Обзор ArXiv: astro-ph, January 11-16, 2017

От Сильченко О.К.

Astro-ph: 1701.02750

The effect of ram pressure on the molecular gas of galaxies: three case studies in the Virgo cluster

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Свойства 3х галактик

Table 1. General Information of Sample Galaxies[a].

Galaxy	NGC 4330	NGC 4402	NGC 4522
Right ascension (J2000)	$12^h23^m17^s.0$	$12^h26^m07^s.6$	$12^h33^m39^s.7$
Declination (J2000)	$+11°22'03''.5$	$+13°06'47''.4$	$+09°10'30''.2$
Morphological type	Sc	Sb	SBc
Inclination (°)	79	82	79
Position angle (°)	60	89	35
V_{rad}(km s^{-1})[b]	1565	232	2328
D_{25}(arcmin)	2.29	3.55	3.47
Total apparent B-band magnitude	12.02	12.05	11.86
Total K-band luminosity (10^9 L$_{\odot,K}$)[c]	6.58	21.30	5.64
M_{HI} (10^8M$_\odot$)[d]	4.45	3.70	3.40
def_{HI}[d,e]	0.80	0.74	0.86
d_{M87}(°)[d]	2.1	1.4	3.3

[a] General information of the sample galaxies from Paturel et al. (2003) (HyperLeda, http://leda.univ-lyon1.fr/).

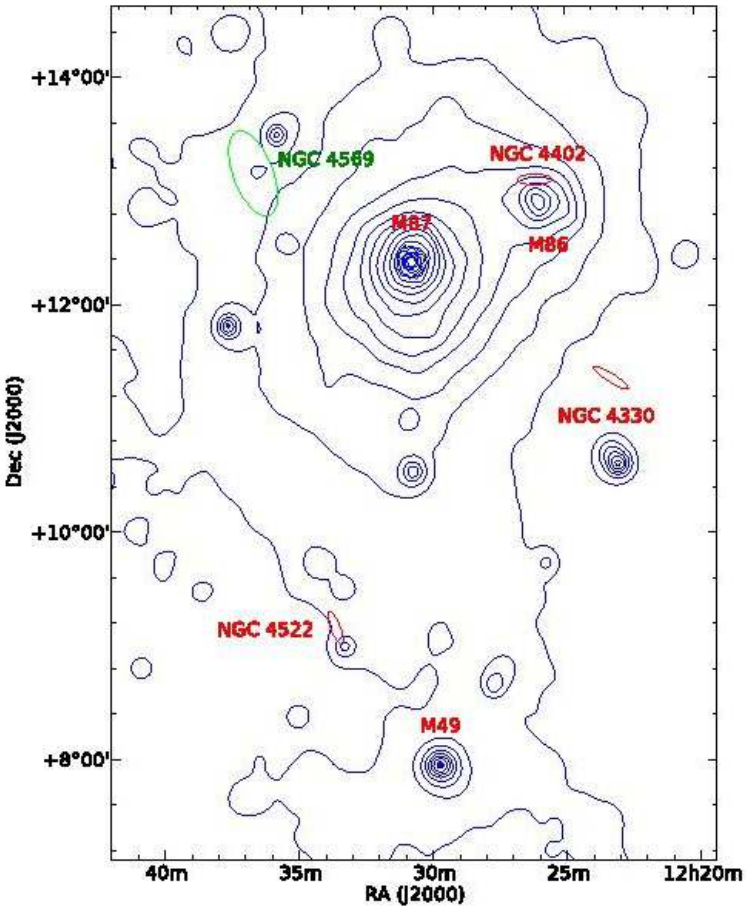
[b] cf. the Virgo mean ~1100 km s^{-1} (Mei et al. 2007).

[c] Skrutskie et al. (2006), cf. Milky way: 8.24×10^{10} L$_{\odot,K}$ (Drimmel & Spergel 2001), M31: 1.29×10^{11} L$_{\odot,K}$ (Barmby et al. 2006).

[d] the VIVA study (Chung et al. 2009).

[e] $def_{HI} = \langle \log \overline{\Sigma}_{HI,all} \rangle - \log \overline{\Sigma}_{HI,obs}$, where $\langle \log \overline{\Sigma}_{HI,all} \rangle$ is the mean HI surface density of field galaxies (Haynes & Giovanelli 1984), and $\log \overline{\Sigma}_{HI,obs}$ is the mean HI surface density of an observed galaxy (Chung et al. 2009). In this work, morphology independent deficiency has been adopted as Chung et al. (2009).

Расположение в Virgo



Наблюдения

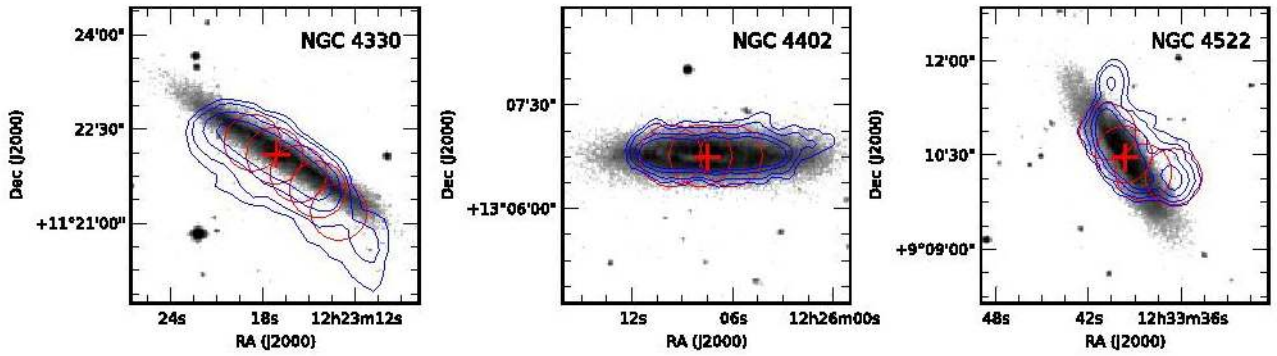


Figure 2. The HI distribution of NGC 4330, NGC 4402 and NGC 4522 (from left to right) is shown in blue contours overlaid on the Digitized Sky Survey 2 (DSS2, https://archive.stsci.edu/dss/index.html) red image. The red cross indicates the stellar disc centre of each galaxy estimated from *Spitzer* 3.6 μm data (Salo et al. 2015), and the thin red circles represent the SMA observation points, each of which corresponds to the size of the primary beam at 230 GHz ($\approx$54 arcsec).

Субмиллиметровый интерферометр SMA на Гавайях (высота 4 км): 7 антенн по 6 метров каждая.

Наложение молекулярного газа на оптическое изображение

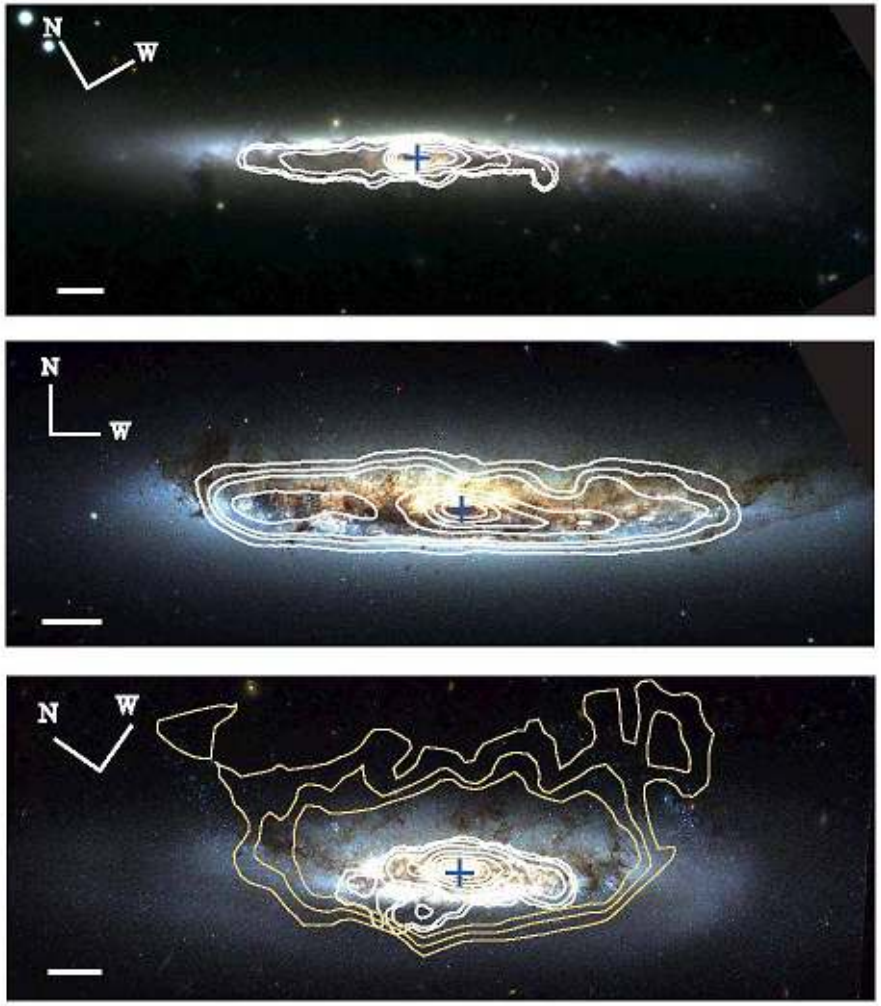
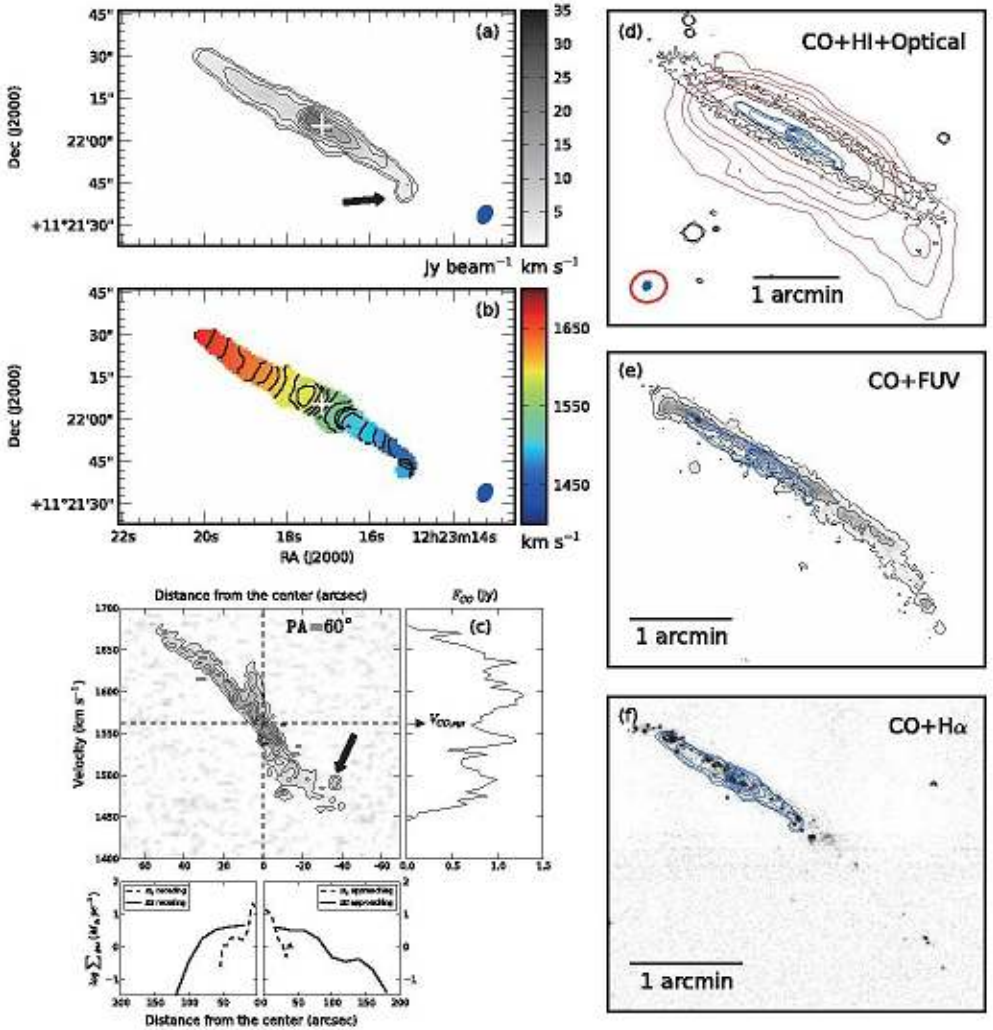
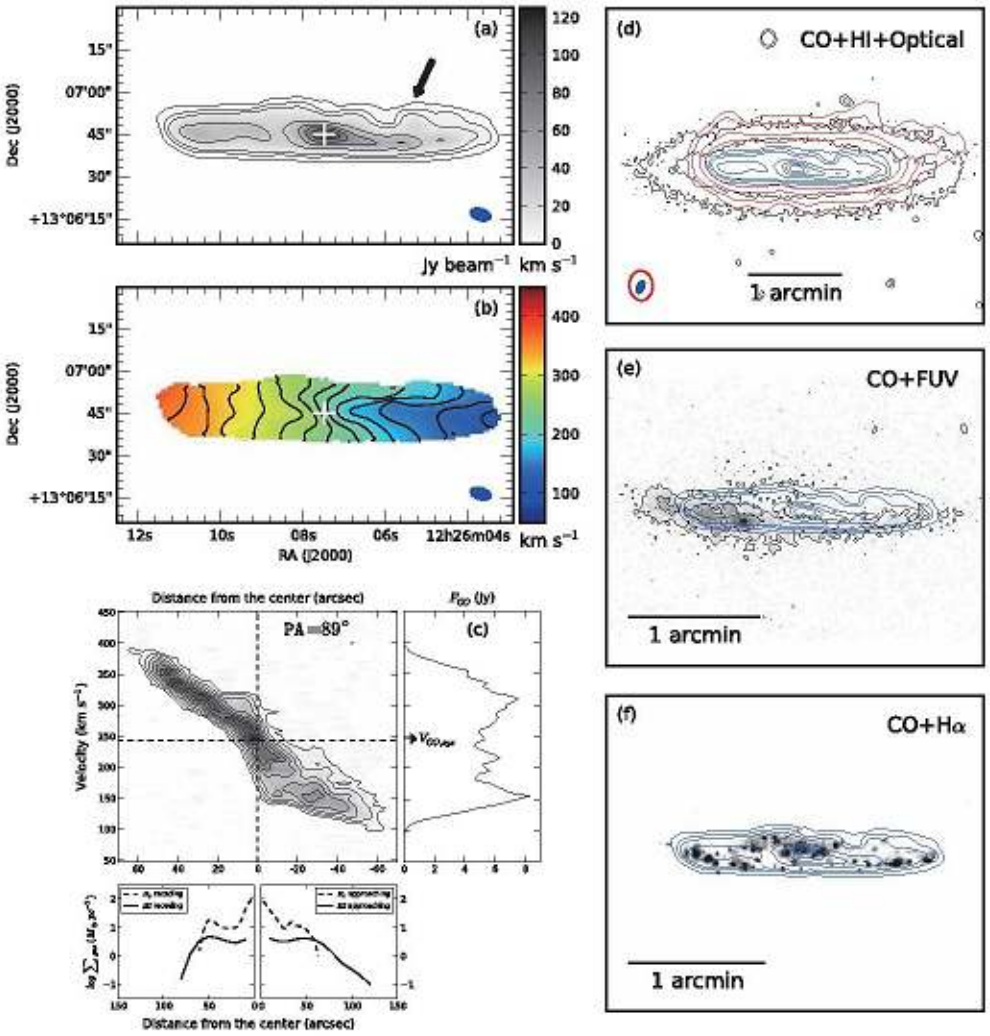


Figure A1. 12CO (2−1) contours (white contours: SMA, yellow contours: IRAM) are overlaid on optical colour images (NGC 4330: WIYN 3.5m telescope BVR colour image; Abramson et al. 2011, NGC 4402 and NGC 4522: *HST*[5] BVI colour images). Top: NGC 4330. Middle: NGC 4402. Bottom: NGC 4522. The physical scale bar (20 arcsec) of each galaxy is shown at the bottom left. The blue cross indicates the stellar disc centre of each galaxy.

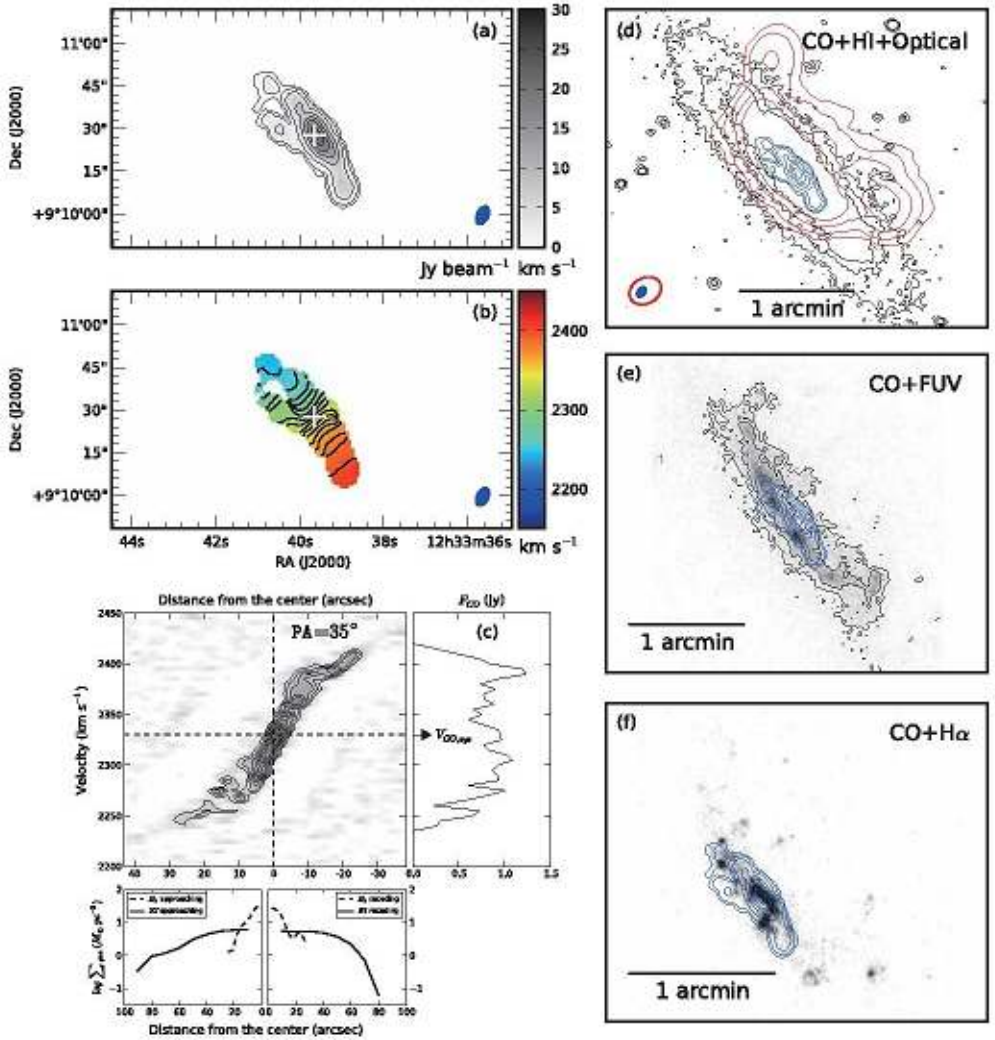
NGC 4330


(a)
(b)
(c)
(d)
(e)
(f)
Dec (J2000)
RA (J2000)
Jy beam^{-1} km s^{-1}
km s^{-1}
Distance from the center (arcsec)
PA=60°
Velocity (km s^{-1})
CO+HI+Optical
CO+FUV
CO+Hα
1 arcmin

NGC 4402


(a)
(b)
(c)
(d)
(e)
(f)
CO+HI+Optical
CO+FUV
CO+Hα
1 arcmin
Dec (J2000)
RA (J2000)
Jy beam^{-1}
km s^{-1}
PA=89°
Velocity (km s^{-1})
Distance from the center (arcsec)

NGC 4522


(a)
(b)
(c)
(d)
(e)
(f)
Dec (J2000)
RA (J2000)
Jy beam^{-1}
km s^{-1}
CO+HI+Optical
CO+FUV
CO+Hα
1 arcmin
PA=35°
Distance from the center (arcsec)
Velocity (km s^{-1})

Все – и NGC 4569 для сравнения

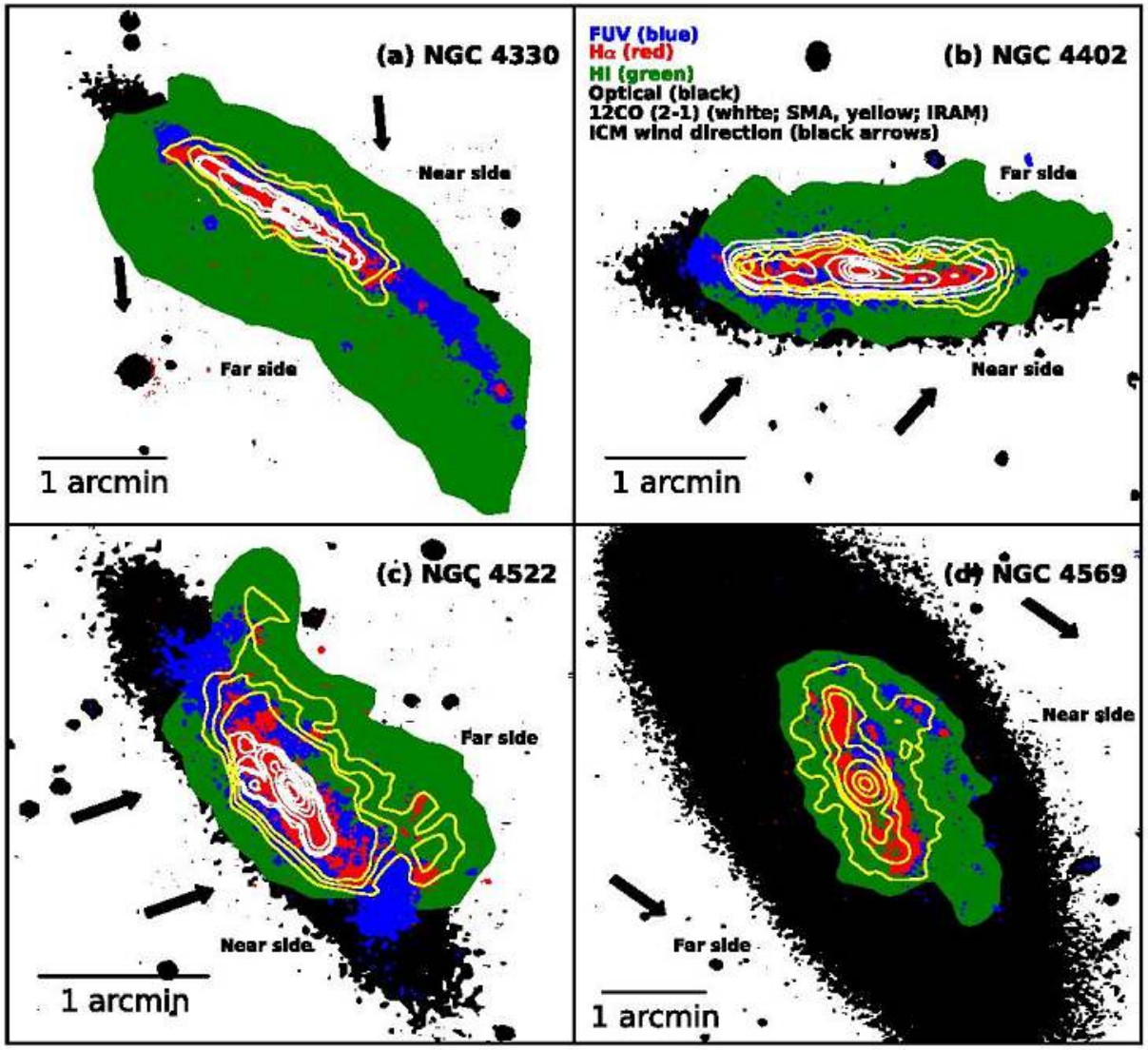


Figure 6. A composite map of FUV (blue; Gil de Paz et al. 2007), Hα (NGC 4330 and NGC 4569 from Gavazzi et al. 2003, NGC 4402 from Crowl et al.

Astro-ph: 1701.03466

The imprints of bars on the vertical stellar population gradients of galactic bulges

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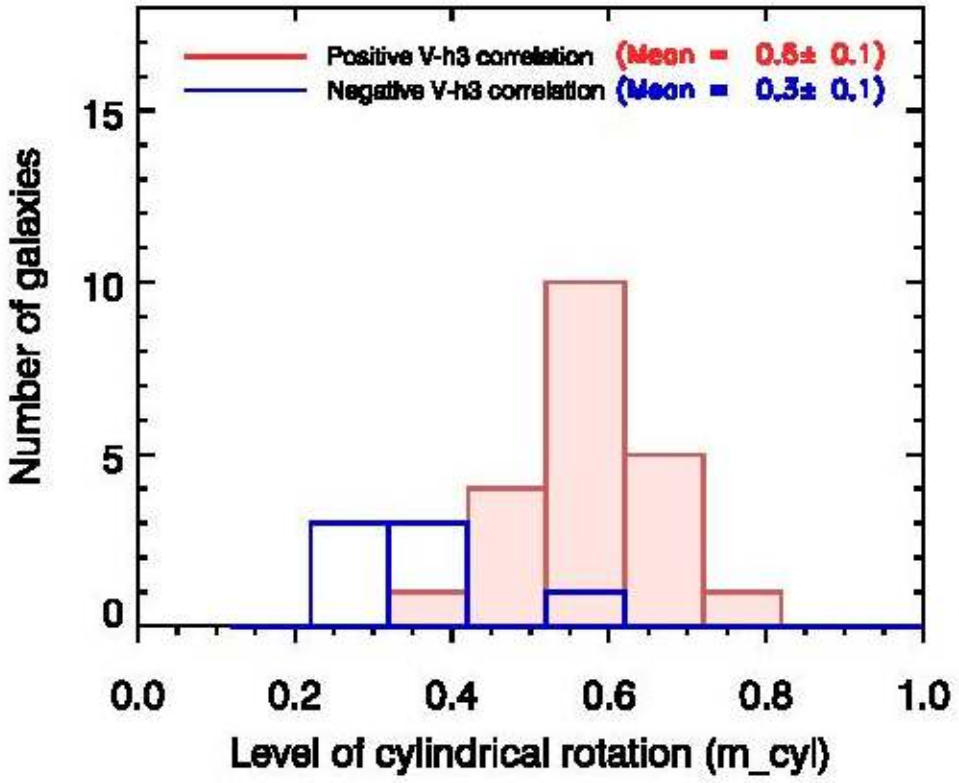
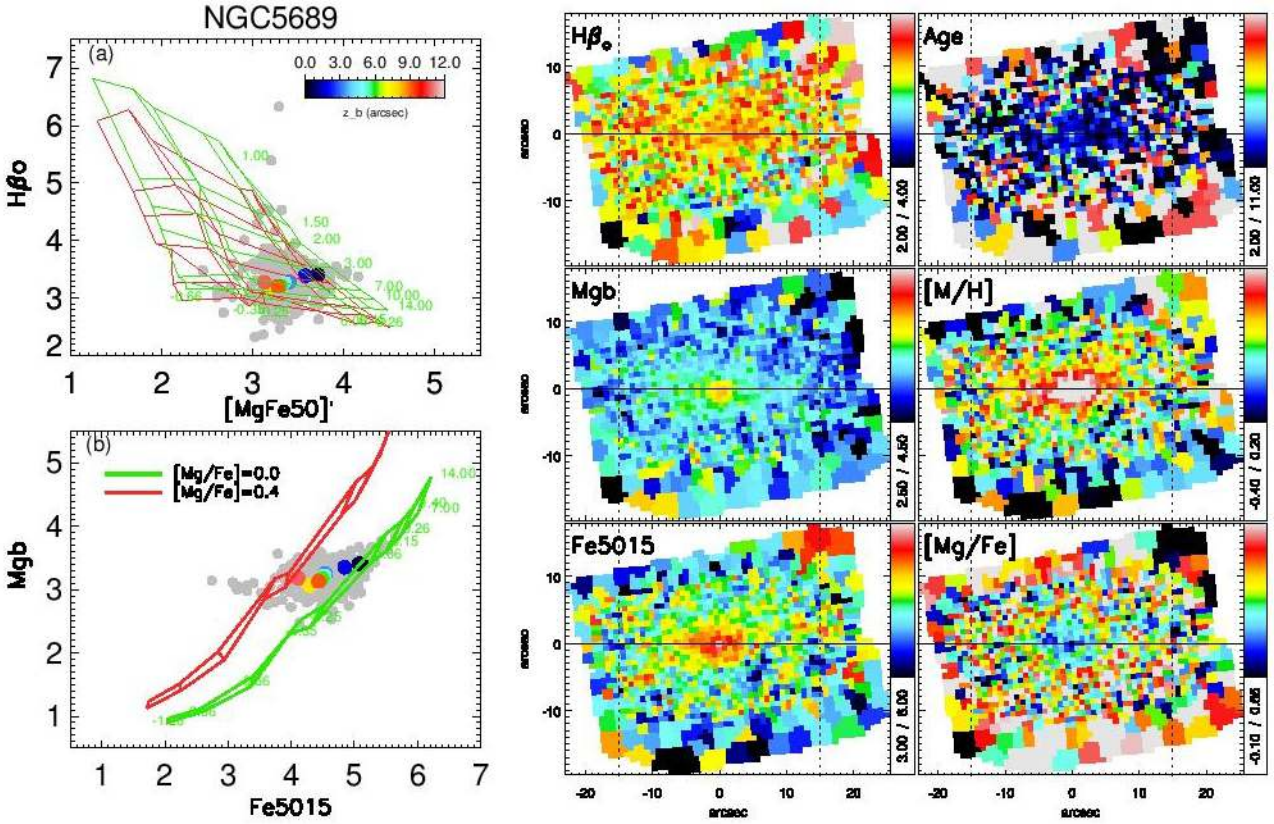
Объекты: 21 с баром и 7 без баров

Galaxy	Sample	PA (deg)	V_{hel} (km s^{-1})	M_K (mag)	T–type	incl. (deg)	σ_0 (km s^{-1})	Dust	m_{cyl}	Bar	z_{disc} (arcsec)	x_B (arcsec)	z_B (arcsec)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
NGC3098	S2	88.5	1397	−22.72	−1.5	90	126.2	N	0.54±0.20	N?	1.5	10	9
NGC4026	S2	177.5	985	−23.03	−1.8	84	158.1	N	0.54±0.13	Y	3.0	12	10
NGC4036	S2	261.2	1385	−24.40	−2.6	75	181.9	F	0.26±0.24	N	2.0	12	9
NGC4179	S2	142.8	13	−23.18	−1.9	86	167.5	N	0.59±0.12	Y	2.0	13	10
NGC4251	S2	99.0	1066	−23.68	−1.9	80	128.8	N	0.73±0.08	Y	2.0	12	9
NGC4270	S2	109.8	2331	−23.69	−2.0	80	139.6	N	0.58±0.12	Y	1.5	13	10
NGC4346	S2	98.8	832	−22.55	−2.0	77	127.0	N	0.63±0.11	Y	3.5	12	12
NGC4425	S2	25.8	1908	−22.09	−0.6	90	82.8	N	0.53±0.15	Y	3.0	14	8
NGC4435	S2	10.0	791	−23.83	−2.1	68	152.8	D	0.51±0.14	Y?	3.0	11	9
NGC4461	S2	8.1	1924	−23.08	−0.8	71	133.0	N	0.58±0.15	Y	3.5	13	9
NGC4474	S2	79.4	1611	−22.28	−2.0	89	87.9	N	0.55±0.17	Y?	2.0	10	9
NGC4521	S2	166.3	2511	−23.92	−0.1	90	185.8	N	0.71±0.08	Y	2.0	10	8
NGC4710	S2	27.4	1102	−23.53	−0.9	88	104.7	D	0.54±0.20	Y	3.0	19	13
NGC4762	S2	29.6	986	−24.48	−1.8	90	133.7	N	0.66±0.13	Y	1.0	10	7
NGC5103	S2	140.6	1273	−22.36	–	90	111.2	N	0.37±0.21	N	2.0	9	8
NGC5326	S1	130.0	2520	−23.77	–	65	144.9	N	0.35±0.20	N	2.5	10	8
NGC5353	S2	140.4	2198	−25.11	−2.1	80	281.2	D	0.57±0.11	Y	3.0	15	9
NGC5422	S1	152.3	1838	−23.69	−1.5	90	161.8	N	0.69±0.08	Y	2.5	16	10
NGC5475	S1	166.2	1671	−22.88	–	79	115.0	N	0.25±0.25	N	2.5	12	8
NGC5574	S2	62.7	1589	−22.30	−2.8	89	81.9	N	0.51±0.23	Y	2.0	11	9
NGC5611	S2	64.6	1968	−22.20	−1.9	74	137.4	N	0.40±0.24	N	1.5	10	9
NGC5689	S1	84.0	2160	−24.00	–	81	157.4	D	0.64±0.09	Y	3.0	17	13
NGC5707	S1	35.0	2212	−23.22	–	80	131.8	N	0.25±0.20	N	1.5	11	8
NGC5746	S1	170.0	1727	−24.99	–	81	202.8	D	0.61±0.09	Y	3.5	22	15
NGC5838	S1	40.1	1341	−24.13	−2.6	72	246.0	N	0.47±0.17	Y	2.0	11	9
NGC5854	S2	54.8	1663	−23.30	−1.1	74	104.7	N	0.38±0.26	Y	3.5	13	10
NGC5864	S2	65.6	1874	−23.62	−1.7	74	110.7	N	0.59±0.12	Y	1.5	13	10
NGC6010	S1	102.9	2022	−23.53	–	90	159.2	D	0.45±0.19	Y	3.5	11	10

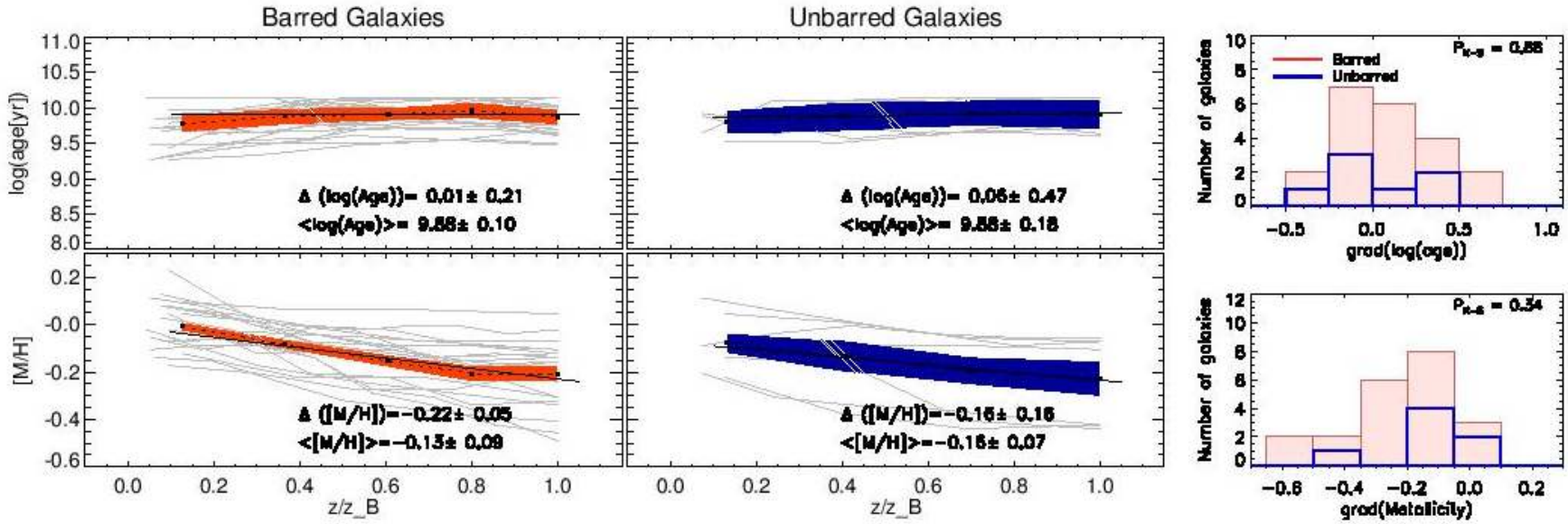
Кинематическая диагностика присутствия бара



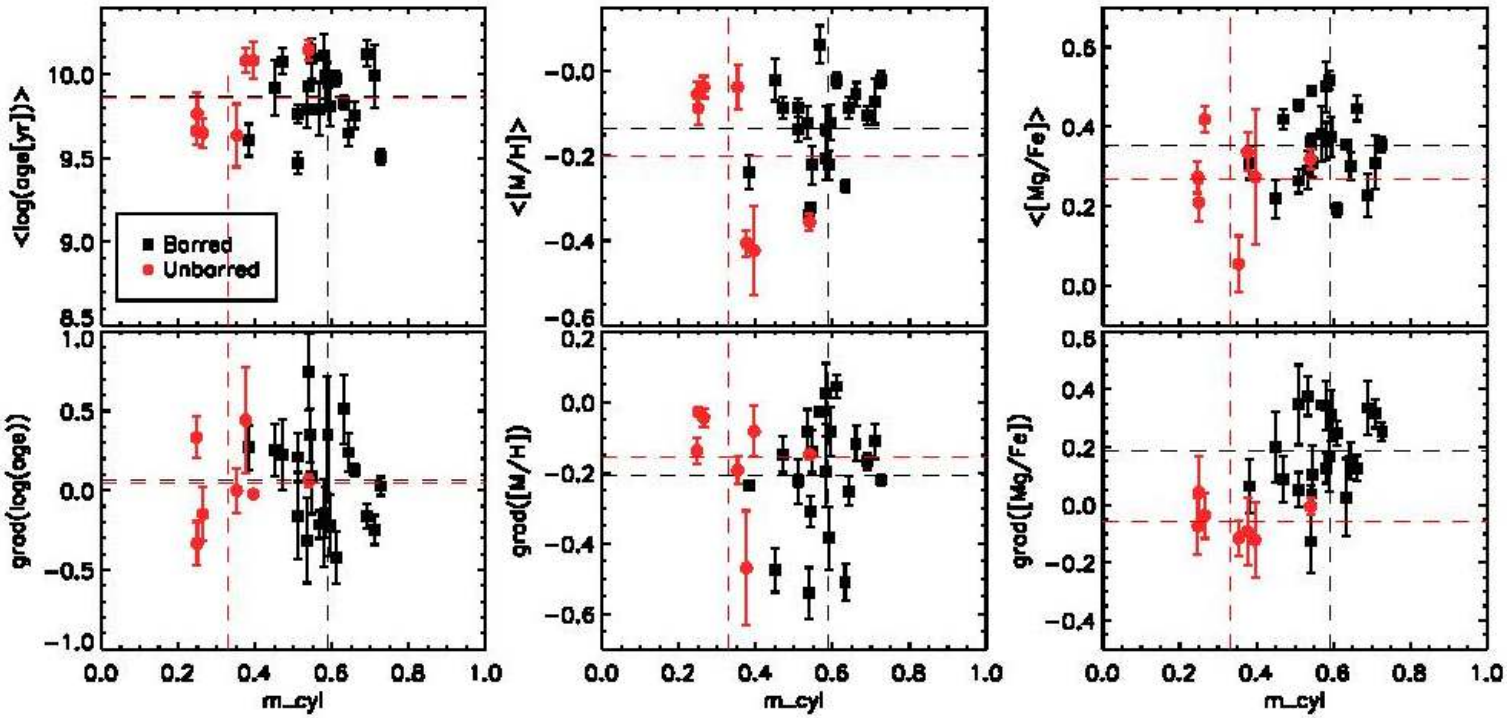
Пример индивидуального рассмотрения



От бара не зависит ничего…



… ничего, кроме отношения магния к железу!



В барных галактиках отношение магния к железу в звездах растет по малой оси балджа!

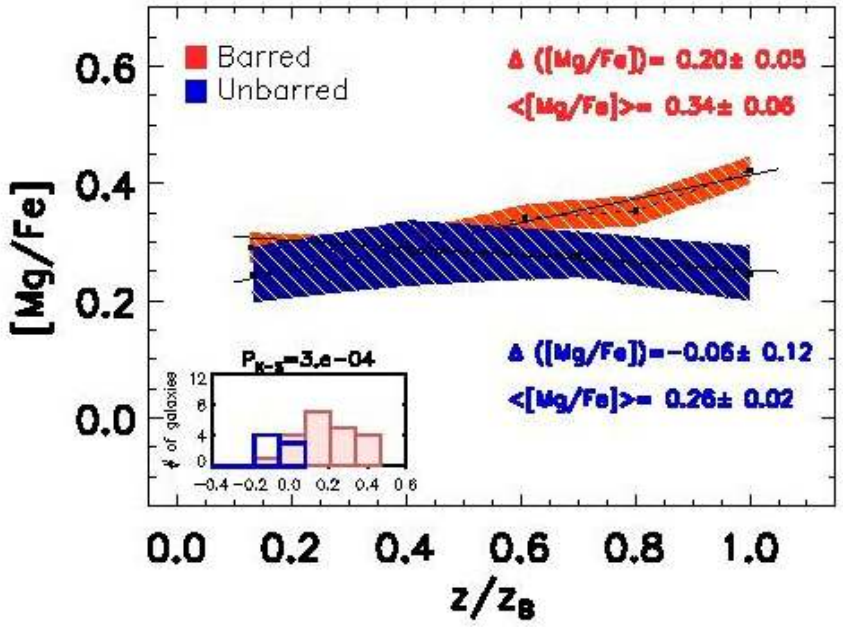


Figure 7. The integrated, error weighted average profiles of the variations of the [Mg/Fe], with increasing height (z) from the disc plane for both barred and unbarred galaxies in our sample. The inset histogram shows the distribution of the vertical gradients in [Mg/Fe] for both classes of bulges in our sample. Gradients have been measured in the range $z_{disc} < z < z_B$, normalized by the vertical extent of the bulge (z_B) in arcsec. P_{KS} gives the probability that the two distributions are drawn from the same populations, as derived from a K-S test.

Astro-ph: 1701.03681

The M101 group complex: new dwarf galaxy candidates and spatial structure

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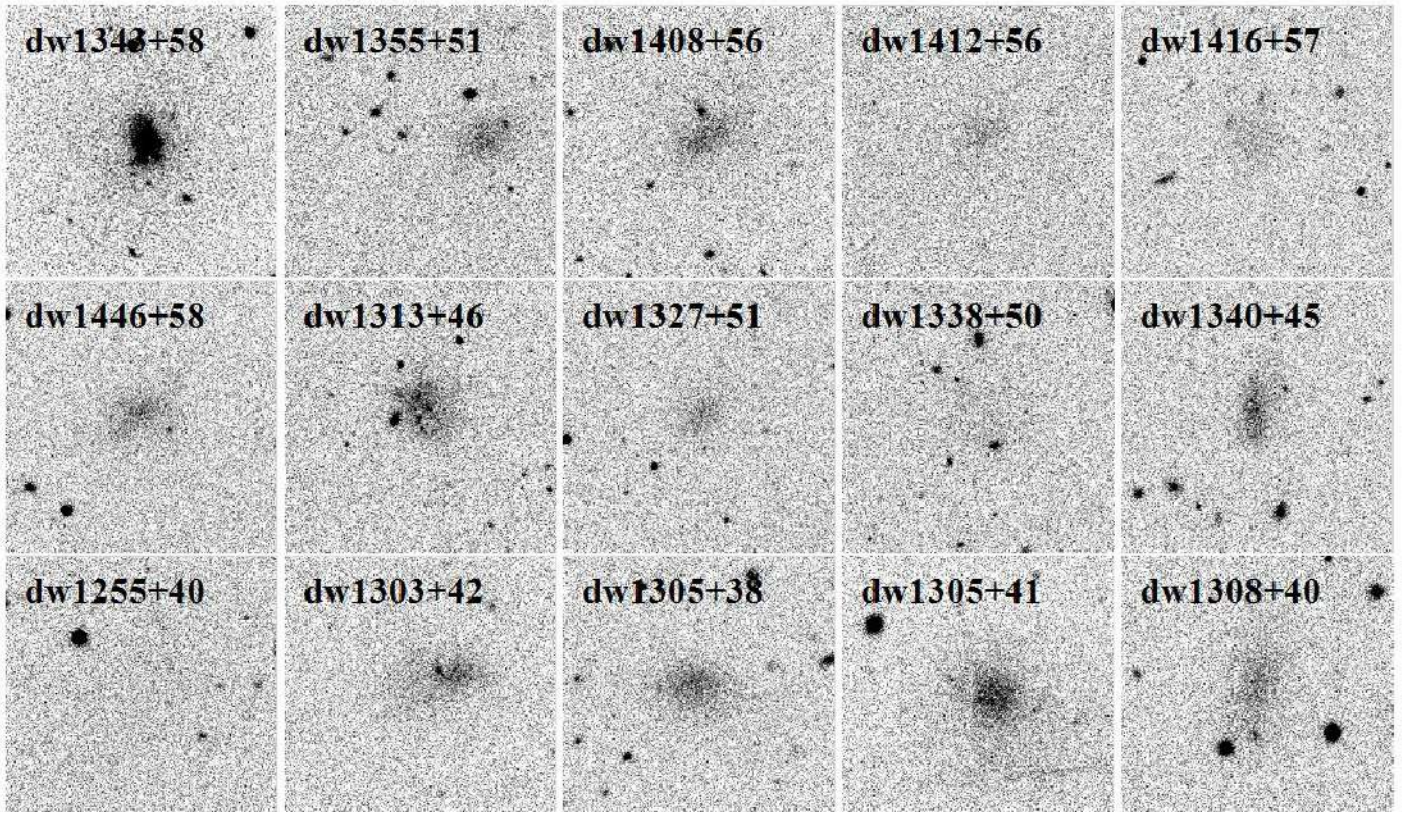
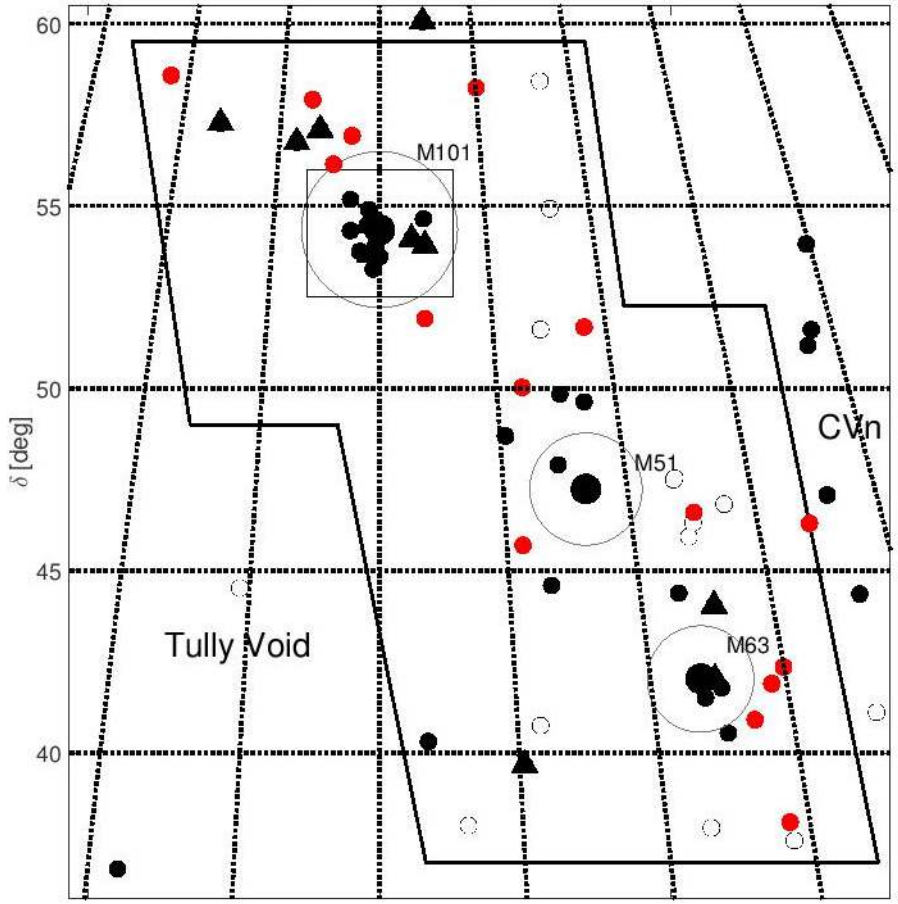
15 новых карликов в группе M101 – разглядыванием картинок SDSS



Вот как они расположены на небе – красные точки



Плоскость спутников, лежит на нашем луче зрения!

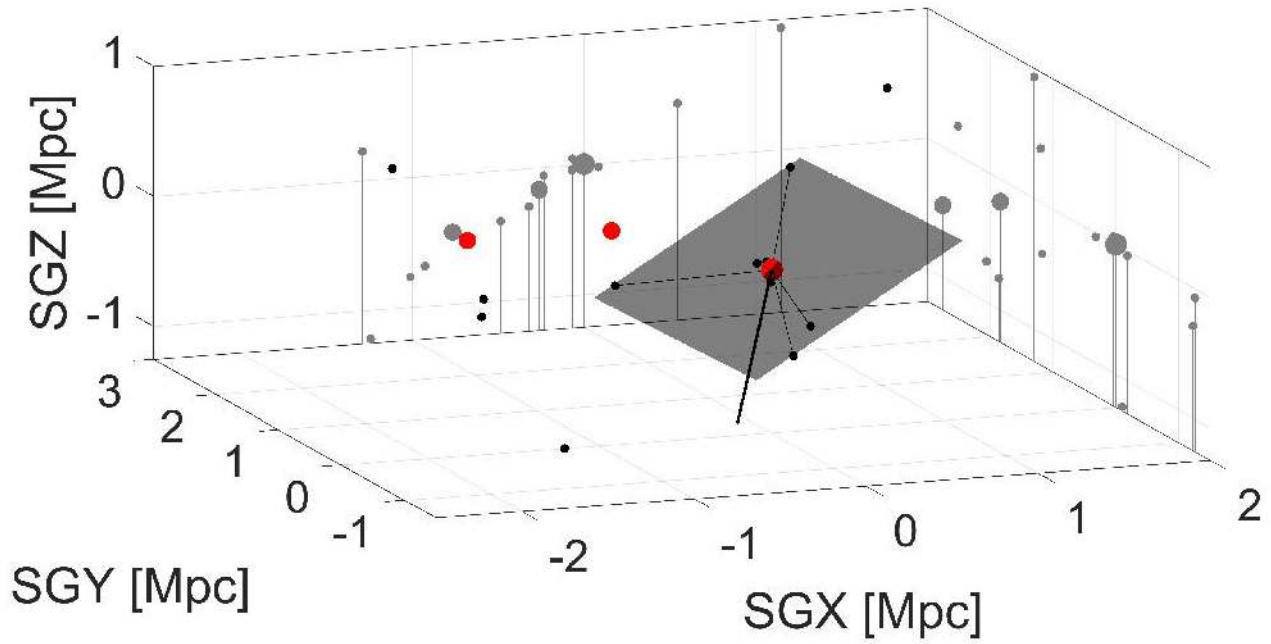


Fig. 7. 3D distribution, in supergalactic coordinates, of all galaxies with distance measurements in the surveyed M 101 group complex, centered at M 101. The red dots correspond to the major galaxies M 101, M 51 and M 63, the black dots to dwarf galaxies. The grey dots (shadows) appearing

Проекции: при взгляде сверху на плоскость спутников видны филаменты!