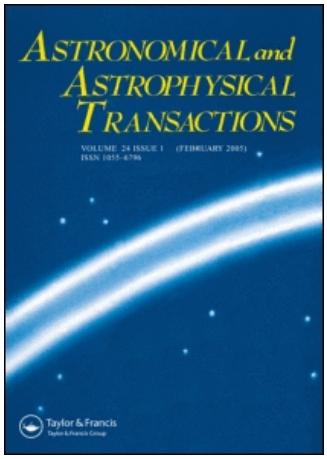

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INTRODUCTION

At the end of the century, all branches of science discuss and review their future. Astronomy is one such branch of science and in Saint-Petersburg we decided to look into the distant future of experimental radio cosmology, and to emphasise particularly the unsolved problems of the very distant Universe, which demand new instrumentation.

It is not easy to predict the list of the first priority targets in any field of science. Professor M. A. Markov tried to compile a list in the 1930s just asking many world famous scientists. He reviewed this in 1970s but all predictions happened to be wrong!

Technology development progresses exponentially; it is strange, but the rate of development can be predicted, even if the technical solutions of the next generation instrumental problems are not yet known. All history of radio astronomy confirms that statement (Khaikin *et al.*, 1964; Kardashev, 1992).

The last half century demonstrated that much greater progress can be achieved by solving specific problems, but not through construction of general purpose instrumentation. There are at least two popular ways to make progress technology. First one – strong financial government support (e.g. defense technology). Second way – concentration around the scientists of the engineering intellectual potential on the specific science problem. The memorial George Gamow conference provides a good opportunity to use the second way. Very complex and difficult Early Universe problems may be expressed in an understandable way and they definitely belong in the primary interest category for society.

It is appropriate that we discuss here the impact that George Gamow had on science and technology in Saint-Petersburg. His working room was a few metres from our conference hall. His teacher A. Friedmann 'made the Universe expand' here, in the same room. As S. E. Khaikin mentioned, Professor A. S. Popov was the first 'radio astronomer', who began to explore the Universe by radio waves with

his first 200 sq.m radio telescope with 'thunderstorm marker' in 1896. It is not well known that the first direct discovery of the isotropical 3K background was achieved at Pulkovo Observatory in 1956 by Tigran Shmaonov, using perfect equipment, and the first deep anisotropy measurements at mK level were done with 130 m Pulkovo Radio Telescope using world best receivers. This result stimulated the work of the world famous research group of Ya. B. Zeldovich (see e.g., Doroshkevich, 1986), and later many variants of the CMBA theories appeared, which, in turn, simulated observational and receiver technology.

Russian physical cosmology teams are well known and the monograph 'Structure and Evolution of the Universe', 1974 by Ya. Zeldovich and I. Novikov initiated great activity in the main physical centres abroad, and to date their book is used and regarded as a 'Bible'. But, for the younger generation, let me recall the role of some Russian persons in the motivation of the popular Early Universe paradigms. Lifshits (1946): Newton's suggestion of simple gravitational instability as the main structure formation process does not work. Mukhanov, Chibisov: significance quantum effects; Gliner (1965), Kirgnits, Linde, Starobinski: vacuum phase and inflation can resolve many problems; Sakharov: barion asymmetry can be explained by violation of the particle symmetry laws in Early Universe; in the photon–barion gas 'Sakharov oscillations' should appear (1965). The latter prediction happened to be the main target of all CMBA experiments and next generation projects, including MAP (USA), PLANCK (ESA), Cosmological Gene (Russia).

We hope the information presented on world leading next generation experiments in cosmology will inform our (mostly Russian) audience, and also that the presentation of new Russian ideas and new projects in this field will be of interest to our Western colleagues.

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