Scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the Academy of Sciences of the USSR (26–27 February 1986)

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A joint scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the USSR Academy of Sciences was held on February 26 and 27, 1986 at the S. I. Vavilov Institute of Physical Problems of the USSR Academy of Sciences. The following reports were presented at the session:

February 26

1. *V. L. Afanas'ev.* Relation between the structure of galaxies and the activity of their nuclei.
2. *V. F. Shvartsman.* Investigations in relativistic astrophysics and cosmology with the six-meter telescope.
3. *I. M. Kopylov.* Spectral observations of binary systems with relativistic companions using the six-meter telescope.
4. *L. I. Snezhko.* Large six-meter BTA telescope status and prospects.

February 27

5. *P. G. Kostyuk.* The operation of a nerve cell.
6. *V. L. Dunin-Barkovskiĭ.* Multineuronal structures: theory and experiment.
7. *L. B. Ioffe and M. V. Feĭgel'man.* Spin glasses and models of memory.

Summaries of five of the reports are presented below.

V. L. Afanas'ev. *Relation between the structure of galaxies and the activity of their nuclei.* This report is devoted to the question of the relation between the structure of active galaxies, in particular, Seyfert galaxies, and the nature of their activity. The resolution of this question is of fundamental significance for understanding the origin and nature of active galactic nuclei.

Galactic activity is linked with processes occurring at the center of a galaxy. The characteristic size of this region in Seyfert galaxies is less than 10 pc (10^{20} cm) and the power involved is of the order of 10^{44} erg/s, which is three to four orders of magnitude larger than the typical values for normal galaxies. In quasars this quantity reaches 10^{47} erg/s.

With respect to size and mass the region where activity (nonthermal radiation, radiation in broad gas lines, noncircular motion, etc.) is observed does not exceed 1% of the size and mass of the entire galaxy.

At the present time there are two approaches to understanding the nature of active nuclei:

1. All galaxies pass through the phase of nuclear activity, which lasts for (10^{10} (N_a/N_Σ) years, where N_a is the number of active galaxies and N_Σ is the total number of galaxies. For the observed frequency of occurrence of active galaxies we have $N_a/N_\Sigma = 0.01 - 0.02$, which gives a duration of the order of 10^8 years for the active phase.

2. Active galaxies are a special small class of objects, and the activity of their nuclei is a property embedded in the galaxy during the epoch of stellar formation.

The duration of the active "phase" is then of the order of the age of the galaxy (10^{10} years).

Observational data supporting the second approach, obtained on the six-meter telescope and other telescopes in the USSR, were presented in the report.

A sample of Seyfert and normal galaxies of similar morphological types was studied. The basic features of such a study were indicated:

the construction of a uniform sample of objects;
the necessity of using uniform methods on large telescopes; and
selection problems.

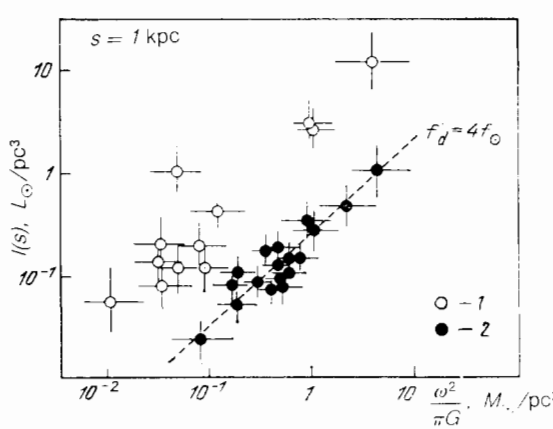

Fig. 1. $I(s)$, $\omega^2(s)$ diagram for Seyfert (1) and normal (2) galaxies at a distance of 1 kpc from the center of the galaxy. The broken line indicates the theoretical straight line for the Friedman-Morozov model of a flat galaxy with a mass-to-luminosity ratio of the diskotic component equal to $4f_\odot$. Activity in Seyfert galaxies is observed both in objects with normal rotation but with strong concentration toward the center and in objects with normal concentration but with anomalously slow rotation.

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The parameters of normal and Seyfert galaxies were compared based on observations of the brightness distribution and the character of the rotation within the framework of the Friedman-Morozov model. The galaxy is described by two components—a spherical component with a small rotational moment and a volume density $\rho(r)$ and an infinitely thin rotating disk with a surface density $\sigma(r)$.

A correlation between the volume luminosity of the spherical component and the activity of the nucleus was determined. The mass-to-luminosity ratio for Seyfert galaxies is similar to the ratio M/L for normal galaxies of the same morphological types. This indicates that the volume density of the spherical component in active objects is linked with the phenomenon of activity. At a distance of 1 kpc from the center the density of stars in Seyfert galaxies reaches 10–60 $M_{\odot}/\mathrm{pc}^3$ and increases as the brightness of the nucleus increases.

The previously observed difference between the values of the surface brightness and the gradients of the brightness in normal and active galaxies was not confirmed. Normal and Seyfert galaxies are more clearly distinguished by comparing the volume luminosity $I(s)$ and the angular rotational velocity $\omega(s)$ at a distance of 1 kpc from the center. The asymptotic solution of the equation of equilibrium for the Friedman-Morozov model at the center of the galaxy gives the following ratio of these quantities:

$$I(s) \approx \frac{\omega^2(s)}{\pi G f d} + \rho(0)\left(\frac{\pi}{f_s} - \frac{4}{3}\frac{1}{f_d}\right), \qquad s \to 0,$$

where f_s and f_d are the mass-to-luminosity ratios for the spherical and disk components.

The $I(s)$, $\omega^2(s)$ diagram is presented based on the observational results for a sample of Seyfert and normal galaxies (see Fig. 1).

The main conclusion drawn in the report is that activity of the nucleus is observed in galaxies with a definite ratio of the density of the spherical component to the angular momentum of the matter associated with the disk.

The activity is generated by a completely determined dynamical galactic structure in galaxies whose age is $\sim 10^{10}$ years.

[1]V. L. Afanas'ev, A. A. Pimonov, and V. Yu. Terebizh, Pis'ma Astron. Zh. **8**, 579 (1982) [Sov. Astron. Lett. **8**, 311 (1982)].
[2]V. L. Afanas'ev, Author's Abstract of Candidate's Dissertation, Moscow (1981); Pis'ma Astron. Zh. **7**, 390 (1981) [Sov. Astron. Lett. **7**, 215 (1981)].