



## 19 The Platform of Virtual Institute of Astroparticle Physics in Studies of Physics Beyond the Standard Model

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**Abstract.** Being a unique multi-functional complex of science and education online, Virtual Institute of Astroparticle Physics (VIA) operates on website <http://viavca.in2p3.fr/site.html>. It supports presentation online for the most interesting theoretical and experimental results, participation online in conferences and meetings, various forms of collaborative scientific work as well as programs of education at distance, combining online videoconferences with extensive library of records of previous meetings and Discussions on Forum. Since 2014 VIA online lectures combined with individual work on Forum acquired the form of Open Online Courses. Aimed to individual work with students the Course is not Massive, but the account for the number of visits to VIA site converts VIA in a specific tool for MOOC activity. VIA sessions are now a traditional part of Bled Workshops' programme. At XXI Bled Workshop it provided a world-wide discussion of the open questions of physics beyond the standard model, supporting world-wide propagation of the main ideas, presented at this meeting.

**Povzetek.** Virtual Institute of Astroparticle Physics (VIA) je večnamensko spletišče za znanost in izobraževanje na naslovu <http://viavca.in2p3.fr/site.html>. Podpira neposredne predstavitve najbolj zanimivih teoretičnih in eksperimentalnih rezultatov, sodelovanje v neposrednih konferencah in srečanjih, podporo za različne oblike znanstvenega sodelovanja, programe za izobraževanje na daljavo, pri čemer ponuja kombinacije videokonferenc z obširno knjižnico zapisov prejšnjih srečanj in diskusije na Forumu. Po letu 2014 so predavanja VIA na daljavo, kombinirana z individualnim delom na forumu, dobila obliko odprtih tečajev na daljavo. Ker cilja na individualno delo s posameznimi študenti, ni množična, vendar je, glede na število obiskov spletišča VIA, le to postalo orodje za množične aktivnosti učenja na daljavo (MOOC). Seje VIA so postale tradicionalen del programa te blejske delavnice. Na letošni enaindvajseti delavnici so omogočile diskusije o odprtih vprašanjih fizike onkraj standardnih modelov za udeležence iz vseh koncev sveta in razširjanje idej, predstavljenih na delavnici, po vsem svetu.

**Keywords:** astroparticle physics, physics beyond the Standard model, e-learning, e-science, MOOC

## 19.1 Introduction

Studies in astroparticle physics link astrophysics, cosmology, particle and nuclear physics and involve hundreds of scientific groups linked by regional networks (like ASPERA/ApPEC [1,2]) and national centers. The exciting progress in these studies will have impact on the knowledge on the structure of microworld and Universe in their fundamental relationship and on the basic, still unknown, physical laws of Nature (see e.g. [3,4] for review). The progress of precision cosmology and experimental probes of the new physics at the LHC and in nonaccelerator experiments, as well as the extension of various indirect studies of physics beyond the Standard model involve with necessity their nontrivial links. Virtual Institute of Astroparticle Physics (VIA) [5] was organized with the aim to play the role of an unifying and coordinating platform for such studies.

Starting from the January of 2008 the activity of the Institute takes place on its website [6] in a form of regular weekly videoconferences with VIA lectures, covering all the theoretical and experimental activities in astroparticle physics and related topics. The library of records of these lectures, talks and their presentations was accomplished by multi-lingual Forum. Since 2008 there were **195 VIA online lectures**, VIA has supported distant presentations of **112 speakers at 25 Conferences** and provided transmission of talks at **64 APC Colloquiums**.

In 2008 VIA complex was effectively used for the first time for participation at distance in XI Bled Workshop [7]. Since then VIA videoconferences became a natural part of Bled Workshops' programs, opening the virtual room of discussions to the world-wide audience. Its progress was presented in [8–16]. Here the current state-of-art of VIA complex, integrated since 2009 in the structure of APC Laboratory, is presented in order to clarify the way in which discussion of open questions beyond the standard models of both particle physics and cosmology were presented at the XXI Bled Workshop with the of VIA facility to the world-wide audience.

## 19.2 VIA structure and activity

### 19.2.1 VIA activity

The structure of VIA complex is illustrated by the Fig. 19.1. The home page, presented on this figure, contains the information on the coming and records of the latest VIA events. The menu links to directories (along the upper line from left to right): with general information on VIA (About VIA), entrance to VIA virtual rooms (Rooms), the library of records and presentations (Previous) of VIA Lectures (Previous → Lectures), records of online transmissions of Conferences (Previous → Conferences), APC Colloquiums (Previous → APC Colloquiums), APC Seminars (Previous → APC Seminars) and Events (Previous → Events), Calendar of the past and future VIA events (All events) and VIA Forum (Forum). In the upper right angle there are links to Google search engine (Search in site) and to contact information (Contacts). The announcement of the next VIA lecture and VIA online transmission of APC Colloquium occupy the main part of the homepage with

Home. Search in site, Contact.

Virtual Institute of Astroparticle physics

ABOUT VIA ROOMS PREVIOUS ALL EVENTS FORUM

Next regular Lecture's |

December 7, 2018 | 16h - 17h Paris time

Lecture by Fiorella Burgio

To Participate

Title of lecture: "Neutron star universal relations with microscopic equations of state"

Language of lecture: EN

Institute & Country: INFN Section Catania, Catania, Italy

All | events

NOVEMBER 6

In the News |

GW170814: A three-detector observation of gravitational waves from a binary black hole coalescence

September, 27, 2017

See the Article

The latest T2K neutrino oscillation results

September, 13, 2017

See the Article

GW170104: Observation of a 50-solar-mass binary black hole coalescence at redshift 0.2

June, 1, 2017

See the Article

First Dark Matter Search Results from the XENON1T Experiment

May, 17, 2017

See the Article

Previous Lecture |

Lecture by Bill Louis

"Significant Excess of Electron-Like Events from the MiniBooNE Short-Baseline Neutrino Experiment"

See All presentations

VIA

sciences

Beyond the standard model

Astroparticle physics

Cosmology

Gravitational waves experiments

Astrophysics

Neutrinos

cosmovia.org

In the News

Applications

Facebook

Partners of VIA

Contact

help

How to use VIA

INFN CERN ASTROPA CPT IN2P3 UNIVERSITÉ DE GENÈVE

Fig. 19.1. The home page of VIA site

the record of the most recent VIA events below. In the announced time of the event (VIA lecture or transmitted APC Colloquium) it is sufficient to click on "to participate" on the announcement and to Enter as Guest (printing your name) in the corresponding Virtual room. The Calendar shows the program of future VIA lectures and events. The right column on the VIA homepage lists the announcements of the regularly up-dated hot news of Astroparticle physics and related areas.

In 2010 special COSMOVIA tours were undertaken in Switzerland (Geneva), Belgium (Brussels, Liege) and Italy (Turin, Pisa, Bari, Lecce) in order to test stability of VIA online transmissions from different parts of Europe. Positive results of these tests have proved the stability of VIA system and stimulated this practice at XIII Bled Workshop. The records of the videoconferences at the XIII Bled Workshop are available on VIA site [17].

Since 2011 VIA facility was used for the tasks of the Paris Center of Cosmological Physics (PCCP), chaired by G. Smoot, for the public programme "The two infinities" conveyed by J.L.Robert and for effective support a participation at distance at meetings of the Double Chooz collaboration. In the latter case, the experimentalists, being at shift, took part in the collaboration meeting in such a virtual way.

The simplicity of VIA facility for ordinary users was demonstrated at XIV Bled Workshop in 2011. Videoconferences at this Workshop had no special technical support except for WiFi Internet connection and ordinary laptops with their internal webcams and microphones. This test has proved the ability to use VIA facility at any place with at least decent Internet connection. Of course the quality of records is not as good in this case as with the use of special equipment, but still it is sufficient to support fruitful scientific discussion as can be illustrated by the record of VIA presentation "New physics and its experimental probes" given by John Ellis from his office in CERN (see the records in [18]).

In 2012 VIA facility, regularly used for programs of VIA lectures and transmission of APC Colloquiums, has extended its applications to support M.Khlopov's talk at distance at Astrophysics seminar in Moscow, videoconference in PCCP, participation at distance in APC-Hamburg-Oxford network meeting as well as to provide online transmissions from the lectures at Science Festival 2012 in University Paris7. VIA communication has effectively resolved the problem of referee's attendance at the defence of PhD thesis by Mariana Vargas in APC. The referees made their reports and participated in discussion in the regime of VIA videoconference. In 2012 VIA facility was first used for online transmissions from the Science Festival in the University Paris 7. This tradition was continued in 2013, when the transmissions of meetings at Journées nationales du Développement Logiciel (JDEV2013) at Ecole Polytechnique (Paris) were organized [20].

In 2013 VIA lecture by Prof. Martin Pohl was one of the first places at which the first hand information on the first results of AMS02 experiment was presented [19].

In 2014 the 100th anniversary of one of the founders of Cosmoparticle physics, Ya. B. Zeldovich, was celebrated. With the use of VIA M.Khlopov could contribute the programme of the "Subatomic particles, Nucleons, Atoms, Universe:

Processes and Structure International conference in honor of Ya. B. Zeldovich 100th Anniversary" (Minsk, Belarus) by his talk "Cosmoparticle physics: the Universe as a laboratory of elementary particles" [21] and the programme of "Conference YaB-100, dedicated to 100 Anniversary of Yakov Borisovich Zeldovich" (Moscow, Russia) by his talk "Cosmology and particle physics" [22].

In 2015 VIA facility supported the talk at distance at All Moscow Astrophysical seminar "Cosmoparticle physics of dark matter and structures in the Universe" by Maxim Yu. Khlopov and the work of the Section "Dark matter" of the International Conference on Particle Physics and Astrophysics (Moscow, 5-10 October 2015). Though the conference room was situated in Milan Hotel in Moscow all the presentations at this Section were given at distance (by Rita Bernabei from Rome, Italy; by Juan Jose Gomez-Cadenas, Paterna, University of Valencia, Spain and by Dmitri Semikoz, Martin Bucher and Maxim Khlopov from Paris) and its work was chaired by M. Khlopov from Paris [27]. In the end of 2015 M. Khlopov gave his distant talk "Dark atoms of dark matter" at the Conference "Progress of Russian Astronomy in 2015", held in Sternberg Astronomical Institute of Moscow State University.

In 2016 distant online talks at St. Petersburg Workshop "Dark Ages and White Nights (Spectroscopy of the CMB)" by Khatri Rishi (TIFR, India) "The information hidden in the CMB spectral distortions in Planck data and beyond", E. Kholupenko (Ioffe Institute, Russia) "On recombination dynamics of hydrogen and helium", Jens Chluba (Jodrell Bank Centre for Astrophysics, UK) "Primordial recombination lines of hydrogen and helium", M. Yu. Khlopov (APC and MEPHI, France and Russia) "Nonstandard cosmological scenarios" and P. de Bernardis (La Sapienza University, Italy) "Balloon techniques for CMB spectrum research" were given with the use of VIA system [28]. At the defense of PhD thesis by F. Gregis VIA facility made possible for his referee in California not only to attend at distance at the presentation of the thesis but also to take part in its successive jury evaluation.

Since 2018 VIA facility is used for collaborative work on studies of various forms of dark matter in the framework of the project of Russian Science Foundation based on Southern Federal University (Rostov on Don). In September 2018 VIA supported online transmission of **17 presentations** at the Commemoration day for Patrick Fleury, held in APC [29].

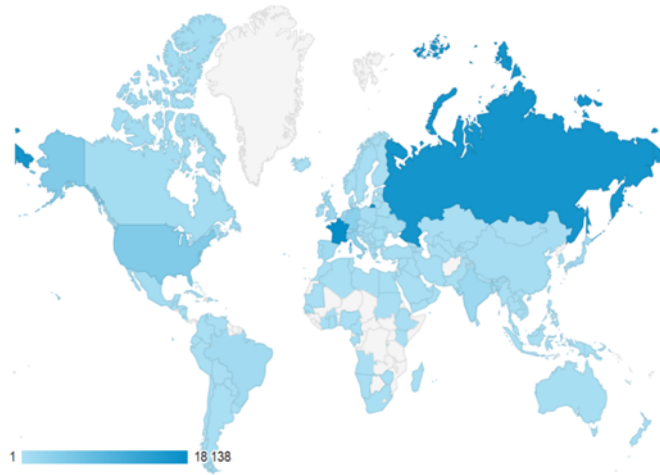
The discussion of questions that were put forward in the interactive VIA events is continued and extended on VIA Forum. Presently activated in English, French and Russian with trivial extension to other languages, the Forum represents a first step on the way to multi-lingual character of VIA complex and its activity. Discussions in English on Forum are arranged along the following directions: beyond the standard model, astroparticle physics, cosmology, gravitational wave experiments, astrophysics, neutrinos. After each VIA lecture its pdf presentation together with link to its record and information on the discussion during it are put in the corresponding post, which offers a platform to continue discussion in replies to this post.

### 19.2.2 VIA e-learning, OOC and MOOC

One of the interesting forms of VIA activity is the educational work at distance. For the last eleven years M.Khlopov's course "Introduction to cosmoparticle physics" is given in the form of VIA videoconferences and the records of these lectures and their ppt presentations are put in the corresponding directory of the Forum [23]. Having attended the VIA course of lectures in order to be admitted to exam students should put on Forum a post with their small thesis. In this thesis students are proposed to chose some BSM model and to study the cosmological scenario based on this chosen model. The list of possible topics for such thesis is proposed to students, but they are also invited to chose themselves any topic of their own on possible links between cosmology and particle physics. Professor's comments and proposed corrections are put in a Post reply so that students should continuously present on Forum improved versions of work until it is accepted as admission for student to pass exam. The record of videoconference with the oral exam is also put in the corresponding directory of Forum. Such procedure provides completely transparent way of evaluation of students' knowledge at distance.

In 2018 the test has started for possible application of VIA facility to remote supervision of student's scientific practice. The formulation of task and discussion of porgress on work are recorded and put in the corresponding directory on Forum together with the versions of student's report on the work progress.

Since 2014 the second semester of the course on Cosmoparticle physics is given in English and converted in an Open Online Course. It was aimed to develop VIA system as a possible accomplishment for Massive Online Open Courses (MOOC) activity [24]. In 2016 not only students from Moscow, but also from France and Sri Lanka attended this course. In 2017 students from Moscow were accompanied by participants from France, Italy, Sri Lanka and India [25]. The students pretending to evaluation of their knowledge must write their small thesis, present it and, being admitted to exam, pass it in English. The restricted number of online connections to videoconferences with VIA lectures is compensated by the wide-world access to their records on VIA Forum and in the context of MOOC VIA Forum and videoconferencing system can be used for individual online work with advanced participants. Indeed Google Analytics shows that since 2008 VIA site was visited by more than **242 thousand** visitors from **153** countries, covering all the continents by its geography (Fig. 19.2). According to this statistics more than half of these visitors continued to enter VIA site after the first visit. Still the form of individual educational work makes VIA facility most appropriate for PhD courses and it is planned to be involved in the International PhD program on Fundamental Physics, which can be started on the basis of Russian-French collaborative agreement. In 2017 the test for the ability of VIA to support fully distant education and evaluation of students (as well as for work on PhD thesis and its distant defense) was undertaken. Steve Branchu from France, who attended the Open Online Course and presented on Forum his small thesis has passed exam at distance. The whole procedure, starting from a stochastic choice of number of examination ticket, answers to ticket questions, discussion by professors in the absence of student and announcement of result of exam to him was recorded and put on VIA Forum [26].



**Fig. 19.2.** Geography of VIA site visits according to Google Analytics

### 19.2.3 Organisation of VIA events and meetings

First tests of VIA system, described in [5,7–9], involved various systems of videoconferencing. They included skype, VRVS, EVO, WEBEX, marratech and adobe Connect. In the result of these tests the adobe Connect system was chosen and properly acquired. Its advantages are: relatively easy use for participants, a possibility to make presentation in a video contact between presenter and audience, a possibility to make high quality records, to use a whiteboard tools for discussions, the option to open desktop and to work online with texts in any format.

Initially the amount of connections to the virtual room at VIA lectures and discussions usually didn't exceed 20. However, the sensational character of the exciting news on superluminal propagation of neutrinos acquired the number of participants, exceeding this allowed upper limit at the talk "OPERA versus Maxwell and Einstein" given by John Ellis from CERN. The complete record of this talk and is available on VIA website [30]. For the first time the problem of necessity in extension of this limit was put forward and it was resolved by creation of a virtual "infinity room", which can host any reasonable amount of participants. Starting from 2013 this room became the only main virtual VIA room, but for specific events, like Collaboration meetings or transmissions from science festivals, special virtual rooms can be created. This solution strongly reduces the price of the licence for the use of the adobeConnect videoconferencing, retaining a possibility for creation of new rooms with the only limit to one administrating Host for all of them.

The ppt or pdf file of presentation is uploaded in the system in advance and then demonstrated in the central window. Video images of presenter and participants appear in the right window, while in the lower left window the list of all the attendees is given. To protect the quality of sound and record, the participants are required to switch out their microphones during presentation and to use the upper left Chat window for immediate comments and urgent questions.

The Chat window can be also used by participants, having no microphone, for questions and comments during Discussion. The interactive form of VIA lectures provides oral discussion, comments and questions during the lecture. Participant should use in this case a "raise hand" option, so that presenter gets signal to switch out his microphone and let the participant to speak. In the end of presentation the central window can be used for a whiteboard utility as well as the whole structure of windows can be changed, e.g. by making full screen the window with the images of participants of discussion.

Regular activity of VIA as a part of APC includes online transmissions of all the APC Colloquiums and of some topical APC Seminars, which may be of interest for a wide audience. Online transmissions are arranged in the manner, most convenient for presenters, prepared to give their talk in the conference room in a normal way, projecting slides from their laptop on the screen. Having uploaded in advance these slides in the VIA system, VIA operator, sitting in the conference room, changes them following presenter, directing simultaneously webcam on the presenter and the audience.

### 19.3 VIA Sessions at XXI Bled Workshop

VIA sessions of XXI Bled Workshop continued the tradition coming back to the first experience at XI Bled Workshop [7] and developed at XII, XIII, XIV, XV, XVI, XVII, XVIII, XIX and XX Bled Workshops [8–16]. They became a regular part of the Bled Workshop's program.

In the course of XXI Bled Workshop, the list of open questions was stipulated, which was proposed for wide discussion with the use of VIA facility. The list of these questions was put on VIA Forum (see [31]) and all the participants of VIA sessions were invited to address them during VIA discussions. During the XXI Bled Workshop the announcement of VIA sessions was put on VIA home page, giving an open access to the videoconferences at VIA sessions. Though the experience of previous Workshops principally confirmed a possibility to provide effective interactive online VIA videoconferences even in the absence of any special equipment and qualified personnel at place, VIA Sessions were directed at XXI Workshop by M.Khlopov at place. Only laptop with microphone and webcam together with WiFi Internet connection was proved to support not only attendance, but also VIA presentations and discussions.

In the framework of the program of XXI Bled Workshop, S. Ketov, gave his talk "Starobinsky Inflation in Gravity and Supergravity" (Fig. 19.3), from Japan, while his co-author M.Khlopov continued the talk in Bled. VIA session also included discussion of searches for new physics at the LHC with participation at distance by A.Romaniouk from CERN. It provided an additional demonstration of the ability of VIA to support the creative non-formal atmosphere of Bled Workshops (see records in [32]).

The talks "Theories for initial conditions" by Holger B. Nielsen (Fig. 19.4) "Experimental consequences of spin-charge family theory" by Norma Mankoc-Borstnik (Fig. 19.5) were given at Bled, inviting distant participants to join the discussion.



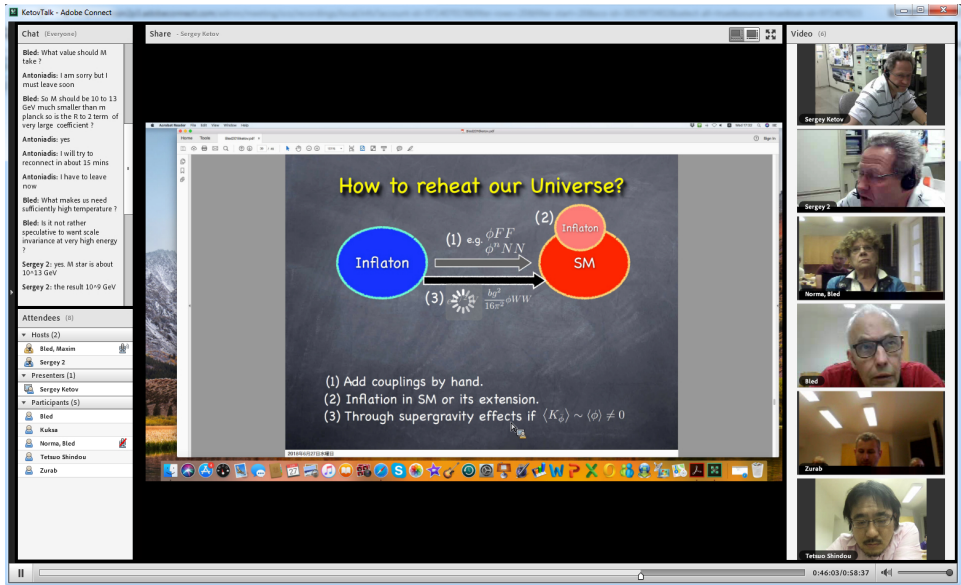


Fig. 19.3. VIA talk “Starobinsky Inflation in Gravity and Supergravity” by S. Ketov from Japan at XXI Bled Workshop

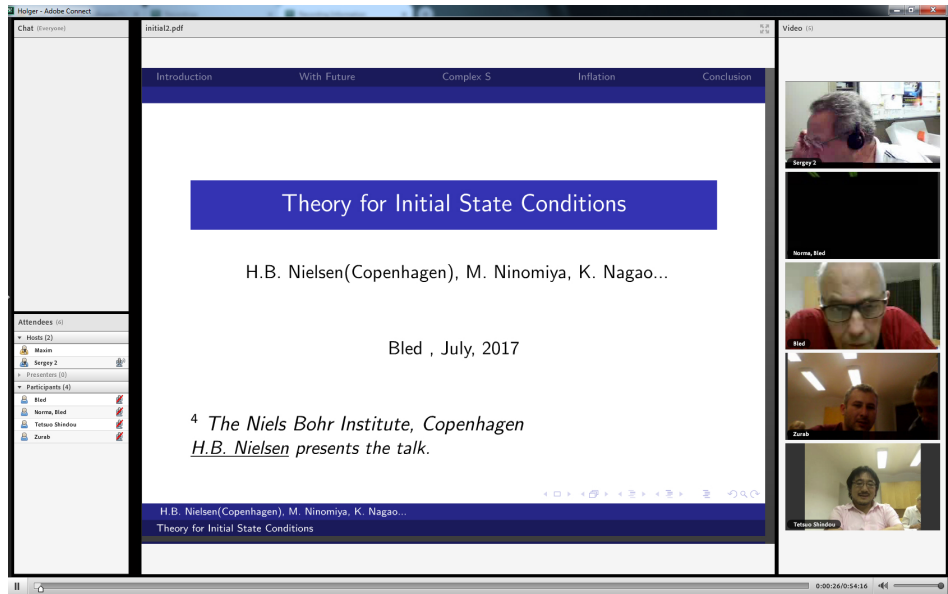


Fig. 19.4. VIA talk by Holger B. Nielsen “Theories for initial conditions” at XXI Bled Workshop

**Predictions:**

There is the fourth family to the observed three families.  
There are two triplets and three singlets determining masses  
and Yukawa couplings of all four families

$$\mathcal{M}^\alpha = \begin{pmatrix} -a_1 - a & e & d & b \\ e^* & -a_2 - a & b & d \\ d^* & b^* & a_2 - a & e \\ b^* & d^* & e^* & a_1 - a \end{pmatrix}^\alpha.$$

arxiv:1412.5866

**Fig. 19.5.** VIA talk “Experimental consequences of spin-charge family theory” by Norma Mankoc-Borstnik at XXI Bled Workshop

The records of all these lectures and discussions can be found in VIA library [32].

## 19.4 Conclusions

The Scientific-Educational complex of Virtual Institute of Astroparticle physics provides regular communication between different groups and scientists, working in different scientific fields and parts of the world, the first-hand information on the newest scientific results, as well as support for various educational programs at distance. This activity would easily allow finding mutual interest and organizing task forces for different scientific topics of astroparticle physics and related topics. It can help in the elaboration of strategy of experimental particle, nuclear, astrophysical and cosmological studies as well as in proper analysis of experimental data. It can provide young talented people from all over the world to get the highest level education, come in direct interactive contact with the world known scientists and to find their place in the fundamental research. These educational aspects of VIA activity is now being evolved in a specific tool for International PhD programme for Fundamental physics. VIA applications can go far beyond the particular tasks of astroparticle physics and give rise to an interactive system of mass media communications.

VIA sessions became a natural part of a program of Bled Workshops, maintaining the platform of discussions of physics beyond the Standard Model for distant participants from all the world. This discussion can continue in posts and post replies on VIA Forum. The experience of VIA applications at Bled Workshops

plays important role in the development of VIA facility as an effective tool of e-science and e-learning.

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26. In <http://viavca.in2p3.fr/> Forum - Education - Small thesis and exam of Steve Branchu
27. <http://viavca.in2p3.fr/> Previous - Conferences - The International Conference on Particle Physics and Astrophysics
28. <http://viavca.in2p3.fr/> Previous - Conferences - Dark Ages and White Nights (Spectroscopy of the CMB)
29. <http://viavca.in2p3.fr/> Previous - Events - Commemoration day for Patrick Fleury.
30. In <http://viavca.in2p3.fr/> Previous - Lectures - John Ellis
31. In <http://viavca.in2p3.fr/> Forum - CONFERENCES BEYOND THE STANDARD MODEL - XXI Bled Workshop "What comes beyond the Standard model?"
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