

DIAS-TH: Dubna International Advanced School of Theoretical Physics
Helmholtz International Summer School
**NUCLEAR THEORY AND
ASTROPHYSICAL APPLICATIONS**

BLTP JINR, Dubna, Russia, July 21 - August 1, 2014

TOPICS:

- nuclear structure and reactions
 - neutrinoless double β -decay
- superfluidity in nuclei and neutron stars
- terrestrial experiments for astrophysics
- neutrino interactions with nuclei / nuclear matter and supernovae
- condensation and phase transitions in dense matter

ORGANIZERS:

J. Margueron (IPN, Lyon)
G. Martínez-Pinedo (TU, Darmstadt)
V. Voronov (JINR, Dubna)

ORGANIZING COMMITTEE:

N. Arsenyev, Scientific secretary (JINR)
V. Novikova, Secretary (JINR)
A. Andreev (JINR)
A. Bezbakh (JINR)
D. Blaschke (JINR&U, Wroclaw)
V. Sargsyan (JINR)
A. Vdovin (JINR)

CONTACT ADDRESS:

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Helmholtz International Summer School "Nuclear Theory and Astrophysical Applications"
BLTP JINR, Dubna, Russia, July 21 - August 1, 2014



DIAS-TH: Dubna International Advanced School of Theoretical Physics
Helmholtz International Summer School
«Nuclear Theory and Astrophysical Applications»
JINR, Dubna, Russia, July 21 – August 1

The *Helmholtz International Summer School «Nuclear Theory and Astrophysical Applications»* was held on July 21 – August 1 at the Bogoliubov Laboratory of Theoretical Physics at the Joint Institute for Nuclear Research. The School was organized by BLTP at JINR together with Centres and Institutes of the Helmholtz Association. The co-organizers of the School were J. Margueron (Lyon, France), G. Martínez-Pinedo (Darmstadt, Germany) and V.V. Voronov (BLTP JINR). The School was also supported by the RFBR. This type of Schools for young scientists, postgraduates and undergraduates is an integral part of the DIAS-TH program established in BLTP.

The School Program was devoted to contemporary problems of the nuclear structure theory, and application of the corresponding results and methods in astrophysical studies. The audience of the School consisted of 44 students from JINR, Armenia, Belarus, Bulgaria, China, Egypt, Germany, Poland, Russia, Slovakia, Ukraine and USA. They attended 19 courses of lectures. Among topics of the lectures were the following: achievements and obstacles of the theory pretending to describe on the common footing atomic nuclei and neutron stars, theoretical predictions on surprising structure of the neutron star core, the search for neutrinoless double beta decay, which should solve the problem is the neutrino Majorana particle or not, and many others.

The Organizers invited the lecturers from universities and research institutes of Bratislava, Coimbra, Darmstadt, Dresden, Dubna, Lyon, Moscow, München, Obninsk, Orsay, Rostock, Wrocław, Würzburg and Jülich. Beside lectures, there were organized special seminars where professors explained in more detail the theoretical methods or specific features of experimental studies. Moreover, the students made exercises, which promoted more deep understanding of the lecture subject. On three special sessions, the School students gave short talks on their own investigations.

The lectures presented at the School are available at the web site: <http://theor.jinr.ru/~ntaa/14/>

Organizers:

J. Margueron (IPN, Lyon)
G. Martínez-Pinedo (TU, Darmstadt)
V. Voronov (JINR, Dubna)

Local Organizing Committee:

N. Arsenyev (JINR, Dubna) – Sc. secretary
V. Novikova (JINR, Dubna) – Secretary
A. Andreev (JINR, Dubna)
A. Bezbakh (JINR, Dubna)
D. Blaschke (JINR, Dubna & U. Wrocław, Poland)
V. Sargsyan (JINR, Dubna)
A. Vdovin (JINR, Dubna)

Lecturers/Lectures:

Blaschke, David (Joint Institute for Nuclear Research, Dubna, Russia and University of Wrocław, Wrocław, Poland)

Quark matter in compact stars

Borzov, Ivan (Institute for Physics and Power Engineering, Obninsk, Russia)

Beta-decay rates and production of heavy elements via r-process

Dzhioev, Alan (Joint Institute for Nuclear Research, Dubna, Russia)

Hot nuclei and weak-interaction mediated reactions in core-collapse supernova

Eremenko, Elena (Moscow Office Helmholtz Association, Moscow, Russia)

Activities of the Helmholtz association

Fischer, Tobias (University of Wrocław, Wrocław, Poland)

Role of microphysics in core collapse supernova simulations

Nguyen Van Giai (Institut de Physique Nucléaire Orsay, France)

The inner crust of neutron star: a mean-field description

Kolomeitsev, Evgeni (Matej Bel University, Banská Bystrica, Slovakia)

Fermi-liquid approach for superfluid systems, neutrino processes in neutron stars

Lähde, Timo (Forschungszentrum Jülich GmbH, Jülich, Germany)

Ab initio calculation of the Hoyle state and the viability of life in the Universe

Margueron, Jérôme (Institut de Physique Nucléaire Lyon, France)

Superfluidity in the crust of neutron stars

Meyer, Uwe (Moscow Office Helmholtz Association, Moscow, Russia and Woltersdorf, Germany)

EU-Russia S&T Cooperation under EU-FP 7: findings and recommendations and topics of horizon 2020

Rodríguez, Tomás (Universidad Autónoma de Madrid, Madrid, Spain and Technische Universität Darmstadt, Darmstadt, Germany)

Energy density functional in nuclear structure, fundamental physics and astrophysics

Röpke, Friedrich (Universität Würzburg, Würzburg, Germany)

Type Ia supernovae – modeling nuclear combustion processes

Röpke, Gerd (Universität Rostock, Rostock, Germany)

Correlations, clusters, and condensates in nuclei and nuclear matter

Šimkovic, Fedor (Joint Institute for Nuclear Research, Dubna, Russia and Comenius University in Bratislava, Bratislava, Slovakia)

Neutrinoless double beta-decay

Stratan, Gheorghe (Joint Institute for Nuclear Research, Dubna, Russia)

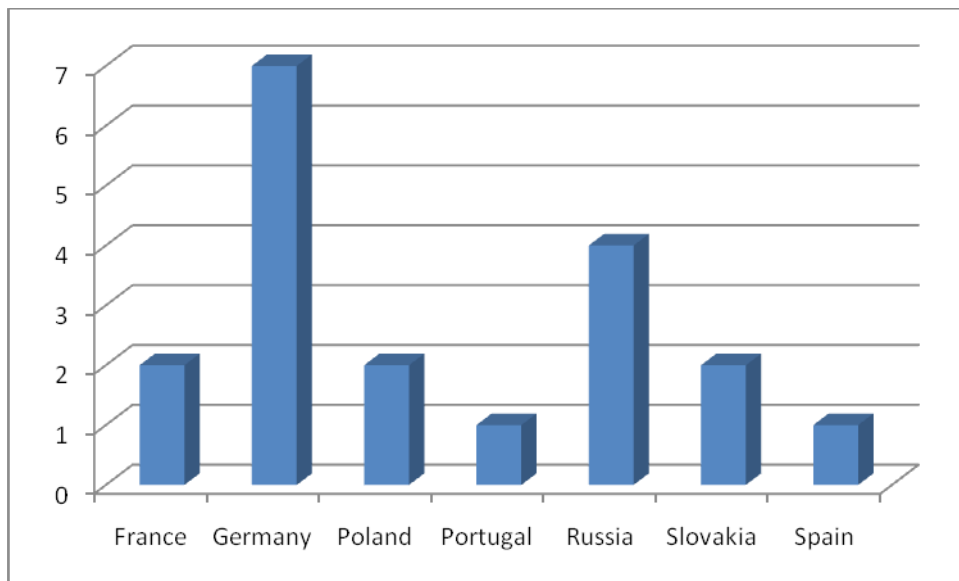
The role and place of Galileo in the first scientific revolution

Szücs, Tamás (Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany)
Underground nuclear astrophysics

Typel, Stefan (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany)
Equation of state in a generalized relativistic density functional approach

Vidaña, Isaac (Universidade de Coimbra, Coimbra, Portugal)
Hyperons, hypernuclei and neutron stars

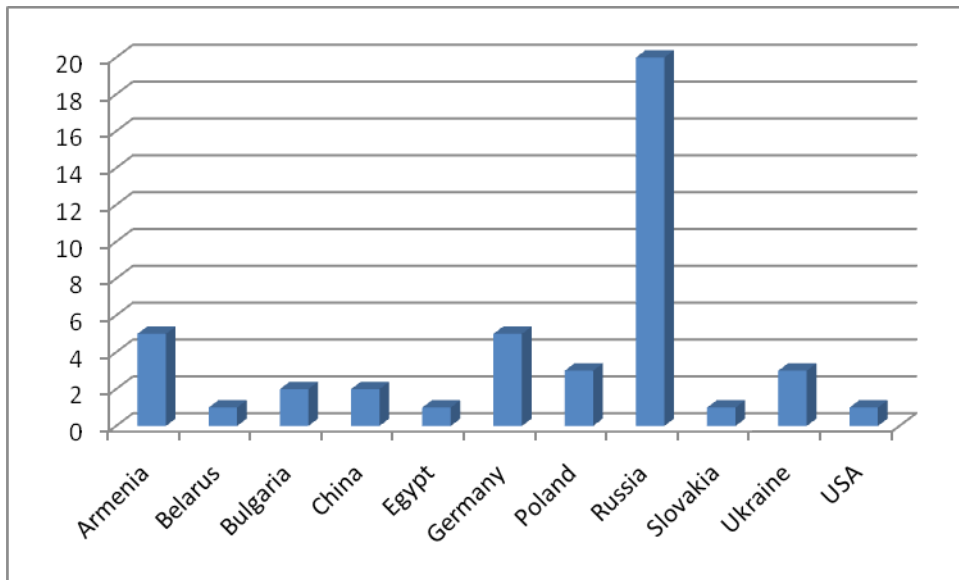
Wolter, Hermann (Universität München, München, Germany)
The nuclear symmetry energy from heavy-ion collisions



Countries	Lecturers
France	2
Germany	7
Poland	2
Portugal	1
Russia	4
Slovakia	2
Spain	1
Total	19

List of participants:

1. **Abzalov, Robert** (Kazan Federal University, Kazan, Russia)
2. **Achakovskiy, Oleg** (Institute for Physics and Power Engineering, Obninsk, Russia)
3. **Alvarez-Castillo, David** (Joint Institute for Nuclear Research, Dubna, Russia)
4. **Babic, Andrej** (Comenius University in Bratislava, Bratislava, Slovakia)
5. **Baza, Hend Magdi** (Modern University for Technology and Information, Cairo, Egypt)
6. **Bormotova, Iryna** (Oles Honchar Dnepropetrovsk National University, Dnepropetrovsk, Ukraine)
7. **Dolbilova, Nadejda** (Kazan Federal University, Kazan, Russia)
8. **Du, Dechuan** (Forschungszentrum Jülich GmbH, Jülich, Germany)
9. **Dubinín, Aleksandr** (University of Wrocław, Wrocław, Poland)
10. **Dvornicky, Rastislav** (Joint Institute for Nuclear Research, Dubna, Russia)
11. **Egorova, Irina** (Joint Institute for Nuclear Research, Dubna, Russia)
12. **Fischer, Sebastian** (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany)
13. **Galiev, Almaz** (Kazan Federal University, Kazan, Russia)
14. **Gevorgyan, Narine** (Russian-Armenian University, Yerevan, Armenia)
15. **Gnezdilov, Nikolay** (National Research Nuclear University MEPhI, Moscow, Russia)
16. **Goriev, Oleg** (Kazan Federal University, Kazan, Russia)
17. **Gorieva, Viktoria** (Kazan Federal University, Kazan, Russia)
18. **Grigoryan, Melanya** (Institute of Radiophysics and Electronics, Yerevan, Armenia)
19. **Kalendarov, Shuhrat** (Joint Institute for Nuclear Research, Dubna, Russia)
20. **Kaltenborn, Mark** (University of Tennessee, Knoxville, USA)
21. **Khachatryan, Knarik** (Byurakan Astrophysical Observatory, Byurakan, Armenia)
22. **Kharitonov, Anton** (Kazan Federal University, Kazan, Russia)
23. **Kolomiytsev, Georgy** (National Research Nuclear University MEPhI, Moscow, Russia)
24. **Kuznietsov, Pylyp** (Institute of Electrophysics and Radiation Technologies, Kharkiv, Ukraine)
25. **Liebing, Simon** (Technische Universität Bergakademie Freiberg, Freiberg, Germany)
26. **Lukashevich, Svetlana** (Gomel State University, Gomel, Belarus)
27. **Marquardt, Kai** (Universität Würzburg, Würzburg, Germany)
28. **Maslov, Konstantin** (National Research Nuclear University MEPhI, Moscow, Russia)
29. **Meng, Xu** (Institute of Theoretical Physics, Beijing, P.R. China)
30. **Mishev, Stoyan** (Joint Institute for Nuclear Research, Dubna, Russia)
31. **Mutafchieva, Yuliya** (Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria)
32. **Naskręć, Michał** (University of Wrocław, Wrocław, Poland)
33. **Naumovets, Artem** (Karazin Kharkiv National University, Kharkiv, Ukraine)
34. **Ohlmann, Sebastian** (Universität Würzburg, Würzburg, Germany)
35. **Pasca, Horia** (Joint Institute for Nuclear Research, Dubna, Russia)
36. **Piloyan, Arpine** (Yerevan Physics Institute, Yerevan, Armenia)
37. **Prosviryakova, Anastasiya** (Dubna University, Dubna, Russia)
38. **Sokołowski, Michał** (University of Wrocław, Wrocław, Poland)
39. **Solovyev, Alexander** (All-Russia Research Institute of Automatics, Moscow, Russia)
40. **Stoyanov, Zhivko** (Institute of Solid State Physics, Sofia, Bulgaria)
41. **Sun, Bao Yuan** (Lanzhou University, Lanzhou, P.R. China)
42. **Sushenok, Evgeny** (Dubna University, Dubna, Russia)
43. **Vardanyan, Ani** (Byurakan Astrophysical Observatory, Byurakan, Armenia)
44. **Zubov, Andrey** (Joint Institute for Nuclear Research, Dubna, Russia)



Countries Students

Armenia	5
Belarus	1
Bulgaria	2
China	2
Egypt	1
Germany	5
Poland	3
Russia	20
Slovakia	1
Ukraine	3
USA	1

Total **44**

Helmholtz International Summer School
“Nuclear Theory and Astrophysical Applications”
 Dubna, Russia, July 21 – August 1, 2014

PROGRAM

	July 22 (Tuesday)	July 23 (Wednesday)	July 24 (Thursday)	July 25 (Friday)		July 28 (Monday)	July 29 (Tuesday)	July 30 (Wednesday)	July 31 (Thursday)
9:30 – 10:00	Opening								
10:00 – 10:45	Nguyen Van Giai	H. Wolter	I. Vidaña	D. Blaschke		G. Röpke	T. Szücs	I. Borzov	T. Fischer
10:45 – 11:15	Coffee break								
11:15 – 12:00	Nguyen Van Giai	H. Wolter	I. Vidaña	D. Blaschke		G. Röpke	T. Szücs	I. Borzov	T. Fischer
12:00 – 12:45	S. Typel	T. Lähde	J. Margueron	E. Eremenko		F. Šimkovic	F. Röpke	T. Rodríguez	T. Fischer/ T. Rodríguez
12:45 – 15:00	Lunch break								
15:00 – 15:45	S. Typel	T. Lähde	J. Margueron	Excursion to NICA		F. Šimkovic	F. Röpke	T. Rodríguez	A. Dzhioev
15:45 – 16:30	G. Stratan	E. Kolomeitsev	E. Kolomeitsev/ I. Vadaña			D. Blaschke/ T. Lähde	G. Röpke/ F. Šimkovic	T. Szücs/ F. Röpke	A. Dzhioev
16:30 – 17:00	Coffee break					Coffee break			Farewell
17:00 – 18:00	G. Stratan	E. Kolomeitsev	H. Wolter/ J. Margueron			PC1	PC2	PC3	
18:00 – 19:00	Welcome	Nguyen Van Giai/S. Typel							

Lectures (45 min + 45 min) are marked with blue, seminars (60 min) are marked with green, PC – participant contributions (15-20 min each)

Saturday, July 26: Excursion to Uglich
 8:00 – departure of bus from the Hotel “Dubna”

Picnic in Ratmino: after excursion, approx. 18:00 – 21:00 (bring your favored music instruments)
 17:30 – departure of buses from the Hotel “Dubna”

Tuesday, July 22

8:30 – 9:30	Registration
9:30 – 10:00	Opening
10:00 – 10:45	Nguyen Van Giai: <i>The inner crust of neutron stars in non-relativistic and relativistic mean-field approaches</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Nguyen Van Giai: <i>The inner crust of neutron stars in non-relativistic and relativistic mean-field approaches</i>
12:00 – 12:45	Stefan Typel: <i>Equation of state in a generalized relativistic density functional approach</i>
12:45 – 15:00	Lunch break
15:00 – 15:45	Stefan Typel: <i>Equation of state in a generalized relativistic density functional approach</i>
15:45 – 16:30	Gheorghe Stratan: <i>The role and place of Galileo in the first scientific revolution</i>
16:30 – 17:00	Coffee break
17:00 – 18:00	Gheorghe Stratan: <i>The role and place of Galileo in the first scientific revolution</i>
18:00	Welcome-party

Wednesday, July 23

10:00 – 10:45	Hermann Wolter: <i>Nuclear symmetry energy from heavy-ion collisions</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Hermann Wolter: <i>Nuclear symmetry energy from heavy-ion collisions</i>
12:00 – 12:45	Timo Lähde: <i>Ab initio calculation of the Hoyle state and the viability of life in the Universe</i>
12:45 – 15:00	Lunch break
15:00 – 15:45	Timo Lähde: <i>Ab initio calculation of the Hoyle state and the viability of life in the Universe</i>
15:45 – 16:30	Evgeni Kolomeitsev: <i>Fermi-liquid approach for superfluid systems, neutrino processes in neutron stars</i>
16:30 – 17:00	Coffee break
17:00 – 18:00	Evgeni Kolomeitsev: <i>Fermi-liquid approach for superfluid systems, neutrino processes in neutron stars</i>
18:00 – 19:00	<u>Seminar A</u> – Nguyen Van Giai: <i>The inner crust of neutron stars in non-relativistic and relativistic mean-field approaches</i>
	<u>Seminar B</u> – Stefan Typel: <i>Equation of state in a generalized relativistic density functional approach</i>

Thursday, July 24

10:00 – 10:45	Isaac Vidaña: <i>Hyperons, hypernuclei and neutron stars</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Isaac Vidaña: <i>Hyperons, hypernuclei and neutron stars</i>
12:00 – 12:45	Jérôme Margueron: <i>Superfluidity in the crust of neutron stars</i>
12:45 – 15:00	Lunch break
15:00 – 15:45	Jérôme Margueron: <i>Superfluidity in the crust of neutron stars</i>
15:45 – 16:45	<u>Seminar A</u> – Evgeni Kolomeitsev: <i>Fermi-liquid approach for superfluid systems, neutrino processes in neutron stars</i>
	<u>Seminar B</u> – Isaac Vidaña: <i>Hyperons, hypernuclei and neutron stars</i>
16:45 – 17:00	Coffee break
17:00 – 18:00	<u>Seminar A</u> – Hermann Wolter: <i>Nuclear symmetry energy from heavy-ion collisions</i>
	<u>Seminar B</u> – Jérôme Margueron: <i>Superfluidity in the crust of neutron stars</i>

Friday, July 25

10:00 – 10:45	David Blaschke: <i>Quark matter in compact stars</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	David Blaschke: <i>Quark matter in compact stars</i>
12:00 – 12:30	Elena Eremenko: <i>Activities of the Helmholtz association</i>
12:30 – 13:00	Uwe Meyer: <i>EU-Russia S&T Cooperation under EU-FP 7: findings and recommendations and topics of horizon 2020</i>
13:00 – 15:00	Lunch break
15:00 – 17:00	Excursion to NICA

Monday, July 28

10:00 – 10:45	Gerd Röpke: <i>Correlations, clusters, and condensates in nuclei and nuclear matter</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Gerd Röpke: <i>Correlations, clusters, and condensates in nuclei and nuclear matter</i>
12:00 – 12:45	Fedor Šimkovic: <i>Neutrinoless double beta-decay</i>
12:45 – 15:00	Lunch break
15:00 – 15:45	Fedor Šimkovic: <i>Neutrinoless double beta-decay</i>
15:45 – 16:45	<u>Seminar A</u> – Timo Lähde: <i>Ab initio calculation of the Hoyle state and the viability of life in the Universe</i>
	<u>Seminar B</u> – David Blaschke: <i>Quark matter in compact stars</i>
16:45 – 17:15	Coffee break
17:15 – 18:00	<p style="text-align: center;">Participant Contributions</p> <p>Anna Bezbakh: <i>Level densities and shell corrections of superheavy nuclei</i></p> <p>Mark Kaltenborn: <i>Exotic nuclear shapes in the pasta phase of matter in neutron stars</i></p> <p>Michał Naskręć: <i>A model for particle freeze-out in the HIC</i></p>

Tuesday, July 29

10:00 – 10:45	Tamás Szücs: <i>Underground nuclear astrophysics</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Tamás Szücs: <i>Underground nuclear astrophysics</i>
12:00 – 12:45	Friedrich Röpke: <i>Type I supernovae – modeling nuclear combustion processes</i>
12:45 – 15:00	Lunch break
15:00 – 15:45	Friedrich Röpke: <i>Type I supernovae – modeling nuclear combustion processes</i>
15:45 – 16:45	<u>Seminar A</u> – Gerd Röpke: <i>Correlations, clusters, and condensates in nuclei and nuclear matter</i>
15:45 – 16:45	<u>Seminar B</u> – Fedor Šimkovic: <i>Neutrinoless double beta-decay</i>
16:45 – 17:15	Coffee break
17:15 – 18:00	<p style="text-align: center;">Participant Contributions</p> <p>Andrej Babic: <i>On the detection of solar neutrinos and reactor antineutrinos via scattering on atomic electrons</i></p> <p>Sebastian Ohlmann: <i>The white dwarf's carbon fraction as secondary parameter of Type Ia supernovae</i></p> <p>Kai Marquardt: <i>Detonation of O-Ne-white dwarfs</i></p>

Wednesday, July 30

10:00 – 10:45	Ivan Borzov: <i>Beta-decay rates and production of heavy elements via r-process</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Ivan Borzov: <i>Beta-decay rates and production of heavy elements via r-process</i>
12:00 – 12:45	Tomás Rodríguez: <i>Energy density functional in nuclear structure, fundamental physics and astrophysics</i>
12:45 – 15:00	Lunch break
15:00 – 15:45	Tomás Rodríguez: <i>Energy density functional in nuclear structure, fundamental physics and astrophysics</i>
15:45 – 16:45	<u>Seminar A</u> – Friedrich Röpke: <i>Type I supernovae – modeling nuclear combustion processes</i>
15:45 – 16:45	<u>Seminar B</u> – Tamás Szücs: <i>Underground nuclear astrophysics</i>
16:45 – 17:15	Coffee break
17:15 – 18:00	Participant Contributions Rastislav Dvornicky: <i>Unique forbidden beta-decays</i> Ani Vardanyan: <i>Chemical and kinematical properties of solar neighborhood stars</i> Knarik Khachatryan: <i>Kinematics of exoplanet hosting stars</i>

Thursday, July 31

10:00 – 10:45	Tobias Fischer: <i>Role of microphysics in core collapse supernova simulations</i>
10:45 – 11:15	Coffee break
11:15 – 12:00	Tobias Fischer: <i>Role of microphysics in core collapse supernova simulations</i>
12:00 – 13:00	<u>Seminar A</u> – Tomás Rodríguez: <i>Energy density functional in nuclear structure, fundamental physics and astrophysics</i>
	<u>Seminar B</u> – Tobias Fischer: <i>Role of microphysics in core collapse supernova simulations</i>
13:00 – 15:00	Lunch break
15:00 – 15:45	Alan Dzhioev: <i>Hot nuclei and weak-interaction mediated reactions in core-collapse supernova</i>
15:45 – 16:30	Alan Dzhioev: <i>Hot nuclei and weak-interaction mediated reactions in core-collapse supernova</i>
16:30	Closing

PARTICIPANT CONTRIBUTIONS

PC1: 28 July, Monday

Anna Bezbakh (Dubna): Level densities and shell corrections of superheavy nuclei

Mark Kaltenborn (Knoxville): Exotic nuclear shapes in the pasta phase of matter in neutron stars

Michał Naskręt (Wrocław): A model for particle freeze-out in the HIC

PC2: 29 July, Tuesday

Andrej Babic (Bratislava): On the detection of solar neutrinos and reactor antineutrinos via scattering on atomic electrons

Sebastian Ohlmann (Würzburg): The white dwarf's carbon fraction as secondary parameter of type Ia supernovae

Kai Marquardt (Würzburg): Detonation of O-Ne-white dwarfs

PC3: 30 July, Wednesday

Rastislav Dvornicky (Dubna): Unique forbidden beta decays

Ani Vardanyan (Byurakan): Chemical and kinematical properties of solar neighborhood stars

Knarik Khachatryan (Byurakan): Kinematics of exoplanet hosting stars

This kind of certificate signed by Prof. V.V. Voronov was given to all students of the School:

**Joint Institute for Nuclear Research
Bogoliubov Laboratory of Theoretical Physics
DIAS-TH: Dubna International Advanced School of
Theoretical Physics**



CERTIFICATE

This is to certify that

Simon Liebing

participated in the

Helmholtz International Summer School

**NUCLEAR THEORY AND ASTROPHYSICAL
APPLICATIONS**

**Dubna, Russia
July 21 – August 1, 2014**

**Prof. V. V. Voronov
School Chairperson**

