Напомена: У договору са аналитичарем за физику, Андријаном Ивановић, увод и закључак су на српском, док је остатак документа на енглеском језику, пошто је материјал преузиман из извештаја кандидата. Хвала пуно на разумевању!

Назив института – факултета који подноси захтев:

ИНСТИТУТ ЗА ФИЗИКУ БЕОГРАДУ

ИЗБОР У ЗВАЊЕ НАУЧНИ САВЕТНИК

РЕЗИМЕ ИЗВЕШТАЈА О КАНДИДАТУ ЗА СТИЦАЊЕ НАУЧНОГ ЗВАЊА

I Општи подаци о кандидату

Име и презиме: **Паси Хуовинен**
Година рођења: **1967**
ЈМБГ: **2407967660038**
Назив институције у којој је кандидат стално запослен:
Институт за физику у Београду

Магистрирао: **1996**, **Универзитет у Јиваскила, Финска**
Докторирао: **1999**, **Универзитет у Јиваскила, Финска**
Постојеће научно звање: **ниједан**
Научно звање које се тражи: **научни саветник**
Област науке у којој се тражи звање: **физика**
Грана науке у којој се тражи звање: **теоријска физика**
Научна дисциплина у којој се тражи звање: **нуклеарна физика и физика високих енергија**
Назив научног матичног одбора којем се захтев упућује: **Матични одбор за физику**

II Научно-истраживачки резултати (прилог 1 и 2 правилника):

1. Монографије, монографске студије, тематски зборници, лексикографске и картографске публикације међународног значаја (уз доношење на увид) (М10):

	број	вредност	укупно
M11 =			
M12 =			
M13 =			
M14 =			
M15 =			
M16 =			
M17 =			
M18 =			

2. Радови објављени у научним часописима међународног значаја (М20):

	број	вредност	укупно
М21а=	**11**	**10**	**110**
М21 =	**14**	**8**	**112**
М22 =	**11**	**5**	**55**
М23 =	**1**	**3**	**3**
М24 =			
М25 =			
М26 =			
М27 =			
М28 =			

3. Зборници са међународних научних скупова (М30):

	број	вредност	укупно
М31 =	**4**	**3.5**	**14**
М32 **=**	**18**	**1.5**	**27**
М33 =	**15**	**1**	**15**
М34 =	**20**	**0.5**	**10**
М35 =			
М36 =			

III **Квалитативна оцена научног доприноса (прилог 1 правилника):**

1. Квалитет научних резултата

1.1. Научни ниво и значај резултата

During the last fifteen years Dr. Pasi Huovinen has published 37 scientific papers in peer-reviewed international journals. Of these papers 11 belong to category M21a, 14 to M21, 11 to M22 and one to category M23. The total impact factor of these works is 127.857. In addition, in that period, Dr. Huovinen has been one of the authors in 57 talks in international workshops and conferences. 22 of these were by invitation.

In chronological order, the five most significant works of Dr. Huovinen during the last fifteen years are:

1. Pasi Huovinen and Denes Molnar,
   ``The Applicability of causal dissipative hydrodynamics to relativistic heavy ion collisions,"
   Phys. Rev. C79, 014906 (2009); doi:10.1103/PhysRevC.79.014906
   (IF 2009: 3.477, SNIP: 1.88, 106/110/107 citations)
2. Pasi Huovinen and Peter Petreczky,
   ``QCD Equation of State and Hadron Resonance Gas,"
   Nucl. Phys. A 837, 26-53 (2010); doi:10.1016/j.nuclphysa.2010.02.015
   (IF 2010: 1.986, SNIP: 0.83, 357/352/334 citations)
3. Harri Niemi, Gabriel S. Denicol, Pasi Huovinen, Etele Molnar and Dirk H. Rishcke,
   ``Influence of the shear viscosity of the quark-gluon plasma on elliptic flow in ultrarelativistic heavy-ion collisions,"

Phys. Rev. Lett. 106, 212302 (2011); doi:10.1103/PhysRevLett.106.212302
(IF 2010: 7.622, SNIP: 2.89, 179/178/150 citations)

4. Harri Niemi, Gabriel S. Denicol, Hannu Holopainen and Pasi Huovinen,
``Event-by-event distributions of azimuthal asymmetries in ultrarelativistic heavy-ion collisions,"
Phys. Rev. C87, 054901 (2013); doi:10.1103/PhysRevC.87.054901
(IF 2013: 3.881, SNIP: 1.89, 141/144/133 citations)
5. Jussi Auvinen, Kari J. Eskola, Pasi Huovinen, Harri Niemi, Risto Paatelainen and Peter Petreczky,
``Temperature dependence of eta/s of strongly interacting matter: effects of the equation of state and the parametric form of (eta/s)(T),"
Phys. Rev. C102, 044911 (2020); doi:10.1103/PhysRevC.102.044911
(IF 2017: 3.304, SNIP: 1.26, 0 citations)

As typical of the candidate's works, the first paper is a collaboration of specialists of two different subfields, Prof. Molnar being a specialist in kinetic theory. In this paper the candidate and his collaborator compared dissipative fluid dynamics and transport theory in detail, and showed that if shear viscosity coefficient over entropy density ratio, η/s, is very low, fluid dynamics is an applicable description of heavy-ion collisions. The reports of the quark-gluon plasma formed in these collisions being the most perfect fluid ever observed were just emerging at that time, and the candidate's results were essential in confirming that these reports were reliable, and not results of using fluid dynamics outside of its realm of applicability.

In the second paper the candicate teamed up with Dr. Petreczky, a specialist in lattice QCD calculations. At the time of writing of that paper, the lattice QCD calculations of the equation of state of strongly interacting matter were hampered by large discretization errors, and inability to carry out calculations using physical quark masses. Thus the lattice QCD equation of state was reliable only at large temperatures. The unphysically large quark masses lead to too heavy pions, and the authros showed that if one evaluates so-called Hadron Resonance Gas equation of state using these unphysically large pion masses, the result agreed with the lattice QCD results. Thus they postulated that a reasonable approximation of the physical equation of state can be obtained using Hadron Resonance Gas model (with physical particle properties) at low temperatures, lattice QCD result at large temperatures, and connecting these regions smoothly. Later lattice QCD calculations showed that this postulate had been correct. The authors provided a set of parametrised equations of state to be used in fluid dynamical calculations, which became immensely popular. As a result, the focus of fluid dynamical modeling of heavy-ion collisions shifted from studying the equation of state of strongly interacting matter to attempts to constrain its transport properties.

Unlike of the first two papers, the authors of the third and fourth paper are all specialists in fluid dynamics, who all had their appointments at the Goethe University in Frankfurt at that time. After it had became established that quark-gluon plasma has very low specific shear viscosity η/s, a question arose how it depends on temperature. In the third paper the authors found that in collisions at RHIC, the viscosity of hadron gas actually dominates over viscosity in plasma, which hardly affects any final observable. Only at the full LHC energy does the viscosity of plasma dominate. This means that extracting the temperature dependence of η/s is very complicated, but on the other hand, collisions at different energies clearly probe the properties of strongly interacting matter at different temperatures.

In the fourth paper the authors found that if scaled by their average values, the event-by-event distributions of the observed momentum anisotropies of the final state particles, and the event-by-event distributions of the anisotropies of the initial state, are identical, no matter what the properties of the fluid (equation of state, transport properties). This was a seminal discovery, since one of the problems of fluid dynamical modeling is that the initial state of the fluid dynamical expansion is unknown. There are various models to evaluate it, but their valdity had to be tested by carrying out the whole fluid dynamical calculation, and comparing to the data. Furthermore, when applied to the calculations, they all lead to slightly different transport properties of the fluid. The result of this paper provided a strong new constraint to the initial state models – it is sufficient to evaluate the event-by-event distribution of anisotropies given by an initial state model, compare to the event-by-event anisotropy data, and proceed only if they agree. This has helped to significantly constrain the state-of-the-art models for calculating the initial state, and therefore reduced the uncertainty in the extracted transport properties of quark-gluon plasma.
In the fifth paper the candidate and his collaborators returned to the topics of parametrised lattice QCD equation of state, and temperature dependence of η/s. The authors carried out a sophisticated Bayesian analysis of the data and the results of fluid dynamical modeling. The advantage of such modeling is that it provides not only favoured values of parameters, but also statistically meaningful credibility ranges to those values. The authors provided new parametrisations of the equation of state and showed that even if the favoured values of η/s depend on the equation of state, the difference is smaller than the inherent uncertainty of those results. Thus all the works in the literature based on by now outdated lattice results are still valid. Furthermore the authors explored how the assumed parametric form affects the temperature dependence of η/s, and found that their parametrisation lead to slightly larger minimum value of η/s than in previous Bayesian analyses (with overlapping credibility ranges). This emphasised the statistical nature of the Bayesian analysis and importance of the credibility ranges.

1.2 Позитивна цитираност научних радова кандидата

According to the Web of Science database, the candiate‘s works written since November 2005 have been cited 2229 times, according to the Scopus database 2235 times excluding author‘s own citations, and 1967 times if the self-citations by all authors have been excluded. This is a significant number demonstrating the candidate‘s contribution to the field, and his recognition among his peers. According to the same databases, the candidate‘s h-index for these publications is 23/23/22 (Web of Scienece/Scopus excludind autocitations/Scopus excluding autocitations by all authors). His h-index for his entire career is 31/30/30.

He is included in the World's Top 2% Scientists by Stanford University study.

1.3. Параметри и квалитет часописа

During the last 15 years the candidate has published 37 papers in international journals. Of these, 11 in category M21a, 14 in category M21, 11 in M22 and one in category M23 (invited review). All the journals are highly esteemed in the field of ultrarelativistic heavy-ion physics. The total impact factor of these works is 127.857.

Подаци о додатним библиометријским параметрима радова су дати у следећој табели:

М21, М22, М23	ИФ	М	СНИП
Укупно	127.857	280	54.73
Усредњено по чланку	3.456	7.568	1.50
Усредњено по аутору	43.576	95.570	18.47

1.4. Степен самосталности и степен учешћа у реализацији радова у научним центрима у земљи и иностранству

In large collaborations like many of the candidate‘s works, it is difficult to pinpoint the main author, and thus it is commonplace for authors to sign in alphabetical order. For example his latest publication was initiated by the candidate, the lattice QCD results were provided by Dr. Petreczky, parametrised by the candidate, the initial state calculation was by Prof. Eskola and Dr. Paatelainen, the fluid-dynamical calculations were carried out by Dr. Niemi, the Bayesian analysis by Dr. Auvinen, and the final paper was largely written by the candidate. In a similar fashion the canddtate has provided crucial inputs to all of his works.

In his scientific work Dr. Huovinen has concentrated on fluid dynamical description of heavy-ion collsions, and he is consired to be one of the leading experts in the field. His works have a reputation of being thoughtful, original, and devoid of hype. His reputation is manifested in the large number of citations of his works, many collaborators and invitations to talk. In addition, thanks to his expertise in fluid dynamical modeling of heavy-ion collisions, the candidate was hired by Dr. Magdalena Djordjevic for a project funded by a prestigious ERC grant.

2. Ангажованост у формирању научних кадрова

As a principal investigator in Wrocław, the candidate was responsible for hiring two graduate students and supervising their work related to the project. However, the candidate could not be their formal supervisor due to the rules of the University of Wrocław.

The candidate has given several well received introductory lectures to fluid dynamical modeling of heavy-ion collisions in various winter and summer schools. During the last decade these average almost one lecture per year.

The candidate has also been engaged in popularising science through well received popular lectures at science festifals in Poland.

3. Нормирање броја коауторских радова, патената и техничких решења

The candidate‘s publications are based on numerical simulations, and are often results of collaborations. Of the 37 publications 33 have five authors or fewer, so they enter with full weight. Two publications have six authors, one seven, and one publication has eight authors. Taking into account the rules on standardising the number of co-authored works, the candidate has achieved a total of **337.43 points** (346 without standardisation), of which **272.6 points** (280 without standardisation) from the M20 categories. These values are way above the minimum quantitative requirements for election to a Principal research Investigator, which prescribe a total of 140 points, and 70 from the M20 category.

4. Руковођење пројектима, потпројектима и пројектним задацима

During his appointment at the University of Wrocław, the candidate was the Principal Investigator of the project „Dissipative properties of strongly interacting matter formed in heavy-ion collisions“ funded by National Science Center (NCN), Poland, with Polonez grant 2015/19/P/ST2. As pricipal investigator, the candidate managed the whole project.

5. Активност у научним и научно-стручним друштвима

The candidate has participated in organising four workshops in heavy-ion physics, two in Germany, and two in Italy, and he was the main organiser of one of them.
He is a referee for several international journals, and has received both the APS outstanding referee award, and the Physics Letters B „Outstanding Contribution in Reviewing“ award. He is also a frequent reviewer of project proposals for three funding agencies.

6. Утицај научних резултата

The impact of the candidate‘s scientific results was discussed in Section 1 through analysis of the significance of the papers, their impact factors and the citation count.

7. Конкретан допринос кандидата у реализацији радова у научним центрима у земљи и иностранству

Dr. Pasi Huovinen has contributed significantly to every work in which he has participated, and due to his expertise in fluid dynamical modeling in general and equations of state in particular, these works would not have been completed without him. In the context of fluid dynamical modeling of heavy-ion collisions he has provided important insights in the validity of fluid dynamics, appropriate equation of state, temperature and chemical potential dependencies of shear viscosity coefficient, and technical details of so-called freeze out (or particlization).

The breadth of the candidate‘s international network of collaborators and connections is demonstrated by the large number of co-authors of his papers extending all around the world. He has ongoing projects with Dr. Petreczky (BNL, USA), Prof. Rischke (Frankfurt, Germany), Profs. Redlich and Sasaki (Wrocław, Poland), and Prof. Eskola and Dr. Niemi (Jyväskylä, Finland). He has been employed by several universities and research institutes, and consequently his work has been carried out in many countries.

8. Уводна предавања на конференцијама и друга предавања по позиву.

In the period of last fifteen years the candidate has given 22 invited talks, i.e. more often than once a year. Four of these talks were recorded as proceedings, and one of them was a plenary talk at the second International Conference on Particle Physics and Astrophysics (ICPPA 2016). He is a regular invitee to the Exited QCD series of workshops, and has given several talks at workshops organised at Brookhaven National Laboratory and at GSI, Darmstadt. All of this demonstrates his significant international visibility.

IV Оцена о научном доприносу кандидата са образложењем:

Резултати др Паси Хуовинена су објављени у великом броју еминентних међународних часописа. У истраживању блиско прати резултате великих експеримената, његова теоријска предвиђања су вишеструко потврђена, и радови цитирани у завидном броју. Значај његових резултата истиче и чињеница да је више пута позиван да представи свој рад на водећим светским конференцијама, као и добијене награде током научноистраживачке каријере. Додатно, уврштен је међу десет најцитиранијих научника у Србији на светској ранг листи научника Станфорд универзитета.

Имајући у виду значајан допринос др Паси Хуовинена области физике тешких јона, велико искуство и углед у овој области, као и остварену значајну међународну сарадњу, мишљења смо да је кандидат достигао високу научну зрелост и истраживачку компетенцију. На основу података из извештаја може се видети да вишеструко задовољава све квалитативне и квантитативне услове Закона о научноистраживачкој делатности Републике Србије за избор у звање научни саветник. Због тога нам је изузетно задовољство да предложимо Научном већу Института за физику у Београду да утврди предлог да се др. Паси Хуовинен изабере у звање научни саветник.

ПРЕДСЕДНИК КОМИСИЈЕ

др Магдалена Ђорђевић
научни саветник, Институт за физику у Београду

У Београду, 29.12.2020. године

МИНИМАЛНИ КВАНТИТАТИВНИ ЗАХТЕВИ ЗА СТИЦАЊЕ ПОЈЕДИНАЧНИХ НАУЧНИХ ЗВАЊА

За природно-математичке и медицинске струке

Диференцијални услов- Од првог избора у претходно звање до избора у звање.	потребно је да кандидат има најмање XX поена, који треба да припадају следећим категоријама:		
		Неопходно XX=	Остварено
Виши научни саветник	**укупно**	**140**	**346 (337.434 нормирано)**
	M10+M20+M31+M32+ M33+M41+M42	**100**	**336 (327.648 нормирано)**
	M11+M12+M21+ M22+ M23+M24	**70**	**280 (272.601 нормирано)**