PART VI ASTRONOMICAL APPLICATION FOR EDUCATION

VIRTUAL OBSERVATORY ON THE BASE OF CONSOLIDATION OF ASTRONOMICAL OBSERVATORIES AND UNIVERSITIES RESOURCES

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Today the resource of astronomical observatories and aerospace complex have cut off, that not permit to organise the new level of education and investigation. The successes in development of computers, telecommunication and virtual world architecture permit to unite the distribution resource and to give the distant access to astronomical telescopes and databases for students and professors. Creation of the experimental education-research complex with remote access on the collaboration base between St-Petersburg State University of Aerospace Instrumentation, Pulkovo and Nikolaev Observatories is discussed.

ВІРТУАЛЬНА ОБСЕРВАТОРІЯ НА ОСНОВІ ОБ'ЄДНАННЯ РЕСУРСІВ АСТРОНОМІЧНИХ ОБСЕРВАТОРІЙ І УНІВЕРСИТЕТІВ - М.Б. Ігнатьєв, Г.І. Пінігін, Ф.І. Бушуєв, Л.Д. Парфиненко – У даний час ресурси астрономічних обсерваторій і аерокосмічного комплексу роз'єднані, що не дозволяє організувати новий рівень освіти і досліджень. Досягнення в розвитку обчислювальної техніки, телекомунікацій і архітектури віртуальних утворень дозволяють провести об'єднання розподілених ресурсів і надати дистанційний доступ до астрономічних телескопів і баз даних студентам і професорам. Обговорюється створення експериментального учбово-наукового комплексу з дистанційним доступом на основі співробітництва між Санкт-Петербурзьким державним університетом аерокосмічного приладобудування, Пулковською і Миколаївською астрономічними обсерваторіями.

ВИРТУАЛЬНАЯ ОБСЕРВАТОРИЯ НА ОСНОВЕ ОБЬЕДИНЕНИЯ РЕСУРСОВ АСТРОНОМИЧЕСКИХ ОБСЕРВАТОРИЙ И УНИВЕРСИТЕТОВ - М.Б. Игнатьев., Г.И. Пинигин, Ф.И. Бушуев, Л.Д. Парфиненко – В настоящее время ресурсы астрономических обсерваторий и аэрокосмического комплекса разъединены, что не позволяет организовать новый уровень образования и исследований. Достижения в развитии вычислительной техники, телекоммуникаций и архитектуры виртуальных миров позволяют провести объединение распределенных ресурсов и предоставить дистанционный доступ к астрономическим телескопам и базам данных студентам и профессорам. Обсуждается создание экспериментального учебно-научного комплекса с удаленным доступом на основе сотрудничества между Санкт-Петербургским государственным университетом аэрокосмического приборостроения, Пулковской и Николаевской астрономическими обсерваториями.

1. On the base of virtual world architecture for astronomy and aerospace education the seven block structure is developed [R.1,2]. This module consist from next blocks:

1) Population - astronomers, professors, students and its agents in virtual world,

2) Passionarity - the intentions of astronomers, professors, students and its agents,

3) Territory - the virtual space, which consist on distribution astronomical and astrophysical instruments and data bases,

4) Production - the process of observations and investigations,

5) Ecology and safety,

6) Finance,

7) External relations of our virtual world with go in and go out flows of peoples, agents, finance, information and another resource; communication between different virtual worlds and real worlds.

According to the linguistical combinatorial method of simulation [R 3,4] we can create the general equation for description of our virtual world

$$A1\times E1+A2\times E2+A3\times E3+A4\times E4+A5\times E5+A6\times E6+A7\times E7 = 0 \qquad (1)$$

where

A1 – characteristic of population of virtual world, E1 – change of this characteristic;

A2 – characteristic of passionarity of virtual world, E2 – change of this characteristic;

A3 – characteristic of territory of virtual world, E3 – change of this characteristic;

A4 – characteristic of production of virtual world, E4 – change of this characteristic;

A5 – characteristic of ecology of virtual world, E5 – change of this characteristic;

A6 – characteristic of finance of virtual world, E6 – change of this characteristic;

A7 – characteristic of external relation of virtual worlds, E7 – change of this characteristic.

The next step of our analysis is the resolution relatively E variables, which can be the derivatives from A,

$$\begin{aligned}
E1&= U1\times A2+U2\times A3+ U3\times A4+U4\times A5+U5\times A6+U6\times A7\\
E2&= -U1\times A1+U7\times A3+U8\times A4+U9\times A5+U10\times A6+U11\times A7\\
E3&= -U2\times A1-U7\times A2+U12\times A4+U13\times A5+U14\times A6+U15\times A7\\
E4&= -U3\times A1-U8\times A2 -U12\times A3+U16\times A5+U17\times A6+U18\times A7 \qquad (2)\\
E5&= -U4\times A1-U9\times A2 -U13\times A3 -U16\times A4+U19\times A6+U20\times A7\\
E6&= -U5\times A1-U10\times A2 -U14\times A3 -U17\times A4 -U19\times A6+U21\times A7\\
E7&= -U6\times A1- U11\times A2 -U15\times A3 -U18\times A4 -U20\times A5-U21\times A6
\end{aligned}$$

where U1,U2,...,U21 (arbitrary coefficients, which can use for organization of different movements on manifold (1) for decision of different task in virtual world.

Equations (2) describe the full combinations of interaction in our virtual world. Each principal (investigator, professor, student) of virtual world can have the agent, which must help its principal. The creation of agents increase the effectiveness of using astronomical and astrophysical instruments and data bases.

2. **The scientific activity, as component of educational process, for example -study of solar phenomenon and on this basis, namely - solar-terrestrial connections.**

The level of solar activity (number of active areas and solar spot, amount and energy of solar flares etc.) varies with a phase about 11years. On the Earth the 11-year's cycle is traced on a lot of appearances of an organic and inorganic nature (perturbation of a magnetic field, polar auroras, perturbations of an ionosphere, modification of growth rate of trees with phase about 11 years established on alternations of a thickness of annual rings, etc.). On terrestrial processes render also action separatective areas on the Sun and happening in them short-term, but sometimes very high-power flares. The lifetime of separate magnetic area on the Sun can reach one year. The perturbations, called by this area, in a magnetosphere and upper atmosphere of the Earth are repeated in 27 day (with a solar rotation period, observed from the Earth). The most high-power developments of solar activity -solar chromospheric flares happen is irregular (more often near to phases of maximum activity), the duration makes them 5- 40 minutes, seldom some hours. Energy of a chromospheres flare can reach 1025 joules, from an energy, selected at a flare, only 1-10 % are fit on electromagnetic radiation in an optical range. On a comparison with a full radiation of the Sun in an optical range the energy of a flare is not great, but short-wave radiation of a flare and electrons, generated at a flare, and sometimes solar space rays can give the noticeable contribution to a x-ray and corpuscular radiation of the Sun. In phases of a raise of solar activity its X-radiation is increased in a range 300-10 nm twice, in a range 10-1 nm in 3-5 times, in a range 1-0,2 nm more than a hundred times. In accordance with a diminution of a wavelength of a radiation the contribution of active areas to a full radiation of the Sun is increased, and in last of the specified ranges active areas stipulate practically all the radiation. Hard X-radiation with a wavelength is less 0,2 eV occurs in a spectrum of the Sun only on short time after flares.

The constancy of an energy obtained the Earth from the Sun, ensures a stationary of a thermal balance of the Earth. The solar activity essentially has no an effect to a power engineering of the Earth as planets, but the separate components of a radiation of chromospheres flares can render significant influence to many physical, biophysical and biochemical processes on the Earth. The active areas are a high-power radiant of a corpuscular radiation. The particles with energies about 1 keV (in basic protons), spreaded along force lines of an interplanetary magnetic field from active areas strengthen a solar wind. These amplifications

(bursts) of a solar wind are repeated in 27 days. The similar streams, but still a greater energy and denseness, arise at flares. They are so called sporadic perturbations of a solar wind and reach the Earth for intervals of time from 8 hours about two day. The protons of a high energy (about 100 Me) from very powerful "proton" flare and electrons with an energy 10-500 keV, included in a structure of solar space rays, come to the Earth through tens minutes after flares; there come that from them little bit later, which have hitted in "trap" of an interplanetary magnetic field and moved together with a solar wind. A short-wave radiation and the solar space rays (in high latitudes) ionize terrestrial atmosphere, that reduces in oscillations of its transparency in ultraviolet and infra-red ranges, and also to modifications of conditions of propagation of short radio waves (in a series of cases the violations of a short-wave radio communication).

Intension of a solar wind called by a flare are observed, reduces in compression of a magnetosphere of the Earth from a solar side, amplification of currents on its exterior boundary, partial penetration of particles of a solar wind in a depth of a magnetosphere, supplement by particles of high energies of radiation belts of the Earth etc. These processes are accompanied by oscillations intensity of a geomagnetic field (magnetic storm), polar auroras and other geophysical appearances reflecting common perturbation of a magnetic field of the Earth. The action of active processes on the Sun (solar storms) on geophysical appearances is carried out as short-wave radiation, and via a magnetic field of the Earth. Apparently, these factors are principal and for physical-chemical and biological processes. To trace the whole circuit of connections reducing in 11-year's periodicity of many processes on the Earth yet not succeed, but the accumulated extensive actual material does not leave doubts in existence of such connections. So, the correlation between an 11-year's cycle of solar activity and earthquakes, crops of agricultural cultures, number of cardiac diseases etc. were established. The marked facts indicate a constant operation of solar-terrestrial connections. That in turn is a compelling condition of not stopping process of monitoring and study of this vital natural appearance.

3. **The development and creation of an experimental educational-research complex (EERC) with remote access through on basis of a solar telescope and observant database of Pulkovo astronomical observatory (remote access forms together with SPUAI)/6/.**

The requirements to the EERC:

· the experimental educational-research complex should ensure remote access through Internet to a horizontal solar telescope of ACU-5, 5-inch Zeiss telescope-refractor and observation data base of the Pulkovo astronomical observatory;

· the EERC provide of "remote" students, observers-users a possibility under the program to observe of the Sun;

· to receive target sample of information from observation data base of Pulkovo observatory and other archives;

· conduct under monitoring correlative connection of data as of solar activity with perturbations of an ionosphere on depth both gradient of deviations of

amplitude and phase of signals VLW (very long waves) radio stations from their regular modifications.

The design complex is supposed on basis of a horizontal solar telescope. It is a classical horizontal solar telescope equipped four-chamber spectrograph and TV spectroheliograph on CCD-matrix (Fig.1). With the help of TV spectrogeliograph it is possible to receive the following information:

1) videomap of magnetic fields and radial velocities of active formations in atmosphere of the Sun

2) monochromatic images (spectroheliogram) of the Sun in any wavelength of a visible spectrum

3) images of the Sun in the infrared line HeI 10830A (dark helium points and of a coronal hole)

4) power spectra and phase diagrams of short-period oscillations of a magnetic field, radial velocities and brightness of solar structures in a range 1 – 300 sec.

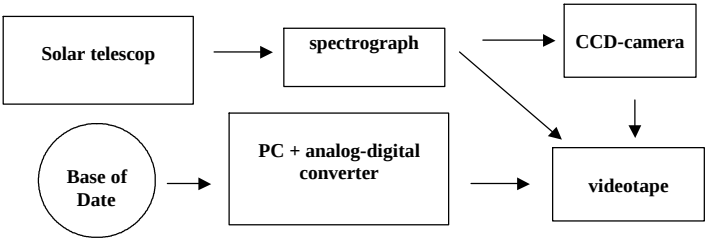

Fig.1 Cording diagram of CCD spectroheliograph

4. In addition it planes a common research with Nikolaev astronomical observatory secondary phase-frequency standard (SPFS) under monitoring correlative connection of data as of solar activity with perturbations of an ionosphere on depth both gradient of deviations of amplitude and phase of signal VLW radio stations from their regular modifications [7]

The design of Nikolaev SPFS is shown on Fig.2:

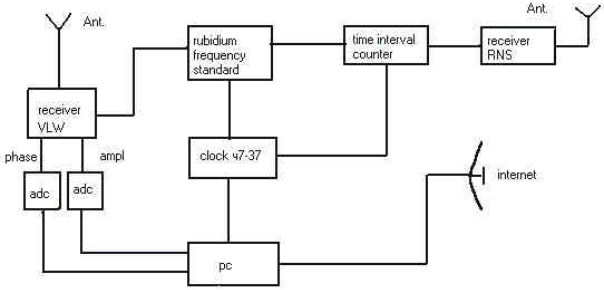

Fig 2. Secondary phase-frecuency standard NAO

The SPFS consist:

· Rubidium standard of frequence with accurace $\pm 1\times10^{-12}$ ($\pm$0,1 mks/day)

· Very Long Waves receiver (10 - 100 kc.)

· Personal computer with analog-digital convertors

· Radio Navigation Stations receiver (100 kc) and digital counter for time scale control

With the help of SPFS it is possible to receive following information :

Monitoring date of amplitude signals station DCF- 77 (Germany) is shown on Fig.3. Amplitude of signals this station are depended from solar radiation to ionosphere and it may be used for solar flares registration. The dates of solar x-ray satelite monitors GOES-8 and GOES-10 are shown also for comparation.

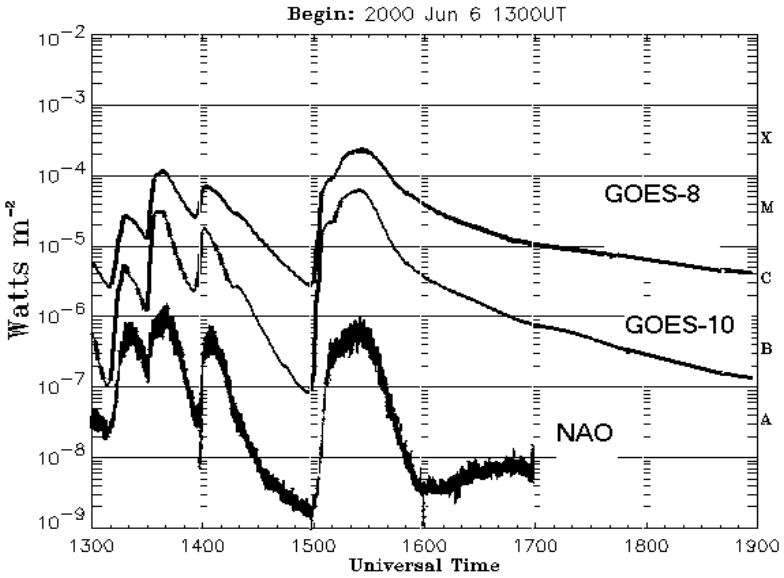

Fig 3. The graph monitoring dates NAO and GOES -8,10 satelites.

Dates of ionosphere control may by successfully used for study solar - earth interactions, earth - quake prognosises , in medicine and geliobiology .

Conclusion

Virtual worlds conception permit to unite the different astronomical and astrophysical resource and increase the educational and investigational potential of world community.

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OPPORTUNITIES FOR EDUCATIONAL LEVEL IMPROVEMENT ON THE BASE OF COOPERATION BETWEEN ASTRONOMICAL OBSERVATORIES AND UNIVERSITIES

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The successes in development of computers, telecommunication and virtual world architecture permit to unite the distribution resources of astronomical observatories and universities resources. It will be possible for students and professors to have a distant access to unique astronomical telescopes and data bases. Also, it will be possible for operative using of current scientific and technique news. On the collaboration base between Nikolaev Astronomical Observatory and Nikolaev State Educational University a joint programs are discussed.

МОЖЛИВОСТІ ПІДВИЩЕННЯ РІВНЯ АСТРОНОМІЧНОЇ ОСВІТИ НА ОСНОВІ СПІВРОБІТНИЦТВА АСТРОНОМІЧНИХ ОБСЕРВАТОРІЙ І ВУЗІВ, Г.І.Пінігін, О.В. Шульга, В.Д.Будак, Я.І.Журецький, І.М.Хейфець - Успіхи в області обчислювальної техніки, телекомунікацій і архітектури віртуальних утворень дозволяють провести об'єднавчу роботу ресурсів астрономічних обсерваторій і освітніх установ. Це надасть тим, що навчаються - студентам, людям, що підвищують кваліфікацію - можливість дистанційного доступу до астрономічних інструментів, багато яких є унікальними, до лабораторних і діючих приладів і баз даних, до наукових і методичних матеріалів. З'являється можливість оперативного