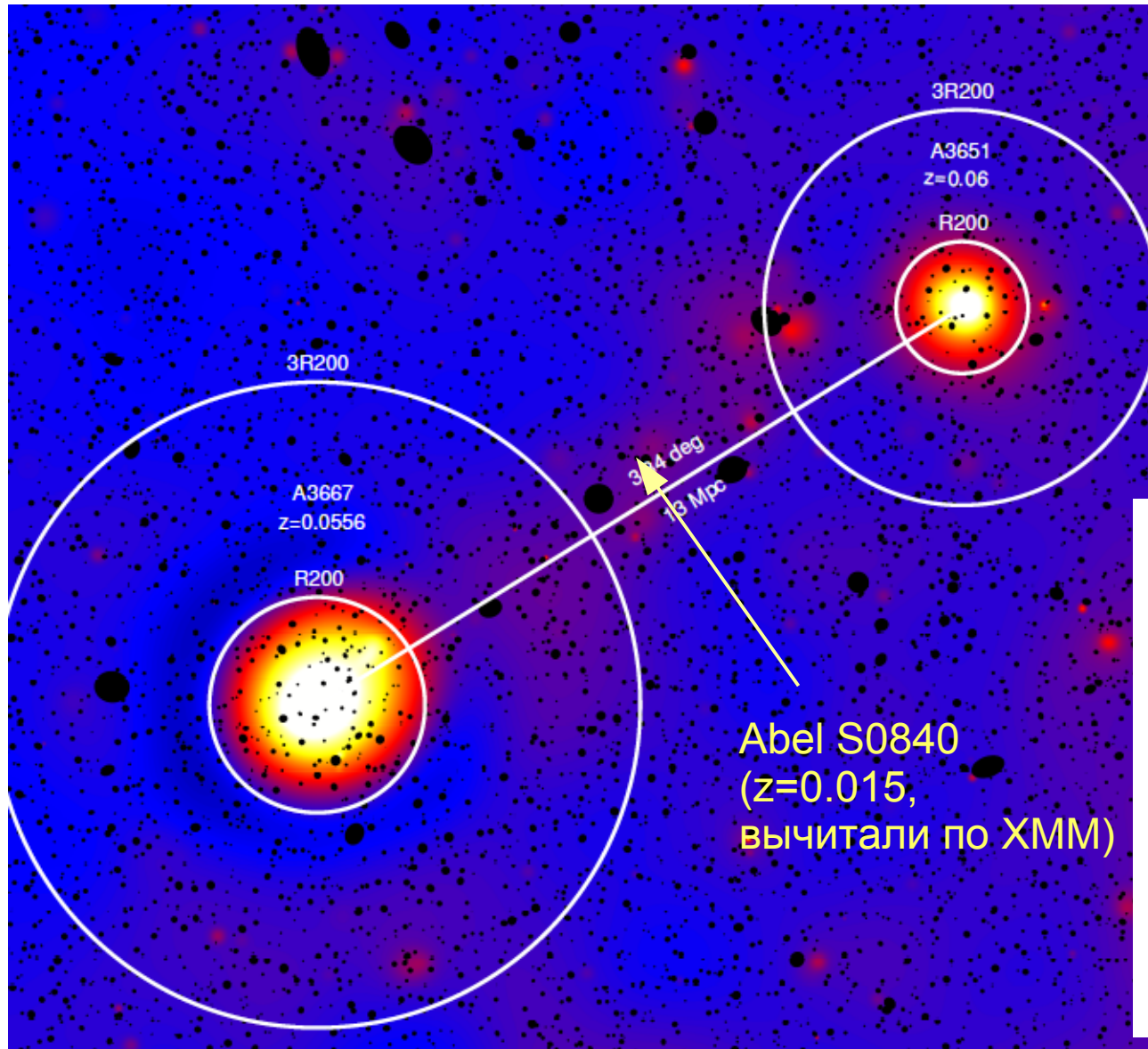


Discovery of a >13 Mpc long X-ray filament between two galaxy clusters beyond three times their virial radii

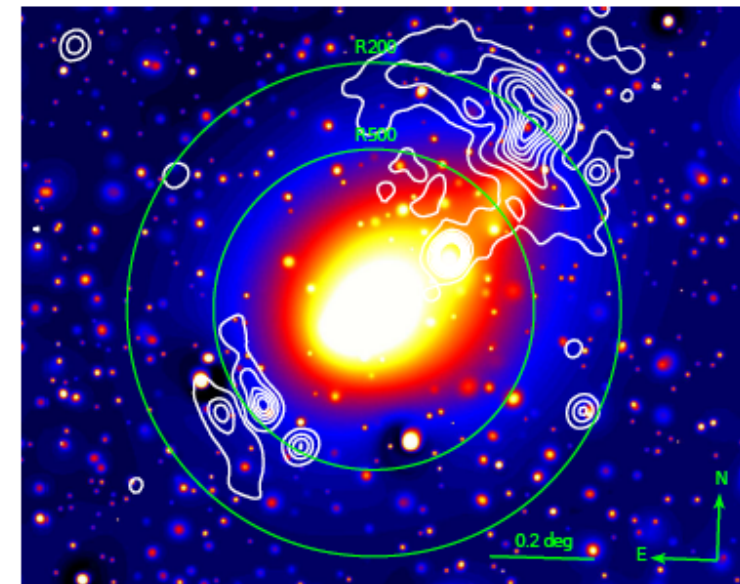
arXiv:2401.17281v1

J. Dietl¹, F. Pacaud¹, T. H. Reiprich¹, A. Veronica¹, K. Migkas^{1,2,3}, C. Spinelli¹, K. Dolag^{4,5}, and B. Seidel⁴

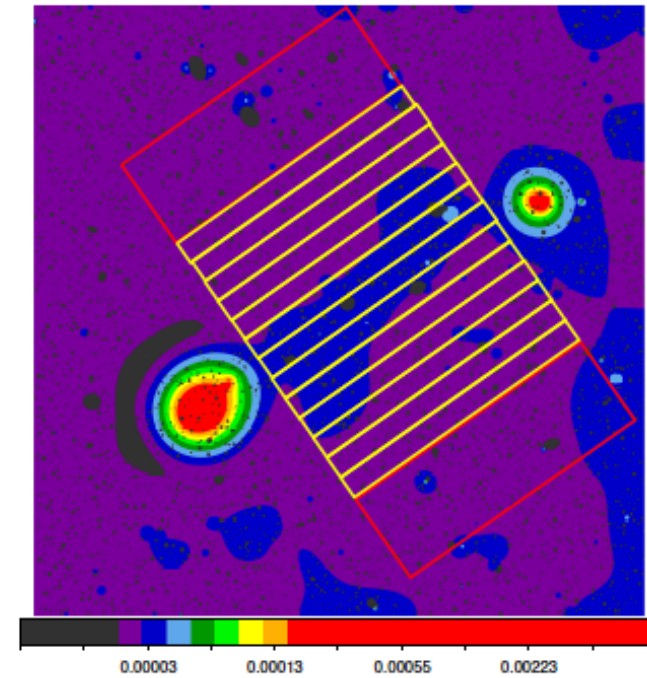
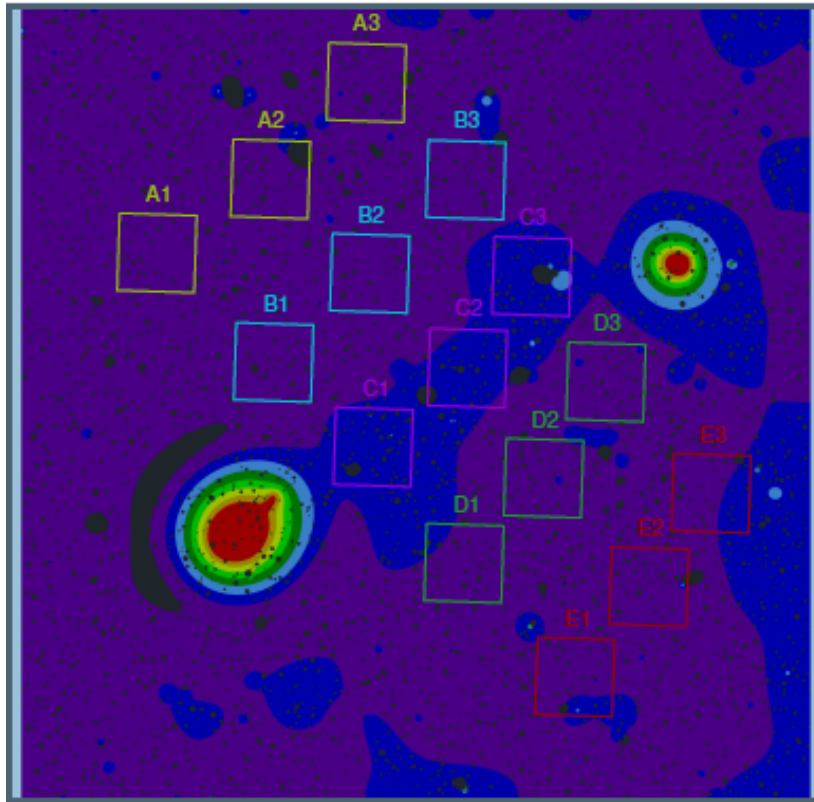


1-4 сканы eROSITA (eRAS:4)
0.3-2.0 keV

Cluster	A3667	A3651
z	0.0556	0.06
RA/°	303.127	298.069
DEC/°	-56.832	-55.062
R_{500} /arcmin	18.503	11.334
$3R_{200}$ /arcmin	85.399	52.313



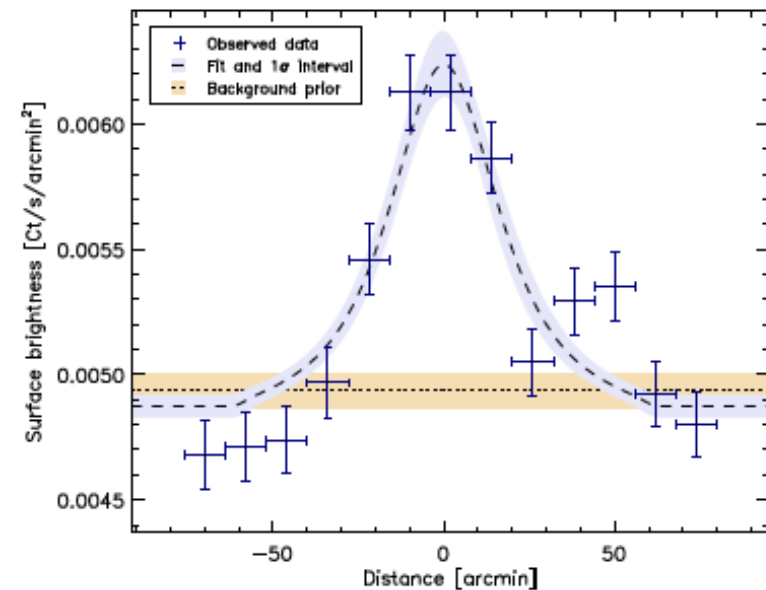
Учёт фона, измерение яркости филамента



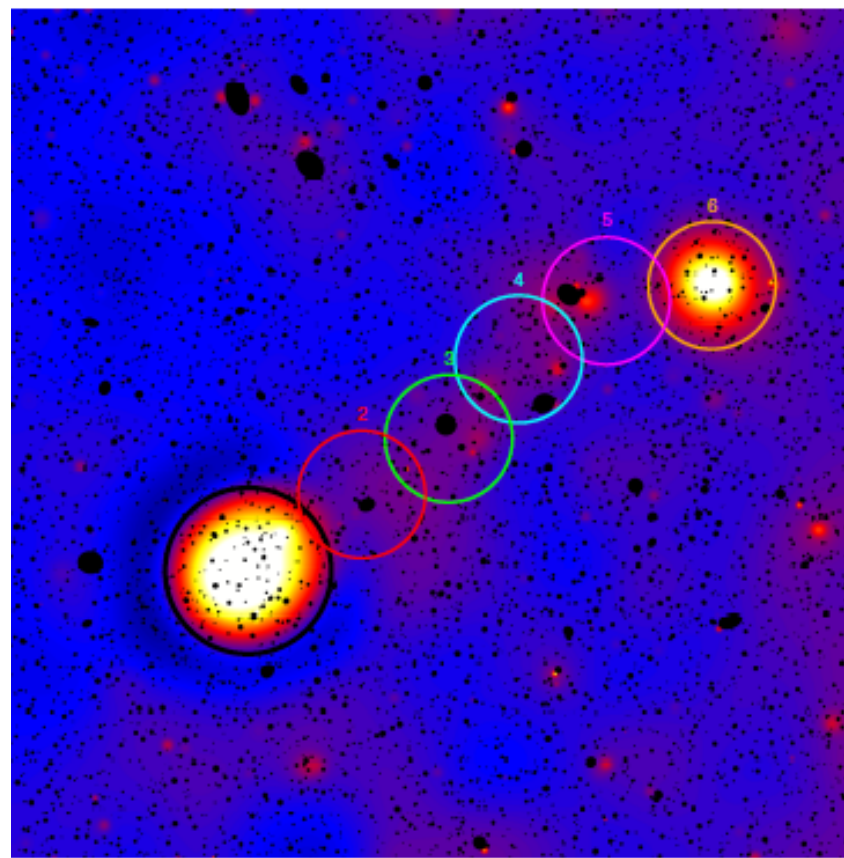
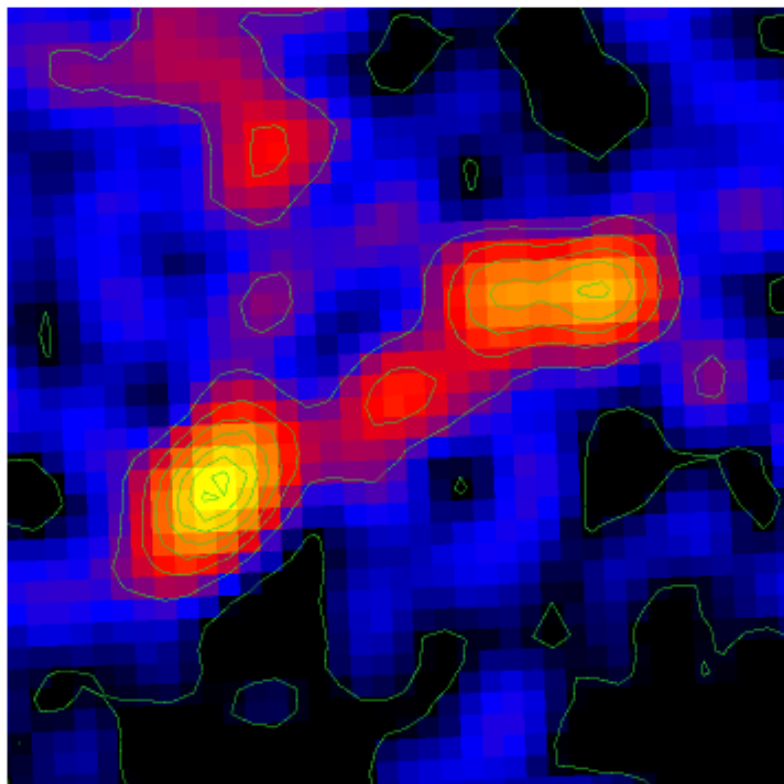
$$\frac{\overline{SB}_{\text{filament}} - \overline{SB}_{\text{bkg}}}{\overline{SB}_{\text{bkg}}} \cdot 100\% = (30 \pm 3)\%$$

with a significance of

$$\frac{\overline{SB}_{\text{filament}} - \overline{SB}_{\text{bkg}}}{\sqrt{(\Delta\overline{SB}_{\text{filament}})^2 + (\Delta\overline{SB}_{\text{bkg}})^2}} = (11 \pm 1)\sigma.$$

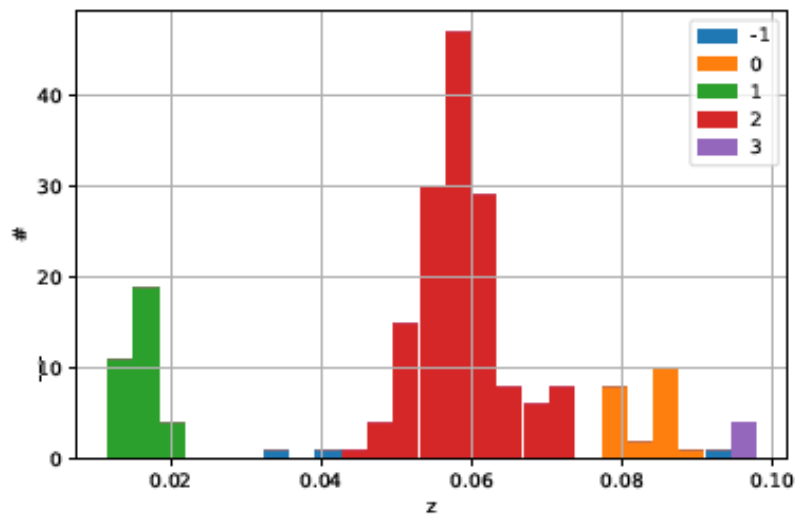
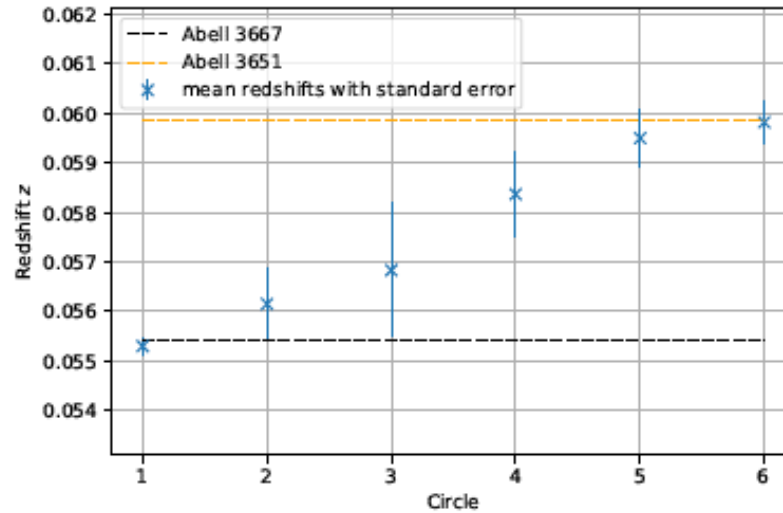
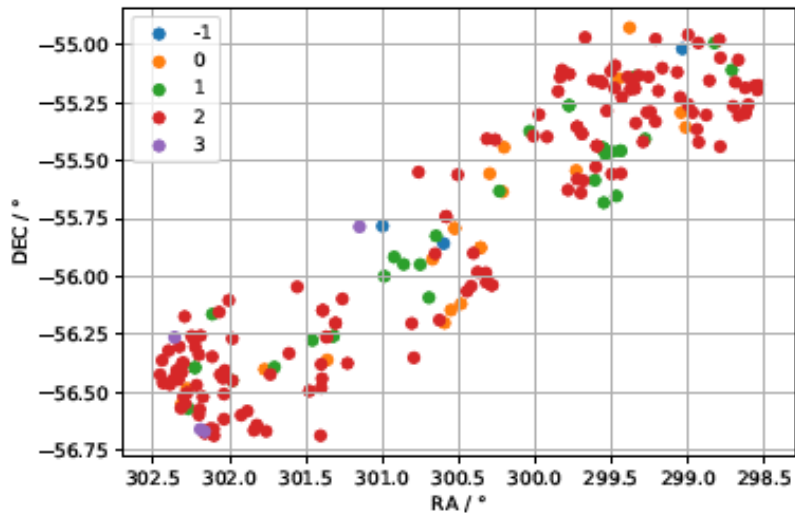


Плотность галактик по 2MASS



Circle	Number of galaxies
1	534
2	49
3	15
4	20
5	49
6	70

Далнейший анализ галактик с известными $z < 0.1$ NED выполнялася только в этих кружках



Т.е. градиент скоростей вдоль филамента – индикатор расстояния.

Расчет длины филамента – исходя из этих z , и типичных величин пекулярных скоростей скоплений: 25-32 Мpc

Воспроизводится в моделировании:

the constrained hydrodynamical
simulation Simulating the LOcal Web (SLOW)

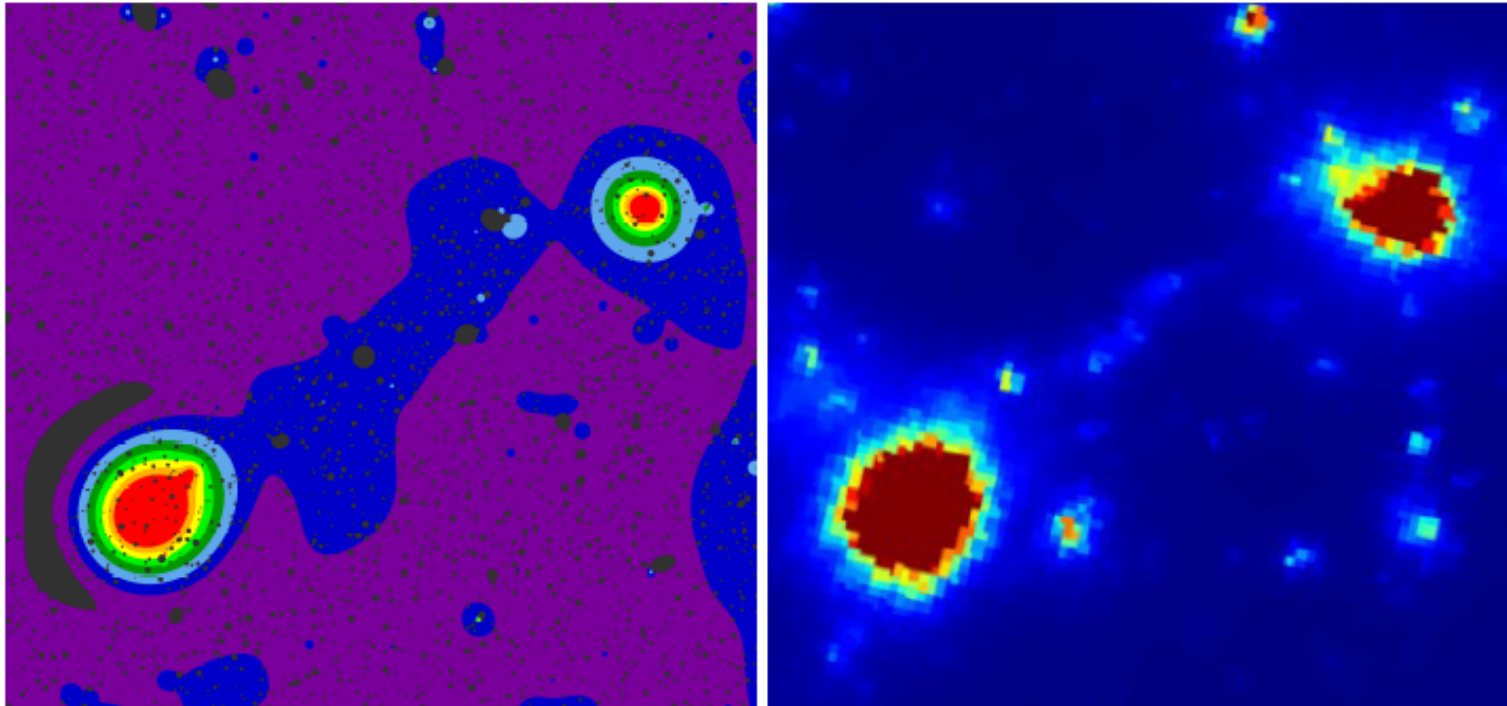


Fig. 9. Left: eRASS:4 X-ray image. Right: Same image section in the constrained simulation *SLOW* (Dolag et al. 2023, Seidel et al. in prep.) Both clusters, their ellipticities and extensions towards the filament region, and the filament itself are reproduced in the mock observation.

Масса газа для интервалов $T=0.2-1.0$ keV, $Z=0.05-0.2$ zsolar:

$$F_X = (7.1^{+2.1}_{-1.0}) \times 10^{-12} \text{ ergs}^{-1} \text{ cm}^{-2}, M_g = (2.8^{+5.4}_{-1.0}) \times 10^{14} M_\odot$$

Ранее нечто похожее наблюдалось длиной в несколько Мpc, а здесь – 3
 вириальных радиуса обоих скоплений
 Решает проблему “потерянных барионов”,
 WHIM (warm-hot intergalactic medium)

Но ярче ожидаемого в моделях:

Fig. 12. Comparison of the electron density profiles of this work, the reproduced filament in the *SLOW* mock observation, and the $L > 20$ Mpc WHIM filaments at $z = 0$ (Galárraga-Espinosa et al. 2021) in the *IllustrisTNG* simulation. The uncertainty intervals of the this work divide into the (smaller) statistical uncertainty of the data and the (larger) systematic uncertainty of varying the assumptions of temperature, metallicity, inclination angle and truncation radius of the β -model. However, it should be noted that these uncertainties are not independent of each other.

