Ágnes Kis-Tóth

Date of birth: 16/09/1980 | **Nationality:** Hungarian | **Gender** Female |

(+36) 705619453 | agnes.kis-toth@ttk.elte.hu | skiszkao.web.elte.hu |

www.linkedin.com/in/agnes-kis-toth-82892b75 | Skype: skiszkao |

Pázmány Péter sétány 1/A, 3rd floor, room 3.312 , 1117, Budapest, Hungary

About me: "First I discovered mathematics since it is the mother tongue of nature. Now that we finally understand each other, it's time for the universe and me to sit down with a cup of coffee and talk about the most mesmerizing things."

EDUCATION AND TRAINING

2016 – CURRENT – Pázmány Péter sétány 1/A, Budapest, Hungary
ASTROPHYSICS PHD DEGREE – Eötvös Loránd University - Faculty of Science (ELTE -TTK)

Studies
- Major: Astronomy, High-energy astrophysics, Extragalactic astronomy
- Minor: Infrared astronomy, Dynamics of star systems, Star- and galaxy-populations, Black hole physics, Physics of the interstellar material, Neutrino physics

Teaching
- Gamma spectroscopy laboratory exercise
- Liquid scintillation spectrometry laboratory exercise
- Vector algebra and vector calculus - For physicists and for environmental science students

Additional skills
- Implementation of practical applications of the "Illustris TNG" cosmological simulation's data.
- Basic knowledge of the James Webb Space Telescope instruments and proposal planning tools.

Thesis: "Cosmological ionized bubbles around quasars in the high redshift universe and the era of Reionization"

Field(s) of study
- Astrophysics and Astronomy

physics.elte.hu/physics_phd

2013 – 2016 – Pázmány Péter sétány 1/A, Budapest, Hungary
PHYSICIST MASTER'S DEGREE – Eötvös Loránd University - Faculty of Science (ELTE -TTK)

Basic subjects
- Atomic and molecular physics, Nuclear physics, Statistical physics, Solid-state physics, Particle physics, Computer simulations, Laboratory exercises and Seminars, etc.

Astrophysics specialization
- Extragalactic astrophysics, Gravitational waves, Cosmology, General relativity, Nuclear and particle astrophysics, Observational methods

Particle physics specialization
- Relativistic quantum-electrodynamics I-II, Weak interaction, Strong interaction at low energies, Quantum chromodynamics, Experimental methods

Facultative subjects
- Galactic astronomy I-II, Space astronomy, Compact stars, Few-body problems in nuclear physics

Thesis: "Cosmological ionized bubbles"

Field(s) of study
- Astrophysics and Particle physics specialization

5.0 (Equivalent ECTS grade: A) with honours | physics.elte.hu/physics_msc

2010 – 2013 – Pázmány Péter sétány 1/A, Budapest, Hungary
PHYSICIST BACHELOR'S DEGREE – Eötvös Loránd University - Faculty of Science (ELTE -TTK)

Basic subject
- Mechanics, Mechanics of continuous media, Electronics, Electromagnetism, Thermodynamics, Optics, Astrophysics, Atomic and quantum physics, Particle and nuclear physics, Condensed matters, Chemistry, Laboratory exercises and Seminars, etc.
- Electro dynamics, Quantum mechanics, Statistical physics, Theoretical mechanics

Theoretical physicist specialization
- Relativity theory, Signal processing, Biophysics, Galactic dynamics, Self-organisation and complex behaviour, Interaction of radiation and matter, Advanced laboratory exercises

Facultative subjects
- Astronomy I-II, Astrometry, Astronomical observational practice I-IV, Evolutionary biology, Fluid mechanics

Thesis: "The effect of microstructure on hydrogen storage properties in magnesium-based amorphous alloys"

Field(s) of study
- Basic physics and theoretical physics specialization

5.0 (Equivalent ECTS grade: A) with honours | ttk.elte.hu/en/

1999 – 2006 – Pázmány Péter sétány 1/A, Budapest, Hungary
MATHEMATICIAN - UNDIVIDED BSC+MSC DEGREE – Eötvös Loránd University - Faculty of Science (ELTE -TTK)

Fundamental education (equivalent to Bachelor's)
Lectures and practical seminars
- Algebra I-IV, Linear algebra, Number theory I-II, Finite Mathematics I-II, Set theory, Mathematical logic
- Analysis I-IV, Functional analysis I-II, Function series, Complex function theory I-II, Ordinary & Partial differential equations, Topology, Algebraic topology,
- Probability theory I-II, Statistics, Operations research, Numerical analysis I-II, Symbolic Programming, Computation science
- Geometry I-III, Differential geometry I-II, Theoretical Physics, etc.

Specialized, more detailed education (equivalent to Master's)
Differential geometry specialization
- Lie-groups, Riemann-manifolds, Transformation groups and symmetric spaces, General structures, Physics and geometry, Bundles and connections, Differential forms

Functional analysis specialization
- Topological vector spaces I-II, Harmonic analysis I-II, C*-algebras, Non-bounded operators, Operator extensions, Geometrical functional alnalysis, Structure of spacetime

Operations research specialization
- Linear- and Non-linear programming, Stochastic programming, Time series, Whole-number programming, Game theory, Lattice theory, Decision analysis, Combinatoric algorithms

Information theory half-specialization
- Introduction, Data compression, Cryptography, Infromation theory methods in statistics

Thesis: "Linear operators on topological vector spaces - Tensor multiplicities and nuclear spaces"

Field(s) of study
- Theoretical mathematics

4.0 (Equivalent ECTS grade: B) | www.math.elte.hu/en/

1995 – 1999 – Bajcsy-Zsilinszky utca 17, Kaposvár, Hungary
HIGH SCHOOL GRADUATION – Táncsics Mihály Grammar School of Kaposvár

Mandatory subjects of the finals
- Mathematics, History, Hungarian grammar and literature

Facultative subjects
- English language, Physics

Field(s) of study
- Basic education and English specialization

5.0 (Equivalent ECTS grade: A) | www.tancsics.hu

WORK EXPERIENCE

2020 – CURRENT
MASTER EDUCATOR – EÖTVÖS LORÁND UNIVERSITY - FACULTY OF SCIENCE (ELTE -TTK)

Physics teaching methodology, Science communication, Astrophysical research
Science and research, mathematics and physics, and teaching and sharing them have become my true calling over the years. Therefore, my current position at the university has three pillars.

- **Teaching** in the 21st century. I want to find ways to improve physics education at all levels of study in order to make it effective, up-to-date, understandable and enjoyable for students, to adapt as much as possible to the changing student needs and to follow technological and societal developments.
- **Science communication.** It is more important than ever to communicate physics to the general public in an understandable and engaging way. My aim is to show the world that physics is an incredibly exciting, fun and cool science, and that physicists are not made to a template, but are just like everyone else: diverse.
- **Astrophysical research.** Physics has captivated me from the first day, but I've always been most drawn to the mysteries of the universe far far away. Every day we discover something new, which then leads to fresh exciting questions. The answers are the result of the thorough work of many scientists and I find it deeply inspiring to be part of this process.

Institute of Physics, Department of Atomic Physics | physics.elte.hu/en/ATOM_KisTothAgnes | Budapest, Hungary

2009 – 2017
TEACHER – PÁZMÁNY PÉTER CATHOLIC UNIVERSITY - FACULTY OF INFORMATION TECHNOLOGY AND BIONICS

Linear algebra, Discrete mathematics, Stochastic processes

- I was invited to teach practical classes of mathematics at the Pázmány Péter Catholic University in 2009. I started with just one group, but as the years went by, I began to teach more and more, and take on more responsibility. I soon played a major role in the practical education of "Linear algebra" and "Discrete mathematics" subjects as part of the basic mathematical education in the first year of Bionics and Information technology students. For a while I also had the opportunity to teach "Stochastic processes". In this Faculty I enlightened students about the beauty of mathematics for 8 wonderful years. I worked with more than 700 one-of-a-kind students and truly admirable co-workers, collected amazing experiences, learned and improved a lot. And I enjoyed every minute of it.

Mathematics Group of Subjects | itk.ppke.hu/en | Práter utca 50/A, 1083, Budapest, Hungary

2006 – 2010
TEACHER – TUTI SULI PRIVATE SCHOOL

Analysis, Economic math, Linear algebra, Probability theory, Statistics, Operations research, etc..

- Tuti Suli is a private school, a company specialising in tutoring university and college students. I started to work here after my mathematics studies In these 4 years I have encountered many subjects that my students needed and this experience was educational not just for them but also for me. I developed new skills in teaching, gained experience in group education, and at last I started to admire the science of statistics.

www.tutisuli.hu | Irinyi József utca 40/a., 1117, Budapest, Hungary

2001 – CURRENT
TUTOR

Teaching all kinds of math and physics to students of all ages and all levels

- When it first came to career choice, I was not attracted to the teaching profession. Yet during my college years I started tutoring. As the years went by, I taught more and more people and so teaching creeped into my life unnoticed. It was the biggest surprise for me when I realized how cool it is. Since then I have worked with countless students. From primary and high school, through university and college pupils to grown-ups and parents or even grandparents in adult education. I wouldn't even know where to begin to list the subjects that have found me over the years.

Budapest, Hungary

RESEARCH

2015 – CURRENT
Cosmological Ionized Bubbles

>> Classical H II regions result from the photoionization of a diffuse gas cloud by ultraviolet photons from a hot exciting star or from a cluster of stars. These sources create almost perfectly ionized sphere shaped bubbles around themselves, the so-called Strömgren spheres. The radius of such a region grows until it reaches an equilibrium state where the ionizations and recombinations balance each other. Quasars have similar ionizing effects in their vicinity. They create almost perfectly ionized nebulae around them, the cosmological ionized bubbles. These can be several orders of magnitude larger than in the classical case due to the higher intensity of the ionizing source and the less dense surrounding medium. While a classical H II region is considered static, an ionized nebula around a quasar can expand along with the universe because of its enormous size.
>> We use the basic theory of the classical Strömgren spheres and modify it to the cosmological case where we identify the sources with high redshift quasars in the expanding universe. The size, structure and evolution of these nebulae mostly depend on the ionizing spectra and the surrounding intergalactic medium (IGM). The density, the clumpiness, the temperature and velocity distribution of the IGM, the ionization rate prior to the luminous phase of the central supermassive black hole, and the amount of dust all play crucial roles. "Illustris TNG 100" simulation offers a good approximation in describing the nature of the circumgalactic and intergalactic medium at different redshifts, so we use that to have suitable initial properties of the gas and dust in our model. Finally we estimate the arising Lyman-alpha (Ly-α) surface brightness spectra of these ionized regions based on a detailed map of recombination events and radiative transfer processes.
>> Observations with the MUSE integral-field instrument of the Very Large Telescope revealed giant Ly-α nebulae around quasars in the redshift range 3-4. We investigate how well our basic theoretical approach of the fluorescent Ly-α radiation emerging after photoionization in a quasar's vicinity can explain the observed brightness in these nebulae. In addition to comparing our model with existing observational results, we aim to forecast the possible detection of such ionized regions before Reionization in the redshift > 6 era with the James Webb Space Telescope.
>> The epoch of cosmological Reionization is an important but still not well understood period in the history of our universe. Our current knowledge suggests that in the early universe ionizing sources, whether stars, galaxies or quasars, embedded in the neutral IGM generated separate H II regions, and these regions eventually could have overlapped to ionize the whole universe around redshift ~6. The goal of this research is to one day have a clearer picture about this era of major phase transition in the young cosmos.

2011 – 2015
Hydrogen storage in magnesium-based amorpous alloys

>> The energy needs of developing societies are increasing by the day, so it is urgent to provide energy with ever greater capacity in a more efficient way and through environmentally friendly techniques. An important issue is the energy supply for our means of transport, which is currently still based on the use of fossil fuels. A possible solution lies in the use of hydrogen (H). It is an excellent energy carrier and it is environmentally friendly. But there are still significant barriers to its use. One obstacle is the proper storage of H. One of the most promising ways to store it economically is to bind it in a suitable solid. Carbon nanotubes, graphene or certain metal alloys and compounds could provide a good basis for this. The most important aspect is their capacity, but many other parameters must be taken into account. The temperature and rate at which H is absorbed and released are crucial. The adsorption-desorption process must be stably reproducible over hundreds of thousands of storage cycles. The material and production costs of the technique cannot be neglected either.
>> Magnesium (Mg) is one of the most promising candidates for storage. Although Mg alone is not suitable for everyday use, its properties can be improved by mechanical alloying. In the case of a metal or a metal alloy, the nature of H sorption is largely determined by the size of the crystal grains, the volume fraction of grain boundaries and the density of crystal defects in the sample. The H uptake-discharge parameters can be drastically improved if the particle size in a powder sample is reduced to the nanometre scale, while the volume fraction of grain boundaries increases enormously. Further progress can be made with further degradation, like techniques based on high ductile deformation. One such method is the high pressure torsion (HPT), where the deformation is achieved by twisting the sample between two anvils. Increasingly reducing the size of the crystalline grains can have a positive effect on H binding, so the question arises as to what happens in the case where there are no crystalline grains at all, when the system is amorphous.
>> We used Mg based rapidly quenched amorphous metallic glasses for our research. The samples were subjected to HPT, which resulted in a deformation dependent microstructure. Based on high-resolution X-ray diffraction, transmission and scanning electron microscopy, and calorimetry results, we found that: The H uptake in a fully amorphous alloy occurs at a significantly lower temperature compared to the fully crystallized state. While maintaining the low adsorption temperature, H storage capacity can be remarkably increased by HPT. Due to the deformation, small Mg_2Ni crystalline granules are formed in the amorphous matrix, and it causes the sequestration of greater amounts of hydrogen.

HONOURS AND AWARDS

07/06/2018
FameLab International Science Communication Competition - Top 12 – Cheltenham Science Festival

Cheltenham, United Kingdom

- "FameLab is the world's leading science communication competition. It spotlights the science communicators of tomorrow, who can show off their area of expertise in a truly engaging way. Participants have three minutes to impress the judges and public, demonstrating world-class content, clarity and charisma."
- In 2018 I had the honour to represent Hungary in the international finals, where amazing science communicators from 27 countries competed. In the semifinal my presentation "Saving lives with complexity science" got me into the final, where I revealed "The true nature of black holes". I presented to the judges and the audience that black holes are actually just like invisible babies. For me, Famelab was not just a competition, it has given me an incredible amount of positive things. Experiences, friends, community, opportunities and development. New horizons and perspectives in my work and beyond.

www.britishcouncil.org/education/he-science/famelab
www.youtube.com/watch?v=_LIr934ND54 www.youtube.com/watch?v=gilB65weeGE

14/05/2018
FameLab Science Communication Competition - Winner – British Council & Hungarian Academy of Sciences

Budapest, Hungary

- The FameLab competition was first organised in Hungary in 2018 by the British Council and the Hungarian Academy of Sciences. That year the national competition consisted of two rounds of semi-finals. My first presentation was about "How to save lives with complexity science", and the second one was about "Holography, a hungarian invention". In the final I finally chose a topic that is the closest to my research and also to my heart: "About the true nature of black holes".

www.youtube.com/watch?v=B0omfWMsf8w

2014
Campus Hungary Scholarship – Ministry of Human Resources

Edinburgh, United Kingdom

- The Campus Hungary Programme is a higher education mobility programme implemented as part of the Social Renewal Operational Programme. The basic aim of the scholarship is to support and encourage the mobility of Hungarian higher education students. I received a grant to travel to Edinburgh and attend the International Conference of Physics Student. My main task was to represent Hungarian physicists and build links between Hungarian and foreign physics communities in the aim of future cooperations.

emmiugyfelszolgalat.gov.hu/hazai-felsooktatasi/campus-hungary-program/campus-hungary-program

2013
Republic Scholarship – Government of Hungary

Budapest, Hungary

- The "Republic Scholarship" is one of the most prestigious scholarships for students at higher education institutions in Hungary. It is given to students who have outstanding academic achievements and do excellent work in a professional field. In addition, the student's involvement in social, sport and other activities may be taken into account. The scholarship is awarded for one academic year.

to.ttk.elte.hu/?q=az-elte-ttk-felhivasa-a-2013-2014-es-tanevi-koztarsasagi-osztondij-palyazatra

18/04/2013
National Scientific Student Conference (OTDK) - 2nd place – National Scientific Student Council (OTDT)

Budapest, Hungary

- OTDK is the largest scientific event in Hungarian higher education. It is a conference and a scientific competition that takes place every two years. The event series has a history of more than seven decades, it covers the full spectrum of sciences, and has a special status in the national higher education talent management. In 2013 I competed in the "Physics, Earth Sciences and Mathematics" section and in the "Materials Science'' sub-section, where I earned a 2nd place.

otdk.hu

10/05/2012
"Faculty's Outstanding Student" Award – Eötvös Loránd University, Faculty of Science

Budapest, Hungary

- Faculty's Outstanding Student award is granted annually by the ELTE TTK Faculty Council on the basis of the recommendation of the Institutes and the opinion of the Academic and Teaching Committee. The title is awarded based on academic achievements, research and competition results, publications, as well as other professional, community and teaching activities.

ttk.elte.hu/content/az-elte-ttk-kivalo-hallgatoi.t.3443

26/11/2011
Scientific Student Conference (TDK) - 3rd place – Eötvös Loránd University, Faculty of Science

Budapest, Hungary

- The Faculty TDK conference is the antechamber of the national OTDK conference. It is an annual scientific competition, where university students present their research to a professional jury. In 2011 in the "Physics" section I received 3rd place and the Special award of the Atomki (Institute for Nuclear research) with my thesis and presentation on "Hydrogen storage in magnesium based amorphous alloys".

ludens.elte.hu/~tdkinfo/tdt

PUBLICATIONS

Cosmological ionized bubbles around quasars before Reionization

Ágnes Kis-Tóth, Zoltán Haiman, Zsolt Frei
2021
- In process -

- The era of cosmological Reionization is an important but still not well known period in the history of our universe. Our knowledge of H II regions around hot stars suggests how this process might have happened. Ionizing sources embedded in the neutral intergalactic medium (IGM) generated separate ionized bubbles, and these regions eventually could have overlapped to ionize the whole universe. We derive the cosmological generalization of the classical Strömgren spheres to the case of a quasar as an ionizing source in a cosmologically expanding gas in a FRW universe before Reionization. We estimate the measurable spectra of these nebulae, and show that in the future we might be able to observe them using JWST.

Cosmological ionized bubbles around quasars at redshift ~ 3 - 4

Ágnes Kis-Tóth, Zoltán Haiman, Zsolt Frei
2021
- In process -

- Quasars can ionize their environment in a similar way as the hottest stars create H II regions around themselves. Observations with the MUSE integral-field instrument revealed giant Lyman-alpha (Lya) nebulae around quasars in the redshift range 3-4. We investigate how well a basic theoretical approach can explain the observed brightnesses. We employ the Illustris TNG simulation to estimate the parameters of the intergalactic gas, thereafter we use the theory of Strömgren spheres but modify it to cosmological size ionized regions illuminated by quasars in an expanding FRW universe. We estimate the arising surface brightness after the recombination events and radiative transfer processes, and compare the outcomes with the observations.

To see the unseen - The first photo of a black hole in hiding

Ágnes Kis-Tóth
epa.niif.hu/02900/02930/00440/pdf/EPA02930_elet_es_tudomany_2019_25.pdf – 2019
Élet és Tudomány (Life and Science) - Weekly scientific journal

- In April 2019, the first image of a black hole, or more precisely its immediate surroundings, went viral on the net. But it didn't just fall into our laps. 100 years of research preceded it, and although it's a huge step, it's really just a stepping stone for further research. This article tells the story of the experimental exploration of black holes, the technique that allowed us to glimpse such a mysterious creature. What can we see in this photo, and what is the connection between the stunning vision of a black hole in the film "Interstellar" and this blurry, donut-like image. And why is this good for us, why is this such a big deal?

Tales from the Universe

Ágnes Kis-Tóth
kpsvr.hu/2019/04/05/mesek-az-univerzumbol-1-resz-szaguldozo-kis-zoeld-emberek – 2019
kpsvr.hu/2019/04/23/mesek-az-univerzumbol-2-resz-szuper-is-es-uj-is-mi-lehet-az
KPSVR - Online news site

- A short collaboration resulted in two science educational articles on an online news site in my hometown, Kaposvár. One of the entries "Speeding little green men" introduces readers to the super exciting astrophysical objects, the pulsars, and tells the unique story of their discovery. The second post "It is super and it is new, what is it?" recalls the history of supernovae observations going back a thousand of years, and the discovery of what these unexpected flashes in the sky really are.

Science communication in three minutes

Ágnes Kis-Tóth
https://epa.oszk.hu/02900/02930/00398/pdf/EPA02930_elet_es_tudomany_2018_33.pdf – 2018
Élet és Tudomány (Life and Science) - Weekly scientific journal

- FameLab is an annual worldwide international science communication competition that has been running since 2006. It is a competition, but its primary purpose is not to be competitive, but to build links between different parts of the world and between different disciplines of science. Hungary joined the programme in 2018, and that year I was able to represent Hungary at the international final at the Cheltenham Science Festival. This is a brief report on my experiences and lessons learned.

High glass forming ability correlated with microstructure and hydrogen storage properties of a MgCuAgY glass

Ádám Révész, Ágnes Kis-Tóth, Lajos K. Varga, János L. Lábár, Tony Spassov
www.sciencedirect.com/science/article/abs/pii/S0360319914009422 – 2014
International Journal of Hydrogen Energy 39 (2014) 9230-9240

- Thermal characterization of a $Mg_{54}Cu_{28}Ag_7Y_{11}$ metallic glass revealed that this alloy exhibits excellent glass forming ability. X-ray diffraction study and transmission electron microscopy show that heating and isothermal annealing treatment results in the nucleation of nanocrystals of several phases. Calorimetry experiments indicate that the as-cast fully amorphous alloy exhibits the largest enthalpy of hydrogen desorption, compared to partially and fully crystallized states. It is assumed that hydrogen storage capacity correlates only with the crystalline volume fraction of the partially crystallized metallic glass and additional parameters do not play a significant role.

Hydrogen storage, microstructure and mechanical properties of strained Mg65Ni20Cu5Y10 metallic glass

Ádám Révész, Ágnes Kis-Tóth, Péter Szommer, Tony Spassov
www.scientific.net/MSF.729.74 – 2013
Materials Science Forum 729 (2013) 74-79

- Melt-spun amorphous $Mg_{65}Ni_{20}Cu_5Y_{10}$ metallic glass compacts were subjected to severe shear deformation by high-pressure torsion. X-ray diffraction analysis and scanning electron microscopy revealed that high-pressure torsion resulted in a deformation dependent microstructure. Nanoindentation measurements indicated that the heavy shear deformation yields an increase in hardness. High-pressure calorimetry revealed that hydrogen uptake in the fully amorphous alloy occurs at a significantly lower temperature compared to the fully crystallized state, while the amount of absorbed hydrogen increased considerably after shear strain due to the formation of Mg_2Ni crystals.

Hydrogen storage of melt-spun amorphous Mg65Ni20Cu5Y10 alloy deformed by high-pressure torsion

Ádám Révész, Ágnes Kis-Tóth, Lajos K. Varga, Erhard Schafler, Imre Bakonyi, Tony Spassov
www.sciencedirect.com/science/article/abs/pii/S0360319911028941 – 2012
International Journal of Hydrogen Energy 37 (2012) 5769-5776

- Rapidly quenched amorphous $Mg_{65}Ni_{20}Cu_5Y_{10}$ metallic glass compacts were subjected to heavy shear deformation by high-pressure torsion until different amounts of ultimate strain. High-resolution X-ray diffraction analysis and scanning electron microscopy revealed that high-pressure torsion resulted in a deformation dependent microstructure. High-pressure calorimetry measurements revealed that hydrogen uptake in the fully amorphous alloy occurs at a significantly lower temperature compared to the fully crystallized state, while the amount of absorbed hydrogen increased considerably after heavy shear deformation due to the formation of Mg_2Ni crystals.

DIGITAL SKILLS

Basics

Linux, Windows | Latex Software | Office (Word, Excel, Outlook) | Zoom, Skype, Google Hangouts, Slack | Online Teaching (Teams, Moodle, Canvas) | Google Suite

Coding

Python programming | Matlab | HTML,CSS, JavaScript | Github | Gnuplot | Origin

Presentations

Prezi: Presentation Software | Microsoft Powerpoint | Basics of Photoediting

Video creating

Basics of Video Shooting | KDenlive video editing | Audacity sound editing

Social Network

Social Media Communication and Campaigns | Youtube

LANGUAGE SKILLS

Mother tongue(s): HUNGARIAN

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken production	Spoken interaction	
ENGLISH	C1	C2	C1	C1	C2
SPANISH	B1	B2	A2	A2	B1

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DRIVING LICENCE

Driving Licence: B