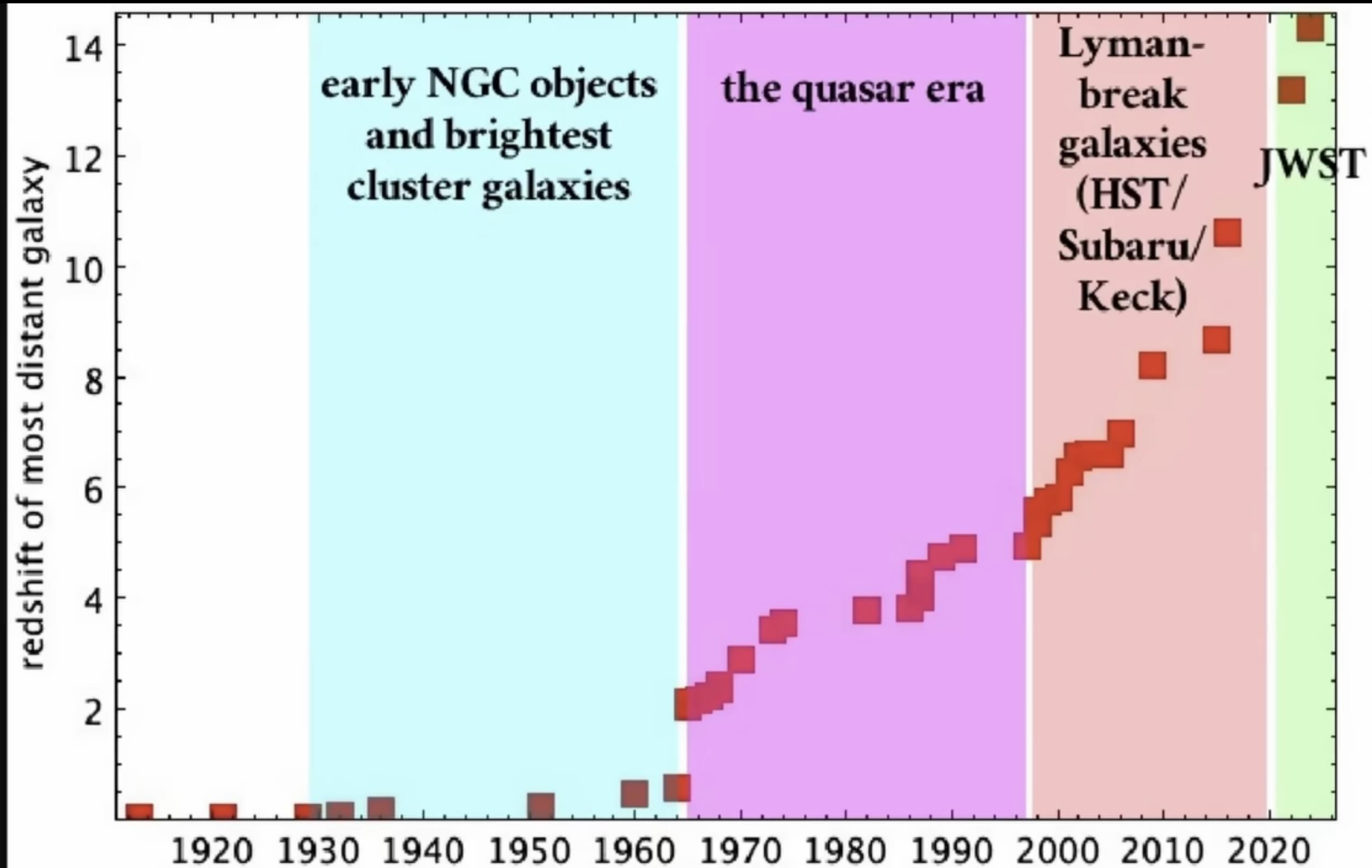


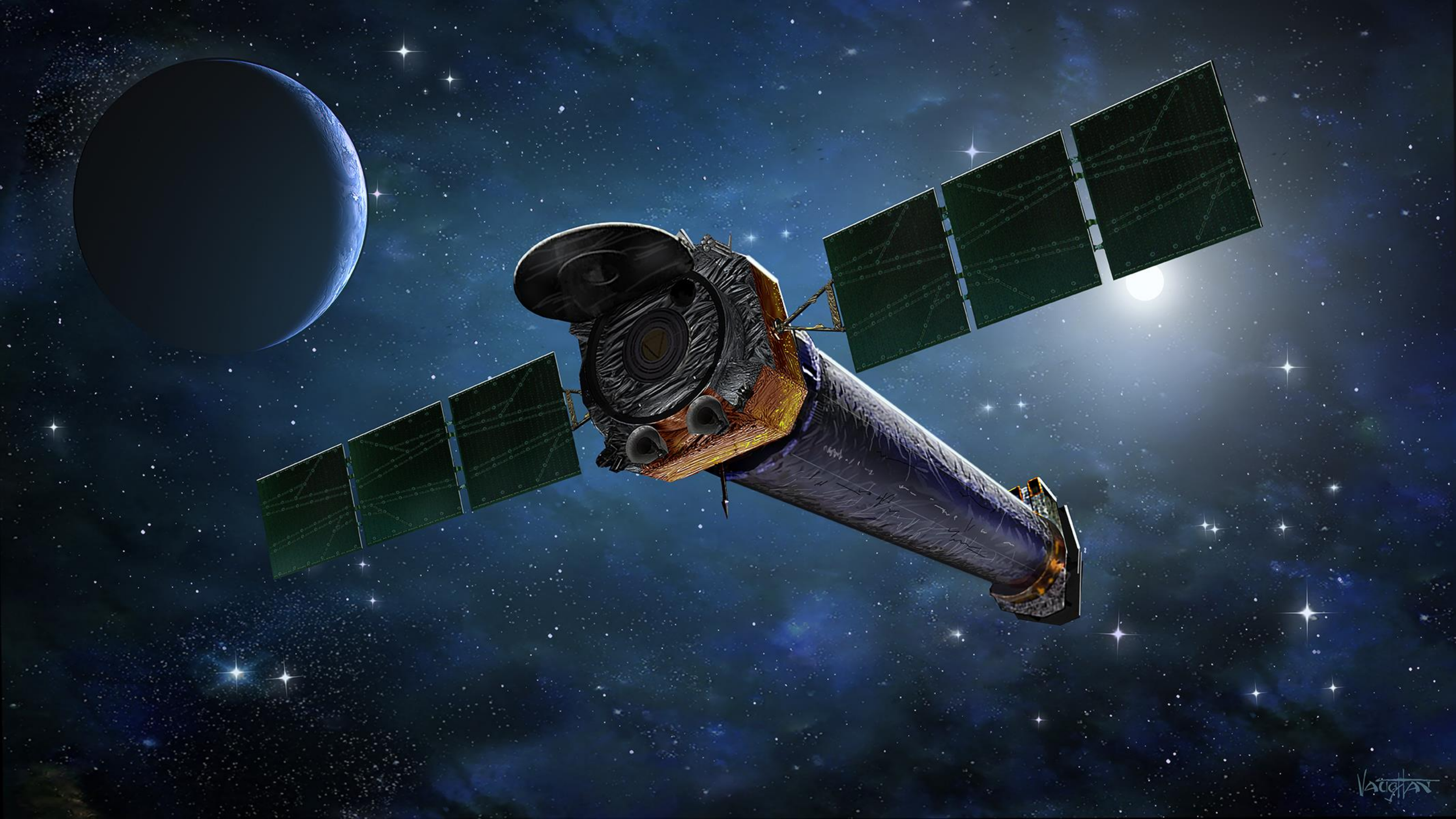


JADES field

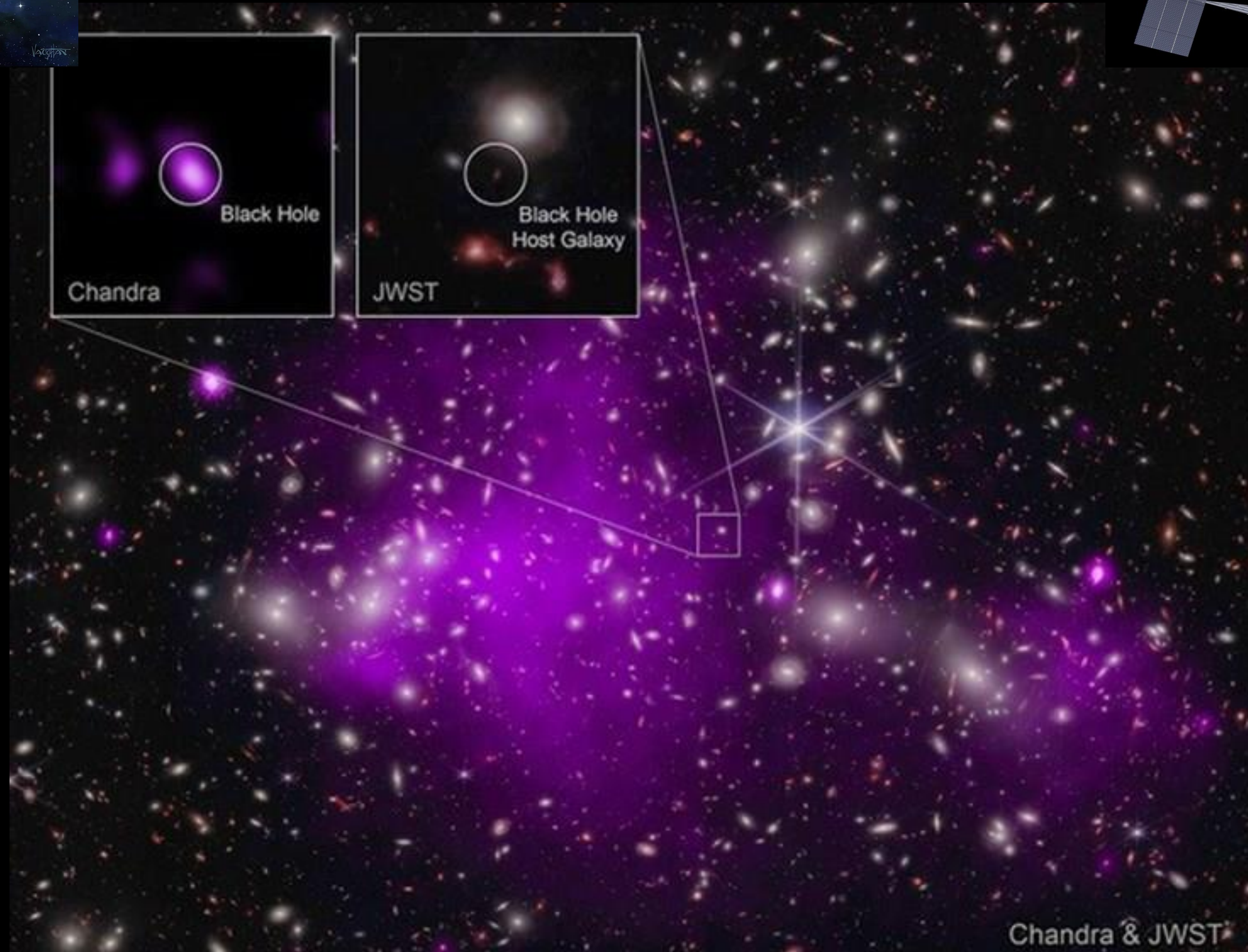
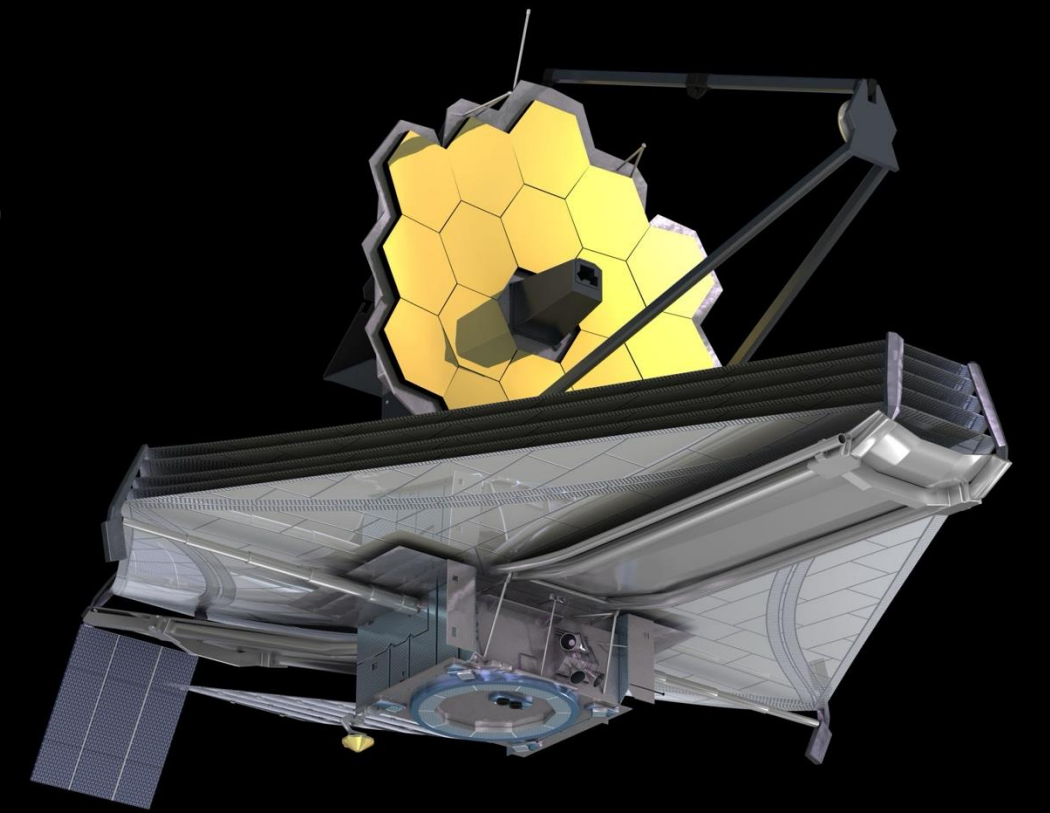




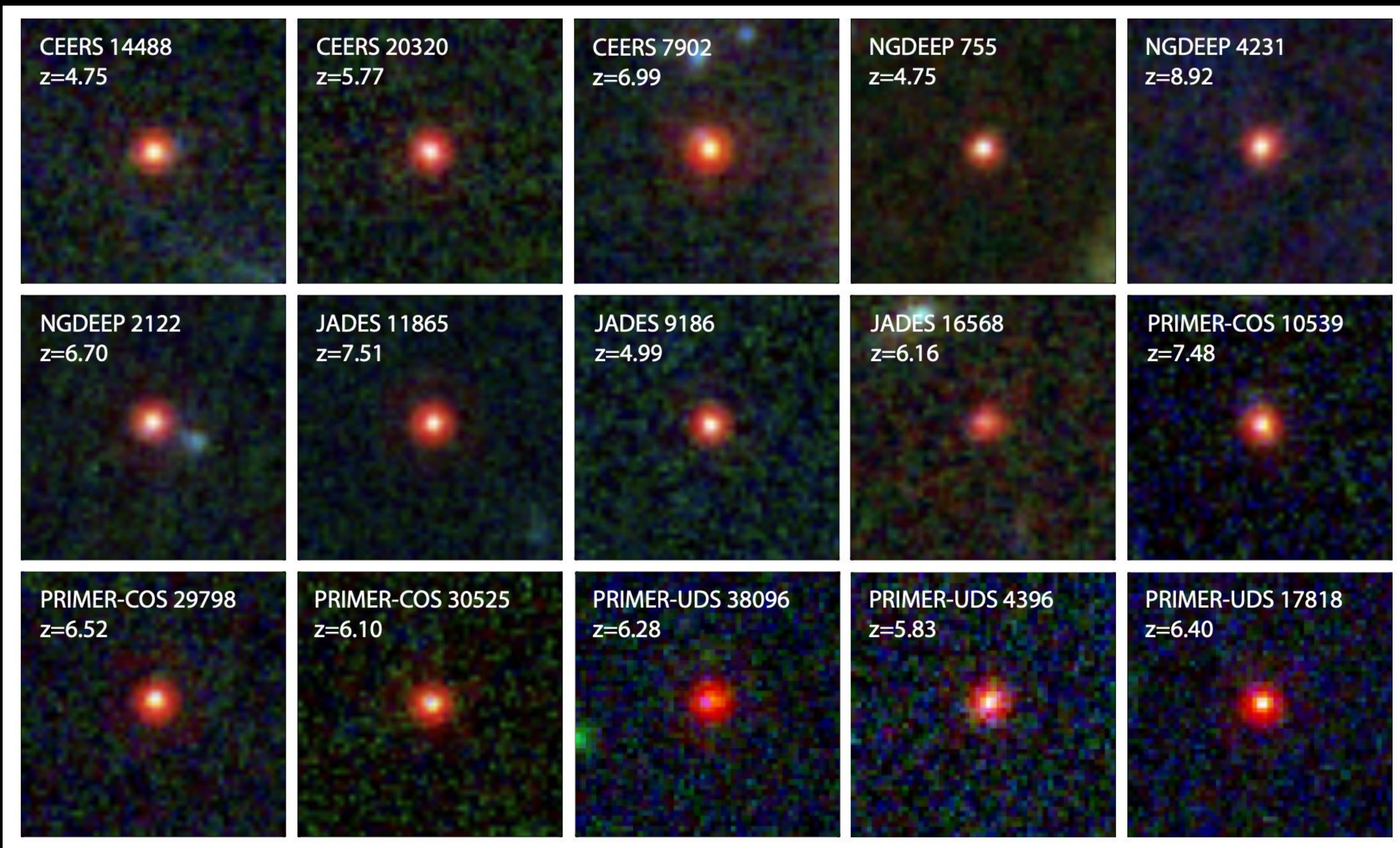




Obrie čierne diery už krátko po veľkom tresku!

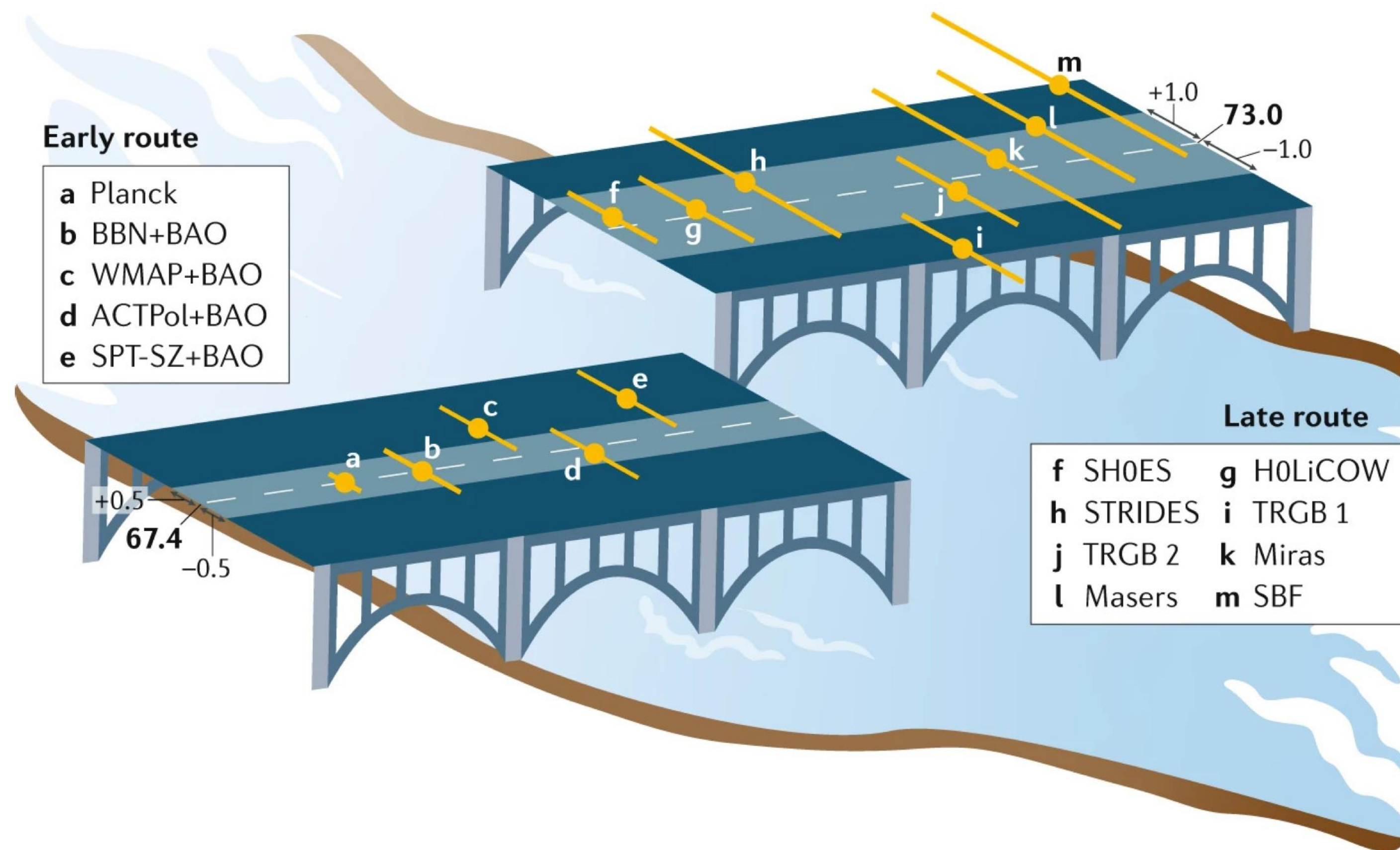


Prekvapivý objav malých červených bodiek

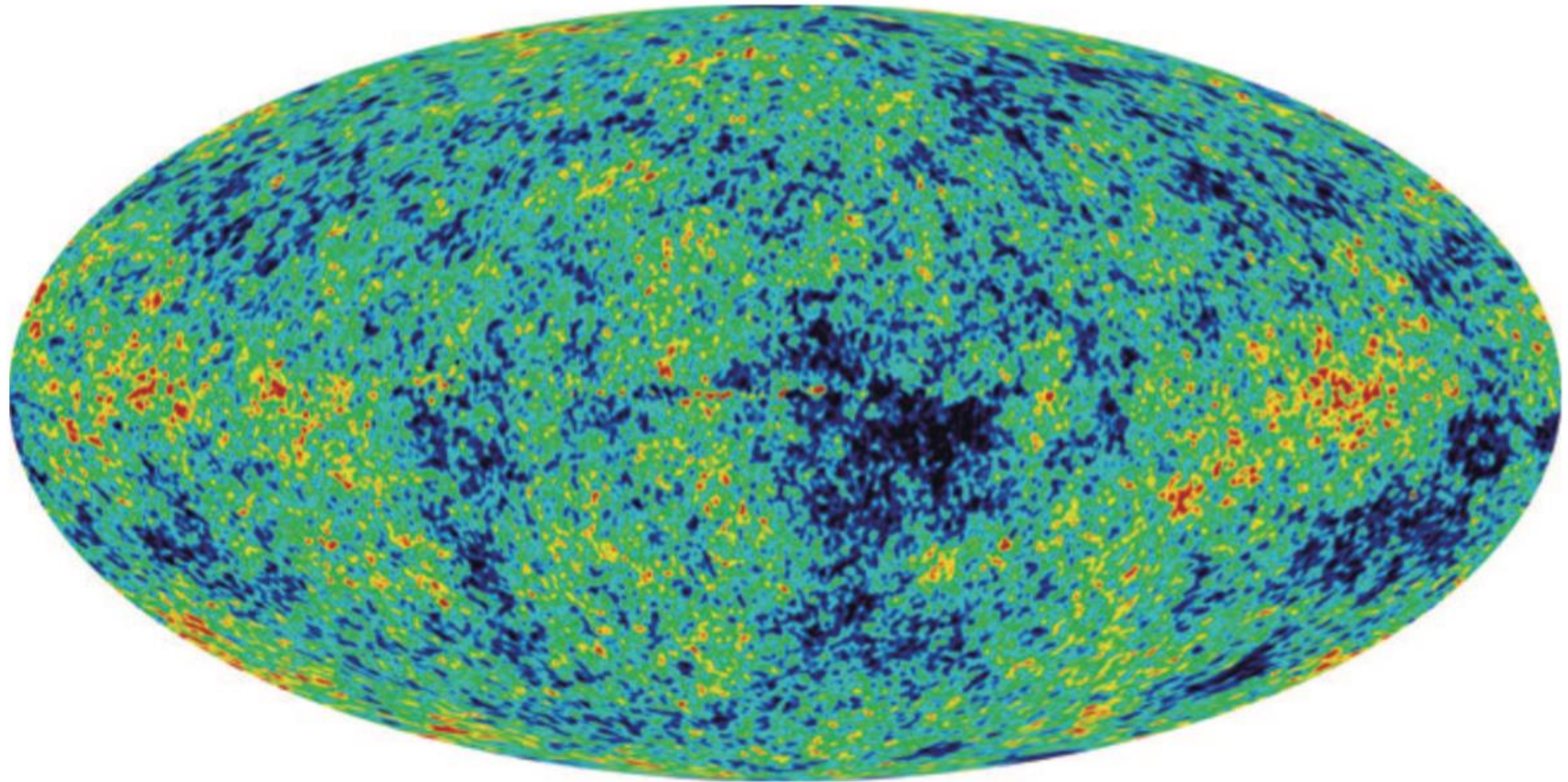


Early route

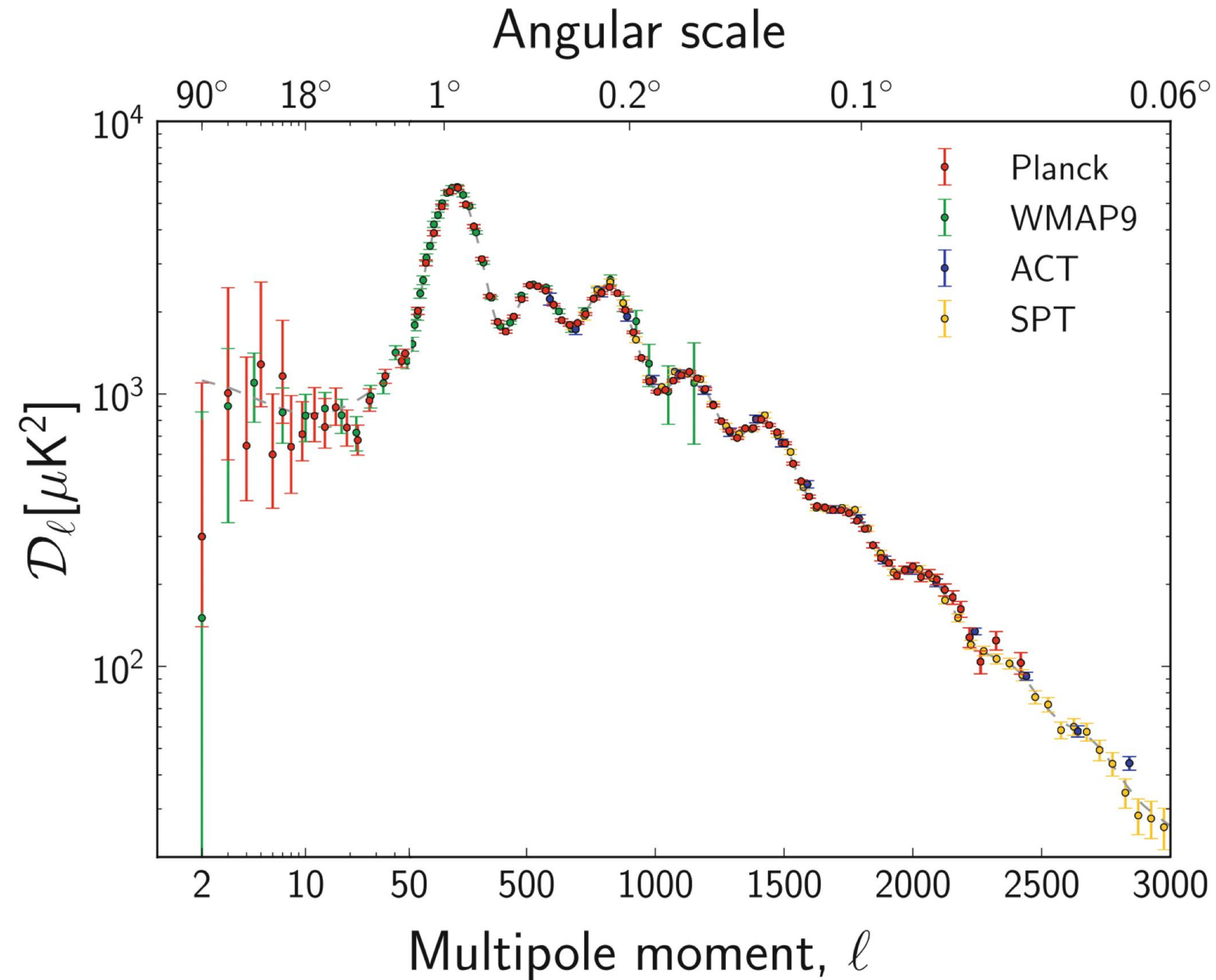
- a** Planck
- b** BBN+BAO
- c** WMAP+BAO
- d** ACTPol+BAO
- e** SPT-SZ+BAO



Kozmické mikrovlnné pozadie z družice Planck



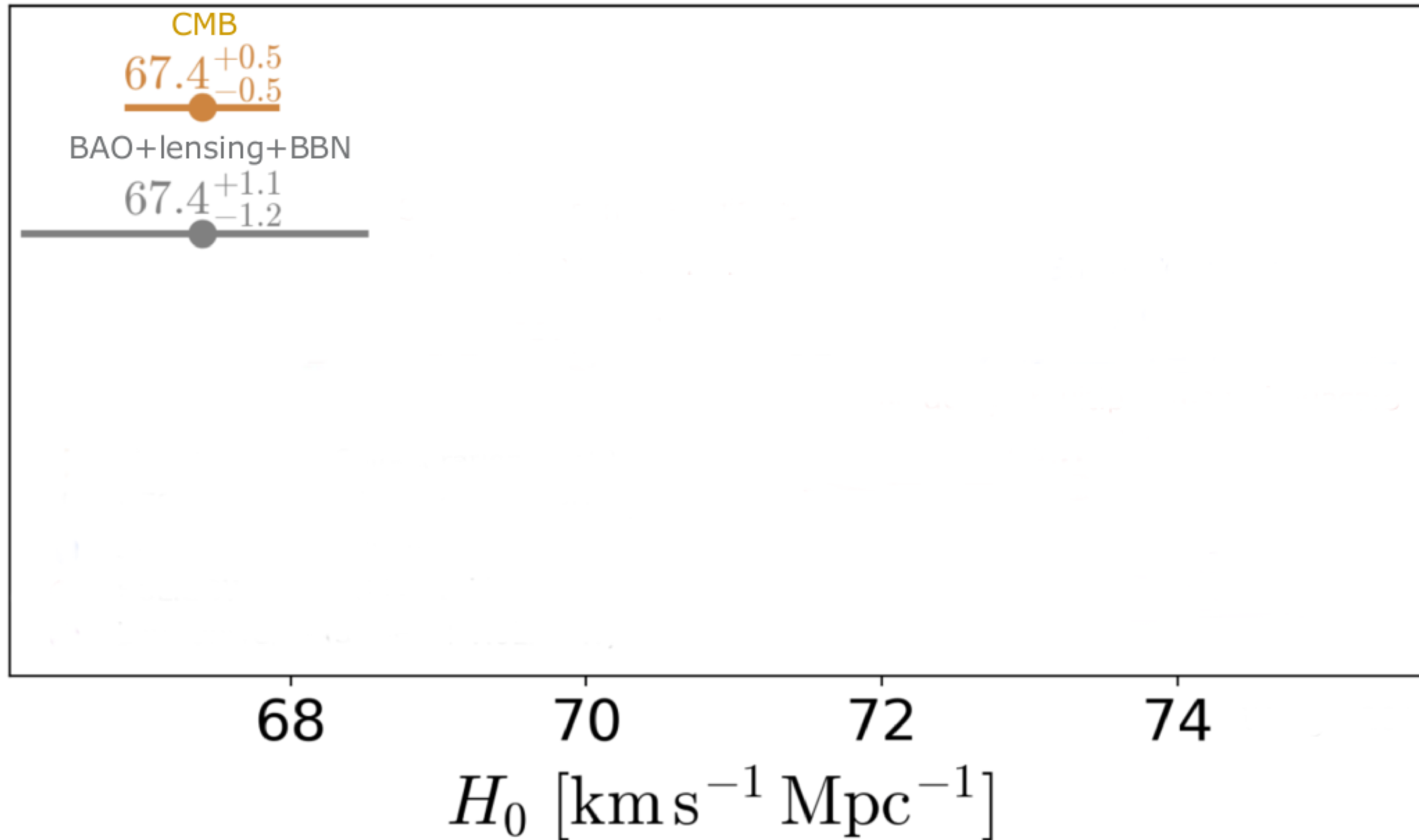
Spektrum kozmického mikrovlnného pozadia



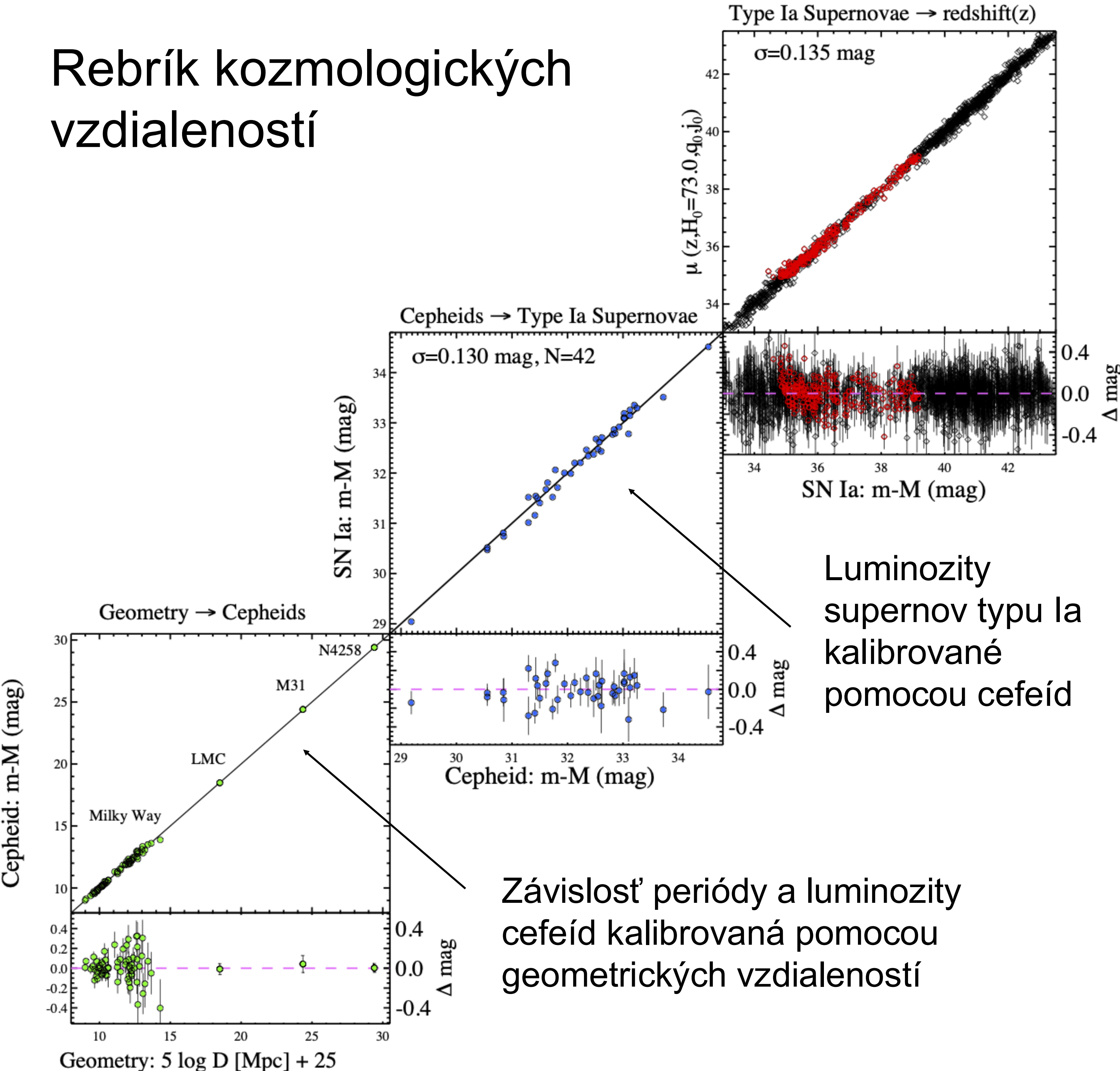
Indirect measurements

flat Λ CDM

Direct measurements



Rebrík kozmologických vzdialeností



SH0ES: ~300 supernov typu Ia vo vzdialenosti $z < 0.15$ dovoluje meranie H_0 s chybou 1.9%

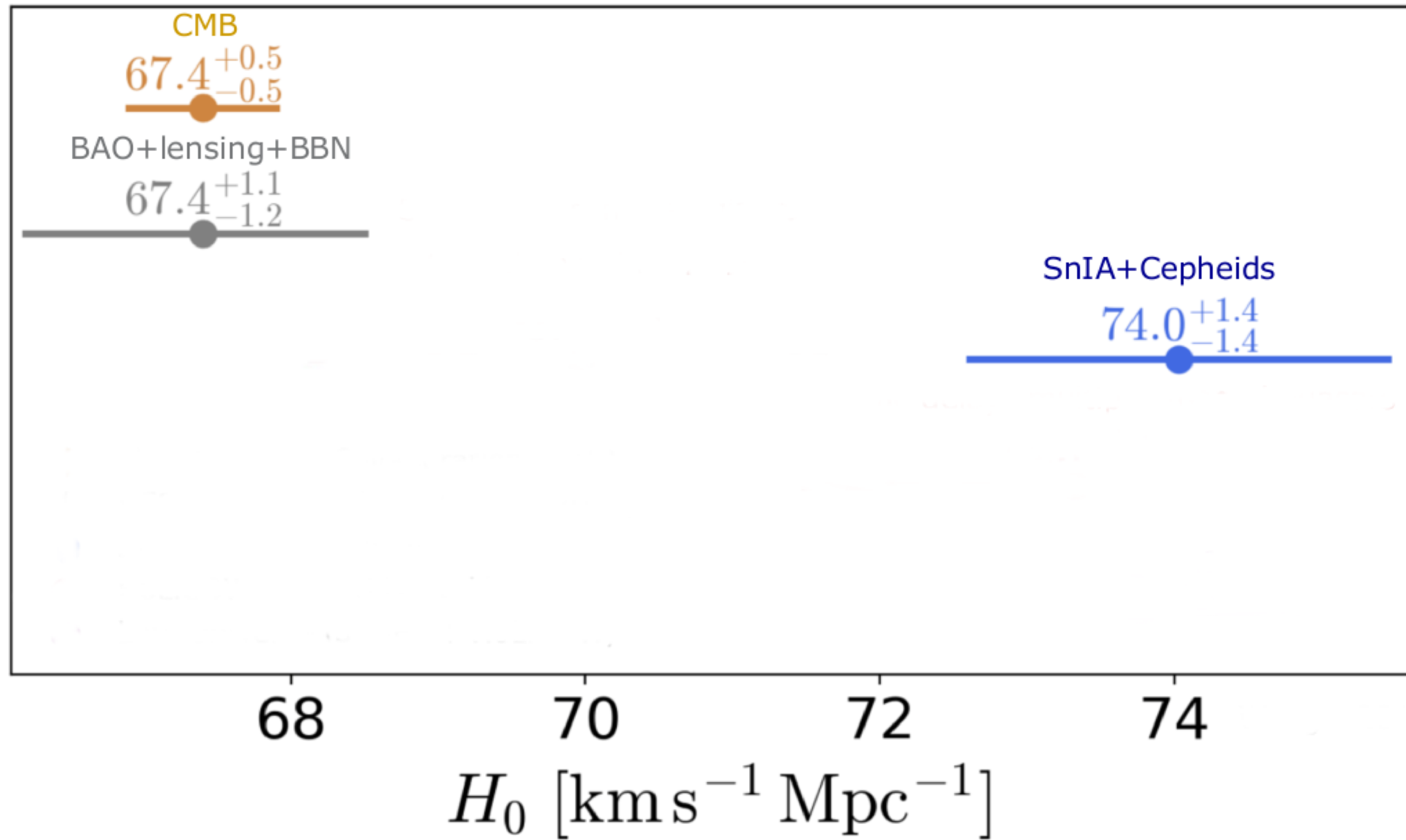
SN Ia kalibrované pomocou cefeíd

$$H_0 = 74.03 \pm 1.42$$

Indirect measurements

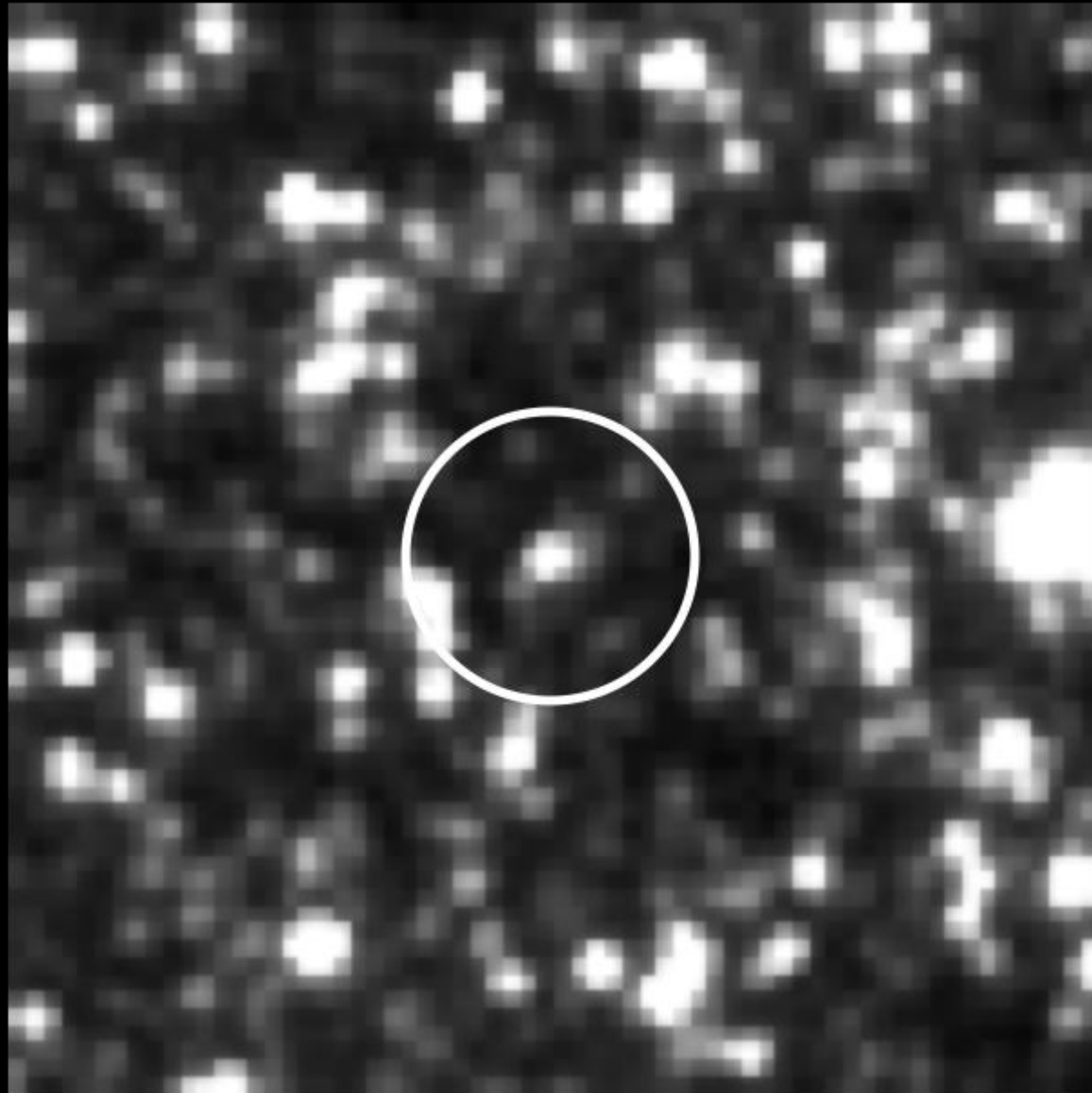
flat Λ CDM

Direct measurements

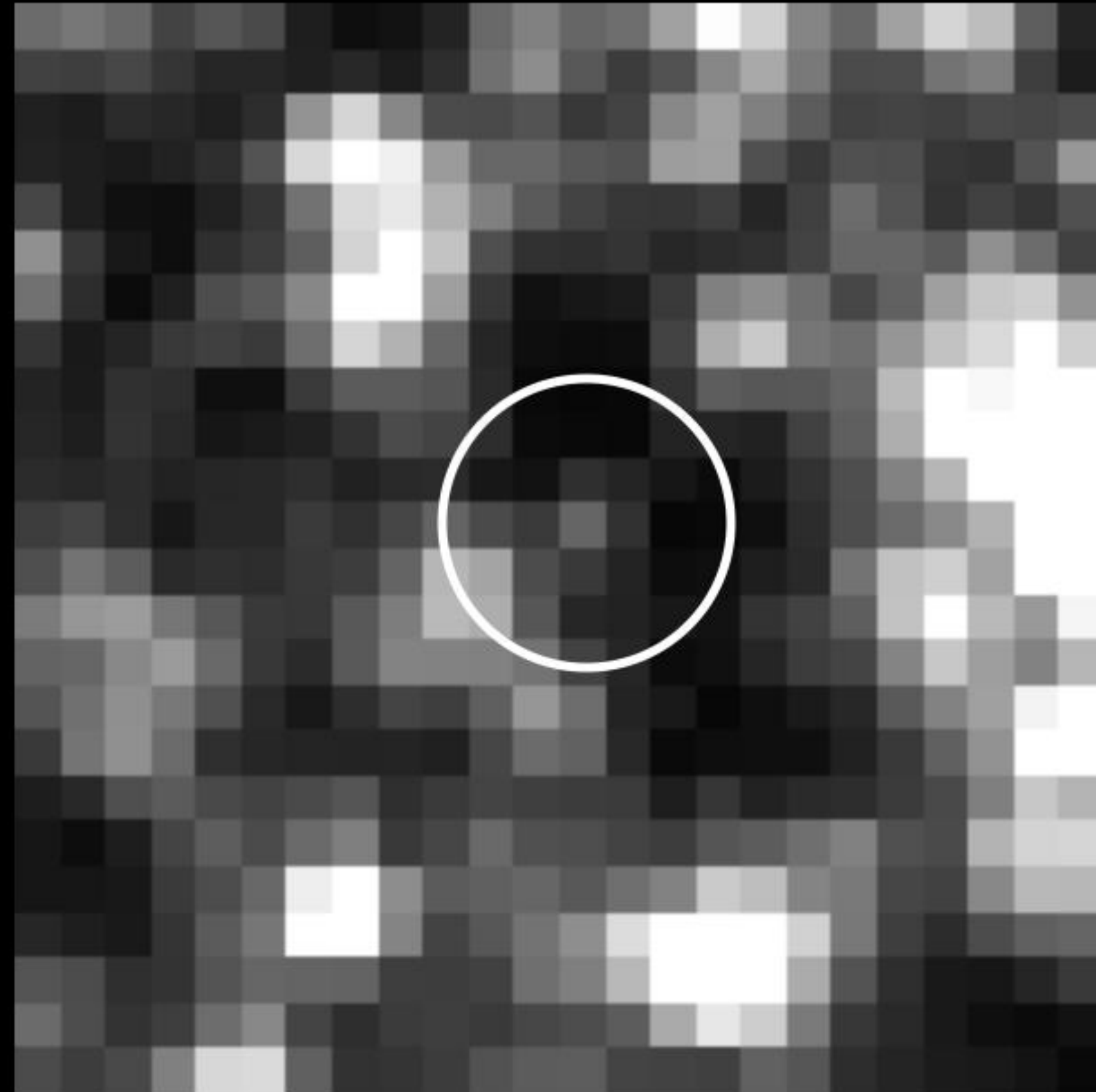


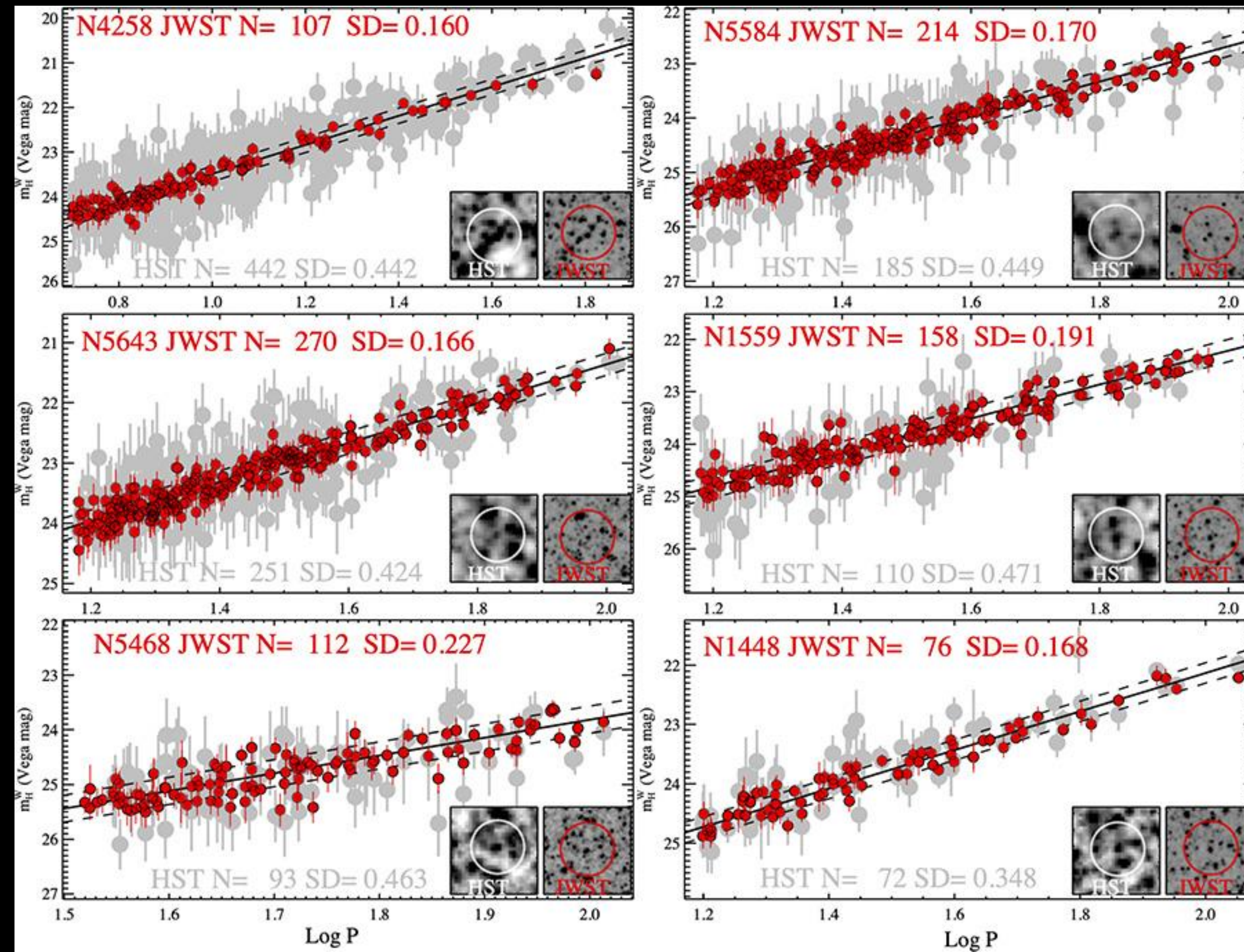


Webb Near-IR

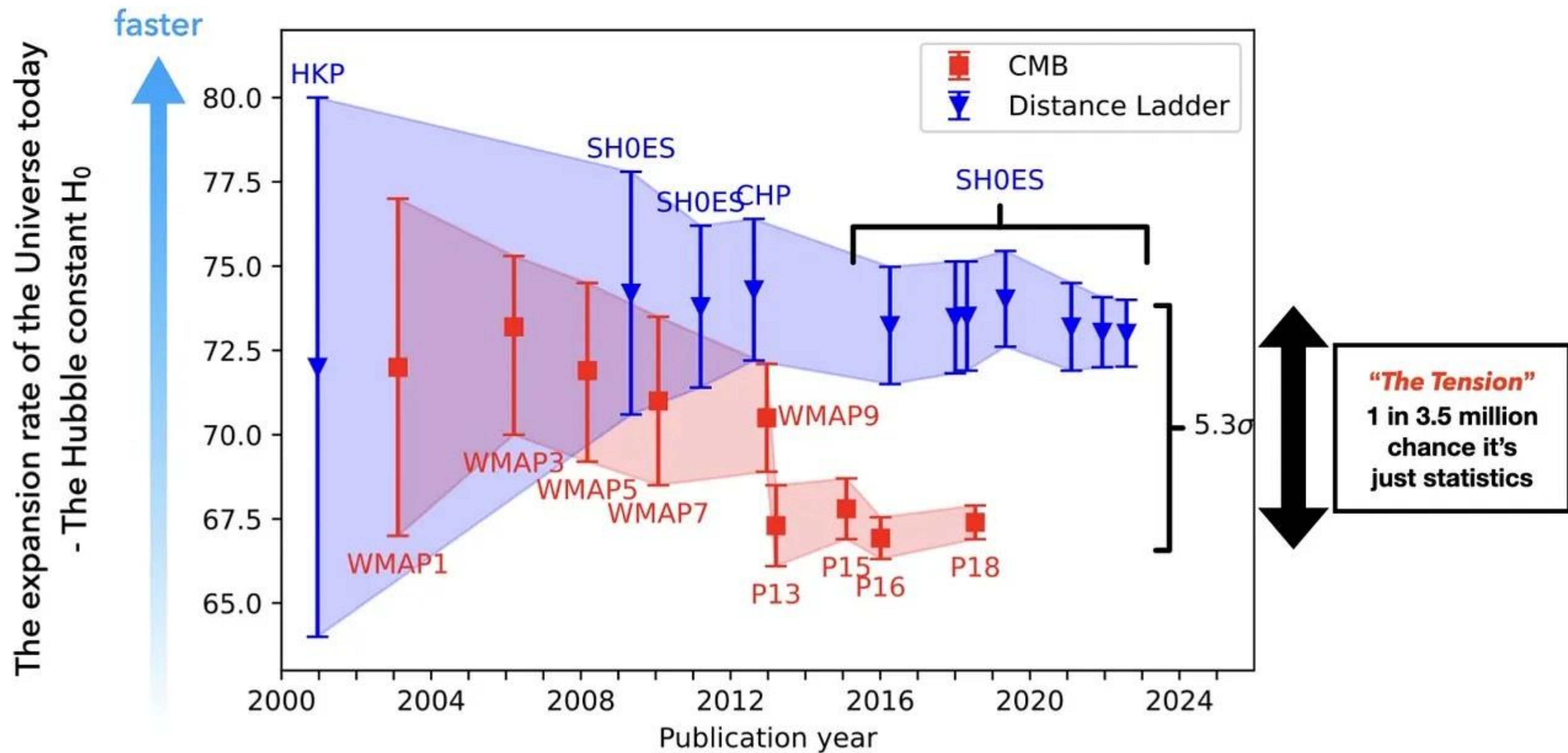


Hubble Near-IR

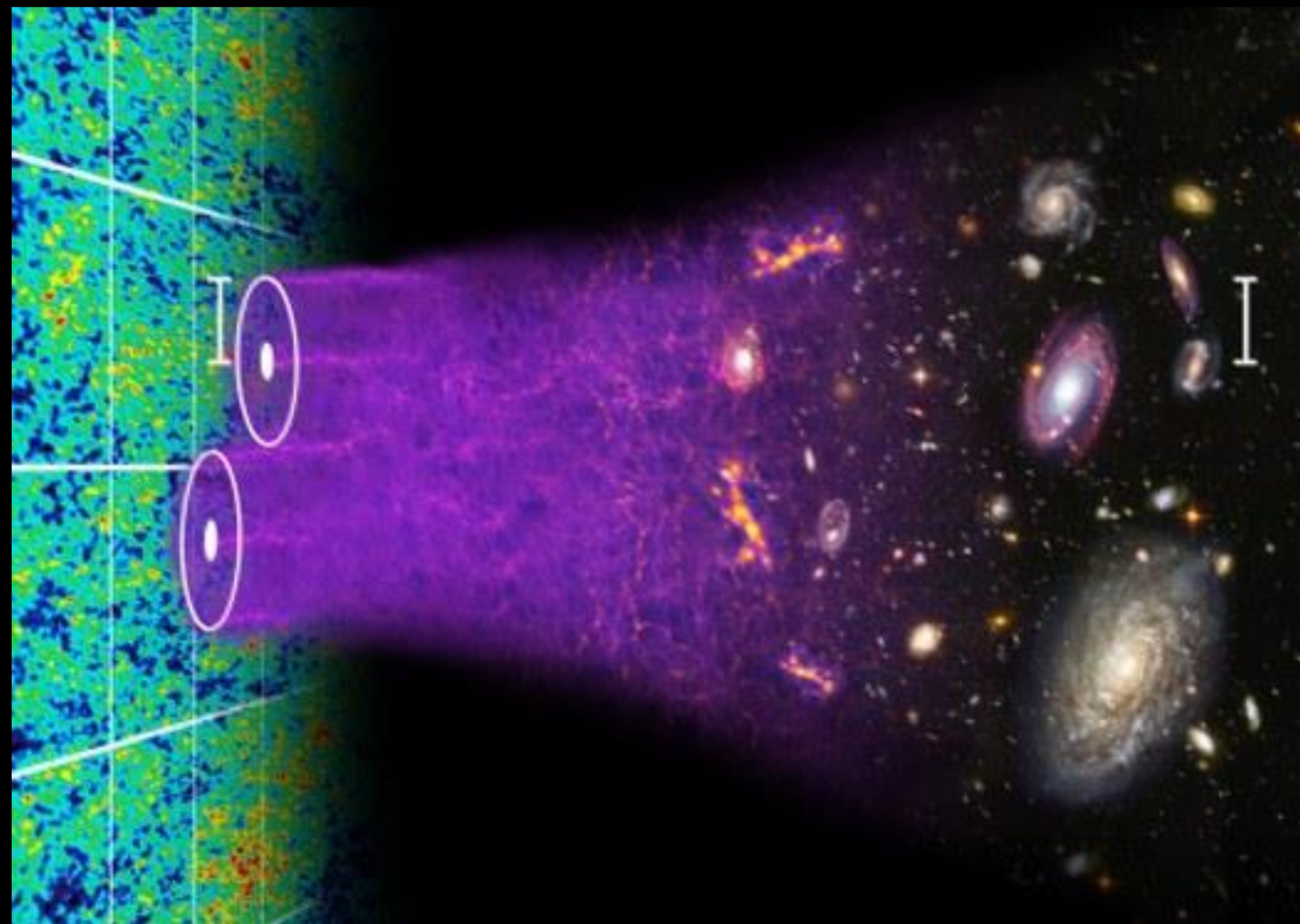




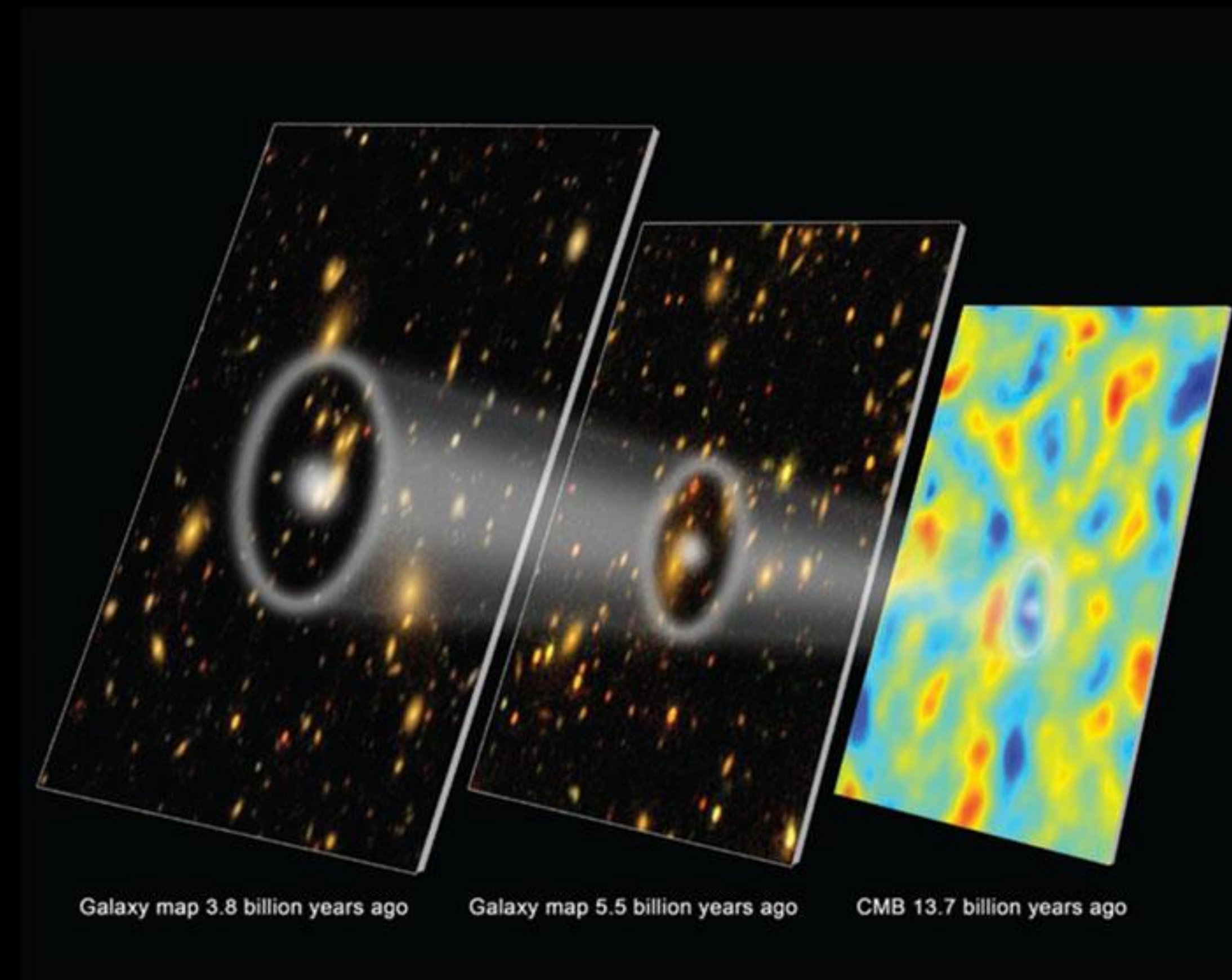
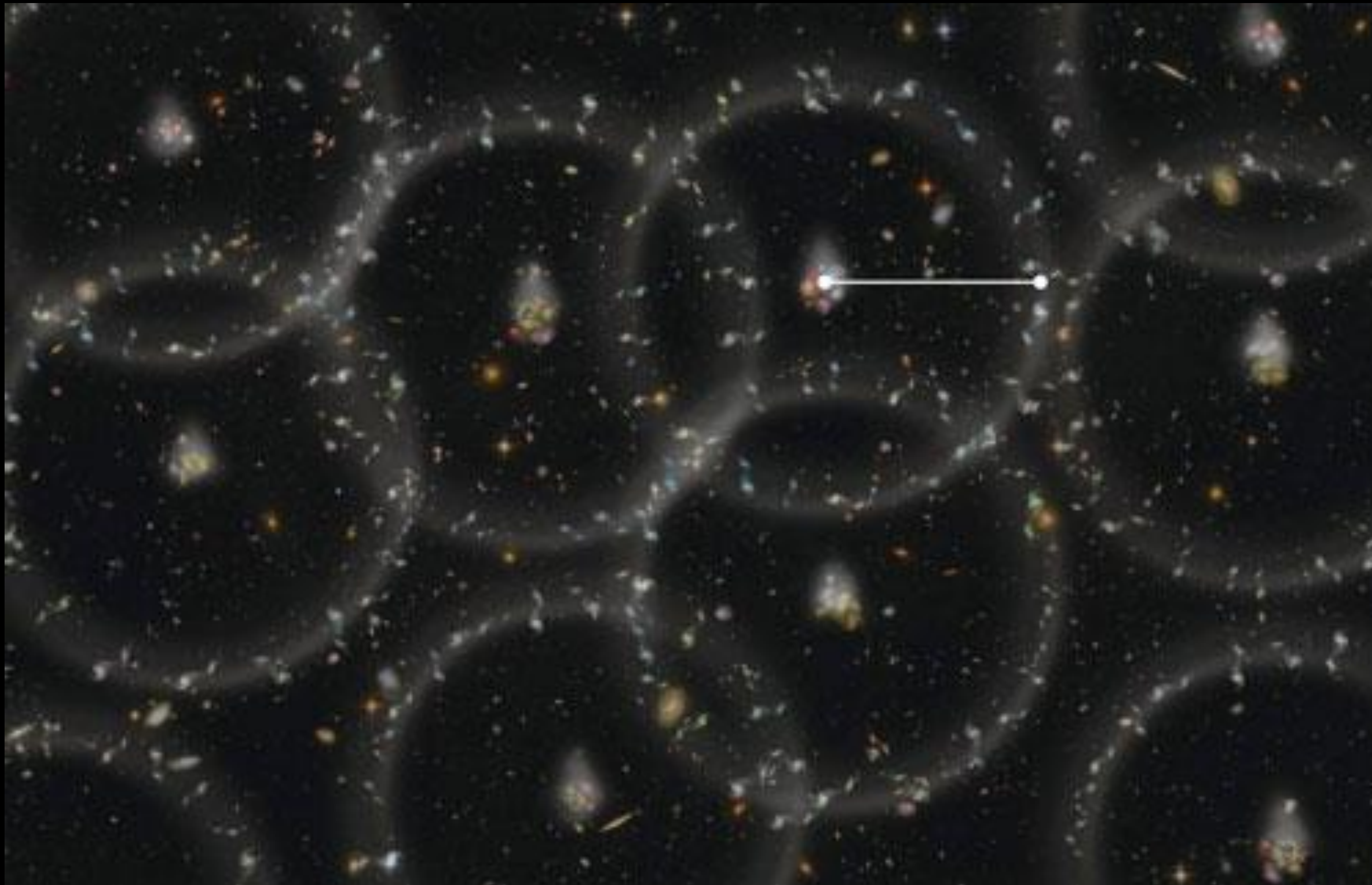
Kríz v kozmológii?



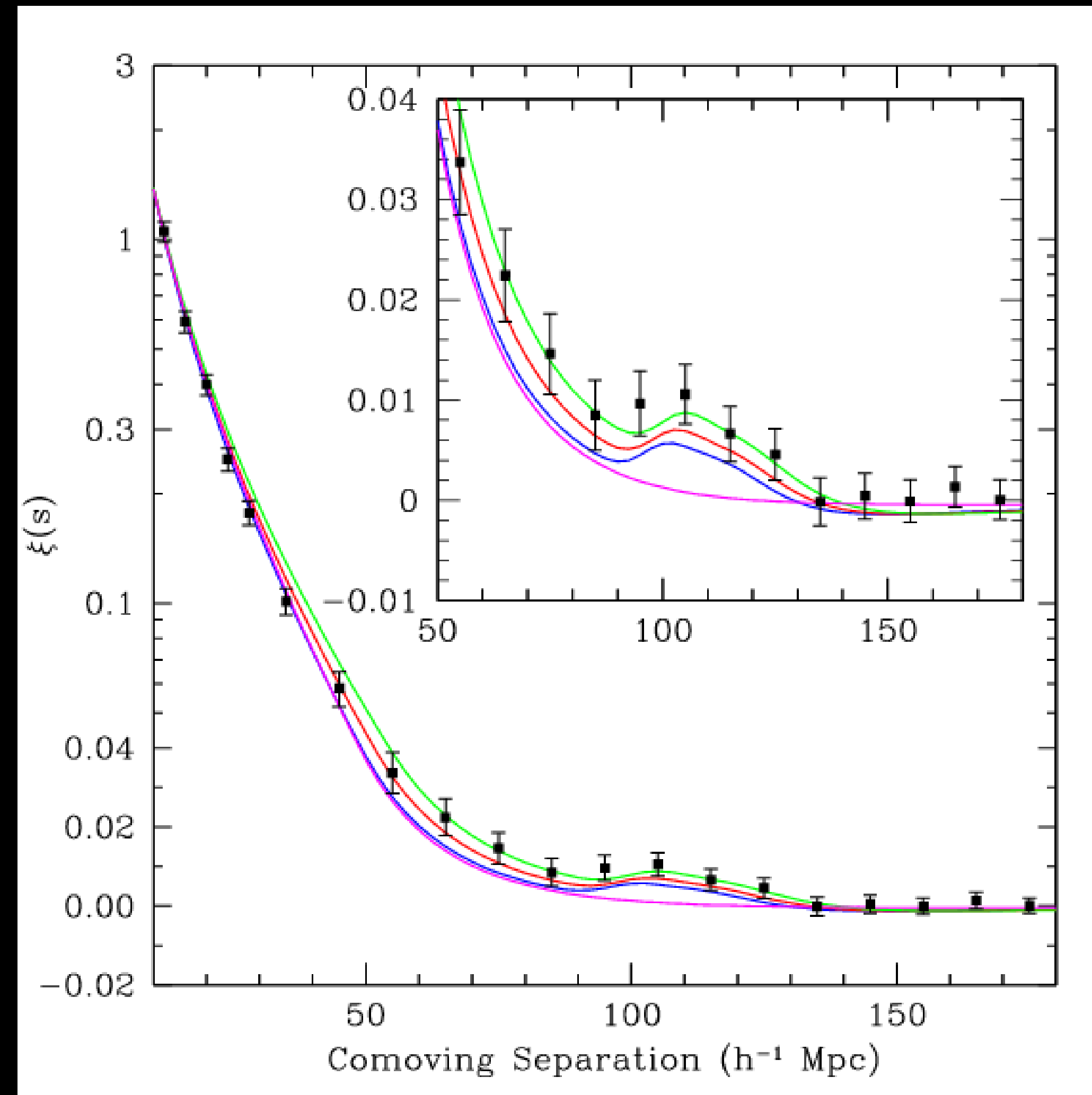
Baryonické akustické oscilácie

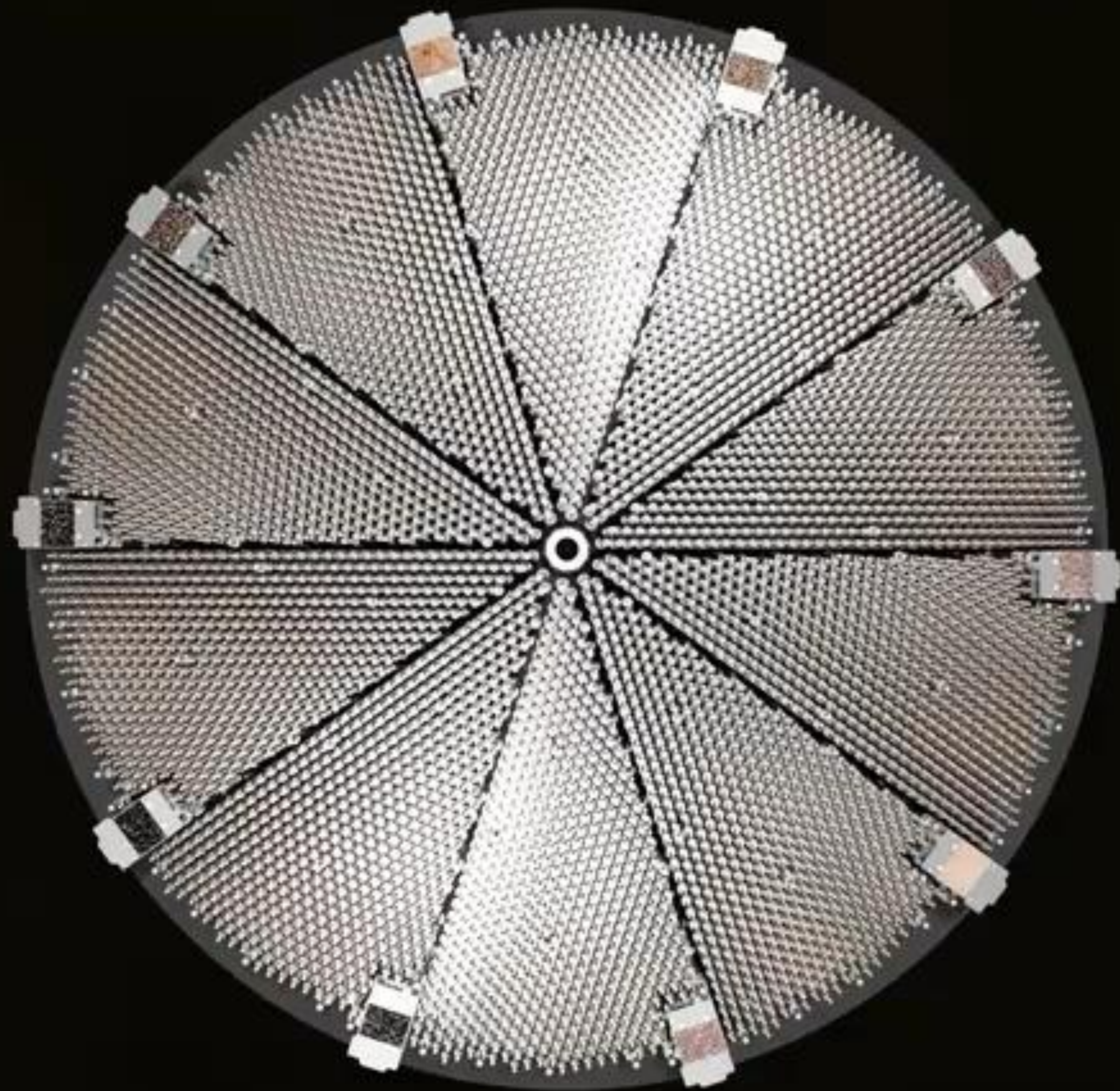


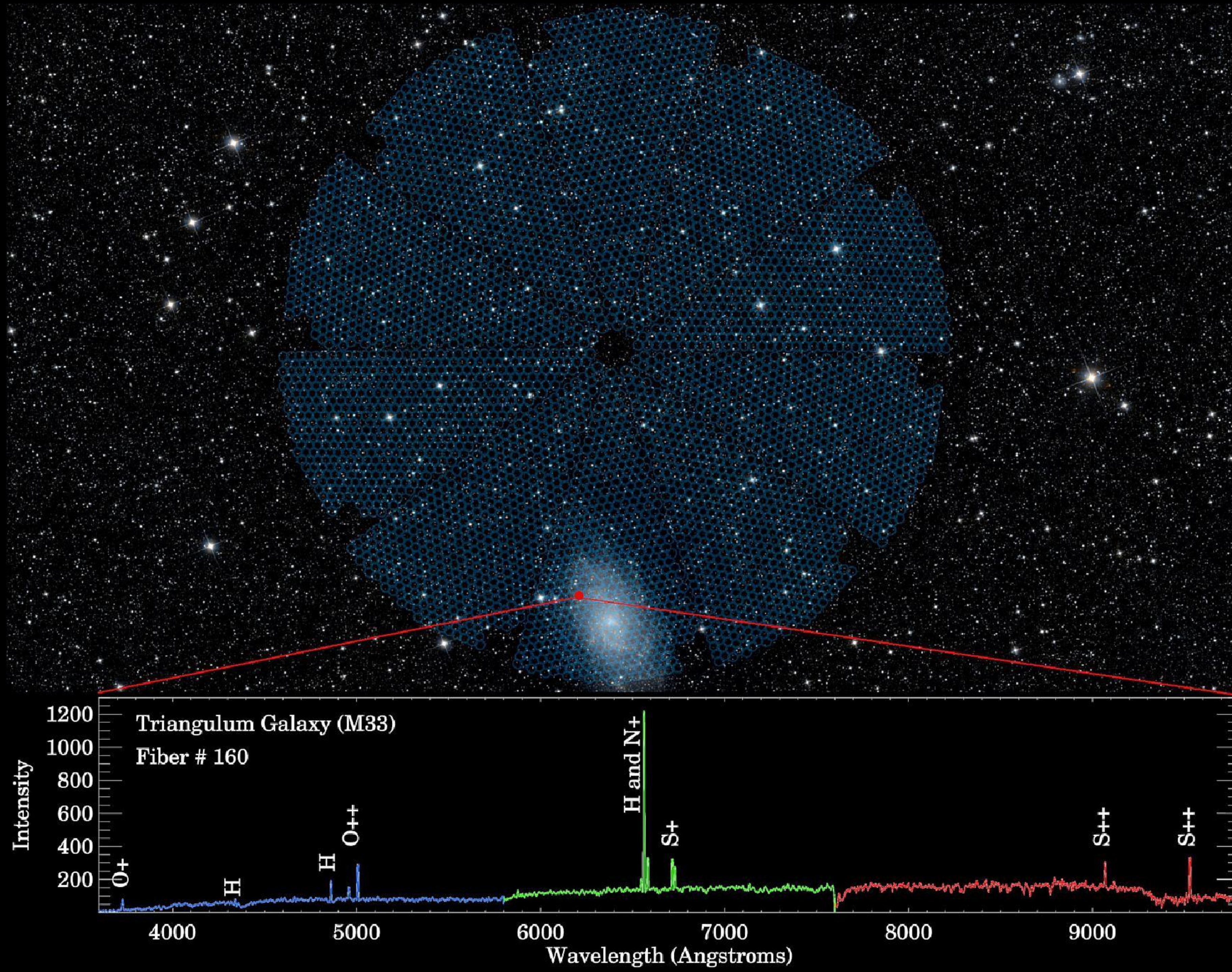
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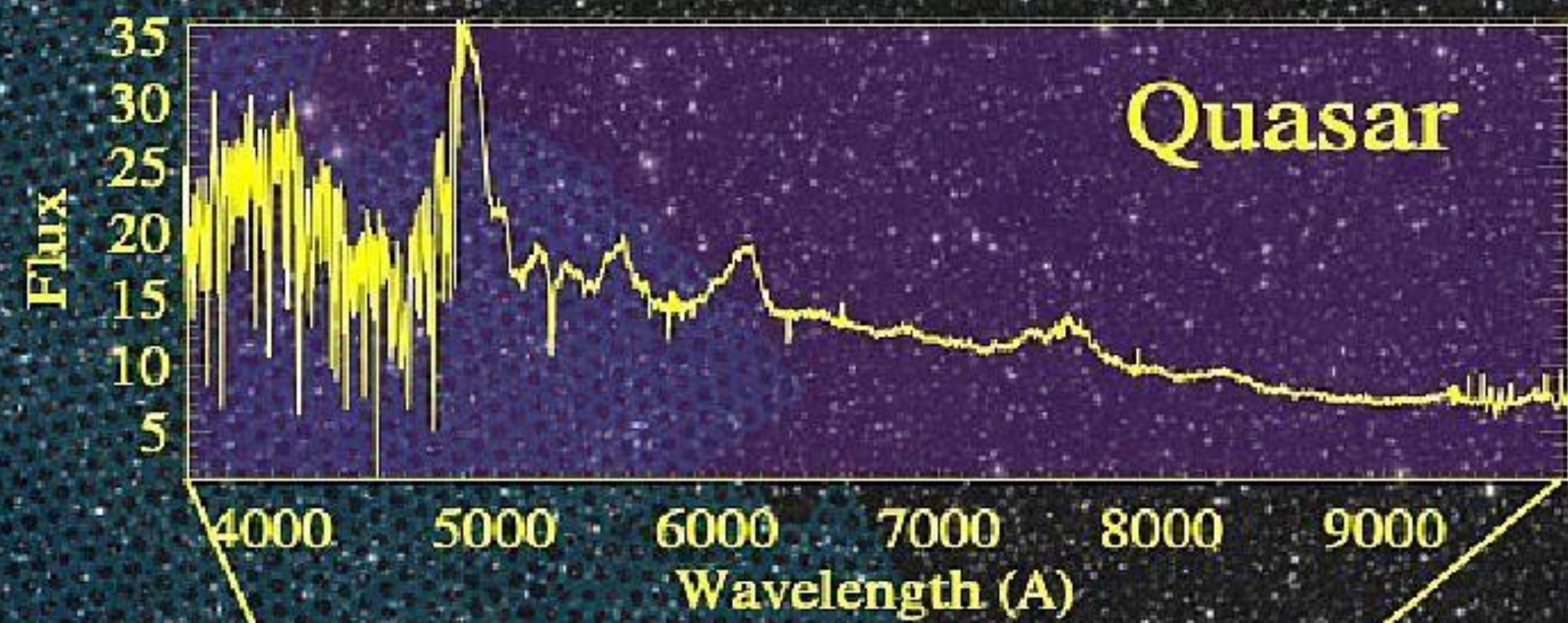
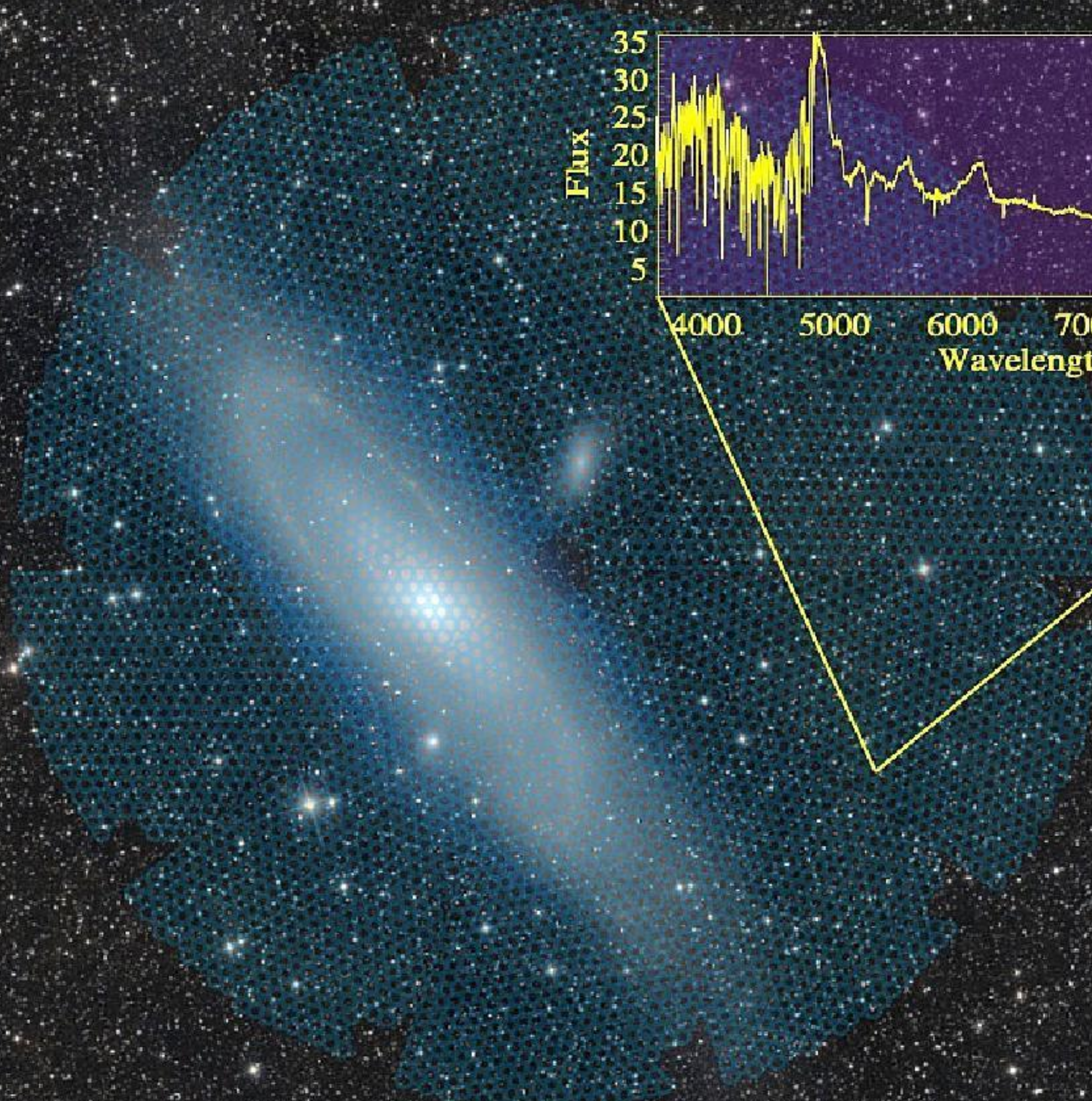


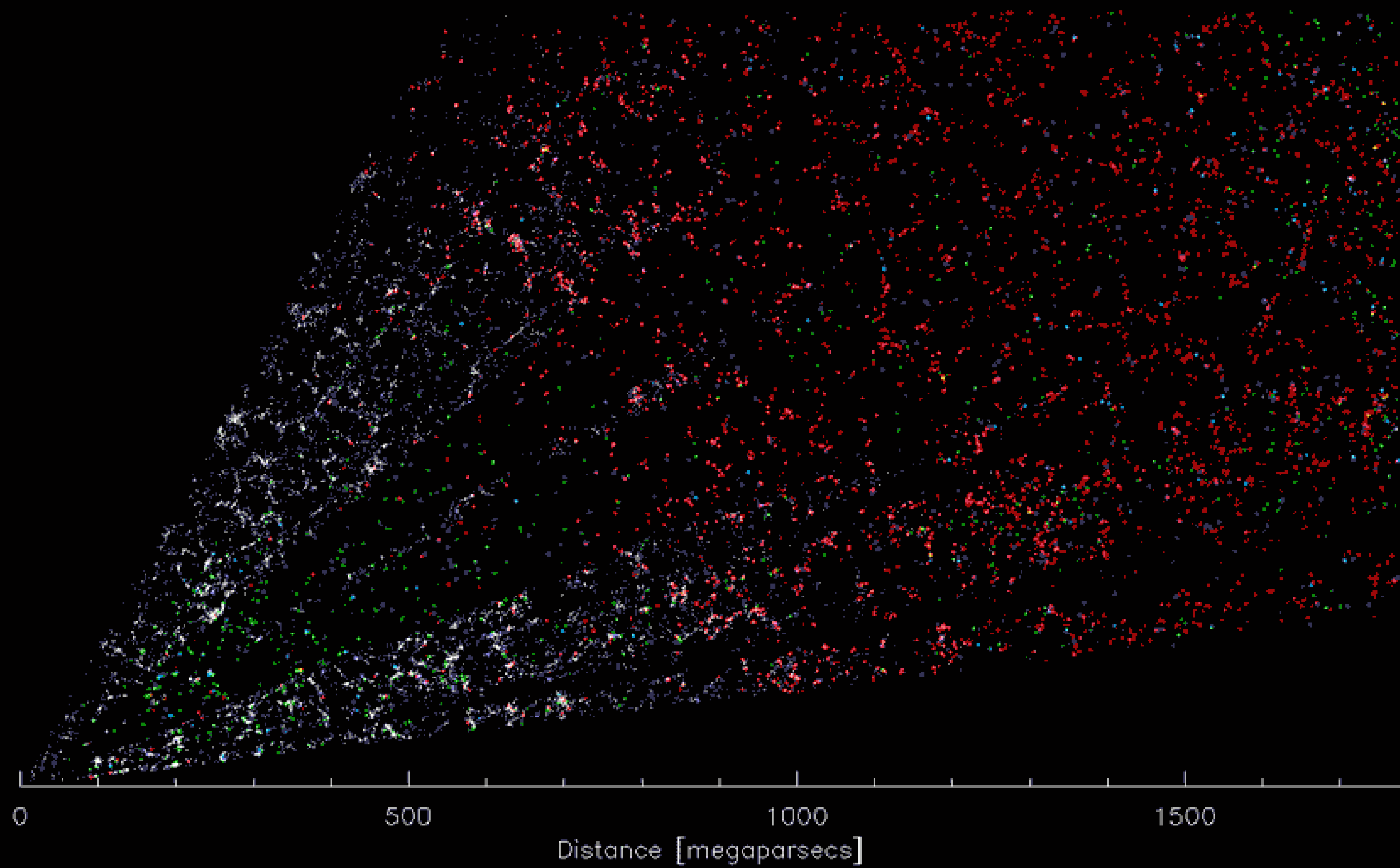
Baryonické akustické oscilácie





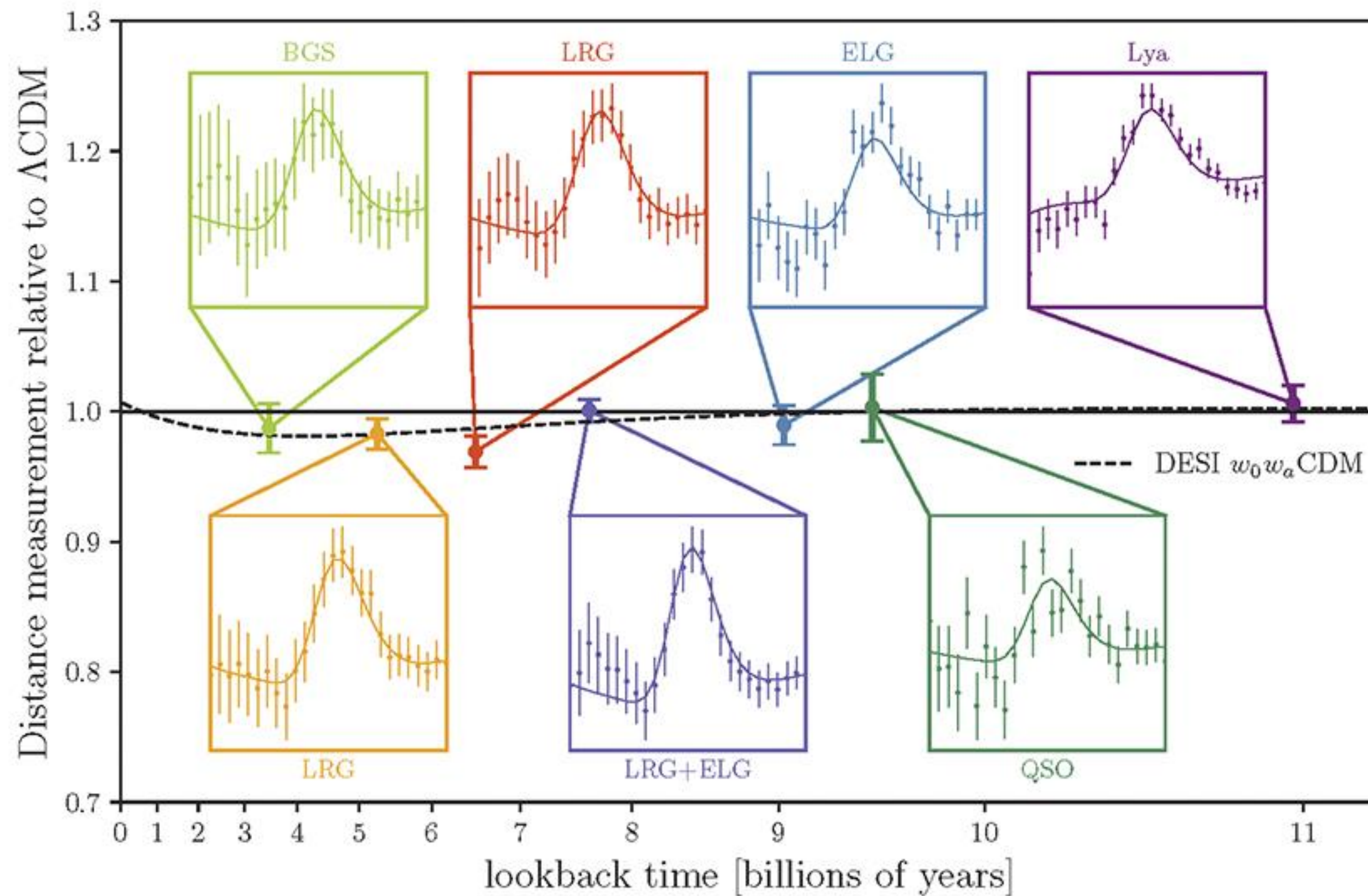




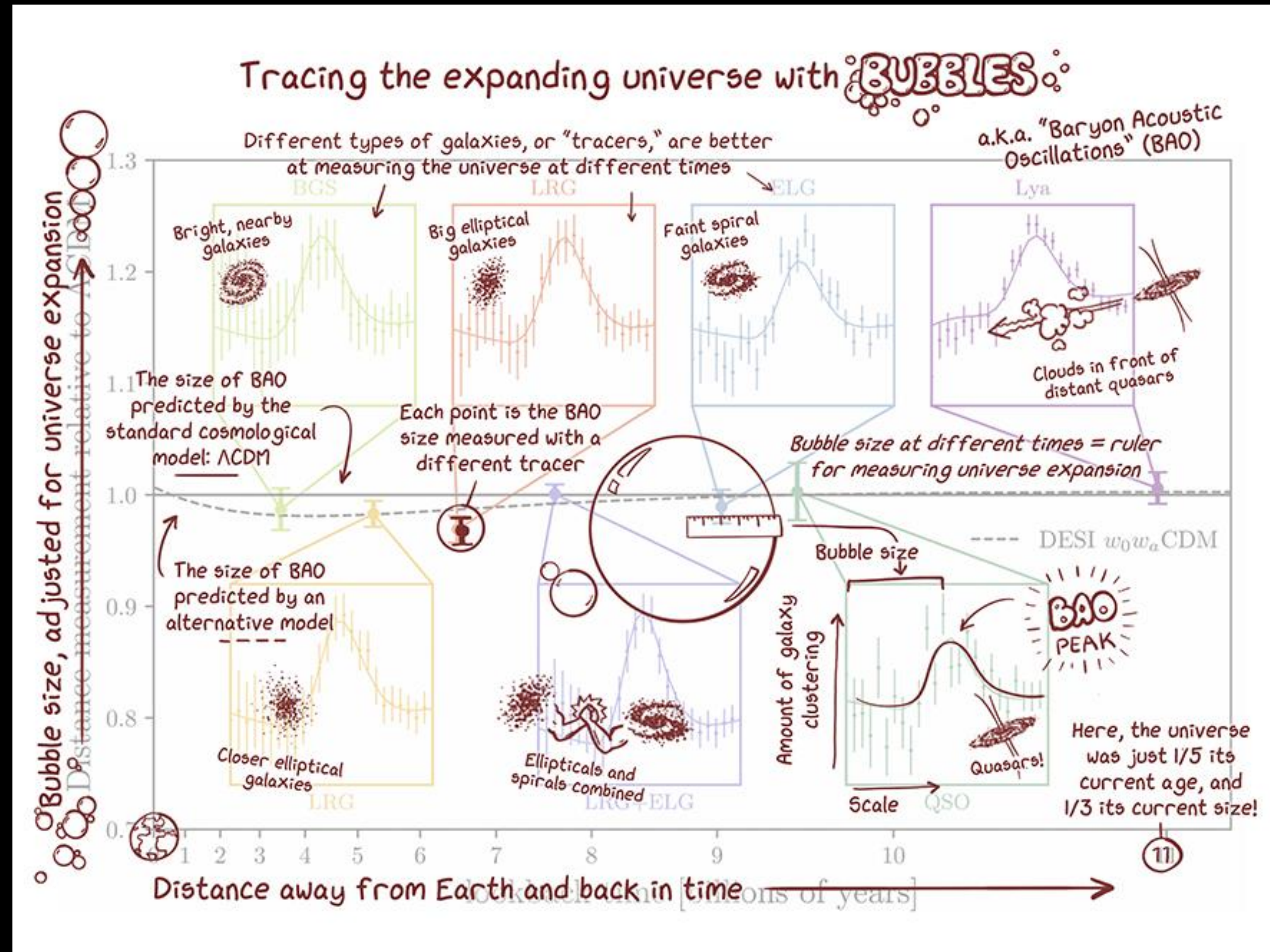




Is the dark energy evolving?



Is the dark energy evolving?



IT'S VERY NICE OF YOU ALL
TO TRY AND HELP, BUT I'M
AFRAID THIS ISN'T THE TYPE OF
DARK ENERGY I'M LOOKING FOR.



Astrofyzika o 25 rokov?

Predpovede:

- Problém Hubblovej konštanty bude vyriešený
- O temnej energii budeme vedieť viac, ale bude stále záhadou
- Rast čiernych dier preskúmame pomocou gravitačných vln
- Spoznáme prvé exoplanéty so známkami života
- Astrofyzici, družice, a prístroje z ČR významne prispejú k posunu nášho poznania