April 17, 2020

BUSINESS CONCEPT FOR THE CREATION OF THE HEROUNI UNITED SPACE CENTER

Argument Consulting Office

Document

Content

1 SUMMARY

The **Armenian Scientific School of Antenna Engineering** was established in Armenia under the leadership of academician Paris Herouni. The established structure had a positive influence on the socio-economic situation in neighboring rural settlements of Orgov and Tegher. The **Science Center of Aragats** (hereinafter referred to as SCA) was built near Orgov in 1975, which is a testing ground for precise antenna measurements, where the world's exclusive **radio-optical telescope ROT-54/2.6** is located. Applications of the Herouni radiotelescope are the study of the **Universe and Deep Space Communications**.

The main idea of this **Concept is to implement SCA on the path of development and inclusion in the leading international programs.** The basis of the program is the restart and improvement of the radiotelescope ROT - 54/2.6. Existing and prospective SCA capacities, their relevance in various frameworks, high scientific qualifications of members of the proposed staff for the implementation of the program, knowledge, and professionalism indicate the possibility of development and promising prerequisites.

The main goal of the program presented in this concept in the foreseeable future is uninterrupted, independent, and full-fledged, multilateral, self-funded, and aimed at the stable development of the **"Herouni United Space Center "**(hereinafter referred to as HUSC) activities.

The expected results can be achieved only with the direct participation and **assistance of the state** (represented by the government of the Republic of Armenia). The proposed program should not be considered in terms of generating business and profit. This is a scientific and educational project that needs state financial assistance for at least the first 5 years. All over the world, such programs require the participation of the state, and at the same time, the state in a short period acquires **a positive reputation as a developed world scientific, educational and cultural center.**

The "Jurisdiction Armenia" Foundation initiated the organization of **scientific and technical expertise** of the state of the HUSC. For this purpose, the Foundation contacted the authoritative European specialized organization JIVE to assess the current state of Herouni's radiotelescope from a professional point of view, the possibility of restarting it, and its further suitability for international science. An international group of highly qualified experts has already started working.

Radiotelescope ROT-54/2.6 is planned to be launched in close cooperation with the international scientific community to implement long-term scientific research projects. Radiotelescope ROT-54/2.6 will be launched to solve scientific and applied problems in the field of **Astronomy and Radio Astronomy and Deep Space Communication.**

Restarting the ROT-54/2.6 radiotelescope (from the initial stage of the process to the extended stage of regular operation) and the development of the antenna measurement range makes it possible to conduct various and numerous **research and educational research activities**. **Space Center** is attractive magnetic point for students, postgraduates, and scientists from around the world as well as a center for scientific tourism and organization of specialized events. There is no such powerful analog laboratory stand in the world that students can use for both study and research. It is planned to conduct research and applied for innovative work on radio astronomy, space communications, antenna measurements, unmanned aerial vehicles, alternative energy, and high technologies at the HUSC.

It is planned to conduct practical courses in the field of high technologies in secondary and higher **education programs** (bachelor's and master's degree), as well as courses in the fields of

postgraduate (graduate, on-job) and lifelong learning and continuing education at summer and winter schools in the Republic of Armenia and Artsakh, including foreign students as well. Together with partner organizations, a unique educational project has been developed, the main idea of which is to conduct remote laboratory work based on reference antennas at the antenna measurement range.
Related activities of HUSC are scientific, educational and entertainment tourism, research, and production activities (for example, experiments to license in an unechoic chamber that has no analogs in exceptional sizes in the region), deployment of high-tech production of antenna systems and components, etc.

The owner of a unique instrument HUSC will be provided with an opportunity to periodically participate in high-class scientific events. HUSC can also become a forge for future winners of prestigious awards in the field of science and technology in the world.

It should be noted that most of the sensational discoveries of recent years, for example, photo of the black hole, supernova explosions, the diamond planet in a distant galaxy, strange radio bursts that have no explanation were made with the help of telescopes which are alike radiotelescope ROT-54/2.6. The Armenian radiotelescope ROT-54/2.6 can receive funding within the framework of similar international programs, get recognition at the proper level, presenting **Armenia on the scientific map of the world as an advanced ideas and cutting-edge technologies.**

2 HEROUNI UNITED SPACE CENTER

2.1 PREHISTORY OF FOUNDATION

2.1.1. Issues

In the half of the 20th century, the USSR made huge expenditures for the development of the scientific sphere, which was due to scientific and military competition with the United States, in particular, intense competition in the field of conquering the universe.

Soviet Armenia took a direct part in the process of developing scientific and technical capabilities and power to solve the country's defense issues. As you may know, people with higher and secondary vocational education were registered in Armenia (especially in technical specialties) with the highest percentage in the USSR, accounting for about 20% of the total population of the Republic. Therefore, in parallel with the rapid development of industrial, applied, and fundamental science in Soviet Armenia, numerous big enterprises were created and successfully operated in the fields of chemistry, heavy industry, astronomy, and modern physics. Higher educational institutions in Yerevan (Yerevan State University and the Yerevan Polytechnic Institite after Karl Marx) have trained a large number of graduates in radiophysics and radio engineering.

All-union Scientific Research Institute of Radio Physical Measurements (ASRIRPM) was created in 1971 by an outstanding scientist, Doctor of Technical Science **Paris Misak Herouni**, who acted in the sphere of double subordination to the state standard of the USSR and the military-industrial complex. Since its foundation until the collapse of the USSR in 1991, the Institute was the leading enterprise of the USSR in the field of antenna metrology, where a huge amount of work was done for the welfare of the country, including many orders of military-industrial significance. Several new scientific directions were founded, and the Armenian scientific school of antenna engineering was formed and developed at that time as well. ASRIRPM greatly contributed to the recognition of Armenia as a leading science and technology Republic, which undoubtedly provided the spread of the good reputation of science in Armenia.

In the 1980s, the number of employees of the Institute of the ASRIRPM was 800 -1,000, and the annual turnover was two hundred million Soviet rubles (200 million US dollars). Since the ASRIRPM was the leading research enterprise in the USSR and played a leading role in its field, at the same time it operated with the Union's financial resources, while all human and property resources belonged to Armenia.

2.1.2 Goal

Professor Herouni, having created the scientific polygons of the ASRIRPM on the southern slope of Aragats, wanted to implement theoretical achievements in practice, that is, to make devices out of metal, therefore, to materialize. That is, to turn theoretical into the practical. For this purpose, in a short time, he traveled all over Armenia to find the appropriate territory for future research sites.

In the early 1970s, the location of the Science Center of Aragats (hereinafter referred to as the SCA) was established at the state level between the villages of Orgov and Tegher, which at that time were located in the Aragats district. At that time, the population of Tegher village had already moved to the

Proshyan state farm in the Ararat valley due to the lack of roads, electricity, water supply, radio, and other infrastructure. A similar move was envisaged for the residents of the village of Orgov.

In the first years of the creation of the SCA, a road and water supply were built, electricity was provided, and other infrastructure was built, which became a **good prerequisite for ensuring social conditions in villages**. At the same time, residents of the villages of Orgov, Tegher, and Byurakan took an active part in the construction of various SCA facilities, and many of them were provided with work, as well.

On the territory of the SCA, the staff of the ASRIRPM planted a lot of fruitful and ornamental trees, as a result of which the SCA became **a very picturesque place**.

2.1.3 The Historical Process

Since 1971, under the leadership of academician Paris Herouni, a set of manuals in the field of radiophysical measurements was created in Armenia. According to the author and chief designer, the following scientific, research and production units were included in the set:

1. Scientific Center of Aragats (near the villages Orgov and Tegher in Aragatsotn region),
2. Center for office and research activities in Yerevan
3. “Alik” (Wave) experimental plant in Yerevan.

In the scientific-production complex, created by Herouni was held scientific and technological research in the following areas: antenna theory and technology, radio astronomy, satellite communications, telecommunications, communication systems, control systems, telecommunications, and industrial services. In other related fields, experimental and design work was done, as well.

Under the leadership of Herouni, institute’s scientists were awarded several high government awards (8 state prizes of the USSR, 7 state awards of the Armenian SSR and certificates of honor), as a result of scientific research, scientists/researchers have defended 10 doctoral and 35 Ph.D. theses. Also, the Chair of "Antenna Systems" was created at the Yerevan Polytechnic Institute after Karl Marx (now the National Polytechnic University of Armenia), etc.

The ASRIRPM owns a unique instrument, the name of which is known in the international scientific sphere as the Herouni radio-optical telescope ROT-54/2.6. It is a large parabolic antenna with a diameter of 54 meters, which is also combined with an optical telescope with a diameter of 2.6 meters. This system is the first and only one in the world. This Armenian antenna has several advantages compared to the characteristics of other big antennas in the world. ROT-54/2.6 application areas are **Universe exploration and Deep Space Communications**.
The ASRIRPM created and stored **world's first antenna measurement standards (11 complexes)** recognized as **state standards of the USSR** (take a look at annex No1).

Over the years the ASRIRPM has organized six **international conferences** with three different titles. Many famous specialists of the world have arrived in Armenia with their reports. ASRIRPM organizes **educational and industrial practices** for students from various leading universities in Moscow.

After the collapse of the USSR in 1991, under the conditions of independent Armenia, ASRIRPM lost major central budget funding and was re-registered in the RA Ministry of Economy as a JSC **Research Radio-physics Institute (RRI).**

11 standard complexes of antenna measurement were recognized as **national standards of Armenia** in 1995. The ROT-54/2.6 radiotelescope was recognized as a **national value** and was financed from the state budget in the period 1991-2011 with a fixed grant of about 20 million drams[1] per year.

To preserve and develop antenna measurement standards, the RRI received an average of 60 million drams[2] per year under the basic funding grant of the RA science Committee in the period 1991-2011.

During the period of independence of Armenia, due to the entrepreneurship abilities of Professor Paris Herouni and recognition by the world scientific community, the RRI has also implemented **some business projects**, including the financing of international structures. In particular, they have developed reflector antennas for satellite TV (produced and sold in the Armenian market), designed and made the secondary standard for measurements for the UK Ministry of Defense, was a study developed for the French company "Thomson", the ground mounting and rotating bases for big antennas for American firm “ESCO” were made and sent, etc.

Radiotelescope ROT-54/2.6 in 2002 was registered as a historical and cultural value (Memorial N: 2.114.19.11).

In the context of the energy crisis of 1991-1995 academicians, Herouni developed the idea of an alternative solar energy concentration new type power plant.

For many years, RRI has had a professional scientific Council approved by the RA General Supreme Commission, which awarded **candidate and doctoral titles** in the specialty «Antennas and microwave technologies». **Educational and industrial practices** were organized for students of Polytechnic University.

2.1.4 Beginning of The End and “Status-quo”

In 2012 after the reorganization of the scientific and technical institutions, the SCA was under the direction of National Institute of Metrology (NIM), which was under the guidance of the RA Ministry of Economy. In 2012, the process of scientific development stopped at the SCA. Moreover, some buildings located on the territory, for example, the foundry (where the mirrors of the Herouni’s radiotelescope were manually merged using a special technology), the boiler room with its 20-meter-high chimney, and the greenhouse with its metal structure were destroyed. Paris Herouni's archive and the library of the Institute were destroyed without any registration.

Until 2016 the territory of the SCA was about 100 hectares[3]. Currently, according to cadastral documents, the SCA covers an area of about 83 hectares. It is not known why this tangible part of the territory was alienated. Today only 3 of the 28 guards of the SCA are left as a result of periodic staff cuts. Over the past 5 years, trees throughout the territory have not been watered, because the NIM doesn’t pay a fee for water, moreover, even the partisan staff has been reduced[4].

The infrastructure of the SCA, in particular the power transformer, cable, and other capacities were periodically destroyed, and no one cared about restoration. Even the fence of the SCA was torn down and the stones were taken away, which is why the entrance for cows and thieves is free.

[1] Data from RRI archive, Strategic plan of Development of RRI, 2011
[2] Data from RRI archive, Strategic plan of Development of RRI, 2011
[3] Source: agreements, reports and memorandums of ASRIRPM, later RRI and NIM for 1975-2015
[4] Source: data from HR documentation of the Antenna Standards dep. of NIM, 2018

Picture 1 - One of the destroyed sections of the SCA fence

In the Soviet years, the ASRIRPM Institute also owned the experimental plant "Alik" (Wave), located on the administrative territory of Yerevan, Zeytun. In the post-Soviet period, this plant no longer served its main purpose and it was transferred to the State Property Management Department in 2016.

The NIM tried to sell a unique carousel machine in the SCA machine shop building and six other working machines in 2018. However, in a letter from the "Jurisdiction Armenia" Foundation to the RA Prime Minister[5], this suspicious transaction was suspended.

Without having any participation in the design, construction, and operation of a radiotelescope, in their numerous speeches, the employees of NIM: N. Yolchyan, R. Ter-Antonyan, M. Khorasanjyan, A. Voskanyan, as well as invited by NIM as an "expert" H. Harutyunyan constantly repeated that the antenna should be demolished and sold as scrap non-ferrous metals. This is noted in public records[6] of the niece of Herouni, professor Arevik Sargsyan, who was responsible for the scientific work of the radiotelescope in 1993-2013.

Over the past 8 years, about 50 million drams have been allocated annually from the state budget of the Republic of Armenia to NIM through the channels of the RA Science Committee for the preservation and development of reference antenna measurement complexes in the SCA. However, as a result, 4 of the 11 national benchmarks remained, with the last two stolen[7] in October 2019 (it is noteworthy that at the time of registration of the robbery, the seal on the locked door was not broken). “Low-quality scientific articles resulting from research activities of the relevant Department teas, the existence of which could find any, according to the records of the teas posted in the information zone have nothing in common with the primary aim of financing and mostly published in journals of dubious credibility” – insist the heads of the professional and scientific-technical team of the HUSC project Professor A. Sargsyan, Doctors H. Abrahamyan and K. Martirosyan.

All the leaders of the NIM did not take part in any ASRIRPM scientific research and experimental polygon of SCA. By the way, 5 NIM managers have been changed since 2012. All the leaders of the NIM were not familiar with the scientific direction of the abolished site and do not have a strategic idea of what direction and how this landfill should continue to work now.

[5] Outgoing letter of JAFCEO-1827-R (0615)
[6] Source: audio records of the meeting in National Assembly of RA, October 16th, 2019
[7] Source: outgoing letter of JAFCEO-2003-I (0131)

3 CONCEPT OF DEVELOPMENT

3.1 SITUATIONAL PROBLEMS

3.1.1 Functions of NIM

According to the information provided on the official website of NIM, the main functions of the institution are:

- creation, maintenance, and improvement of national standards of units of quantities,
- examination of metrological characteristics of measuring instruments in operation,
- metrological report of measurement methods in the field of legislative metrology,
- approval of measuring instruments types,
- calibration of measuring instruments,
- training, specialization, retraining of staff in the field of insurance of the unity of measurements with the issuance of appropriate certificates.

NIM carries out metrological control of electricity, gas and liquid meters, force, strength, and pressure measuring instruments, weight plates, automobile gas filling compressor stations, time-frequency and radio-electronic measuring devices, physical-chemical, thermal and ionization. NIM also does measuring instruments calibration on the territory of the Republic of Armenia: verification, examination, testing, and approval of the type.

3.1.2 Main and Secondary Problems

The main and current problems of SCA include:

- The average age of the scientific and technical staff working in the scientific **department of protection of NIM standards** exceeds 70 years, there is no specialist with modern knowledge and full-fledged abilities.
- Over the past 10 years, **no any** NIM researchers **have participated** in professional conferences, seminars, or other industry events in the field of radio-physics.
- During the management of the NIM, no strategic or tactical activities were carried out to develop science (for example, to restore the radiotelescope) in the SCA, the **decision making and willing are absent**, there were no successful business initiative, modern management methods, tools and approaches were not applied, there are no financial resources necessary for development (moreover, nothing is being done to extract them).

The following secondary problems come from the above listed main problems:

- The **radio-electronic parts of antenna systems** (both radiotelescope ROT-54/2.6 and reference complexes) that are associated with the transmitting, receiving, cable distribution of radio signals, and various processing are morally **worn out**. In the context of modern digitization, these functions are performed by modern radio-electronic devices and technologies.
- **Antenna standards have lost its previous meaning and the value of preserving**. In general, in the modern world in, the standards of all physical quantities are no longer of a material nature, they have all indiscriminately turned into virtual versions, the last was the standard of weight - the kilogram, which two years ago turned into a digital form, as well (take a look at the annex No 2).
- **Antenna Standards have lost their usefulness and applicability** with the current conservation and development strategy. The reason is not only that Armenia does not have a large military industry, but also that in the modern world, even in not very developed countries

(for example, in the Islamic Republic of Iran), producing antennas enterprises (both military-industrial and domestic) no longer need to be certified using the standards produced by SCA.

- **Lack of financial resources** in the budget of the Country. It is impossible to provide the entire amount necessary to restart the radiotelescope at the expense of the state budget[8].
- **NIM does not have a human resource capable** of restarting the Herouni's radiotelescope, as well as for the real development of reference complexes of antenna measurement (ensuring economic applicability) and skilled in this scientific and technical field.

3.2 CONCEPTS PREPARATION AND OBJECTIVES OF THE PROPOSED PROJECT

As the title of this section implies, it is necessary to clearly distinguish the goals of the preparing document and implementing the program proposed by this document. They are different, although interrelated.

3.2.1 Purpose of Preparing the Concept

The preparation of this concept aims to put on the table of the heads of state structures that determine the fate of the "Herouni United Space Center" (hereinafter referred to as HUSC) a document that, although entitled as a Concept, is more comprehensive. This document contains detailed information about the creation of ASRIRPM, later RRI, the path is taken, reaching the highest point of its development, and then about the decline, inefficient management and loss of former power. This document is the result of the work of the initiative group of professionals, devotees in their field. The document is a guideline aimed at saving and restoring the assets and exceptional values of the SCA which was under the leadership of institutions of ASRIRPM, later RRI, and which today is under the management of NIM. The concept contains a specific program proposal, the implementation of which will allow at the initial stage to stop the dispersion of SCA assets, and then, in the medium term, to gradually restore the once capacity and restore the world scientific reputation.

3.2.2 Objectives of the Proposed Project

The **ultimate goal** of the proposed program and realization of this concept is a **full, comprehensive, self-funding, uninterrupted, aimed at stable development activity of Herouni United Space Center (HUSC).**

Intermediate goals of the program implementation in the medium term.

1. Conducting stable scientific and educational activities in HUSC which at the same time can serve as practical courses of educational institutions and a base for conducting industrial practice.
2. Implementation of sustainable research activities of HUSC with a trend of dynamic development of certain target areas (for example, defense and military aerospace industries, air transport, telecommunications, etc.)
3. Implementation of stable economic activity on the part of HUSC aimed at providing high-quality services to various partners, stimulating innovation, developing knowledge-based business, etc. These actions will contribute to the implementation of financial security and smooth operation of HUSC.

Short-time goals of the Project are:

1. Protection of SCA's from final destruction and rescue of still existing short-sighted property.

[8] Source: part of the letter from the RA Scientific Committee N 9-1-1/4348 at 25.02.2020

2. Abolishing rights of NIM taking into an account the current highly inefficient management system of the SCA and transferring assets to experienced and dedicated old professionals, new young people living in their homeland, world-class scientists, technologists, and other involved professionals.
3. Allocate funds allocated from the state budget of Armenia over many years and inefficiently used to the proposed new structure with the condition of achieving clearly defined goals and under strict control.
4. Creating jobs for residents of nearby rural areas.

A detailed description of the administrative work performed already under the HUSC restoration program is provided in Annex No 3. In 2020, the HUSC sub-entity of the "Jurisdiction Armenia" Foundation was registered in the State Register of the Republic of Armenia.

3.3 THE ROLE OF THE STATE IN THE IMPLEMENTATION OF THE CONCEPT

3.3.1 General Role of the State

This concept of resuscitation and rehabilitation of SCA will be implemented by dedicated specialists who have proven their high scientific and professional qualifications, personal dedication to the center, high interest, and consistency in achieving success over the decades. However, none of the planned results can be achieved without the direct involvement and assistance of the State (represented by the RA government).

It should be noted that this is not only about material assistance, but also about moral and style representation support. The management and employees of the HUSC, local and international partners have to understand that they are employees, beneficiaries and partners of this organization, whose activities claimed by the State and the Armenian society, as was the case with the Yerevan Opera Theatre, Armenian Nuclear Power Plant, Karen Demirchyan Complex, Zvartnots International Airport, Cascade, Byurakan Observatory, Yerevan Institute after Mergelyan and many other objects of our country that have been of benefit to the people for decades, an important part of the power of the State and Society. All of them should be sure that the government of Armenia is behind them, and they will direct all their further successes in the latter plan to the benefit of the country.

On this general ideological basis, this Concept provides for several aspects of direct involvement of the RA government, which can be divided into two large groups: support and control. Next, we will touch on these two functions attributed to the state.

3.3.2 Support Function

In the context of the implementation of this Concept, it is envisaged that the government of the Republic of Armenia can contribute to the activities of HUSC with the following functions:

- **Administrative and legislative assistance.** Based on the kind of HUSC activities, it may need extensive legislative, by law, and general administrative assistance. Providers of this assistance may be the RA National Assembly, implementing the relevant legislative initiatives, the RA government with making the management decisions at the national level and regional and local authorities, which can facilitate the provision of infrastructure, provision of necessary areas, providing local tax incentives, etc. Taking into account the scientific and educational aspects of HUSC's activities, such assistance will be very appropriate.
- **Financial Support.** First of all, in the first year of implementation of this concept, the HUSC needs financial support. In the following years, the center will be able to independently finance

its programs. Nevertheless, we consider it appropriate to offer the RA government to take part in financing the center's operating expenses in the amount of 100 mln AMD per year. This will be the best evidence that the HUSC is under the patronage of the government of the Republic of Armenia, and the product of its activities is subject to disposal in priority areas established by the Government.

3.3.3 Control Function

The need for the control function of the state is due to the allocation of large-scale property to the Fund established for the management of HUSC, as well as the provision of financial assistance to cover regular operating expenses. By performing this function, the State will be able to monitor the state and form of use of the allocated property, assess the effectiveness of expenditures, monitor the degree of implementation of the planned results, and so on. Only the final results, confirmed by regular monitoring, can become a prerequisite for continuing further funding.

At the same time, the kind of control cannot become an obstacle to the implementation of development programs, cannot affect the effectiveness of the HUSC. These likely challenges can be overcome by transferring the monitoring and control functions to the "Jurisdiction Armenia" Foundation, which is sufficiently informed about the program, has sufficient resources to perform the monitoring function, and is a state-established Fund that can dispose of the RA Government at its discretion at any time. This will avoid excessive monitoring and create an effective accountability system.

4 ACTION PLAN OF THE CONCEPTUAL PROGRAM

4.1 SUGGESTED ORGANIZATIONAL ADMINISTRATIVE AND LEGAL ACTIVITIES

4.1.1 Sub-entity of the foundation

"Jurisdiction Armenia" Foundation is a state-based structure that functions as an operational body of the Council of the same name. Annex 4 provides some information about the foundation's mission. The implementation is in the mandate of the foundation, as both during the re-launch of the ROT-54 / 2.6 radiotelescope and during the implementation of other components of the program, it is supposed that human resources and significant financial resources will flow to Armenia with high-quality professional potential.

Project Manager of HUSC is Ph.D., **Professor Arevik Sargsyan**, who is already a high class professional, a deserving student of an academician Paris Herouni. Her scientific life is connected with the antenna of the ROT-54/2.6 radiotelescope. In 1993-2014 she was responsible for the scientific work of the ROT-54/2.6 radiotelescope. At the National Polytechnic University of Armenia, she managed to continue to develop the Armenian Scientific School of Antenna Engineering, created by Herouni. Appendix 5 gives brief biographical information about Arevik Sargsyan.
The official website of the HUSC Program can be found at the following link: www.husc.am .

In "Jurisdiction Armenia" Foundation a separate sub-entity Herouni USC was established. **The staff of the sub-entity consists of 25 people**.

- Ashot Aslanyan, Executive Director of "Jurisdiction Armenia" Foundation,
- Arevik Sargsyan, Project Manager of HUSC Program,
- Hrayr Abrahamyan, Technical Responsible of HUSC Program,
- Karine Darbinyan, Operating Officer of "Jurisdiction Armenia" Foundation,
- Hasmik Eghiazaryan, Public Relations Officer of HUSC Program,

- The program includes **18 highly qualified specialists** from various fields, whose personal information can be requested,
- Several foreign scientists, specialists, businessmen are actively cooperating with the program, including
  - Leonid Gurvits, radio astronomer, VLBI ERIC (JIVE),
  - Peter Visser, astronomer Delft University of Technology,
  - Sergey Belousov, programmer, businessman, investor, Acronis International GmbH,
  - Pierre-Marie Robitaille, radiologist, Ohio University,
  - Kees Van't Klosten, radio engineer, IEEE Antenna Society.

As Arevik Sargsyan was elected **Armenian Ambassador** of the Institute of Electrical Engineering and Electronics Engineers in 2019 (IEEE, https: //www.ieeee.org/) and in November the event of the **IEEE R8 Entrepreneurship Initiative** had to be organized, so by the support "Jurisdiction Armenia" Foundation and volunteers ROT-54/2.6 several cleaning, power supply restoration, bathroom renovation activities have been made (See picture 2).

Picture 2 - The cleaning of the control panels of the ROT is carried out by the volunteers

4.1.2 The operational management system of the new structure

Taking into account the large physical area of HUSC, the large volume of existing capacities and building assets, the nature of the planned works, as well as the need to combine HUSC's effective scientific activity, we propose to divide the government into two parts: general administrative and scientific. Accordingly, the center will have 2 equivalent heads: scientific and administrative directors.

The Director of Science will be responsible for organizing HUSC's scientific activities, providing scientific services, managing scientific staff, relevant scientific discussions, development of relations with partners, and other similar issues. The administrative director will be mainly responsible for the efficient organization of construction works, the security of HUSC, the coordination of the general restoration works' implementation, and other administrative and commercial activities.

In the case of operational functions, these two leaders must be separated, although the right to a final decision belongs to the Director of Science.

4.1.3 Activities

As a starting point for the implementation of the action, we propose to establish a new, separate legal entity, the HUSC, which will undertake the implementation of all further actions included in this Concept. To this end, the ‘’Jurisdiction Armenia’’ Foundation has developed and submitted to the relevant state structures a draft decision of the Government of the Republic of Armenia on the establishment of that entity (see Annex 6), which sets out the following basic provisions.

1. Consolidate the relevant property and provide the transfer of that property to the HUSC. Prohibit the alienation of that property to third parties.
2. Give the right to ‘’Jurisdiction Armenia’’ Foundation to organize fundraising events, capital investment activities (including crowd funding, initial money supply, development and promotion of various financial instruments and goods for current financing), to attract partner organizations within the framework of public-private partnership, to receive loans and borrowings.
3. Grants from the government for the protection, maintenance, or development of property and other means, including the amount for maintenance of antenna standard systems for 50 million drams paid annually by the state budget. Consolidate and transfer the allocation to the HUSC Institution for the implementation of the minimum volume of scientific works.

4.1.4 The need for a transitional stage

This Concept envisages the implementation of a rather ambitious program, which will allow saving one of the most famous scientific heritages in Armenia from the final destruction. However, there are also risks to the feasibility of the program, control of that process, and normal implementation. To alleviate such concerns, we suggest setting up a conventional transition phase for Project implementation. This stage can be defined as 3, 6, 9, or even 12 months, according to the State, at the discretion of the “Jurisdiction Armenia” Foundation.

This stage will not affect the proposed investment process, as long as there is no noticeable deviation from the established process. In case of such deviations, and the case of their reasonable explanation, the implementation of the proposed Concept should be stopped or the implementation function should be handed over to another organization. This mechanism will allow to maintain the interest of the heads of the structure and ensure the achievement of the intended results.

4.2 RADIOTELESCOPE RESTORATION AND DEVELOPMENT ACTIVITIES

4.2.1 A detailed description of the radiotelescope

4.2.1.1 Brief description of the ROT-54/2.6 radiotelescope

The design and construction of the ROT-24/2.6 began in 1980. In 1985, work began on the regulation and adjustment of the radiotelescopes' antenna.

Picture 3 - ROT-54/2.6

In 1987, the radiotelescope was put into operation. This type of radiotelescope was named Herouni Mirror Telescope. The devastating earthquake of 1988, fortunately, did not affect the structure of the antenna, which confirms the highest level of the antenna engineering project, the infallibility of technological solutions, and the stability of the structure. A hemispherical large reflector with a diameter of 54 meters and a small reflector with a special profile shape, the aperture of which is 5 meters. The hemispherical reflector is unmovable and is built in natural concavity, in a concrete bowl.

Picture 4 - Arecibo radiotelescope

Only on the island of Puerto Rico (USA), a 300 m diameter radiotelescope is built in the area of Arecibo with a large unmovable spherical reflector. At the same time, the antenna of this radiotelescope was made double-reflector, based on the successful experiment of the ROT 54 / 2.6 antenna, 10 years after the commissioning of the ROT. The scanning angle of the antenna pattern is limited to 70 degrees.

Picture 5 - FAST radiotelescope in China

In 2020, the world's largest radiotelescope was officially put into operation in southwest China. FAST (Five hundred meter Aperture Spherical Telescope), also known as the Tyanyan[9]. The cost of building the radiotelescope exceeds $ 185 million. Despite the name of the Chinese radiotelescope, it works as a parabolic antenna with rearranged apertures. The angle of scanning of the antenna pattern is limited to 80 degrees.

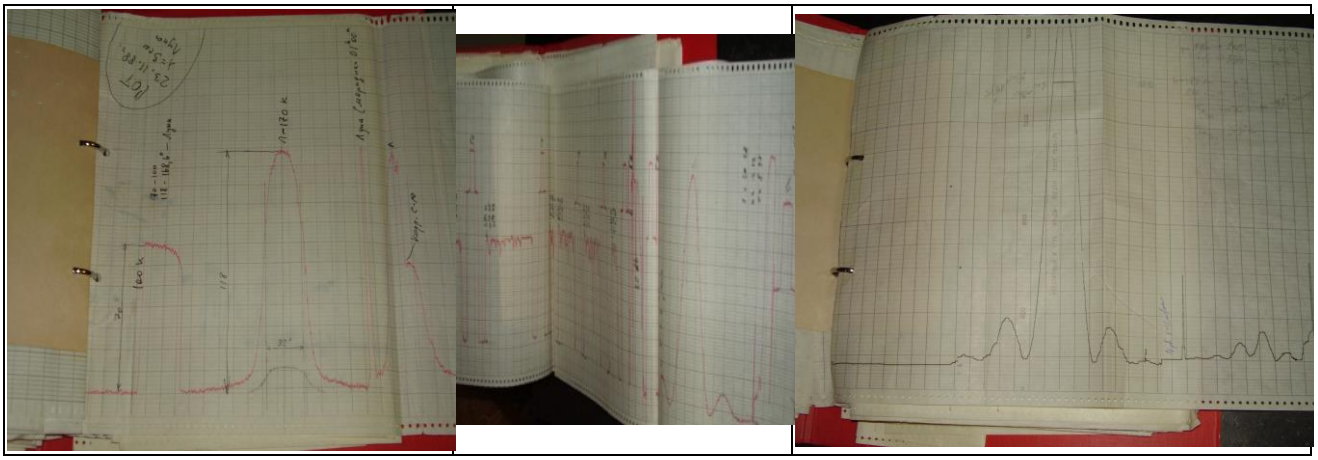
Due to the structural feature, the **main advantages** of the Armenian radiotelescope are 1) High accuracy, 2) High sensitivity, 3) Very low self-noise.
And the **only disadvantage** is that antenna pattern scanning angle is limited to 120 degrees (instead of theoretical 180 degrees).

Picture 6 - Images of ROT-54/2.6

Planned observations under the management of Professor Herouni were done in 1987 – 1990. **The Explosion of Red Giant Star was recorded** (Etta star in Gemini constellation), multiple scientific articles were published in USSR periodical and abroad, Herouni has participated and presented results about ROT construction and parameters in a big number of International Conferences.

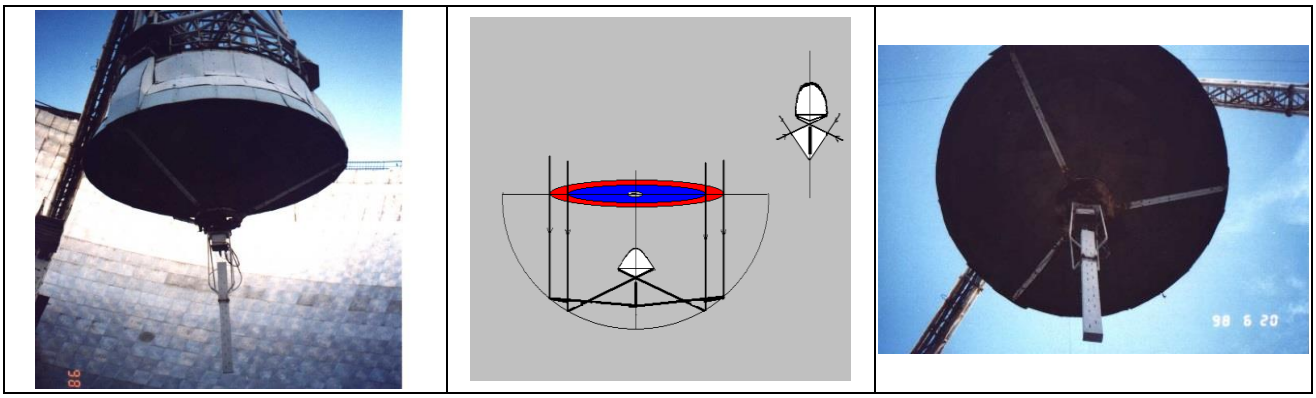
[9](Chines, https://ru.wikipedia.org/wiki/%D0%9A%D0%B8%D1%82%D0%B0%D0%B9%D1%81%D0%BA%D0%B8%D0%B9_%D1%8F%D0%B7%D1%8B%D0%BA 天眼, «Sky Eye»)

Picture 7 - Records of various sources of space radio emission, and antenna pattern measurement using the radio-astronomical method



During the energy crisis of 1990-1995, **numerous measurements of antenna parameters using the radio astronomical method** were performed, **new radio sources were registered** by Professor A. Sargsyan and a group of young scientists and students led by her.

Picture 8 - The ROT - 54/2.6 radiotelescope view with the supplementary feed



In 1995-2001, the old computer control system of the radiotelescope was dismantled and replaced by PC and special software programs were developed. In collaboration with the **Astronomical Union of Russia and the National Technical University of Athens Technology**, research works were carried out on the development of radiotelescope. Antenna feeding system has been updated and improved, various other antenna-related topics have been developed. One Ph.D. dissertation has been defended on the topic of the antenna feeding system. Within the framework of financing from the state budget, some **preventive actions** were carried out year after year.

During the last five years of that period, some parts of the antenna's management and control system were dismantled, some radio electronic plates of the devices disappeared, and however, the mechanical structure of the antenna is in good condition and can serve its purpose.

Theoretical and experimental work on the antenna has been carried out in the last 25 years under the condition of very limited funding, mainly due to the free dedication of the staff.

After the reorganization of scientific and technical institutions of the Ministry of Economy of the Republic of Armenia in 2012-2015, the ROT-54/2.6 unique radiotelescope did not serve its purpose. According to the decision of the National Institute of Metrology (NIM) leadership, the **ROT-54/2.6 antenna is preserved** because of the lack of funds. Thus, the instrument is not financed by the state budget.

However, the ROT-54/2.6 antenna is **in working condition** today. The engines that provide motion of the antenna, the mechanical structural systems of both reflectors, several automatic control systems, including correcting systems, are also in working condition.

The antenna is equipped with feeds. Even today's uncomplicated state of the reflective surface allows us to measurements, making sure that the antenna maintains the values of its main characteristics in the decimeter and centimeter range of radio waves.

However, the antenna needs **to be repaired**, necessary to perform lubrication and inspection of portable mechanisms, it should be equipped with modern control systems, to restore some services, as well as to complete complex adjustment.

Picture 9 - The ROT - 54/2.6 radiotelescope on the background of Ararat and Tegher church

The professional reference on the technical data of the ROT-54/2.6 radiotelescope is presented in Annex 7.

4.2.1.2 Expertise conclusions.

In 2018 on March 6-9 Chief Astronomer of Joint Institute for Very Long Baseline Interferometry European Research Infrastructure Consortium (VLBI ERIC (JIVE)), head of space science and innovative programs, professor **Leonid Gurvits**, was invited to Armenia by ”Jurisdiction Armenia” Foundation

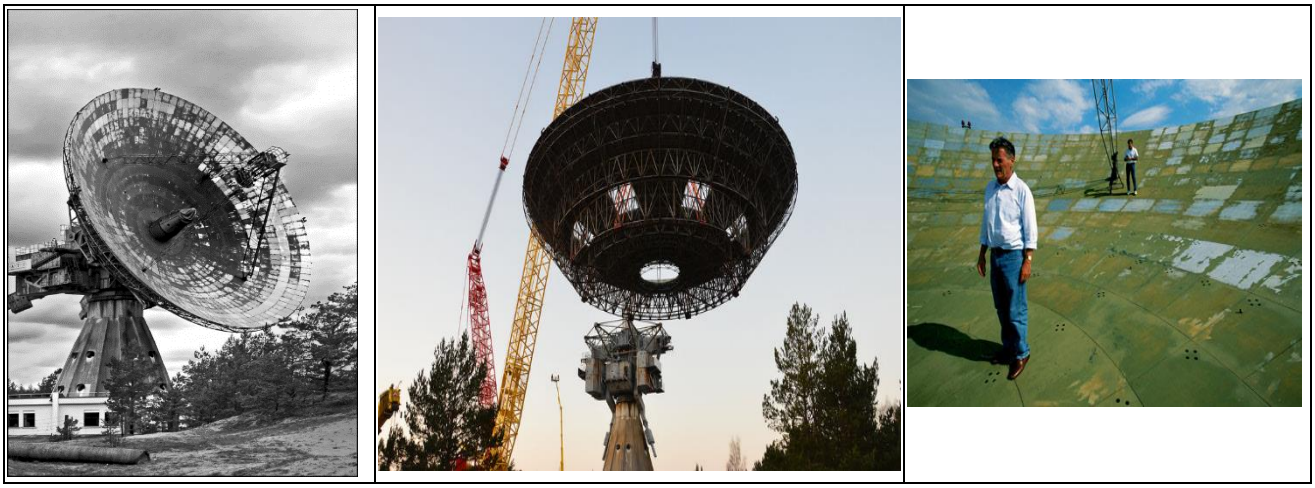
On March 7, a meeting was held with the Minister of Economy of RA during which they discussed the issue of equipping and improving the ROT-54/2.6 radio-optical telescope, as well as the prospects of JIVE and RA cooperation in the field of radio astronomy. The Ministry reaffirmed its readiness to

participate in the formation of the HUSC and to assist in the restoration and re-vitalization of the ROT-54/2.6 radio-optical telescope. As a result of the meeting, the minutes of the meeting on the re-built of the ROT-54/ 2.6 telescope was signed between the Minister of Economy of RA and JIVE.

The cost of building the ROT-54/2.6 radio-optical telescope was 4 million rubles, which in those years corresponded to about 4 million US dollars. The special structure of the antenna and the presence of a spherical reflector is the reason why the costs of construction and operation are significantly reduced (at least **ten times**) compared to antennas with the main parabolic reflector. For example, the classic full-rotating antenna with the characteristics of the level of the ROT could then be made by investing 40-50 million dollars.

Professor Leonid Gurvits proposed to make a preliminary assessment of the USSR's restoration work indirectly, based on a similar experience in observatories that have joined EVN over the past five years, such as the restoration of a 32-meter parabolic radiotelescope in Latvia. In the pictures taken, one can see the Latvia radiotelescope antenna's condition (especially surface) before and after the restoration.

Picture 10 - The Latvian Irbene radiotelescope before and after renovation



Based on the initial situation, it can be said that the Irbene radiotelescope would be almost rebuilt. In 2014-15, the EU spent about 16 million euros to restore the Latvian radiotelescope determining the cost of restoration work, it should be noted that the current state of the Armenian ROT antenna can be assessed as at least twice as good as the initial state of the Latvian radiotelescope.

The total surface of the ROT is about twice large (54 m), but due to the phenomenon of its structure (which in turn is due to the immobility of the main hemispherical mirror) the diameter of the antenna's operating surface is equal to 32 m, just like the Latvian radiotelescope. Therefore, these two antennas can rightly be compared in terms of working characteristics. And taking into account the structural peculiarity of the antenna of the

Armenian radiotelescope, the cost of the complete restart of the ROT and surrounding infrastructure will be estimated at 1.8 million dollars.

In the period of September 17-19, 2018 **Kees van't Klooster**, an internationally known specialist in the field of antenna equipment and an independent expert from the Netherlands arrived in Armenia from the Netherlands.

The expert opinion is presented in Annex 9. According to the opinion, after correcting the small mechanical defect of the antenna system, the radio antenna is completely ready to work with short-range radio waves. Moreover, the surface of the mirror is excellent even in today's state, which is proved by the clarity of the optical reflection.

Picture 11 - Pictures of Chili ALMA radiotelescope

Kees van't Klooster suggested a comparative version to assess the value of ROT rehabilitation work. Of the 66 antennas in the ALMA (Atacama Large Millimeter Array, Chile's the Atacama Desert) complex, 54 antennas are with a 12-meter-diameter parabolic main reflector. The cost of one such radiotelescope was $ 6.25 million in 2010. The special structure of the antenna of the Armenian radiotelescope - the presence of a spherical immovable main mirror, compared to the antennas with the parabolic main mirror (at least ten times) significantly reduces construction and operation costs.

Considering that the diameter of the operating surface of the Armenian antenna is about three times larger (32 m) than the one of the 12-meter Chilean antennas, it can be assumed that it would cost $ 18.5 million to build a 30-meter parabolic antenna from scratch. Dividing that number by ten, it is possible to conclude with some probability that the expenditure to be made on the infrastructure of the ROT and its surrounding infrastructure will amount to about 1.8 million dollars.

European experts pay special attention to the relatively better condition of ROT-54/2.6 radiotelescope surface. This means that the cost of restarting a radiotelescope, which is related to ensuring the accuracy of the antenna's radiating surface, in our case will not be the most financially dominant. In the case of ROT, the main costs of restarting will be covered by the introduction of a new management system, the acquisition of radio-electronic equipment and software.

Picture 12 - The surface of the large mirror of the ROT-54/2.6 radiotelescope

4.2.2 Application of radiotelescope

As a separate unique hypersensitive tool, the operation of the ROT-54/2.6 radiotelescope will allow conducting further radio astronomical research:

- The physics of objects at large z (quasars, radio galaxies, BL Lac).
- Pulsars, Super Novae stars, and their variability.
- The integral flux of radio sources with angular sizes less than 1 arcmin.
- The inhomogeneity with angular sizes of less than 1 arcmin.
- The temperature radiation of New stars.
- Observation of flare and TTau stars.

- For most noted objects it is possible to do the simultaneous radio-optical observations. This study will help to complete the results obtained with the best radiotelescopes and make a new Catalog.
- Solar System: search of new molecules in comets and planetary atmospheres.
- As the 54m spherical telescope ROT - 54/2.6 has a low antenna temperature (~5K), its radio-noise will not exceed the level of 1-2 mJy if the receiver will have the bandpass of 1 GHz and the integration time of 1 sec. Then the radiotelescope will enable us to study very weak objects (the sensitivity of VLA is in the same order).
- After some renovation of the telescope and the construction of corresponding receivers the ROT-54/2.6 will fully satisfy the requirement of VLBI and can be used in this system filling up its aperture.
- The ROT should be dedicated to long term scientific projects in strong cooperation with the international scientific community both in the fields of Astronomy and Deep Space Communication.

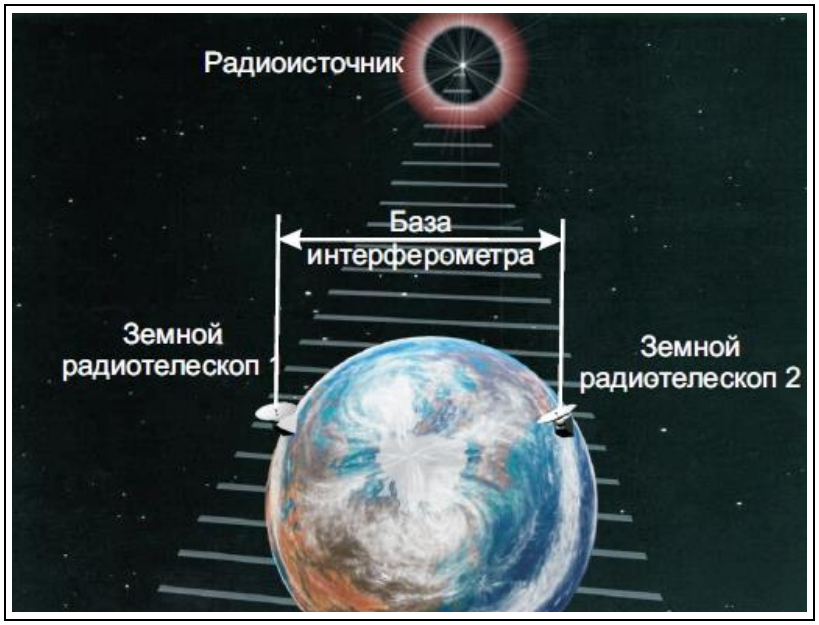
It should be noted that most of the sensation discoveries of recent years - the photo of the black hole, the explosions of supernovae, the diamond planet in the distant galaxy, strange radio bursts that have no explanation were made with the help of such radio interferometers. Armenian ROT-54 / 2.6 can receive funding under similar international programs at the same time **presenting our country on the scientific map of the world as a center of advanced ideas and state-of-the-art technology.**

ROT-54/2.6 radio telescope will carry out long-term scientific research projects in close cooperation with the international scientific community of the world to solve fundamental and applied problems in the field of both **astronomy and radio astronomy and deep space communication**.

The ROT-54/2.6 radiotelescope will be used not only as a separate **unique hypersensitive instrument** but also in combination with other powerful world-class radiotelescopes **as part of a radiointerferometric network**. Picture 13 clarifies the basic principles of radiointerferometric network operations.

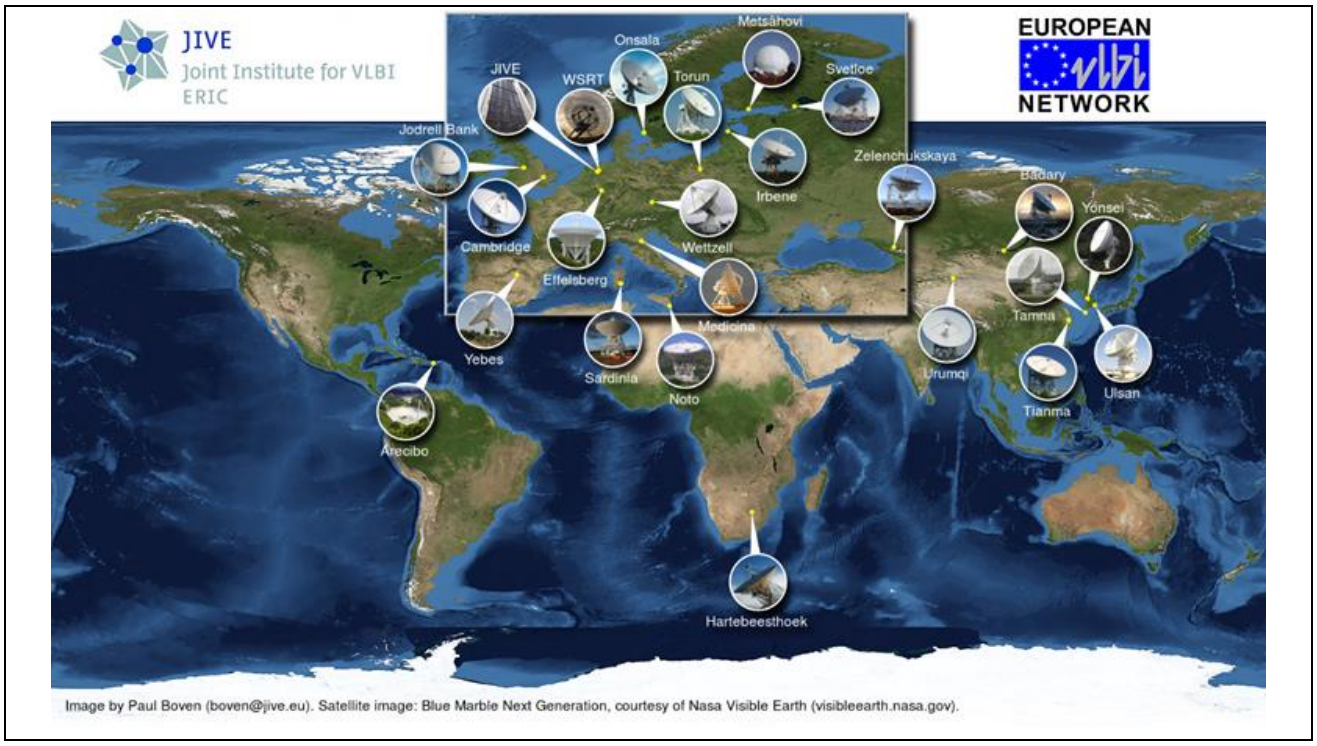
After ROT-54/2.6 upgrade and in case of having appropriate radio receivers, it will fully comply with VLBI requirements: it can be used to fill in the aperture of that instrument. In collaboration with Joint Institute for Very Long Baseline Interferometry European Research Infrastructure Consortium (VLBI ERIC (JIVE)), it will be possible to include the ROT-54 2.6 radiotelescope in the EVN radiointerferometric network.

Picture 13 - Image of radio interferometer operation



The first step of the mentioned cooperation was taken by the Herouni United Space Centre Program at the beginning of 2018 when the memorandum with JIVE and the Ministry of Economics of RA was registered (see Appendix 8).

Picture 14 - European Radiointerferometric Network



The following link introduces the principle of a radiointerferometric network operation: https: //www.almaobservatory.org/en/images/3d-model-of-an-alma-antenna/. Only as a result of the simultaneous work of different antennas included in the radiointerferometric network is it possible to record scientific results, such as obtaining images of a black hole (see Appendix 11).

4.2.3. Resource evaluation

Based on the experience of similar initiatives in EVN observatories over the past five years (for example, the restoration of a 32-meter radiotelescope in Latvia and other relative assessments), the “Jurisdiction Armenia” Foundation has clarified the actions of the first three phases of the ROT

restoration.
and it has also estimated the amount needed for these works.

1. **A preliminary examination was carried out by the" Jurisdiction Armenia" Foundation. The current technical condition of the radiotelescope antenna was studied** which is sufficient to work with short-range radio waves after some mechanical adjustments (see details in the Appendix 9).
2. It is planned to organize a **scientific-technical examination** by "Jurisdiction Armenia" Foundation by applying to the prestigious European specialized organization EVN to find out the current state of Herouni radiotelescope from a professional point of view, the possibility of its reopening and further suitability for international science. An international group of top experts has already begun its work.

3. The "Jurisdiction Armenia" Foundation has estimated the amount needed for the first three stages of the resumption of active scientific research at HUSC which **amounts to $ 12 million**.
   - ✓ 0 - 1 Stage. The budget for the organization of scientific works, the budget for the further development of the HUSC, and the long-term development (100 million drams per year) as a factor guaranteeing the state interest, the condition of attracting investors - **$ 0.2 million**. Duration: the first ten months of the project.
   - ✓ 2 Stage. In the form of grants, financing from investors involved in private fundraising, financial resources attracted from external sources with modern financial instruments for the full operation, the approximate amount is **$ 1.8 million**. Duration: during the first two years.
   - ✓ 3 Stage. As a result of the negotiation the installation of equipment received from partners, the introduction of technology, and other technical support, in the form of assistance and investments from international scientific funds - **$ 10 million**. The beginning: during the second year, with continuity of 5 years.

As **further sources of funding** in addition to international and Armenian grant programs (Horizon 2020, IEEE Special Programs, NSF, FAST, etc.) there can be also the allocations of the RA State Budget Reserve Fund or support provided by Science Committee to the object of national value and Start-up.

Below is the **program matrix of the preparatory works for the de-conservation of the Herouni radio-optical telescope antenna (the first 6 months of the program in phase 0).**

Table 1 - The matrix of preparations for the Herouni radiotelescope antenna de-conservation

	Action	Human Resource	Material Resource	Financial Resource	Time
1	Discussions on the preparatory work of the telescope restarting (antenna power supply, necessary actions during the conservation. The possibility of using the mechanical mini-plant, the possibility of providing labor and other organizational issues)**:**	project manager, 4 people from the professional staff	Office conditions in Yerevan and Orgov telecommunications and vehicles	Up to 0.5 thousand dollars	First 2 months of the project
2	**Detailed inspection** of the radiotelescope's current condition: • Engines and mechanisms installed on elliptical ring of cardan, • Mechanisms of a small reflector and movable farm,	The scientific and technical professional staff of the project	Necessary tools	About 2 thousand dollars	First 6 months of the project

	• Conditions of the optical mirror, cover, and camera, • Management and correction system, • Management systems, automation, time services installed in the control panel building, • Building conditions, infrastructure details.				
3	Prophylactic (if necessary, capital) **urgent repair** of the antenna and its infrastructure systems	10 people from the project staff	Necessary tools	About 5 thousand dollars	From 2 to 6 month of the project
4	High-quality **internet connection** in the territory of SCA, preliminary work.	2 people from the project staff, invited to the company through the competition.		About 30 thousand dollars	First 4 months of the project
5	**Experimental works** on new equipment for accuracy control of large mirror surface.	2 people from the project staff postgraduates, masters and students.	Necessary tools	Up to 1 thousand dollars	First 6 months of the project
6	Skype or other conferences with **JIVE EVN, ARPA INSTITUTE, Acronis, National Instruments, Yerevan Engineering** and another specialists from partner organizations	3 people from the project staff			First 6 months of the project
7	**Visits** of different guests for professional and educational purposes, guests of international scientific events	5 people from the project staff		Up to 5 thousand dollars	First 6 months of the project
8	Inventory work	4 people from the project staff		Up to 1.5 thousand dollars	First 3 months of the project
9	Unplanned work				First 6 months of the project

All in all, up to 50 thousand US dollars as preliminary investments for the zero stage.

4.3 HEROUNI UNITED SPACE CENTER ACTIVITY

4.3.1 Scientific activity

The reopening of ROT-54/2. 6 radiotelescope, including from the first stage of the process to the main stage of regular operation, will allow performing a large number of different **research and study activities**. They will come to Armenia from all over the world to study and conduct scientific research.

There is no such powerful laboratory in the world that provides students with the opportunity to work and study. It can be a powerful way to attract master, postgraduate, and postdoctoral students from

abroad **on a paid basis** to conduct research works. There is a memorandum of cooperation to equip the antenna polygon with modern equipment, signed with the world-known German company **Rohde & Schwarz** (see Appendix 8).

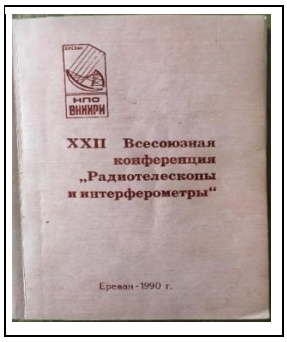
Researches and practical innovations will be carried out at the Herouni United Space Centre in the fields of radio astronomy, deep space communication, antenna measurements, unmanned aerial vehicles, alternative energy and other high-tech technologies (including, among others, military-industrial significance).

Different research groups will have the opportunity to test and design various programs in the fields of radio astronomy, communication systems, control systems, and other related scientific and production services. In particular, a memorandum was signed with the **ARPA Institute** (Analysis Research & Planning for Armenia Institute (ARPA)) which highlights the development of space science and telecommunications research within the framework of this project (see Appendix 8).

Using the production facilities available in the consolidated resource list at Herouni United Space Canter, such as the ALIQE (The wave) factory, as well as the mini-plant in Aragats, the **knowledge-based production of antenna systems and their components** will be expanded.
There are many letters of support for HUSC from research organizations and individual scientists from different countries of all over the world: USA, Russia, Australia, Germany, the Netherlands, Iran and other (see Appendix 8).

Rearrangement of Herouni radiotelescope from the point of view of the management of Byurakan Observatory is considered to be the most important step for **the restoration and development of the scientific school of radio astronomy in Armenia**. They all believe that the **reopening of the Herouni radiotelescope will open up new possibilities** in the field of science, it will be a huge positive work and a big step in the training of new specialists in the field of science and technology.

Picture 15 - The cover of the conference proceedings organized by Herouni



Continuing the traditions founded by Academician Herouni, the sub-entity of the “Jurisdiction Armenia” Foundation initiated the implementation of the **XXIII International Scientific Conference entitled "Radiotelescopes and Radio Interferometers"** on September 17-18, 2020.
The key topics for discussion at this year's conference will be the engineering and scientific issues related to the modernization of the ROT-54/2.6 radiotelescope. The scientific conference has its website www.herouni.am. A number of conferences after that topics were organized by Paris Herouni in Armenia in 1968-1990.

4.3.2 Educational Activity

In 1984, Professor Paris Herouni established the **Antenna Systems Basic Chair** by ASRIRPM at the Polytechnic University, which he headed until 1995. In 1995-2007, the duties of the head of the chair were performed by Arevik Sargsyan. Now, after the structural changes at the Polytechnic University, the teaching staff of that chair has been replenished with the Telecommunication Systems Chair of the Institute of Information and Telecommunication Technologies and Electronics of NPUA. For nearly 40 years, the close cooperation between the Herouni Institute and the Polytechnic University in the field of science and education has not stopped. We are talking about the organization of students' educational and production practices at the SCA, in particular, on the antenna of the ROT-54/2.6

radiotelescope, the organization of research and training activities of master's and postgraduate students.

Armenian Engineering Scientific School, created by Academician Paris Herouni, **has been preserved and developed**. Under the scientific guidance of Professor Arevik Sargsyan, about 35 masters' and 4 candidates' dissertations have been defended in the field of antenna theory and technology.

Continuing the tradition, Herouni United Space Centre will cooperate with the sectoral universities of the Republic of Armenia and the Republic of Artsakh and it will expand **the international cooperation in the field of education.**
Practical training courses in secondary and high (bachelor's and master's level) professional educational programs in the field of high technologies will be implemented, postgraduate (graduate, on-job), **lifelong learning and continuing education** will be organized. Summer and winter schools will be organized not only for RA and Artsakh but also for international students (on average 200 students per year).
An example of a training program at the HUSC is provided in Annex 12 (the training program was developed in collaboration with the **Yerevan Telecommunication Research Institute**).

An exclusive educational project has been developed together with the German organization **Rohde & Schwarz**. It is planned to develop and prepare several laboratory stands based on antenna measurement standard systems in the HUSC, the implementation of which **will be available for any student in the world remotely**.

Project Manager of HUSC in "Jurisdiction Armenia" Foundation, professor Arevik Sargsyan was elected Armenian Ambassador of the Institute of Electrical Engineering and Electronics Engineers (**IEEE**, www.ieee.org). In November 2019, the **IEEE R8 Enterprise Initiative** was organized named IN ANTENNA PALM. The event included **a competition for engineering start-up student teams**. You can get acquainted with the short video presenting the event at the following link: https: //www.facebook.com/HerouniUnitedSpaceCentre/videos/2641876292514957/. And quite recently, by the decision of the international jury, among the four countries, the Ambassador of Armenia was recognized as the **Best Ambassador** of 2019.
There are many letters of support for HUSC from different universities of the world (see Appendix 8). For example, in his April 13, 2018 letter, Professor Peter Visser (Professor **Delft University of Technology**) welcomed the idea of restarting ROT-54/2.6, emphasizing the educational potential of the telescope and their university interest in participating in further educational processes.

4.4 HUSC FINANCING PLAN

This section presents financial components of HUSC operations. Based on the current and envisaged status, bad financial situation, need for immediate investments, need for multi-aspect works, etc., decision was made to present only Cash Flow projections in the context of this Concept. These projections contain a large volume of information on the operational activities of HUSC and comprehensive information on financial and investment activities.

4.4.1 Necessary Investments

The financial plan of the concept envisages 2 main types of investment flows:

- **HUSC restoration investments**. These investments must be made immediately and fully, as soon as possible, to be able to operate the center's equipment – radiotelescope, etalons, and other

capacities. With these investments, it is planned to carry out capital repairs of the infrastructure of a certain part of the production, laboratory and adjacent areas

- **HUSC development investments:** Some of the development investments are planned to be implemented in parallel with the restoration works, although most of them will be carried out after that. These investments include development of communication and telecommunications infrastructure, development and installation of radio-control systems, the installation of new high-tech equipment, deployment of a large number of computer equipment, acquisition of vehicles, and creation of recreational infrastructure.

Investment sources will be diverse. It is expected that the Government of the Republic of Armenia will be the first of the permanent investors, even with the least investment. Some money can be provided by the government as a grant or as interest-free loans. The further operation of the HUSC will allow all such obligations to be served without tension.

Among other investors, the following organizations can be mentioned (but this not the complete list, future partners will be much more). Acronis, National Instruments, Armenian Monetary Fund, EU, USAID, IEEE, NSF-NASA, ESA, etc.

It is planned to start the implementation of HUSC restoration investments from the first month of the implementation of this Concept and to continue it until the 22nd month. The total approximate volume of restoration investments will make about 400 million AMD.
It is planned to start the HUSC development investments from the first month of the implementation of this Concept and to continue this phase until the 42nd month. After that, one-time investments are planned in coming years. The total approximate volume of development investments will make about 5.6 billion AMD but most of this amount is donated by ACRONIS (5 billion AMD) ($ 10 million) Thus, the vast majority of development investments are planned to be made at the expense of donations and grants received as a result of international cooperation.

4.4.2 Operating Costs

To ensure the regular and uninterrupted operation of the center, it is planned to finance the following main groups with operational expenses

- **Radiotelescope service costs:** This covers the salaries of administrative, scientific, marketing and technical staff, costs of delegated services, costs of office and utilities, taxes, etc.
- **Etalon service costs:** This article also covers the salaries of administrative, scientific, marketing and technical staff, the costs of delegated services, the costs of office and utilities, taxes, etc.

Other operating outputs are not included in this section. In particular, the use of grants is envisaged in the section on financial outflows. In case of providing some operating services and receiving receipts (for example, in case of hotel activities), conditional net inflows have been counted.

Taking into account the inevitable inflation, the annual indexation for all expenses (particularly wages) was calculated at 5% in the first year, and up to 10% in the following years, depending on the financial results of HUSC operations.

4.4.3 Provided services

After the completion of the investment stages, HUSC will be able to provide the following various services, which, include, but is not limited to the following:

- **Radiotelescope rental.** With the help of all the world's top radioastronomers, the practice of the open sky model is defined for radio astronomical observations. This approach assumes that the owner pays for the operation of the equipment, and users get the opportunity to use it for free. The main idea is that the most valuable inventions in this field have been done by scientists, who have provided the best competition applications to the radio observatory, regardless of the citizenship, the residence of the country, workplace, or other similar circumstances. And the organization that owns the tool thus gets the opportunity to participate in the highest possible scientific events at the moment. From the market viewpoint, this seeming strangeness is ensured by the "top science" level. Also, it will be necessary to pay an annual membership fee to JIVE.
  Pay for Time - this model is used for making special orders for the Pentagon or NASA in the United States. It is supposed that with the advent of the age of space flight to Mars, the working time of the radiotelescope will be more in demand to ensure a distant space. It is planned to start operation in the 18th month of the implementation of this concept, but it will reach the maximum overload level (70% or 500 hours per month) in the 37th month.
- **Professional training and production practice with the help of a radiotelescope.** Students from different technical universities of the world will spend about a month of their practical training in Armenia, studying the work of radiotelescopes.
- **Measurements with standards.** The professional research work of the scientists and post-graduate students, where it is necessary to make an accurate measurement, will be organized by using antenna standard systems in HUSC.
- **Educational practice with etalons:** It's the same with a radiotelescope.
- **Online education with standards, laboratory-practical work.** Any student or researcher anywhere in the world who uses the Internet will be able to make accurate measurements online, without a physical presence, at the HUSC.
- **Orders in anechoic chamber.** Details are provided in 5.2 chapter of this concept. This is one of HUSC's most likely/planned investment sub-projects, which is likely to be implemented by attracting and investing around € 5 million in external credit resources: At this stage, HUSC should accomplish other more important investments. At the same time, it will take a long time to implement this sub-program and return the investment. The parallel implementation of the necessary initial investments and the response of the sub-program for the establishment of the chamber contains certain risks from servicing the attracted loans. Thus, it was decided to postpone the implementation of this sub-program.
- **Scientific tourism services, conferences, cultural events.** Chapter 5.1 of this concept provides more details on this issue. The provision of scientific tourism services will be one of the important components of Herouni's USC activities. The planned volumes are quite modest; pessimistic scenario has been applied, taking into account the current state of the tourism industry due to the outbreak of the new COVID-19 virus pandemic. In addition to the main types of activities, HUSC is expected to provide additional services, allocating some of the capacity of its territory to various events, such as conferences and cultural events. In this case, quite modest predictions have been made
- **Production of antennas and components.** HUSC activities involve recruiting highly qualified scientific and engineering personnel. To ensure the operation of the radiotelescope and the standards, it will be necessary to create certain production capacities. In the presence of such capacities, the HUSC will be able launch modest production of antennas and components. This product is in great demand in the market, the revenues from sales can be good addition onto HUSC financial flows and can be used to provide a decent salary for the staff.

In return for the provided services, HUSC will generate some financial flows, which will be used to cover operational expenses and even some investment. However, it must be clearly understood that at least during the period under review, the HUSC cannot become self-sufficient, and the main source

of funding for operating expenses will remain the State funding. During the 5 years of implementation of the Concept, it is envisaged that the amount of state funding will make about 500 million AMD or about 67% of the proceeds conventionally called operational revenues. In other words, the proposed program should not be considered in terms of business and profit generation. It is a scientific-educational project, which, for at least the first 5 years, needs uninterrupted funding from the state. At the same time, it is worth mentioning that as a result of providing various educational and scientific (related) services, HUSC will be able to generate more than 250 million AMD in the observed period, which is quite a good indicator for such a structure.

As mentioned above, to organize its activities, the HUSC will need the support provided by the state. First of all, this refers to the state funding of about 100 million AMD every year, which will be directed exclusively to the remuneration of the scientific staff and the financing of the minimum expenses for the operation of the radiotelescope. Besides, HUSC will need about 270 million AMD interest-free loan, which will be used to finance investments. It is planned to attract this amount in 1-8 months and return it within 19-32 months of the implementation of this program. The amount of this investment financing is expected to be attracted from the State, but in case of impossibility of that option, the HUSC will attract it from other donors or in the form of a loan. In the latter case, the refund will take few months longer and will incur interest payments.

4.4.4 Donations and grants

The radio-optical observatory will be the focus of many international organizations (Science and International organizations that finance scientific research, cooperating educational-scientific institutions, etc.). Many organizations have already confirmed their readiness to provide HUSC with donations and grants, and have even signed memorandums of cooperation. Below we briefly present the possibilities of cooperation with only a few similar structures.

Partner	The Promise of cooperation
Acronis	▪ Up to 10 years provide cloud storage space defined by space data software, with a storage limit of up to 2 TB per day, estimated at $ 10 million ▪ Investments in the infrastructure are needed for the project.
National Instruments	▪ Technical inspection ▪ Professional advice provision, ▪ Assistance in telescope management systems upgrading. The support is estimated at more than $ 50,000 :
”Jurisdiction Armenia” Foundation	Up till today, the JAF has spent about 5.2 million AMD on the HUSC Project
Interested parties	Up till today, about 3.5 million AMD has been spent by those interested in the work of the HUSC Project (including Arevik Sargsyan, Ashot Aslanyan. and others)
ROHDE & SCHWARZ International GmbH	Collaborate in the areas of testing and measurement, broadcasting, secure communication, radio monitoring, and spectrum analysis in standardized, technical, and other processes. Currently, the technical task of preparing an anechoic chamber of the HUSC Project is being prepared by joint efforts.
IEEE	The Special Interest Group on Humanitarian Technology (SIGHT) Project Grant Program has been invited to submit annual applications.

4.4.5 Cash flow projections

As a result of the implementation of this Concept, some of the following important conclusions can be drawn about the foresight of cash flows.

1. Operating expenses for the first year are about 120 million AMD, including employee salaries, delegated services, taxes, and office and infrastructure (utility) expenses. These costs will grow in coming years due to the increase in the volume of activities, the involvement of new employees. The Government of the Republic of Armenia is expected to receive a certain part of the financing of the HUSC operating expenses for 100 million AMD per year: It will finance other operating expenses from the revenues from the provision of its services and the implementation of grant programs. It will be the best way to prove its rights to the HUSC by the Government of the Republic of Armenia and will be a corresponding message for partner financiers.
2. To carry out its operational and investment activities, HUSC will have to attract some debts in the first year of the program's implementation, in the amount of only 270 million AMD. The debt will be incurred before the 8th month of the first year of operation. The repayment of the debt will be made mainly from the receipts received for the provided services by the center during the 19-32 months of activity. This debt (or interest-free loan) has attracted HUSC can be covered by both from the Government of the Republic of Armenia and international financial organizations, and even from Armenian or foreign banks.
3. The already signed agreements on specific donations and grants, as well as the revenues generated for the provision of services, will allow some investments to be made after the initial stage of restoration and development in the 4th and 5th years after the implementation of the concept. This Concept cannot make very clear predictions for such a distant horizon. Appropriate momentum decisions will be made on these investments.
4. HUSC will have challenges in providing financial flows exclusively in the first year of activity, in 6-9 months. During this period, cash flows will reach a minimum and will not allow drastic decisions on expenses and investments. Instead, such decisions can be made after the end of the investment stage starting from 31-32 months of the project implementation.
5. From the very beginning of its activity, HUSC will provide up to 40 permanent jobs, providing a salary close to the market. In the coming months, the number of jobs will increase to 60. Similarly, staff salaries will increase every year, forming for almost 140% of the initial year of program implementation.
6. The HUSC intends to make certain investments to ensure the living and working conditions of the employees, to provide them with proper nutrition and rest, and to ensure the transfer of specialists from Yerevan. All of these actions are reflected in the Cash Flow projections.

4.4.6 Summary of financial indicators

Financial plan of the current Concept is attached. However, some snapshot introduction of the main projected indicators is presented below.

Table 2 – Main financial indicators of the implementation of the Concept

Indicators (for the projected 5 year period)	Amount, AMD	Share
Total operational cash inflow, of which:	**747,497,500**	**100%**
Budget allocations	*500,000,000*	*67%*
Net inflow from scientific tourism	*50,437,500*	*7%*
Net inflow from production of antenna and spare-parts	*64,260,000*	*9%*
Net inflow from educational activities	*47,800,000*	*6%*
Net inflow from organization of events	*85,000,000*	*11%*
Total operational cash outflow, of which:	**1,062,793,664**	**100%**
Salaries, remunerations, and wages (60 positions)	*783,271,688*	*74%*
Administrative personnel	179,715,330	23%
Scientific personnel	290,606,572	37%

Servicing personnel	106,604,718	14%
Technical personnel	126,996,978	16%
Marketing personnel	79,348,090	10%
Expenses on complex recovery of radiotelescope	*98,214,900*	*9%*
Office expenses (internet, instruments, telephone)	*93,441,880*	*9%*
Delegated services	*56,962,216*	*5%*
Utilities (electricity, water)	*20,342,980*	*2%*
Total donations, including	**5,948,200,000**	**100%**
Computer equipment (for servers)	*5,000,000,000*	84%
Other	*900,000,000*	15%
Grants	**775,000,000**	**100%**
Capital restoration investments	**392,000,000**	**100%**
New (development) investments	**5,653,300,000**	**100%**

5 Related Activities of Herouni USC

5.1 Scientific, Educational and Entertainment Tourism

Many people, when planning their vacation try to change the environment to have complete rest. Others, on the other hand, travel thousands of miles from home to climb mountains, risking their lives to navigate the mountain rivers, to travel in the desert, to catch fish with a hook, to shoot a volcano, and so on. And some dream of searching for traces of ancient civilizations, abandoned cities, castles, amazing monasteries, or spending their time searching for sunken ships, historical treasures, or taking part in archeological or other expeditions. Only to discover something new, but also to bring some benefit to the common geography.

In the era of the Fourth Post-Industrial Revolution, scientific complexes are a great resource for scientific tourism. The list of most interesting scientific sites includes specialized exhibitions, observatories, nuclear power plants, space centers, reserves, and aqua parks, etc.

Visits to scientific facilities are organized both for specialists in specific fields and for ordinary tourists. For example, the Kennedy Space Management Center in Florida attracts a huge number of tourists each year, providing scientific and educational information to tourists unaware of the field.

In the 1980s, American researcher Dwayne Nickel developed and published a guide for a scientific tourist: «For space exploration and astronomy related site visits». This guide helps tourists build effective routes, including observatories, astronaut museums, NASA flight, and research centers, where visits are not prohibited. For example, the US Naval Observatory in Washington DC, the Lick Observatory in California, the Lowell Observatory in Arizona, the Sun National Observatory in New Mexico, the Arecibo Radio Observatory in Puerto Rico. The guide lists houses and museums associated with the names of eight famous scientists, astronomers and astronauts, from Albert Einstein to the first American astronaut, John Glenn.

Also, according to some studies, Armenia is recognized as one of the safest countries in the world, which, of course, encourages tourists, stated Hripsime Grigoryan, former head of the State Committee for Tourism of the Ministry of Economy[10] in one of her announcements.

Cultural and social characteristics of visiting places are a priority for tourists from all over the world in the XXI century. Among the factors influencing the attractiveness of the region are the availability of space, the existing infrastructure, the attitude towards tourists, the relative availability of prices, the availability of shopping and educational centers. The latest in the context of attracting tourists and developing new tourism products are now becoming the most important.

Scientific tourism can be considered as a special type of tourism, the main feature of which is the direct participation of tourists in the research program of the campaign. The Declaration of Scientific and Cultural Tourism, adopted by UNESCO, the World Tourism Organization (WTO) and the World Tourism Manila Protocol, provides the following definition: “The purpose of scientific and cultural tourism is the personal discovery and study of *inter alia*: scientific achievements, historical sites and monuments”. Scientific tourism is **the source of employment and extra-budgetary investments of the local population, the guarantee of the full development of scientific institutions, specialized infrastructure, preservation of achievements and research activities.**

[10] https://ru.armeniasputnik.am/society/20181124/15836458/dinamika-voodushevlyaet-kak-izmenitsya-turisticheskoe-lico-armenii.html

According to UNESCO, the share of scientific tourism in global tourism will be 25% by 2025, and the annual volume will be about 2 trillion US dollars. Scientific tourism is divided into 3 types.

1. Scientific and cognitive when tourists are introduced to natural and man-made objects and provide clarifications.
2. Subsidiary participants, when tourists participate in scientific work as support staff. For example, restoration or field research.
3. Independent research of tourists.

Scientific tourism is developing according to the principle of branching planning when as many objects as possible are created near the main object: museum exhibitions, folk handicraft workshops, local cuisine facilities, as well as cultural and entertainment events. This allows us to attract even more tourists, and, consequently, to increase the efficiency of tourist infrastructure.

In the case of HUSC, the inexplicable feeling of power by modern science, and people's interest in space themes, HUSC is intended to become one of the must-to-visit places in Armenia. During the short-term visit to HUSC, tourists will be able to get acquainted with the research topics, participate in some primitive laboratory works and observations, purchase souvenirs, visit Professor Herouni's House-Museum.

Picture 16 - Must-to-visit place

Over the past 30 years, a rich trilingual (Armenian, Russian, English, and English) tour to the ROT-54/2.6 radio telescope has been accumulated by both professionals and the uninformed public. If only Arevik Sargsyan, the Project manager of HUSC program, has such skills at the moment, then there will be a need to train guides in the future.

The center is expected to receive at least 1,500 tourists a year. If we suppose that the tourist will spend money on visit, souvenirs, food in the cafe, then we can expect that more than **10 million AMD a year will go to the budget of the HUSC from scientific tourism.** This number also includes the **adventurous tourists**. People are attracted by **educational-cognitive-events-tourism** offers. From this point of view, HUSC is interesting for organizing tours dedicated to various celebrations, for example, Navasard, which is celebrated on August 11 with the original Armenian calendar, The nominal birthday of ROT-54/2.6 on June 23, the Day of Space on April 12, etc. It also makes sense to organize 2-3 day trips to visit different places, for example, from the pre-historic observatory Qarahunj to the Byurakan Observatory named after V. Hambardzumyan and HUSC. Special quest events for tourists, for example, dedicated to the summer solstice, can also be organized.

The formation of **education tourism** is based on the new needs of the 21st-century man, the targeted assignments of international organizations, and the exchange of experience in state educational systems. Education tourism is a rapidly developing branch of the economy, which is more promising in the context of the economic crisis than other types of tourism. To get short-term travel, to learn a language and to improve their skills, people see it as an investment in developing their abilities and as a good way to combine entertainment with education.

There is a huge variety of educational tourism. Currently, the most popular are educational tours for learning a foreign language, scientific-educational practice in enterprises, academic programs, in particular, research and production practice, master's degree, postgraduate studies, doctoral studies within the framework of higher education. Educational tourism contributes to the formation of educational mobility, the acquisition of self-education skills. The integrated process of educational tourism is manifested as a result of the unification and penetration of educational and tourism activities.

In particular, in the case of HUSC postgraduates, graduate students and students from different countries and educational institutions from all over the world will be involved in the stages of restoration works of ROT-54/2.6. For example, a group of scientists from the Islamic Republic of Iran has already visited the area of the radiotelescope, presenting their proposal to organize the modernization of the radiotelescope with the participation of young Iranian scientists and students. There are similar offers from universities in the Netherlands, Germany, Denmark, Russia, and other countries. In the case of educational tourism, the main material value will be the availability of various topics and directions for research activities. As well as the possibility of organizing educational and production practices for various specialists and students - antennas, automated control engineers, programmers, mechanics, electrical engineers, radio electronics. The basis for generating funding, in this case, will be European programs for funding the mobility of students and academics, for example, cooperation with ERASMUS.

In the process of world economy globalization, the international migration of the population and the mental migration within its framework is becoming more and more important factors for the economic, social, and demographic development of many countries. For a small country like Armenia, which has a large Diaspora, special measures in the field of innovative policy make sense, which is designed to simplify the return of Armenian migrants with higher education and work experience. It is necessary to

interest and attracting foreign specialists to work in our country and to settle down (possibly temporary).

HUSC is expected to provide scientific and educational services, including educational and production practices on radiotelescope, conducting research, conducting online laboratory work using standards, etc. In general, services will be provided to several thousand entities, and the total amount of **scientific and educational services will exceed 165 million AMD during the five years of implementation of the Concept**.

Another type of tourism, called **business tourism**, has long gained popularity. For this type, the abbreviation MICE is more often used: Meetings / Incentives / Conferences / Exhibitions. Through business tourism, people combine pleasure with usefulness, in other words, in interesting places at the same time they relax, hold business meetings, and negotiate.

In addition to hosting its scientific conferences, such as Radio Telescopes and Interferometers (the next one is scheduled for September 17-18, 2020), Herouni United Space Centre in cooperation with tourism companies specializing in the organization of conferences can actively develop the business tourism concentrating on the main goal of these tourists which is to look for new business opportunities. Herouni United Space Centre is expected to hold at least two conferences a year. If we assume that the expected income from each conference will be up to 4 million drams, we can expect that the **Herouni USC will receive 8 million drams a year from business tourism.**

Urban exploration is the study of the forgotten or blocked part of human civilization, which involves visiting abandoned industrial areas, engineering structures, buildings created for production or other purposes.

For example, Insight TV, which broadcasts for 130 million young subscribers (https: //www.insight.tv/), «Tales of Forgotten Places» shot a film about Herouni radiotelescope.

In 2017, ROT-54/2.6 was included in the range of CETI Lab modern mobile outdoor exhibitions in the HAYP Pop Up Gallery. The event, in memory of the First World Conference on Types of Aliens held in 1971 at the Byurakan Observatory, was dedicated to the perception of the alien consciousness of modern artists. Lvis Meja, German sound artist organized a special installation in the bowl of the radiotelescope mirror (https: //youtu.be/Z6Mwue0Lplc).

Exhibitions, festivals, music events, themed evenings, etc. - all this can certainly be organized at the Herouni USC.
According to preliminary estimates, if 2 such cultural or entertainment events are held annually at HUSC and if the agreements with the co-organizers are limited only to the lease of the territory, then **due to entertainment events an inflow of about 10 million drams will be provided annually.**

Together with Strategic Partners, a **Strategic Plan for the Development of Scientific-Educational Tourism at Herouni USC** should be developed. This Strategic Plan should reflect the analytical assessment of the current situation, the main directions, priorities, and problems of tourism development should be outlined, PR strategy, as well as recommendations for their implementation: implementation of comprehensive projects to create tourism and ancillary infrastructure, high-quality and competitive tourist product package in the field of domestic and international tourist markets, access to tourism services, a recreation of citizens, development of professional management system for tourism activities, the involvement of investors from different sectors, in terms of the selection of

priority tourist projects in line with the plans, the implementation of supportive/patent processes with the help of beneficiaries and state bodies.

In the future Strategic Plan, it will be necessary to work out not only the orientation of the masses of tourists to the HUSC but also to treat people already known to Herouni USC as regular customers and to develop directions making them confederate by incorporating these people into the ongoing projects under the Citizen Science program. For example, Citizen Science largest and most well-known project today https: //www.zooniverse.org/. In 2009, the Citizen Science Alliance Association developed many projects for citizen participation in scientific development: some projects do not involve even the direct participation of the citizen, it is enough to provide the power of your computer to perform complex calculations, that is, not to turn off the computer at night, ensuring its participation in the calculations.

It is also worth noting that the dominant slogan of Herouni United Space Center's tourism activities should be**, the sustainable development of tourism allows the modern population of the world to meet their own needs for rest and recovery without the risk of losing that opportunity for future generations** (UNDP, Production and consumption branch, 1998).

5.2 Scientific and Production Activities

Below is a business proposal for furnishing anechoic chamber in collaboration with Rohde & Schwarz International GmbH [11]:
In the late 1980s, at SCA an anechoic chamber for measuring antennas and other radio-electronic equipment was built at the management of Professor Herouni. The chamber was the largest one in Europe (at that time). Within the framework of this project, it is planned to cooperate with such a well-known market leader in this field as Rohde & Schwarz International GmbH. Modernization (up to 40 GHz working frequency) of this anechoic chamber to establish an exclusive commercial laboratory for licensing of civil radio-electronic equipment in the territory of the Republic of Armenia (later with the possibility of expanding the scope of services in the field of testing and licensing of military equipment).

Properly registered in the Unified Register of Licensing and Experimental Bodies (Centers) of the Customs Union, this laboratory will be able to accept orders from all possible enterprises and organizations.
According to the technical regulations of the Customs Union EASR TR TS 020/2011, they are obliged to test and patent their products.

For more information see` Customs Union Technical Regulation "Electromagnetic compatibility of technical means " (ՄՄՏՏ 020/2011).

Licensing generally allows:
- to determine the compliance of goods with the requirements of GOST,
- a guarantee of product quality, protecting buyers from unscrupulous manufacturers,
- confirms that the purchased product is not dangerous for life and the environment,
- measures the level of information leakage, including in the case of ceremonial services,
- protects consumer rights.

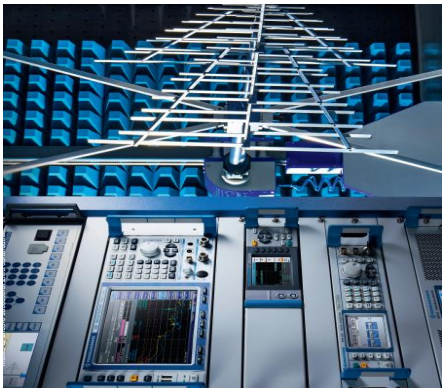
[11]See` https://www.rohde-schwarz.com/ua/solutions/test-and-measurement/overview/test-and-measurement-overview_232778.html

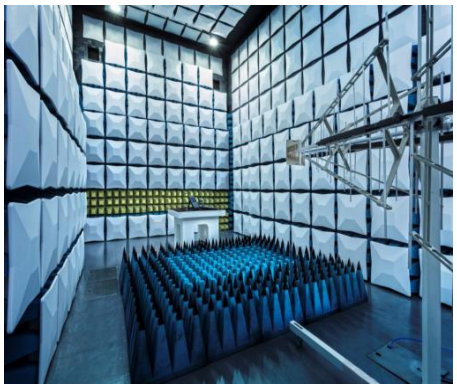
Picture 17 - Current state of an anechoic chamber

Manufacturers can voluntarily obtain a quality license for their products, which will be tested in special laboratories. The results of selective measurements against the radiation background of imported or exported products will be provided to the relevant control bodies. The control bodies constantly check the quality of the products, imposing fines on unscrupulous producers. Products that do not meet the norms and standards are taken out of the commercial network.

Picture 18 - Anechoic chamber

ROHDE&SCHWARZ





In the Anechoic chamber, patent measurements of electromagnetic comparability will ensure the sanitary-hygienic safety of the population of Armenia and the protection of the radio ether from the irregular/inadmissible, including because of IoT, radiation.

Laboratory services will cover a wide range of products, including:

- household appliances (refrigerators, washing machines, TVs, computers, etc. medical equipment (including for diagnosis),

- IT equipment (including those installed on cars and trucks),
- Radio equipment, antennas, means of communication,
- Electromagnetic background measurements outside / inside (using mobile laboratory equipment),
- Smart city equipment NB-IoT, Lora, Zigbee, NFC,
- Testing of devices using GPS, JRA GLONASS systems.

All this is necessary to check the quality of the product following GOST requirements and international norms, to protect the rights of consumers and to test the danger to life and the environment.

For this purpose, it is supposed to repair 300-400m^2 of a special area in the territory of Herouni United Space Centre and to buy from Rohde & Schwarz and then to install the necessary equipment for 5 million Euros (depending on the number of options and additional opportunities).

It should be noted that there is no laboratory with similar capabilities in Armenia, moreover, there is no one in the region (Georgia, Azerbaijan, South of Russia, Kyrgyzstan, Uzbekistan), and in some countries (Iran, Turkey, Kazakhstan) there is one such laboratory. Supposedly depending on the size of the tested product and the type of service, the average service fee paid by potential customers will be in the range of $ 1,000 - $ 25,000, the number of orders will be less than 50 per year, it can be estimated that Lab will bring back the above-mentioned investments in 7 years.