80 minute light echo signalling a 10,000 solar mass black hole in a bulgeless dwarf galaxy

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Nature?

NGC 4395 :
D=4.95 Mpc
M_B=-17.8 (https://www.sao.ru/lv/lvgdb)
LSB, bulgeless, central cluster

Observations:

Spectra:
GMOS L-S , 2017 Apr 29, 36*300 s

Images:
H-alpha: 2.5-m MDM telescope
V-band:1.3-m and 1-m telescopes

2017 May 2 and 2018 Apr 29

Bad weather at Gemini-North precluded simultaneous spectroscopic monitoring for both dates....

$\tau = 55^{+28}_{-32}$ min

$\tau = 49^{+14}_{-15}$ min

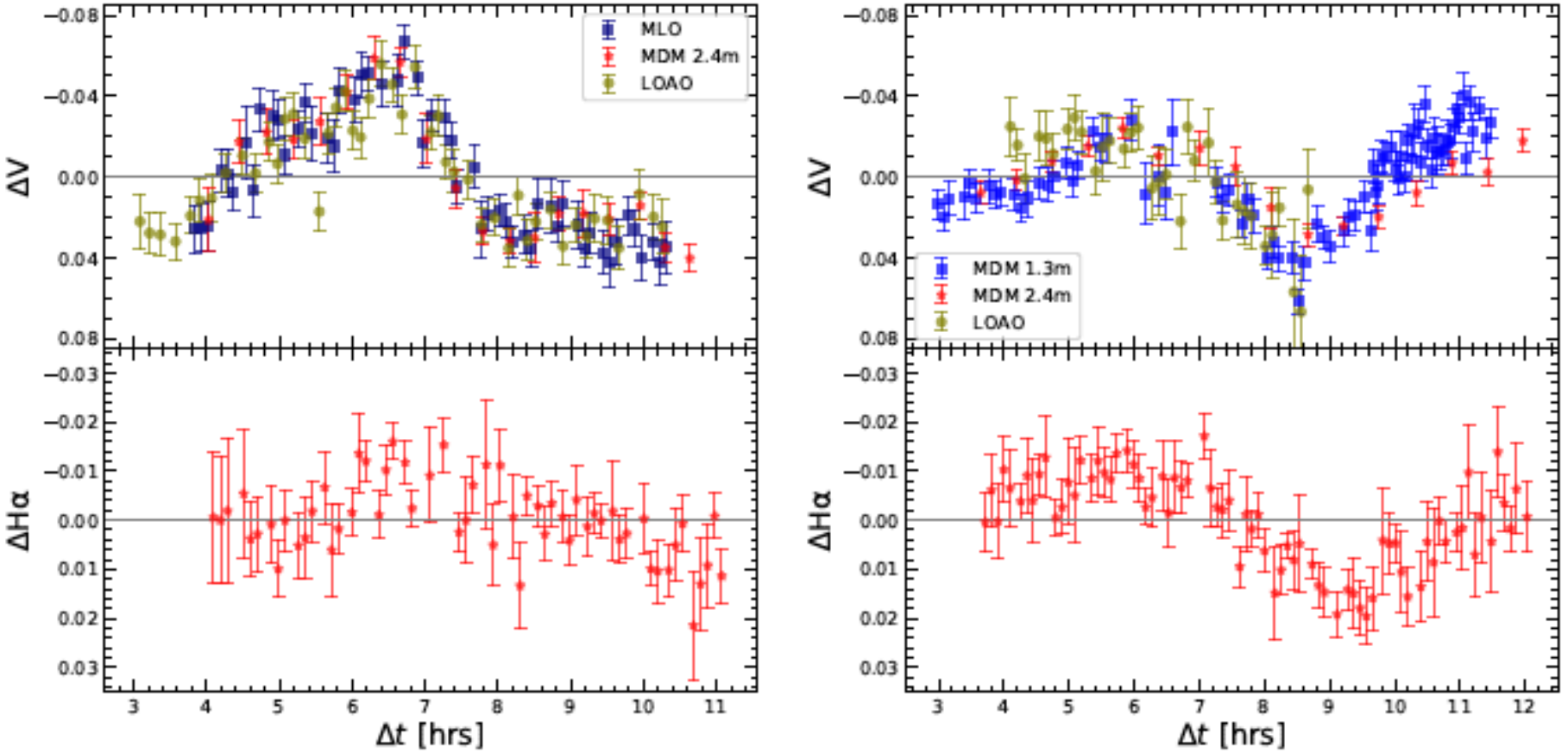
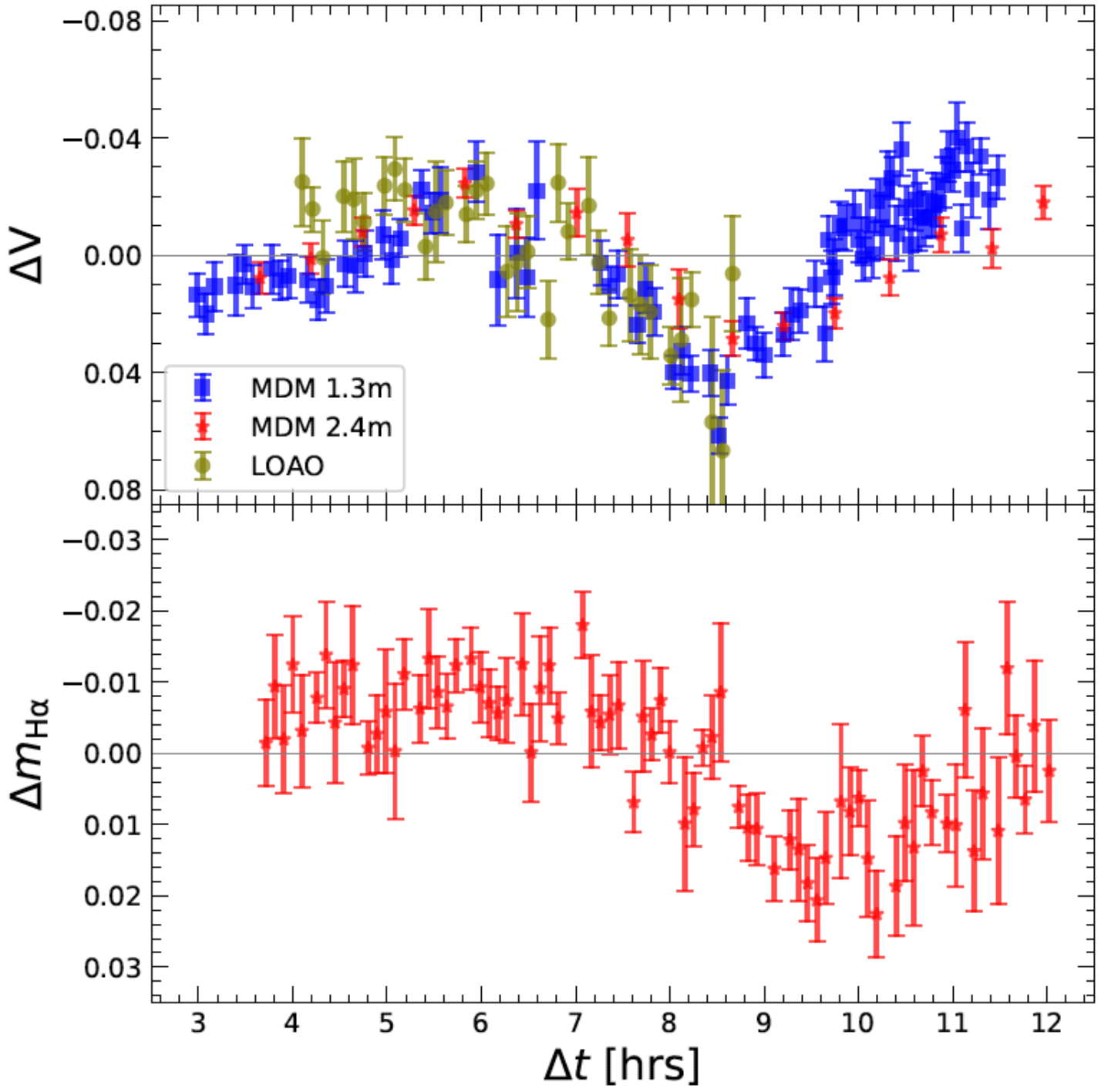


Figure 1: V- and narrow Hα-band photometric light curves. The light curves are generated



Если континуум в Ha по переменности аналогичен V.

$\tau = 83 \pm 14$ min

От меня:
вклад Hb в V <5%

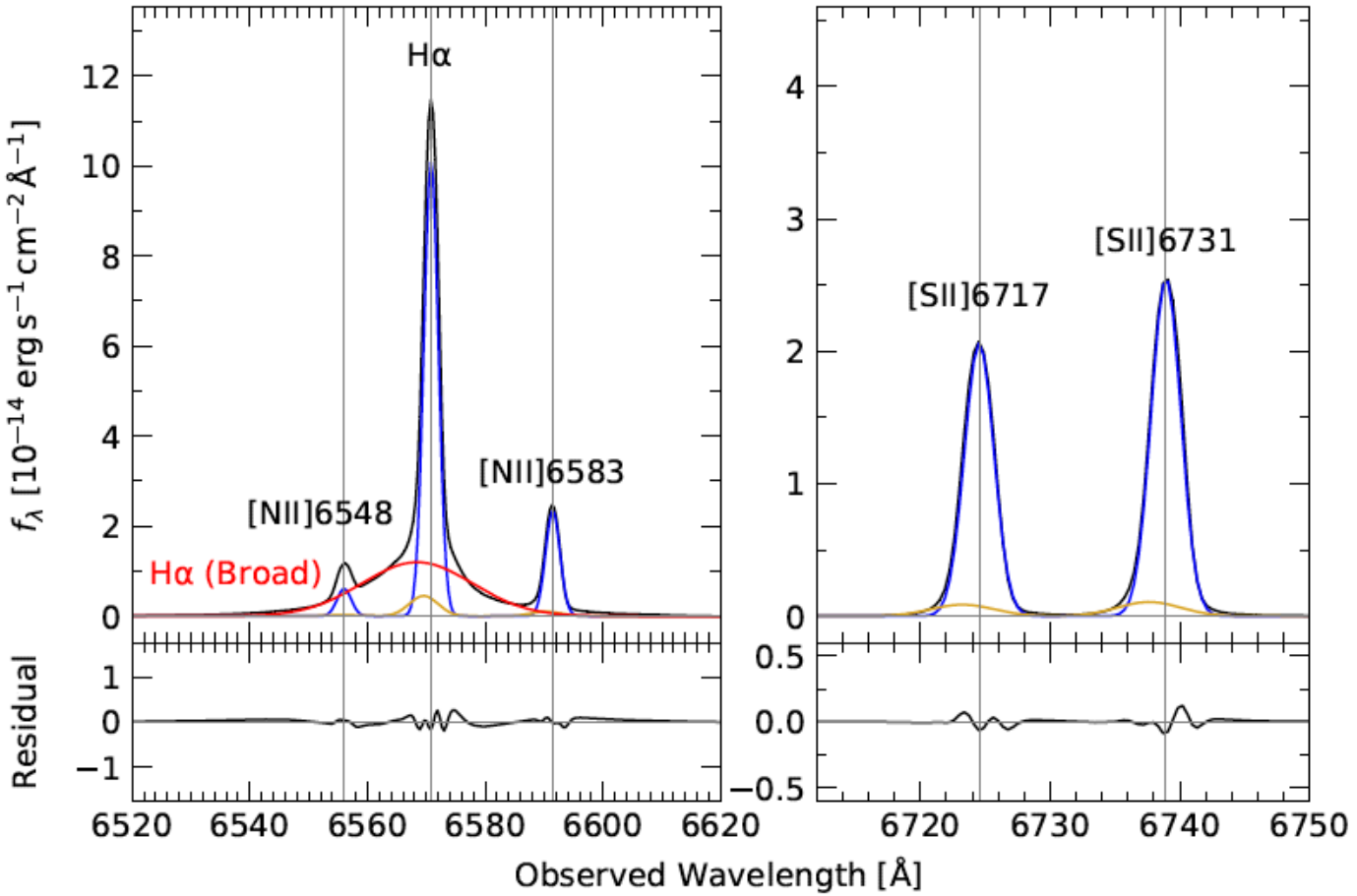


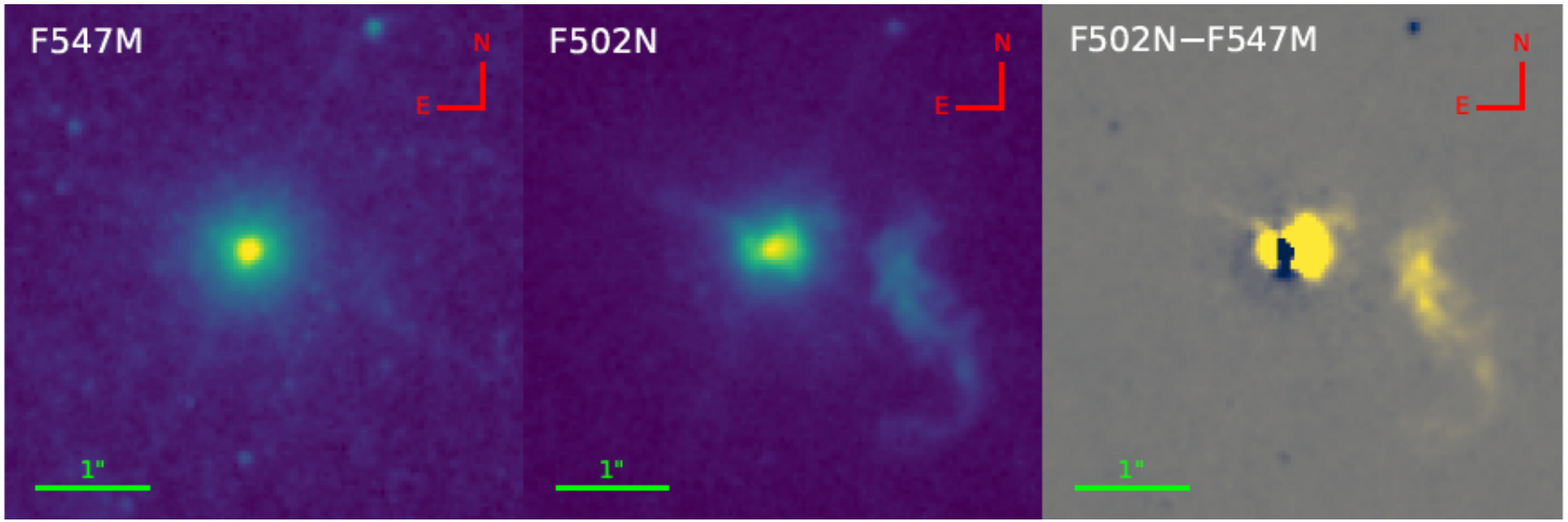
Figure 3: **Spectral decomposition of the Broad Hα emission line region.** The GMOS spectrum was decomposed into the broad Hα (red), narrow Hα, and narrow [NII] components (blue). The width of the broad Hα is measured as $\sigma_{\rm line} = 426 \pm 1\,{\rm km\,s^{-1}}$. The narrow lines, which reflect the

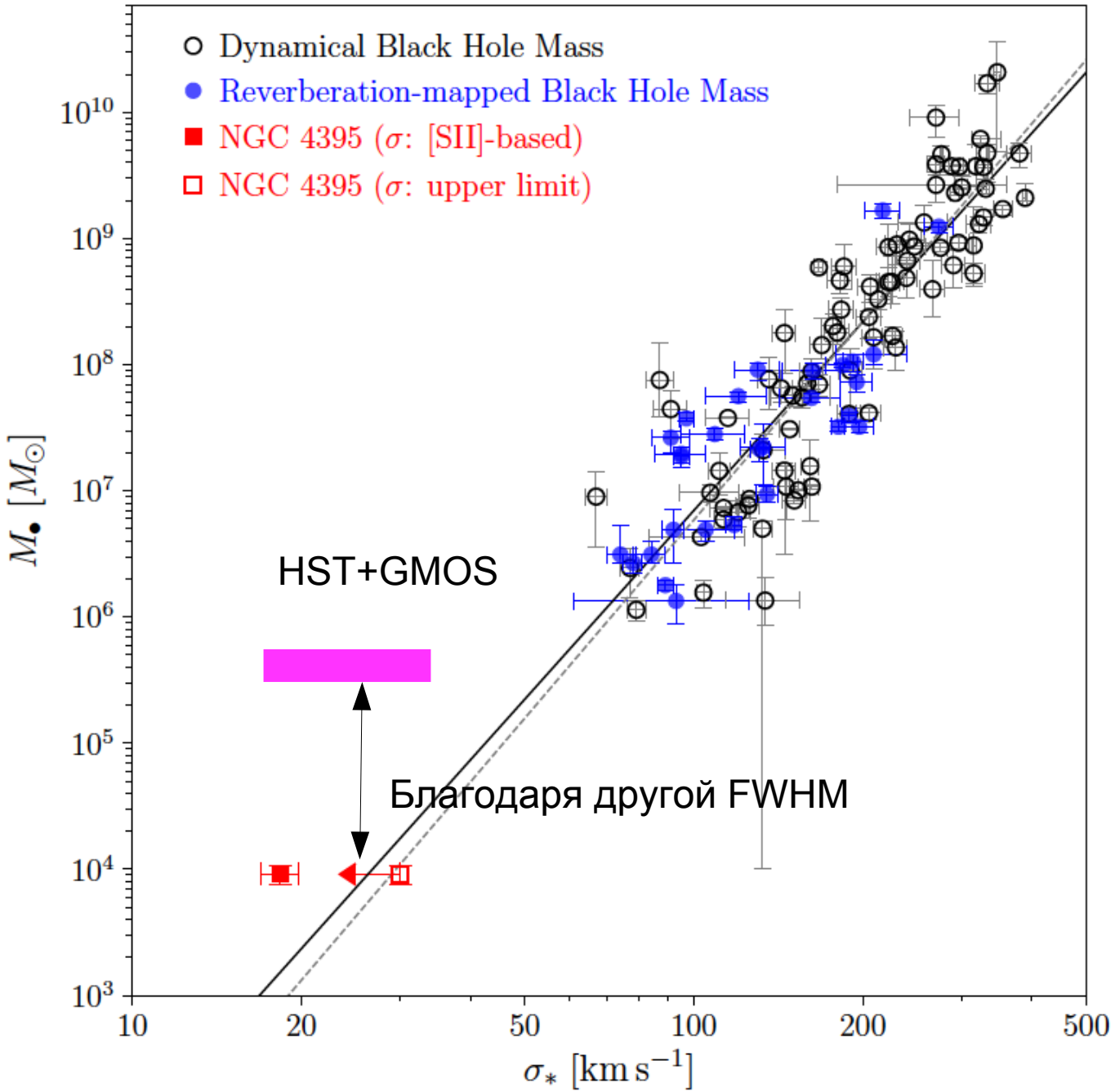
The mass of the black hole is given by the virial theorem and can be written $M_{\rm BH} = f(c\tau)\sigma^2_{\rm line}/G$, where f is a scale factor that accounts for the orientation of the BLR to the line-of-sight and anisotropy in the line profile, $\sigma_{\rm line}$ is the line-of-sight velocity dispersion of gas in the

Using the most updated value[20], $\langle f \rangle = 4.47$, we determine $M_{\rm BH} = 9100^{+1500}_{-1600}\ M_\odot$

Аргументы, что <f> можно использовать (т.е. тор виден не плашмя, i>20-30 deg):

- HST показывает в [OIII] нечто в виде конуса ионизации
- GMOS AO H2 velocity field: i=37 deg





Оценка σ* по [SII] ;-(

Проблемы ранних оценок:

HST STIS CIV reverberation (Peterson+ 2005) t~1 h:

- CIV – та еще линия (не гаусс)
- FWHM разная по спектру и по rms

А здесь – оценки сходятся!

GMOS – область 10 пк, включает более массивное центральное скопление

Где нет ни слияния, ни фидбека..

This indicates that the relationship between MBH and σ need not depend on* ***hierarchical growth through galaxy mergers*** *that would produce a bulge, and that low-mass galaxies (where feedback from supernovae is more important than that from black holes) need not have under-massive black hole..*

От себя:

- почему-то не показали, виден ли эффект в GMOS спектрах (36 штук за 3 часа)
- хорошая задача для средних телескопов на 1-2 ночи!