electronic systems and the systems of communication, navigation, telemetry, control, remote sensing, surveying and ground control facilities of rocket and space technology for dual purposes.

Specialized products are designed for long life in harsh conditions of space and meet the high requirements of reliability and quality. The production is certified based on GOST ISO 9001-2011.

Russian space becomes different. Roscosmos and URSC have started the system modernization of the industry. They audit all important projects and fill in the competency matrix. This matrix is formed due to the specialization of each company closely connected with spacecrafts, carrier rockets, etc. They also make marketing audit, study business models and estimate the economy. Moreover, they carry out the audit of the management arrangements, technology and quality [2].

URSC is forming a new system of quality assurance in outer instrument-making. In particular, URSC is going to avoid the system of quality assurance which is achieved by the control of the final product, and proceed to the quality assurance in production processes.

References:

1. The improvement of the efficiency of Space engineering in Russia [electronic resource] – URL: http://rkp.rniikp.ru/product.htm (accessed March 17, 2015).
2. Russian space becomes different [electronic resource] – URL: http://vpk.name/news/125655_generalnyii_direktor_oao_rks_andrei_tyulin_reshaem_ambicioznuyu_zadachu__postroit_konkurentosposobnoe_obedinenie_mirovogo_urovnya_v_segmente_kosmicheskogo_priborostroeniya.html (accessed March 17, 2015).

Linde's Chaotic Inflation model of the Universe

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Physical cosmology is the study of the largest-scale structures and dynamics of the Universe and is concerned with fundamental questions about its origin, structure, evolution, and ultimate fate. [1]. Dramatic advances in observational cosmology since the 1990s, including the cosmic microwave background, distant supernovae and galaxy redshift surveys, have led to the development of a standard model of cosmology. Linde's Chaotic inflation model is one of several cosmological models that awaits to be supported or refuted by evidence.

Prior to the inflation scenario there was no reason to believe that the world is highly heterogeneous on a large scale. On the contrary, astronomers say that the scale ~10^{28}sm. observable universe heterogeneity $\delta\rho/\rho \sim 10^{-4}$, and they are small. The Inflation Model implies that the observable universe is but a tiny fraction of the world as a whole and the question of uniformity of the Total Universe becomes more complicated. The theory of inflation states that there are domain walls and the Universe as a whole is absolutely heterogeneous. Consider the behavior of a scalar field φ in the chaotic inflation scenario (**CXP**) in the model $V(\varphi) = (\lambda\varphi^4)/4$/. A characteristic time:

$$\Delta t \sim \mathbf{H^{-1}} \sim M_P/(\lambda^{1/2}\varphi^2) \Rightarrow H^2 \propto (\lambda\varphi^4)/M_P^2$$

homogeneous field φ due to expansion of the universe is reduced by the amount of

$\Delta\varphi = (M_P^2)/(2\pi\varphi)$.

On the other hand for Δt due to quantum fluctuations generated field inhomogeneity φ with wavelength $l \sim \mathbf{H^{-1}}$ and with an average amplitude $\delta\varphi \sim H \sim (\lambda^{1/2}\varphi^2)/M_P$.

Hubble's law: $v = Hl = 1 = C = l/(\Delta t) \Rightarrow l \sim \Delta t \sim \boldsymbol{H}^{-1}$

Equating $\Delta\varphi = \delta\varphi$, find φ^*: $\varphi^* = \lambda^{-1/6} M_P$.

If $\varphi << \varphi^*$, influence of quantum fluctuations φ immaterial $|\delta\varphi| << \Delta\varphi$ and vice versa if $\varphi >> \varphi^*$ quantum fluctuations are important. If $\varphi \to \infty$ $\delta\varphi_{кв.} \to \infty$, $\Delta\varphi \to 0$.

Consider the domain size of the inflationary universe $\delta l \sim \boldsymbol{H^{-1}}$, containing the field $\varphi>>\varphi^*$

Swelling in this region is independent of what happens in other areas. Field in these areas has a high degree of homogeneity, as initial heterogeneity decreased due to inflation, and the new heterogeneity have a wavelength greater than $\boldsymbol{H^{-1}}$, $\Rightarrow$ they are beyond the horizon. A characteristic time $\Delta t \sim \boldsymbol{H^{-1}}$, linear dimension of the region will increase e-fold, the volume increases by $e^3 \approx 20$ times. The old region can be divided into 20 sub-regions with a size $r_{\mathbf{гор.}} \sim \boldsymbol{H^{-1}}$. Moreover, these 20 mini universes (CF) are not causally connected, one universe has generated 20 mini universes which from this point on developed independently. Quantum fluctuations are large, thus the field increases in a half of these mini universes, then the process will be repeated. In this case, the full volume of the grand universe, occupied by the ever-growing field φ , is growing exponentially. It turns out that in a finite time the field in such areas will become infinite, the expansion stops and the areas will return to the state of the quantum Planck foam. Indeed, in some areas of the field φ growing every time $\delta\varphi \sim$ H за $\Delta t \sim \mathbf{H^{-1}}$.

The growth rate of φ: $d\varphi/dt \approx (\delta\varphi_{кв.})/\Delta t = H/(H^{-1}) = \mathbf{H^2} \propto V(\varphi)/(M_P^2) \propto (\lambda\varphi^4)/(M_P^2)$

$d\varphi/dt = \lambda_0\varphi^4$. $\lambda_0\int dt = \int\varphi^{-4}d\varphi$, $\lambda_0 = \text{const}$, $\lambda_0 t = (\varphi^{-3})/(-3) + (\varphi_0^{-3})/3$.

Multiply it by 3: $\varphi^{-3} = \varphi_0^{-3} - 3\lambda_0 t$. If the right-hand side is zero, $\varphi = +\infty$. $\varphi_0^{-3} - 3\lambda_0\tau = 0 \Rightarrow$

$\tau = (\varphi_0^{-3})/(3\lambda_0) = (M_P^2)/(\lambda\varphi_0^3)$.

During τ field φ becomes infinite, in fact, the field reaches a value such that the inflation ceases, as τ through this universe will be the Planck density, that is, return to a state of "quantum foam."

But fluctuations φ lead not only to the formation of mini universes with $\varphi >> \varphi^*$, but also areas with $\varphi << \varphi^*$. Such areas and give rise to enormous relatively homogeneous expanding mini universes, one of which we are.

It is believed that the most natural initial conditions $\varphi \sim \lambda^{-1/4}M_P >> \varphi^* = \lambda^{-1/6}M_P$, $(\lambda \sim 10^{-12})$, that is, the field is strong. This mini universe generates more and more flared mini universes endlessly! [2].

In many Universes there is a very strong field, others are characterized by the weak one. $\Rightarrow$ The whole universe as a whole never collapses, even if closed! The whole universe as a whole will never turn into "nothing" (Space Vacuum). And there is no reason to expect that before in a single moment t =0 was a global singularity. Thus, the entire grand universe never collapses**.** It does not mean that there are no singularities in the universe, on the contrary, much of the volume of the universe at any time is in the singular quantum foam (but the density there is still less than infinity). But different regions of the Universe reach the singularity state at different times and there is no single end of time, only perhaps, a single start time ***t*** for the whole of the universe is not. Zel'dovich and Novikov earlier emphasized that unified start and end t for the whole universe cannot exist simultaneously, if the universe is Friedmann-local, but globally heterogeneous then it is a quasi-homogeneous universe. [3] The only explanation for the uniformity of the observable universe is associated with the scenario of inflation. $\Rightarrow$ The whole universe is in a very large scale is absolutely homogeneous: from 10^{-29}g/cm$^{\mathbf{3}}$

to $\rho_P \sim 10^{94}$g/cm.$^{\mathbf{3}} \Rightarrow$ unified start and end of World Total no!

To prove or disprove this theory we need to detect abnormalities of the cosmic microwave background. There is a standard, classic set of anomalies that exists in the cosmic microwave background, basically they are all associated with low harmonics. The proof of the theory would be detection of a "cold spot" anomaly. There is a Relict cold spot or Eridanus Supervoid region in the constellation Eridanus with an unusually low microwave radiation and large size compared with the expected properties of the relict radiation. Relict cold spot is some 70 mkK cooler than the average background temperature (about 2.7 K) [4]. This supervoid conditionally which occupies a plot of the sky in the Eridanus constellation, presumably lacks not only the usual matter, but the notorious dark matter as well. In other words, the main physical component of the Eridanus Supervoid is this elusive dark energy (the vacuum of space, pervasive ultra-weak field).

We may detect this anomaly by using the NASA spacecraft - Wilkinson Microwave Anisotopy Probe (WMAP) or by using the interferometer VLA, the so-called New VLA Sky Survey, where we see a hole in the distribution of radio sources, another hole in the distribution of the microwave background radiation. This anomaly can be detected from the surface of the Earth and from space. To detect from Earth the components of the National Radio Astronomy Observatory were used, in particular interferometers, which are located in the plains of San Agustin. To detect "cold spots" from space probes used WMAP and Planck unit. Modern interferometers are clocked at 74 MHz to cover the 50 GHz [5]. Increase in frequency coverage to hundreds of GHz can allow us to explore this anomaly in more detail and to detect new, previously inaccessible anomalies. To achieve this it is necessary to increase the resolution of the interferometer $\sim \lambda/D$, and the wider is the baseline, the better it is. You can display the interferometer in space and receive: optical images of galaxies and quasars with a resolution of hundredths and thousandths of a second of arc, increased by several orders of accuracy mutual angular distances of stars, implement measurement of small parallaxes of stars. You can also increase the performance of these devices, raising them to a higher altitude above sea level, at the moment this is the height of 2124 m.

To prove that the findings in Eridanus Supervoid support supporting the theory we need to use the method of finding the voids, and in particular VoidFinder Algorithm. To carry out this analysis, it is necessary to calculate the density of space in the area enclosed in a spherical radius of 2 neighboring galaxies. In the void boundaries are different and are determined by the average density of the space outside the walls of the density reaches 100%, which will allow us to identify the void's boundary, the between the two universes. To improve the performance of the algorithm, it is necessary to provide it with accurate data. To improve the accuracy of the data we need to build interferometers with a larger base distance. Most basis currently stand at 4405 km, a distance allowing to receive data from both the radio and optical telescopes in high-resolution and speed of gravity experiments use an interferometer composed of a Spektr-R space telescope and ground-based radio telescopes. The next step in is moving of radio telescopes that make up the interferometer beyond Earth, preferably in the geostationary orbit at an altitude of 390,000 km, which will provide a tenfold increase of base. Space-based interferometers are the future of Space Instrument and will help us learning more about the Universe, its structure and history.

References:

1. Physical_cosmology [Electronic resource] - URL: https://en.wikipedia.org/wiki/Physical_cosmology, свободный. – Загл. с экрана.

2. Линде А.Д. Физика элементарных частиц и инфляционная космология. – М.: Наука Гл. ред. физ.-мат. лит., 1990. – 280 с.

3. Зельдович Я. Б., Новиков И. Д. Строение и эволюция Вселенной. – Наука, 1975.-731с

4. Eridanus Supervoid [Electronic resource]: Режим доступа: http://ru-cosmos.livejournal.com/1207780.html, свободный.-Загл. с экрана.

5. Томпсон Р., Моран Дж., Свенсон Дж. Интерферометрия и синтез в радиоастрономии / Под ред. Л. И. Матвеенко. — М.: Мир, 1989. — 568 с. — 1220 экз.