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NEW TYPE OF EXTRAGALACTIC OBJECTS?

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We have reported the discovery of a population of the normal extragalactic field galaxies with the clear presence of the strong FHIL (Forbidden High Ionized Lines) and HeII 4686 emission. In this paper we present a dozen of them extracted from the SDSS dr7. The high resolution spectra 0.86 Å/px obtained with the 6-m telescope of the Special Astrophysical observatory of Russia are introduced for one of them - SDSS J093801.63+135317.0 confirming the presence of strong and wide FHIL and HeII 4686 emission. These objects show typical narrow (FWHM ~ 120 - 250 km s^{-1}) emission lines both of HI and forbidden emission lines of [NII] 6548/84, [SII] 6717/31, [OI] 6300, [OII] 3727, [OIII] 5007/4959 with underlying stellar absorption lines, coupled with the strong FHIL emission of [FeVII] 5721, 6087, [FeX] 6375, [FeXI] 7892, [FeXIV] 5303 and HeII 4686, sometimes very broad up to 1500 km s^{-1}. Following to the direct images all morphological types is introduced: spherical, elliptical, spiral, barred spiral, etc., without morphological or other peculiarity and any sign of "standard" AGN activity. None of them are X-ray source. The appearance of the FHIL emission in normal galaxies (the objects of SBN/HII/ELG spectral types) might be one of the important sign of the beginning of the AGN activity. The existence of the numerous normal extragalactic objects with FHIL and HeII 4686 emission tell us that the link between the AGNs and the normal galaxies perhaps might be realized with the FHIL flare in normal galaxies. For all of them the existence of the non thermal source in normal galaxies should be proposed.

Key words: *FHIL emission:normal galaxies:AGN*

1. *Introduction*. The normal field galaxies are very difficult to investigate systematically because of their enormous number. All surveys without exception used selection criteria (color, UV excess, peculiarity, etc.) to isolate some proportion of the most interesting objects among the "normal" galaxies within the author's interests. In the last 50 years most of the extragalactic surveys are related with the selection of AGN (Active Galactic Nuclei) among field galaxies.

The study of AGN relies on observational data. The AGN may include any determination of the nuclear activity of the galaxy depending on the author's definition. Empirical classification of AGN is based on numerous factors including morphology, emission lines, strong emission in other regions of the electromagnetic spectrum apart from the visible.The original definition of Seyfert(Sy) galaxy was for a bright, point-like nucleus showing *wide* strong emission lines and residing in (usually) a spiral galaxy. Further Sy galaxies are classified solely on their spectral characteristics.

Many astronomers start to use as a reasonable working definition for an active galaxy the following definition: an active galaxy is one in which a

significant fraction of its total luminosity is radiation not ultimately attributed to stellar photosphere. This physical definition of AGN is very difficult to use in practice. The accurate quantitative optical classification scheme for AGN classification which led to the fundament of the physical processes ongoing in AGN/QSOs was created during the last 30 years.

A velocity cut FWHM(HI) > 250 - 300 km s^{-1} was a reasonably step to isolate the AGN from the normal field galaxies, because the velocity dispersion of the most galaxies are less than FWHM(HI) < 250 km s^{-1} [1].

Theoretical physical differences that distinguish a narrow-line AGN from HII galaxies were used by Baldwin et al. [2] in schematic diagnostic diagram for emission line objects. Further the similar diagnostic diagrams by Velleux and Osterbrock [3] became one of the standard diagnostic diagrams for AGN isolation from starburst and normal galaxies.

In parallel with the expansion of the empirical databases the recent year tendency yield the multiwavelenghth AGN luminosity classification where the objects might be classified as AGN if they have comparable with SyG/QSO luminosities in the corresponding waveband. An additional criterion like the presence of the FHIL (Forbidden High Ionized Lines), FeII blends, etc. start to be used in the recent years as well. Due to the dramatic increase of the observational data, and the expansions of the AGN classification criteria, the extragalactic databases are full of the opposite classifications for the same objects which seriously affect their usefulness. On the other hand a number of arguments suggest that the existing optical/multiwavelength classification schemes and diagrams for AGN classification seems not enough to cover all classes of AGN discovered to date [4].

Extragalactic surveys together with the AGN selection produced the observational data as a by-product for hundreds of thousand normal field galaxies - the "soup" of extragalactic objects consisting of emission and absorption line galaxies, unknown objects, unclassified, etc.The existing databases for extragalactic objects available to date allow as returning to the analysis of the subtypes of the extragalactic objects among the field galaxies.

The spectral and other information available in the literature have been systematically analyzed for more than 1500000 extragalactic objects. Spectral data for a few hundred thousand objects were re-measured using our own software. An attempt was made to classify them using the known standard classification scheme for extragalactic objects. An attempt was made also to compile the low-redshifted AGN database with $z < 0.33$ (complete sample) and $z < 0.83$ (partly complete sample) in optical window 3300 - 9200 Å using the classical definition for AGN established in the literature.

Starting from the Markarian survey in 1963 [5] (later on called First Byurakan Survey - FBS, 1963-1980), through the Second Byurakan Survey

(SBS), 1973-1991 [4 and references therein], using the results of the hundreds of extragalactic surveys up to the most powerful Sloan Digital Sky Survey (SDSS), [6], in parallel with their publications we try to analyze, re-reduce and summarize the published original observational data aiming to the creation of the precise AGN database.

The analysis of the best quality high resolution ($R<2A$) spectral information for extragalactic objects spread in the literature resulted:

- the classical optical definition for Sy galaxies; the traditional use of the velocity cut limit FWHM(HI) > 250 - 300 km s^{-1} for AGN separation from starburst and normal galaxies, the "broad" and "narrow" emission line width cut [FWHM(HI)] > 1000 km s^{-1} for broad and < 1000 km s^{-1} for "narrow" line AGN, [FWHM(Hβ)] < 2000 km s^{-1} for NLS1 separation, the secondary classification criteria for Sy2s, [NII]6584/Hα6563 > 0.6, [OIII]5007/Hβ4861 > 3, LINERs [NII]6584/Hα6563>0.6, [OI]6300/[OIII]5007>1/3, [OII]3727/[OIII]5007>1, etc., reject thousands of objects which should be classified as AGN. Similarly with the emission line diagnostic diagrams which used the emission line ratio only of the numbers of emission lines like [OIII]4959/5007, [OII]3727, [OI]6300, Hα6563, Hβ4861, [NII]6648/84 and [SII]6717/31.

The existence of the objects with the FHIL emission which following to Osterbrock and Dahari[7] should be proposed as AGN, the use of the presence of FeII blends in optical region, the multiwavelength definition for AGN, completely smooth the borders between the AGN and non-AGN.

The discrepancies of the AGN classification and their separation from normal galaxies still come from two main reasons - the relatively low spectral resolution $R\sim 5-10$ Å and low $S/N\sim 15-20$ available for thousands of AGN and other extragalactic objects observed in the last decades and the absence of the general agreement among astronomers as to precise definition of an active galaxy.

The final sample of the relatively bright AGNs with $z<0.4$ with the best spectroscopic data available in the literature we were able to isolate and re-reduce their data consists of about 35000 objects. All of them were classified within the standard classification scheme of Seyfert galaxies. Most of them easily fall into known classes of objects, but the others cannot be classified within the known classification scheme.

We assume that at least a few groups each of a few hundred objects perhaps represent new population of extragalactic objects, in particular AGN, not yet recognized.

There were many attempts to search the objects with very narrow emission lines typical for SBN or HII with the presence of HeII 4686. Osterbrock and Robertis[8] show that HeII 4686 is not observed in HII regions or in nearly any galaxies known to be photoionized by OB stars. Normal galactic O stars apparently do not emit enough far-ultraviolet radiation to produce any appreciable

amount of ionization from He^{-} to He^{--}.

Our discovery is that, not only HII like galaxies with HeII 4686 emission exist; besides of the classical AGN, there are numerous emission and/or absorption line normal field galaxies showing not only HeII 4686 emission, but also very strong FHIL emission of [FeVII]5721, 6087, [FeX]6375, [FeXI]7892, [FeXIV] 5303, often very broad (1500-2000 km s^{-1}). So, the FHIL emission is not only the priority of the classical AGNs. If the presence of the FHIL emission is the indicator of the AGN activity, then all these objects independent of their spectral types should be classified as AGN. For all of them the existence of the non thermal source in normal galaxies should be proposed.

The conclusion is that, there are numerous extragalactic objects with narrow emission lines typical for normal field galaxies pointing the presence of the non thermal energy source.

2. *FHIL emission lines and the AGN phenomena.* The first report of very highly ionized iron in Seyfert galaxies was by O.C.Wilson in 1956 (references in Oke and Sargent [9]. Furthermore Osterbrock [10]; Nussbaumer and Osterbrock [11]; Netzer [12]; Osterbrock and Koski[13], etc., mentioned the detection of the FHIL emission in particular [FeX]6375 in Seyfert galaxies).

Astronomers in general seem agree to the comments of Osterbrock and Dahari [7] - if the objects show the iron forbidden high-ionization (FHILs) "coronal" emission lines, they certainly are AGN, so the presence of FHIL emission lines proposed as one of the sign of the AGN nature of the object. FHIL definition - the objects showing any forbidden line having an ionization potential IP > 100 eV, [FeVII] 6087 IP ~ 100 eV, [FeX] 6375 IP > 250 eV, [FeXIV] 5303 IP > 260 eV ~ indicators of the $Te \sim 10^6$ K. Historically the [FeX] line and other highly ionized species have been referred in the literature as "coronal lines" because these species were first identified in the spectra of the solar corona.

For Sy1s and Sy1.5 Osterbrock [14] mentioned that in addition to their broad permitted emission lines of HI, HeI, HeII and FeII, narrow-line spectra very similar to Sy2, but often with stronger high-ionization lines such as [NeV] 3346, 3426, [FeVII] 5721, 6087, [FeX] 6375 and [FeXI] 7892 are clearly presented.

Osterbrock and Martel [15] show that many Sy1.8, 1.9 and Sy2 show weak [FeX]. Koski [16] presented 20 Sy2s many with [FeVII] 5721, 6087 and [FeX]6375 emission and suggest that the Sy2 phenomenon refer only to those spectra with strong emission lines of high ionization ions like [NeV]3346, 3426 and HeII 4686. Most of Sy2s do not show these emission lines. Veilleux [17] shows that high-ionized Sy galaxies shows in their spectrum besides HeII 4686 emission also [FeVII]5721, 6087 and [FeX]6375.

Veron et al. [18] mentioned that all NLS1s in their sample show FeII emission with various strength, but only 1/7-th of them show in addition [FeVII] 5721, 6087 and [FeX]6375 emission lines.

During the last 30 years astronomers discovered numerous extragalactic objects with the rare for AGN properties, i.e., Mkn1388, Mkn477, Mkn142, Mkn359, Mkn42, etc. Osterbrock [19] described Mkn1388 as a very rare, unusual, exceptional case of Sy galaxies combining a relatively strong featureless continuum and high level of ionization, similar to typical Syl galaxies, with narrow HI and forbidden lines, similar to typical Sy2 galaxies. Mkn1388 shows high-ionization lines in particular, of [FeVII]5721, 6087 and [FeX]6375 and a strong featureless continuum, but narrow HI lines.Osterbrock and Pogge [20,OP85] note that Mkn1388 and Mkn359 may, perhaps, be most simply described as unusually high-ionization Sy2 galaxies. Mkn1388 included in OP85 as NLS1s on the basis of the strong emission lines of [FeVII] 5721, 6087 and [FeX] 6375. Mkn477 and similar objects are the other group of non typical unusual Sy2 galaxies with [FeVII] 5721, 6087 and [FeX]6375 emission. Until now they are called in the literature as unique, exceptional, unusual, rare, etc. Their nature still is a subject of discussions. In the last decades the number of objects cited as unusual, exceptional, etc., reach to enormous number.

In the last years two unusual objects; SDSSJ095209.56+214313.2 and SDSSJ124134.25+442639.2 with the extremely strong FHIL emission were reported by Komossa et al. [21,22] and Gelbord et al. [23]. Komossa et al. mentioned that the optical spectrum of SDSSJ095209.56+214313.3 and its multiwavelength properties turned out to be exceptional. The optical spectrum is dominated by strong iron coronal lines with the highest ratios of several [FeVII]5721, 6087 transitions over [OIII]5007 measured among galaxies. Gelbord et al.[23] have published the results of the search of the FHIL emission objects among the SDSS dr6 selected on the basis of their [Fe X] 6374 emission. They have defined a sample of 63 AGN with strong FHIL emission (totally 200 candidate objects were selected), yielding one of the largest and the most homogeneous sample of FHIL-emitting galaxies with $z < 0.4$. Except one galaxy, SDSSJ124134.25+442639.2 the sample of Gelbord et al, consist of 14 Syl, 12 NLS1, 16 Syl.5, 3 Syl.9 and 18 Sy2.

Astronomers in general agree that "classical" Sy2 galaxies do not show FeII blends, and as a rule not show high-ionized lines of [FeVII]5721, 6087 and [FeX]6375 emission. Nevertheless of that, hundreds of objects with $300 < <FWHM(HI) < 2000\ km\ s^{-1}$, $[NII]6584/H\alpha\,6563 > 0.6$, $[OIII]5007/H\beta\,4861 > 3$, strong [FeVII] 5721, 6087, [FeX] 6375, [FeXI] 7892 emission and/or weak FeII blends 4600-4800 Å, 5100-5300 Å still included both in the Sy2 class of AGNs and NLS1 samples.

3. *FHIL emission in normal field galaxies.* Perhaps it is the first systematic search of the FHIL emission for normal emission and absorption line field galaxies.

As was mentioned above, more than 35 000 AGN with the best quality data with $z < 0.4$ we have isolated among the SDSS dr7 extragalactic objects.

More than 4000 of them show strong FHIL emission lines. Most of them should be classified as classical AGN of the well established Seyfert types. The FHIL emission in AGNs is not rare, AGN with FHIL emission lines (excluding LINERs) constitute at least 20% of all types of AGN. Besides of the classical AGN showing FHIL emission, numerous extragalactic objects showing strong FHIL emission lines, sometimes very broad, combined with the presence of narrow optical emission lines of typical ELG, HII and/or other types of field galaxies were isolated as well. We divide the latters into two groups:

1. A group of normal emission-line galaxies with narrow (FWHM ~ 120-250 km s^{-1}) "standard in optical region" ([NII]6584/48, [SII]6717/31, Hα6563, Hβ4861, [OIII]5007/4959, [OII]3727, [OI]6300/6363) etc. emission lines with underlying stellar absorption, coupled with strong sometime broad (FWHM ~1500-2000 km s^{-1}) emission lines of [FeVII]5721, 6087, [FeX]6375, [FeXI]7892, [FeXIV] 5303 and HeII 4686.

2. The objects with narrow FWHM~120-250 km s^{-1} emission lines both for FHIL and "standard in optical region" lines.

Table 1 presents the basic data for a dozen of objects with $z < 0.4$ FHIL and HeII 4686 emission lines selected from the SDSS dr7. Column 1 - the J2000 coordinates, 2- the SDSS name, 3- the SDSS spectral name, 4 -the redshift, 5 - the SDSS *g* magnitude. The spectral images of the objects given in Table 1 might be found in http://www.sddss.org/cas.sdss.org/astrodr7/en/tools/getimg.

Table 1

BASIC DATA FOR OBJECTS

	J2000	SDSS name	SDSS spectral name	z	g
1	02^{h}12^{m}01.5+00°39'39.6	J021201.64+003939.6	33.00683+0.66102	0.205	19.36
2	03 12 45.9-06 08 54.5	J031245.89-060854.5	48.18121-6.14847	0.253	19.54
3	08 27 13.4+16 35 17.3	J082713.39+163517.3	126.80581+16.58816	0.096	18.54
4	09 16 19.0+19 59 36.6	J091619.00+195936.6	139.07920+19.99353	0.302	19.61
5	09 38 01.6+13 53 17.0	J093801.63+135317.0	144.50682+13.88808	0.101	17.12
6	13 24 40.5+31 18 06.1	J132440.51+311806.1	201.16882+31.30172	0.194	18.43
7	13 27 51.0+23 06 14.6	J132751.00+230614.6	201.96254+23.10406	0.198	17.50
8	13 50 01.5+29 16 09.6	J135001.49+291609.6	207.50623+29.26936	0.078	18.26
9	14 29 58.2+47 56 32.9	J142958.16+475632.9	217.49236+47.94248	0.078	17.73
10	14 42 42.4+26 58 05.8	J144242.45+265805.9	220.67691+26.96831	0.063	17.07
11	15 30 15.4+11 54 03.6	J153015.39+115403.6	232.56415+11.90102	0.095	17.69
12	15 39 52.3+25 03 03.7	J153952.25+250303.7	234.96772+25.05106	0.092	18.33

4. *Observations.* We have performed the high resolution 0.86 Å/px spectroscopic observations for the candidate objects presented in Table 1 with the 6-m telescope of the Special Astrophysical observatory of Russia.

Here we are presenting the spectra of the SDSS J093801.63+135317.0 obtained with the 6-m telescope first 20.03.2010 with spectrograph SCORPIO in the long

slit mode, with the grating VPHG550G giving dispersion 2.1 Å/px in wavelength range 3800-7500 Å, exposure 5400 s, then 16.04.2010 with the grating

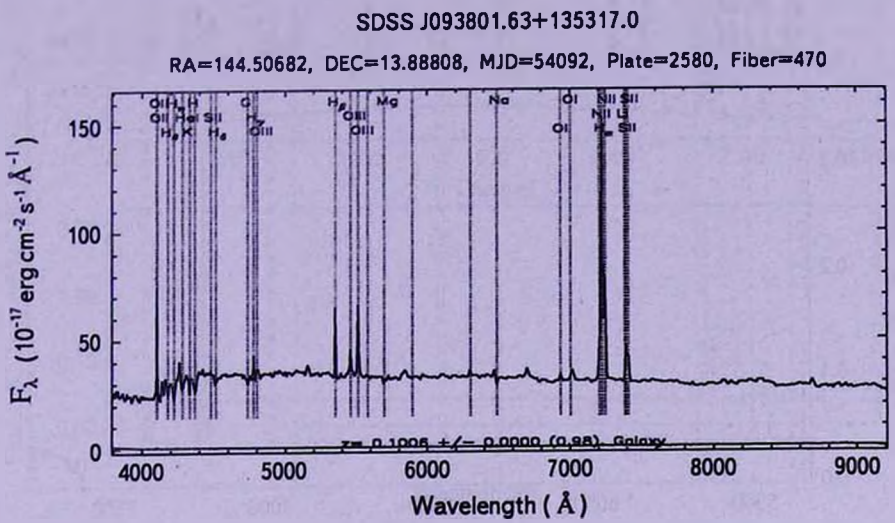

Fig.1.The postscript image of the original spectrum of the SDSS J093801.63+135317.0. Strong and broad HeII 4686, [FeVII] 5721 and 6087, [FeX] 6375, [FeXI] 7892 and [FeXIV] 5303 are clearly seen.

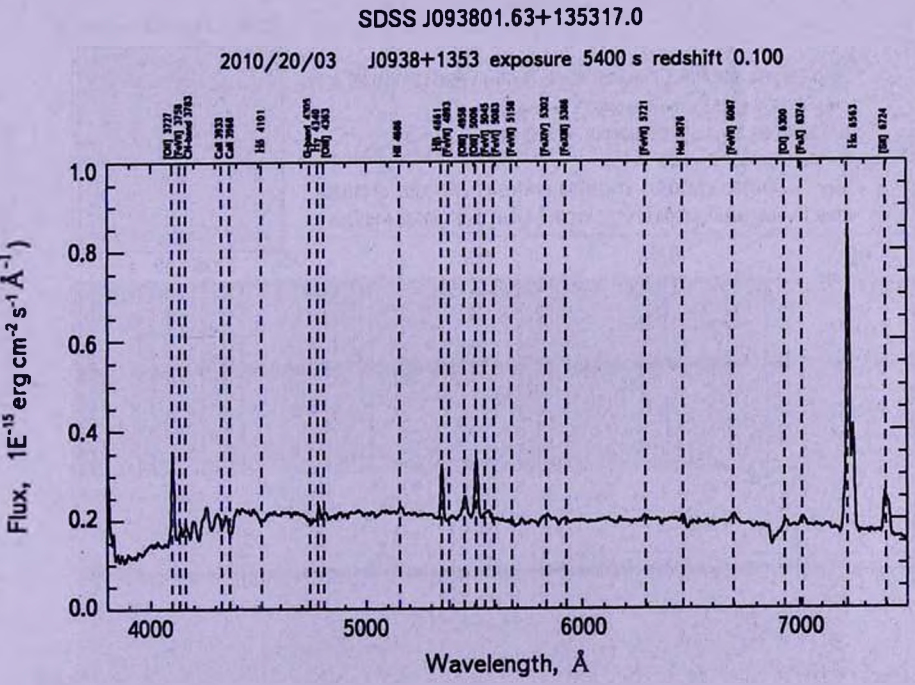

Fig.2 The long slit spectra of the SDSS J093801.63+135317.0 obtained 20.03.2010 (2.1 Å/px) with the 6-m telescope in waveband 3800-7500 A confirming the presence of the strong and broad FHIL and HeII 4686 emission lines.

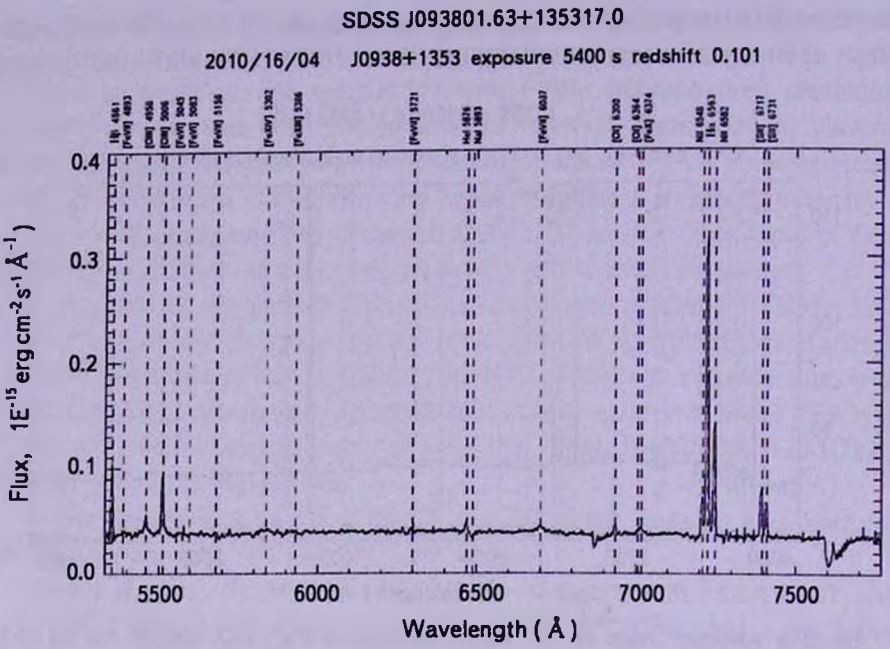

Fig.3. The long slit spectra of the SDSS J093801.63+135317.0 obtained 16.04.2010 (0.86 Å /px) with the 6-m telescope in waveband 5350-7750 Å .

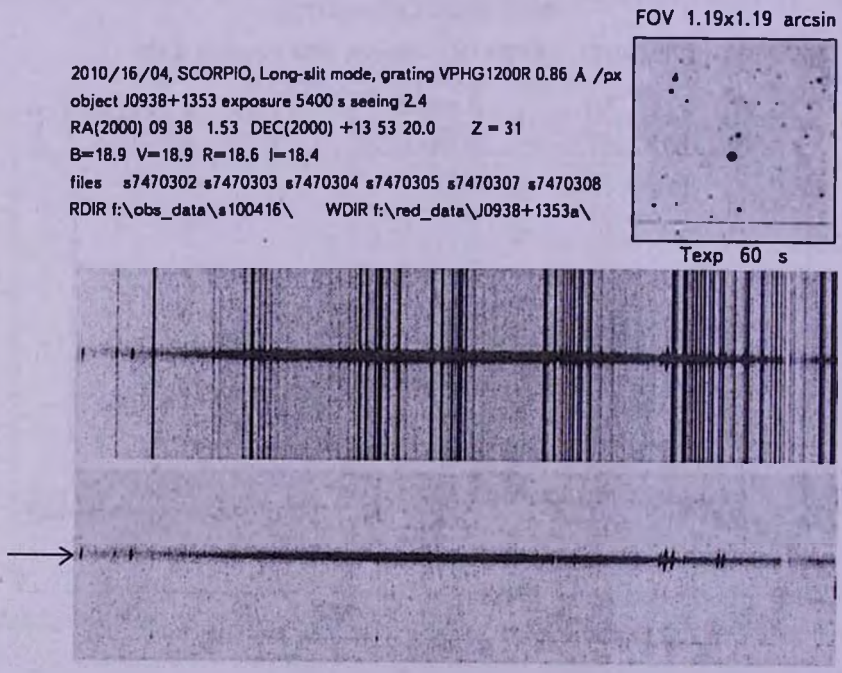

Fig.4. The original long slit spectra of the SDSS J093801.63+135317.0 obtained 16.04.2010 (0.86 Å /px) with the 6-m telescope in waveband 5350-7750 Å .

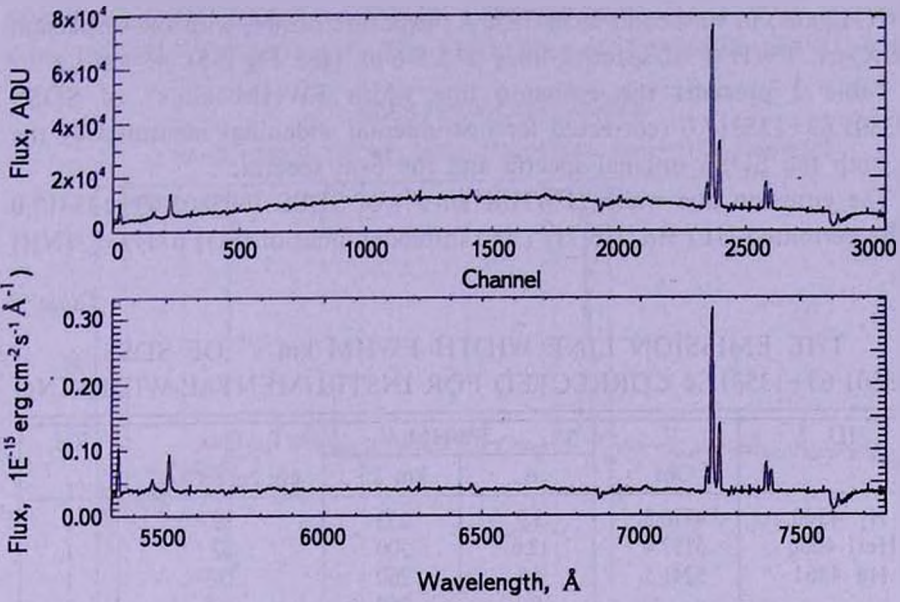

Fig.4. The end.

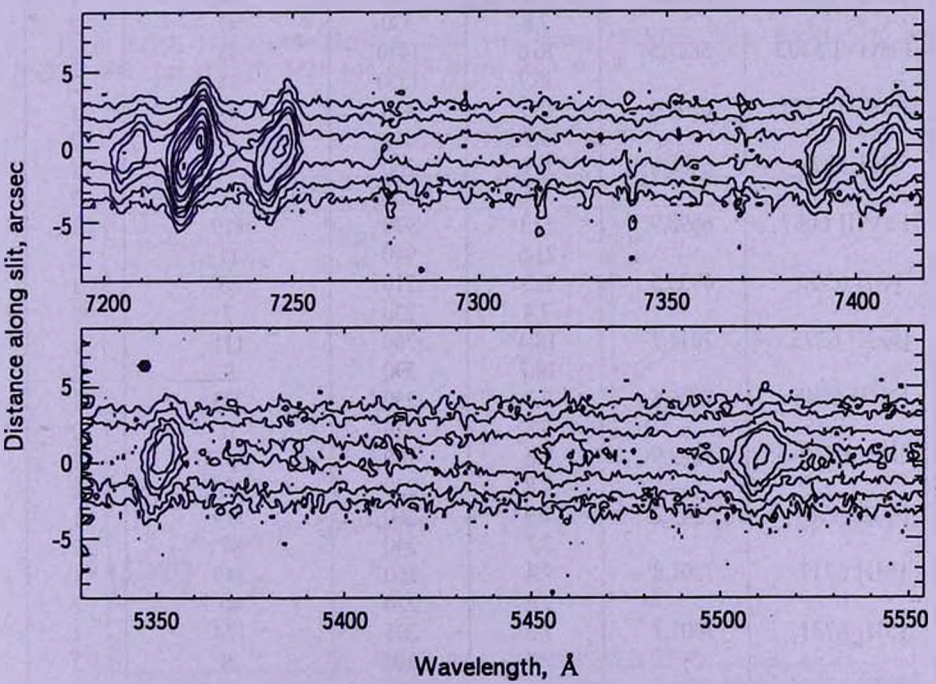

Fig.5. The isophots of the emission line profiles of [NII] 6548/84, Hα 6563, [SII] 6717/31, Hβ 4861 and [OIII] 4959/5007 along the slit from the spectra obtained16.04.2010 (0.86 Å /px) with the 6-m telescope.

VPHG1200R, in waveband 5350-7750 Å, exposure 5400 s, with the dispersion 0.86 Å/px. FWHM of spectral lines is 5.5-6 px (see Fig.1-5).

Table 2 presents the emission line width FWHM km s^{-1} of SDSS J093801.63+135317.0 (corrected for instrumental widening) measured by the use both the SDSS original spectra and the 6-m spectra.

The emission line width (FWHM km s^{-1}) of SDSS J093801.63+135317.0 of the permitted HI (Hα, Hβ, Hγ) and forbidden lines of [SII] 6717/31, [NII]

Table 2

THE EMISSION LINE WIDTH FWHM km s^{-1} OF SDSS J093801.63+135317.0 CORRECTED FOR INSTRUMENTAL WIDENING

ID	λ	FWHM		Flux	Ref.
	Obs	A	km s^{-1}	erg cm^{-2} s^{-1} $Å^{-1}$	
Hγ 4340	4776.3	3.9	233	89	1
HeII 4686	5157.4	13.6	700	52	1
Hβ 4861	5241.5	4.8	260	332	1
		5.0	260	253	2
[OIII] 4959	5456.8	7.4	360	135	1
		9.1	400	17	2
[OIII] 5007	5509.5	7.4	360	404	1
		7.6	330	47	2
[FeXIV] 5303	5837.5	26.6	1450	95	1
		30.7	1550	11	2
[FeVII] 5721	6296.6	10.2	450	47	1
		9.7	410	7	2
HeI 5876	6466.8	6.9	260	41	1
		7.4	250	7	2
[FeVII] 6087	6698.9	22.1	970	119	1
		21.5	940	11	2
[OI] 6300	6933.5	6.3	210	35	1
		7.4	230	7	2
[FeX] 6375	7014.7	18.4	760	111	1
		14.7	590	9	2
[NII] 6548	7206.6	7.7	250	235	1
		7.3	220	31	2
Hα 6563	7222.9	7.6	260	1807	1
		7.8	250	273	2
[NII] 6584	7245.2	7.9	260	719	1
		7.7	240	97	2
[SII] 6717	7391.8	7.4	260	249	1
		7.4	220	40	2
[SII] 6731	7407.7	7.3	205	174	1
		7.3	210	29	2
[ArIII] 7136	7854.6	5.3	180	9	1
[FeXI] 7892	8684.3	15.3	500	62	1

1- SDSS. Data of obs. 18.12.2006, 3800-9200 Å, flux units 10^{-17} erg cm^{-2} s^{-1} $Å^{-1}$
2- BTA. Data of obs. 16.04.2010, 5350-7750 Å, 0.86 Å/px, flux units 10^{-15} erg cm^{-2} s^{-1} $Å^{-1}$

6548/84 and [OI] 6300 have FWHM ~ 200-250 km s^{-1}. [OIII] 4959 and 5007 show FWHM ~ 330-400 km s^{-1}. The FHIL lines of [FeX]6375, [FeVII] 6087,

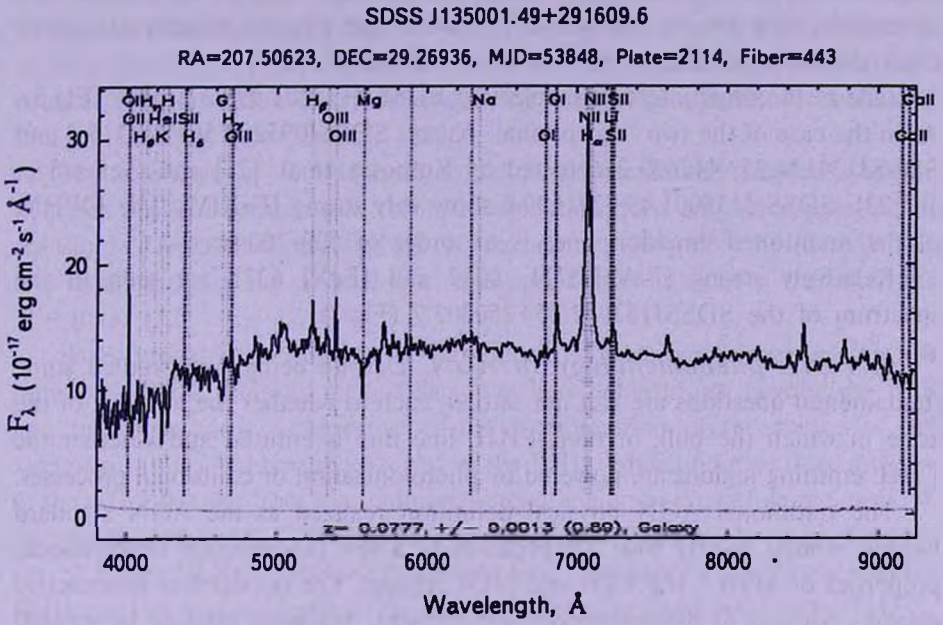

Fig.6. SDSS J135001.49+291609.6 show very strong [FeXIV] 5303, [FeX] 6375 and [FeXI] 7892, but [FeVII] 5721 and 6087 is not seen at all.

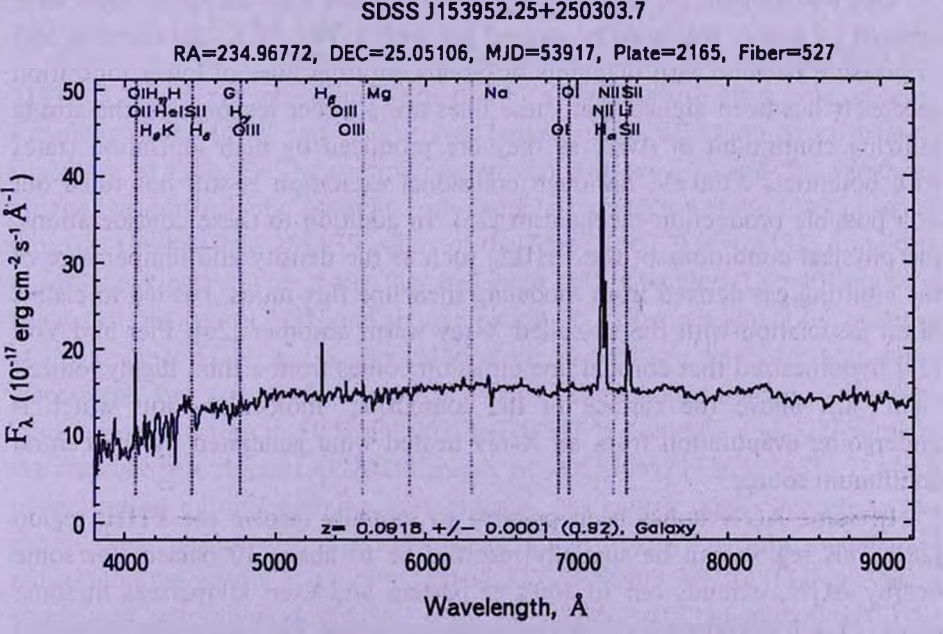

Fig.7. Relatively strong [FeVII] 5721, 6087 and [FeX] 6375 are seen in the spectrum of the SDSSJ153952.25+250303.7.

5721, [FeXIV]5303 and HeII 4686 show much broader emission line width, FWHM ~ 410-1550 km s^{-1}. The emission line ratios put the object in standard diagnostic diagrams among HII objects. The profiles of the FHIL emission are symmetric, they are not blueshifed. The radial disk rotation velocity calculated from the emission line profiles is about 250 km s^{-1}.

One of the most interesting objects is SDSS J135001.49+291609.6 (Fig.6). As in the case of the two "exceptional" objects SDSSJ095209.56+214313.2 and SDSSJ124134.25+442639.2 detected by Komossa et al. [21] and Gelbord et al. [23], SDSS J135001.49+291609.6 show very strong [FeXIV]. The FWHM of the mentioned emission lines is an order of 500-700 km s^{-1}.

Relatively strong [FeVII]5721, 6087 and [FeX] 6375 are seen in the spectrum of the SDSSJ153952.25+250303.7 (Fig.7).

5. *FHIL phenomenology in AGN.* Despite being well studied some fundamental questions are still not settled, such as whether the location of the zone in which the bulk of their FHIL line flux is emitted and whether the FHIL emitting regions are powered by photoionization or collisional processes.

The traditional AGN physical definition realized as the AGN standard models related mostly with the presence of a few fundamental observational properties of AGN - the BLR and NLR regions. The optical flux from active galaxies consists of three components: starlight, radiation emitted by ionized gas and nonthermal radiation [24]. It is generally believed that the nonstellar continuum radiation heats and ionizes the emission-line region [14].

Oke and Sargent [9] originally proposed that the high excitation lines were emitted by a hot, collisionally ionized gas with a $Te \sim 10^6$ K, surrounding and in pressure balance with filaments or clouds emitting lines of lower ionization species.It has been argued that these lines are a direct response to the strong ionizing continuum of AGN as they are produced by high ionization states with potentials >100 eV, although collisional excitation is still not ruled out as a possible production mechanism [25]. In addition to these considerations, the physical conditions of the FHILs, such as the density and temperature of the emitting gas derived from modeling their line flux ratios, has led to claims of an association with the so-called X-ray warm absorber [26]. Pier and Voit [27] hypothesized that coronal line emission comes from a thin, highly ionized "skin" just above the surface of the "obscuring" molecular torus which is undergoing evaporation from an X-ray heated wind generated by the central continuum source.

In some AGN it has been possible to spatially resolve the FHIL region [28]. This region can be spatially resolved be to about 10 parsecs for some nearby AGN, extends out to 100's of parsecs and even kiloparsecs in some cases [29,30]. A consequence of the properties is that FHILs may be employed as diagnostics of outflows from the inner regions of the AGN [28,31].

The emission lines from the FHIL region in Sy galaxies typically have a FWHM of 1000 - 3000 km/s, and are significantly narrower than the broadest components of the permitted lines observed in the same AGN and reached a maximum luminosity around $R \sim 10^{18} - 10^{19}$ cm (0.3 - 3 pc). High-ionization coronal lines [FeVII], [FeX] and [FeXI] tend to be blueshifed relative to, and broader low-ionization lines; the systematic blueshift indicates an outflow of the gas emitting these features [32].

The existence of forbidden lines indicates that in the respective region densities are low enough that the forbidden transitions are not suppressed by collisions. The critical densities are of the order of $10^7 - 10^{10}$ cm^{-3}. The density and temperature of the coronal line region are of the order of $n_e \sim 10^6$ cm^{-3} and $T_e \sim 10^5$ K [32].

Based on the basic generic AGN components it has been suggested that the innermost FHIL emitting regions lie somewhere between just beyond the BLR and the dusty torus. Irrespective of the interpretation of the source of this kinematics, it is clear that at least part of the FHIL emission arises from a region of the AGN distinct from the traditional broad line and narrow line regions [33]. Further evidence that FHILs arise from an "intermediate" region (i.e. between the BLR and NLR) is provided by integral field observations of the near infrared FHILs in two of the closest AGN: the Circinus galaxy and NGC 4051 [34,35].

The AGN models are consistent with the picture that the energetic source for the FHIL production is X-ray reflection which heated the gas above the accretion disk originated by the powerful central engine in intermediate zone between the BLR and molecular torus.

Komossa et al. [22] discussed the outburst scenarios for SDSSJ095209.56+214313.3 in terms of stellar tidal disruption by a supermassive black hole, peculiar variability of an AGN, and a supernova explosion (the explosion of an extreme supernova of Type II). The spectral properties and strong emission-line variability are the consequence of a powerful high-energy flare which was itself not observed directly. The pre-flare 2MASS colors of the SDSSJ095209.56+214313.3 indicate a non-active galaxy, the X-ray flux measured with Chandra ($Lx \sim 10^{40}$ erg s^{-1} is below that of a typical AGN and above a typical SN), does not hint at the presence of a permanent AGN, and the optical spectrum barely has a detectable non-stellar component. The temperature sensitive line ratio implies photoionization as dominant ionization mechanism in SDSSJ095209.56+214313.3. Komossa et al. [22] consider the presence of a classical AGN at the core of SDSSJ095209.56+214313.3, which underwent an unusual outburst, very unlikely. No known non-active galaxy has shown these phenomena. The conclusion is that a very energetic outburst of radiation in the inner 1.5 kpc of the galaxy SDSSJ095209.56+214313.3 take place which was not observed directly. Only the reprocessed radiation into FHIL emission lines was observed.

To estimate the rate of such an unusual objects Komosa et al. [22] undertaken a quick- look search among the SDSS galaxies and detected at least two more events (Komosa et al. and Zhou et al., in preparation). Taking 3 safely identified so far results, they estimate the lower limit on the event rate is 4×10^{-6}/galaxy /(a few years).

The sample we have isolated consists of hundreds of candidate objects with strong, moderate, weak and/or suspected FHIL emission. The high resolution spectral observation is needed to confirm the presence of the FHIL emission for candidate objects. Our preliminary spectral observations during the last years confirm the presence of strong FHIL emission in many of them.

How the traditional AGN models described above might be applied to the new population of extragalactic objects a dozen of which we present in this paper? Could the existence of the numerous normal field galaxies with strong FHIL emission be consistent with the cumulative effects of the Type II supernova scenarios or other scenarios discussed by Komossa et al. [22].

The objects we discuss are normal non-active field galaxies the spectrum of which show narrow HI and forbidden lines co-added with strong, sometimes very broad FHIL emission lines without the presence of any classical AGN properties. The questions to be explained are:

1. What is the origin of the strong FHIL lines in "normal" field galaxies presented above?

2. How may coexist so strong FHIL emission lines, sometimes very broad (~1500 km s^{-1}),with the narrow emission lines in normal galaxies without any peculiarity or sign of AGN?

6. *Summary*. We have reported the discovery of a population of the normal extragalactic field galaxies with HII like emission and/or absorption line spectra with the clear presence of the strong FHIL and HeII 4686 emission. In this paper we present a dozen of candidate objects.

The high resolution 0.86 Å /px spectra obtained with the 6-m telescope of the Special observatory of Russia are presented for one of them - SDSSJ093801.63+ 135317.0, confirming the presence of strong and wide FHIL and HeII 4686 emission.

These objects show typical narrow (FWHM ~ 120-250 km s^{-1}) emission lines both of HI and forbidden emission lines of [NII]6548/84, [SII]6717/31, [OI]6300, [OII]3727, [OIII]5007/4959 with underlying stellar absorption lines, coupled with the strong FHIL emission of [FeVII]5721, 6087, [FeX]6375, [FeXI]7892, [FeXIV]5303 and HeII 4686, sometimes very broad FWHM up to 1500 km s^{-1}. Many of them do not show the Hβ, [OI] and [OIII] emission lines, but strong FHIL emission.Following to the direct SDSS images all morphological types is introduced: spherical, elliptical, spiral, barred spiral, etc., without morphological or other peculiarity and any sign of standard AGN

activity. None of them are X-ray source.

The appearance of the FHIL emission in normal galaxies (the objects of SBN/HII/ELG/ABS spectral types) might be one of the important sign of the beginning of the AGN activity.

The existence of the numerous normal extragalactic objects with FHIL emission tells us that the link between the AGNs and the normal galaxies perhaps might be realized with the FHIL flare in normal galaxies. For all of them the existence of the non thermal source in normal galaxies should be proposed, which may significantly change our understanding of the AGN phenomena.

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НОВЫЙ ТИП ВНЕГАЛАКТИЧЕСКИХ ОБЪЕКТОВ?

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Обнаружена популяция нормальных внегалактических объектов с сильными FHIL (Forbidden High Ionized Lines) и HeII 4686 эмиссионными линиями. В этой статье мы приводим данные о 12 объектах из SDSSdr7. Спектр с высоким разрешением 0.86 Å /px, полученный на 6-м телескопе Специальной астрофизической обсерватории России, приведен для одной из них - SDSSJ093801.63+135317.0, подтверждающей наличие сильной и широкой FHIL и HeII 4686 эмиссионных линий. Эти объекты показывают типичные узкие (FWHM ~ 120 - 250 км $с^{-1}$) эмиссионные линии как для HI, так и запрещенных эмиссионных линий [NII] 6548/84, [SII] 6717/31, [OI] 6300, [OII] 3727, [OIII] 5007/4959 в сочетании со звездными линиями поглощения, и сильными FHIL эмиссионными линиями [FeVII] 5721, 6087, [FeX] 6375, [FeXI] 7892, [FeXIV] 5303 и HeII 4686, иногда очень широкими ~1500 км $с^{-1}$. Согласно прямым изображениям представлены все морфологические типы: сферические, эллиптические, спиральные, спиральные с перемычками т.д., без каких-либо морфологических или других особенностей, характерных для "стандартной" AGN активности. Ни один из этих объектов не является источником рентгеновского излучения. Наличие FHIL эмиссионных линий в нормальных галактиках (объекты SBN/HII/ELG спектральных типов) могут быть одним из важных признаков

начала активности в ядрах галактик. Существование множества нормальных внегалактических объектов с FHIL и HeII 4686 эмиссионными линиями позволяет предположить, что связь между AGN и нормальными галактиками, возможно, может быть реализована FHIL вспышками в нормальных галактиках. Для всех этих объектов необходимо предложение о существовании нетеплового источника излучения в нормальных галактиках.

Ключевые слова: *FHIL эмиссия:нормальные галактики:AGN*

REFERENCES

1. *D.Weedman*, Astrophys. J., **167**, 23, 1971.
2. *J.A.Baldwin, M.M.Phillips, R.Terlewich*, Publ. Astron. Soc. Pacif., **93**, 5, 1981.
3. *S.Veilleux, D.E.Osterbrock*, Astrophys. J. Suppl. Ser., **63**, 295, 1987.
4. *J.A.Stepanian*, Revista Mexicana de Astronomia y Astrofisica, **41**, 155, 2005 (SBS).
5. *B.E.Markarian*, Soobsh. Byurakan. Obs., **34**, 3, 1963 (FBS).
6. *K.N.Abazajian et al.*, SDSS dr7, Astrophys. J. Suppl. Ser., **182**, 543, 2009.
7. *D.E.Osterbrock, O.Dahari*, Astrophys. J., **273**, 478, 1983.
8. *D.E.Osterbrock, M.M. de Robertis*, Publ. Astron. Soc. Pacif., **97**, 1129, 1985.
9. *J.B.Oke, W.L.W.Sargent*, Astrophys. J., 151, 807, 1968.
10. *D.E.Osterbrock*, Astrophys. J. Letters, **4**, 57, 1969.
11. *H.Nussbaumer, D.E.Osterbrock*, Astrophys. J., **161**, 811, 1970.
12. *H.Netzer*, Mon. Notic. Roy. Astron. Soc., **169**, 579, 1974.
13. *D.E.Osterbrock, A.T.Koski*, Mon. Notic. Roy. Astron. Soc., **176**, 61P, 1976.
14. *D.E.Osterbrock*, Publ. Astron. Soc. Pacif., **103**, 874, 1991.
15. *D.E.Osterbrock, A.Martel*, Astrophys. J., **414**, 552, 1993.
16. *A.T.Koski*, Lic. Obs., **786**, 1, 1978.
17. *S.Veilleux*, Astron. J., **95**, 1695, 1988.
18. *M.P.Veron-Cetty, P.Veron, A.C.Goncalves*, Astron. Astrophys., **372**, 730, 2001.
19. *D.E.Osterbrock*, Publ. Astron. Soc. Pacif., **97**, 25, 1985.
20. *D.E.Osterbrock, R.W.Pogge*, Astrophys. J., **297**, 166, 1985.
21. *S.Komossa, H.Zhou, T.Wang et al.*, Astrophys. J., **678**, L13, 2008.
22. *S.Komossa, H.Zhou, A.Rau et al.*, Astrophys. J., **701**, 105, 2009.
23. *J.M.Gelbord, J.R.Mullaney, M.J.Ward*, Mon. Notic. Roy. Astron. Soc., **397**, 172, 2009.
24. *M.H.Demoulin, F.R.Burbidge*, Astrophys. J., **154**, 3, 1968.
25. *M.V.Penston, R.A.E.Fosbury, A.Boksenberg, M.J.Ward, A.S.Wilson*, Mon. Notic. Roy. Astron. Soc., **208**, 347, 1984.
26. *D.Porquet, A.-M.Dumont, S.Collin*, M.Mouchet, Astron. Astrophys., **341**, 58, 1999.
27. *E.A.Pier, M.G.Voit*, Astrophys. J., **450**, 628, 1995.

28. *A.Rodrigues-Ardila, A.M.Prieto, S.Vielgas, R.Gruenwald*, Astrophys. J., **653**, 1098, 2006.
29. *N.Bennert, B.Jungwiert, S.Komossa, M.Haas, R.Chini*, Astron. Astrophys., **456**, 953, 2006a.
30. *N.Bennert, B.Jungwiert, S.Komossa, M.Haas, R.Chini*, Astron. Astrophys., **459**, 55, 2006b.
31. *J.P.Millaney, M.J.Ward, C.Done, G.J.Ferland, N.Schurch*, Mon. Notic. Roy. Astron. Soc., **394**, L16, 2009.
32. *U.I.Erkens, I.Appenzeller, S.Wagner*, Astron. Astrophys., **323**, 707, 1997.
33. *J.P.Millaney, M.J.Ward*, Mon. Notic. Roy. Astron. Soc., **385**, 53, 2008.
34. *S.F.Mueller, R.I.Davies, F.Eisenhauer et al.*, Astron. Astrophys., **454**, 481, 2006.
35. *R.A.Riffel, T.Storchi-Bergman, C.Wingle et al.*, Mon. Notic. Roy. Astron. Soc., **385**, 1129, 2008.