Name of the research centre Jame of the research institute		Basic data				
	Wigner I Institute	Research Centre of the Hungarian Academy of Sciences for Particle and Nuclear Physics				
lame of the department Name of the research group	Theory I Femtose	Department				
eader of the research group	Tamás ( Develor	Songo ment and application of methods of measuring length-scales on the 10##(-15) m or femtometer.				
maximum 5 of the most important)	scale inc	luding: 				
	2. Pheno	solutions of medani nychodynamics menology of relativistic heavy ion collisions				
	4. Applie	memory of easite proton-proton counsions at LTIC, energies cations of the femtoscopic methods in the PHENIX experiment at BNL's RHIC accelerator				
	5. Appa	cations of remtoscopic methods in the TOTEAI experiment at CERN LITC.				
Sumber of staff (average)	The list of	the members of the research group is to be given on the 1st appendix page of the Excel docume	nt.			
sumber of PhDs	-	2				
sumber of Full Members of MTA	(					
umber of researchers under 35 years of age		2				
	The	The most important achievements and plans most important achievements in the last three years (in 3 sentences, maximum 700 characters)	_	_		_
ab-structures of the protons in classic proton-proton scatte sodel. We contributed significantly to a PHENIX paper on Ve are closing the analysis for a TOTEM-D0 paper on the HLC, we will detail the analysis of Levy-stable Bose-Einzer sesterch topics, with the applications of the newly found exa	ing , suggestii .evy stable B Me Odderon dise n correlations ct solutions o	or $_{\rm g}$ $_{\rm D}$ = (µ) quark-disquad structure of the proton at LHC energies, and confirming out (M, C energies), and confirming out (M, C energies), and confirming out (M, C energies) and the structure of the research group (LS version) (ELS versio	Isanád, F. Nei Isss drop of eta n collisions at se effects. Our rever-before ir	mes, T. Csörgő) é t'mesons in these TeV energies. In r theoretical resear naged (sub)structu	arlier results with t collisions. the PHENIX exp rch will support the area of the proton a	he Bialas-Bo eriment at F rse experime at LHC.
The list of the most important pub	ications of th	Publications c research group between 2016-2018 is to be given on the 2nd appendix page of the Excel docur Please also attach the full three-year publication list from MTMT.	nent (maximu	m 5 publications j	per year).	-
		2018 Total number of publications				
					1	number o
Jumulated IF in 2018		in foreign journals in foreign language	number 10	number of Q1	number of D1	Nature Ind
105,125 The number of independent citations in 2018	-	in Hungarian journals in foreign language in other peer-reviewed journals	0	0	0	
927		other (book, part of a book, atlas, map, article) including conference proceedings	44	N/A	N/A	N
Publication	s in the rese	arch group's own subject matter (first or last or corresponding author is a member of the	research gro	oup)		
			number	number of Q1	number of D1	number of
Cumulated IF in 2018		in foreign journals in foreign language	6	2	2	Nature Inc
14,922 The number of independent citations in 2018		in Hunganan journals in foreign language in other peer-reviewed journals	0	0	0	
141		other (book, part of a book, atlas, map, article) including conference proceedings	44	N/A	N/A	Ň
		2017 Total number of publications				
		*	1	1	T	
			number	number of Q1	number of D1	Nature Inc
106,945	_	in toreign journals in toreign language in Hunganan journals in foreign language	12	4	4	
he number of independent citations in 2017 1003		in other peer-reviewed journals other (book, part of a book, atlas, map, article) including conference proceedings	0 54	0 N/A	0 N/A	N
Publicatio	in the rese	arch group's own subject matter (first or last or corresponding author is a member of the	research or	) (100	-	
					r	number o
Considered TE in 2017	_	in familier investe in familier benever	number	number of Q1	number of D1	Nature Ind
3,304		in Hungarian journals in foreign language	0	0	0	
152		in other peer-reviewed journals other (book, part of a book, atlas, map, article) including conference proceedings	5	0	0	
		2016				
		Total number of publications				a.
			number	number of Q1	number of D1	number o Nature Ind
umulated IF in 2016 81,54		in foreign journals in foreign language in Hungarian journals in foreign language	11	5	4	
he number of independent citations in 2016 1087		in other peer-reviewed journals other (book, part of a book, atlas, map, article) including conference proceedings	17	17	5	
Publicatio	in the rese	earch group's own subject matter (first or last or corresponding author is a member of the	research or	(nuc)		
			<b></b>		1	
2. 1. 1101 2017			number	number of Q1	number of D1	Nature Ind
umulated IF in 2016 81,54		in toreign journals in toreign language in Hunganian journals in foreign language	6	0	0	
he number of independent citations in 2016 165		in other peer-reviewed journals other (book, part of a book, atlas, map, article) including conference proceedings	1	1	0	
		Participation in higher education				
	number	1				
egular active group members in Hungarian higher education	4					
y, , containing on unweight, and grad, subdents		1				
brained PhD degrees in the around in the last three	· ·	-				
balanced PhD degrees in the group, in the last three years						
Detained PhD degrees in the group, in the last three years		,				
Durined PhD degrees in the group, in the last three years Durined D.Sc degrees in the group, in the last three years The detailed dat	of the grants	Grants (2016-2018) solutioned by the group in the period of 2016 to 2018 are to be given on the 3rd appendix page of	of the Excel do	ocument		
Detained PhD degrees in the group, in the last three years Munimed D.Sc degrees in the group, in the last three years The detailed dat	of the grants	Grants (2016-2018) s obtained by the group in the period of 2016 to 2018 are to be given on the 3rd appendix page of	of the Excel do	ocument		
Donined PhD degrees in the group, in the last three years Donined D.Sc degrees in the group, in the last three years The detailed dat be number of obtained or ongoing <b>national individual</b> gr ou by a member of the research group.	of the grants	Grants (2016-2018) obtained by the group in the period of 2016 to 2018 are to be given on the 3rd appendix page of total corresponding grant budget per year (in thousand forms)	of the Excel de	ocument		
Denined PhD degrees in the group, in the last three years Denined D.Sc degrees in the group, in the last three years The deniled dat The deniled dat The number of obtained or orogoing <b>national individual</b> , go on by a member of the research group he number of obtained or orogoing <b>international individ</b> .	of the grants	Grante (2016-2018) colstained by the group in the period of 2016 to 2018 are to be given on the 'bel appendix page of notal corresponding grant budget per year (in thousand forints) total corresponding grant budget per year (in thousand forints)	1000 (est)			
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Csörgő Tamás Leader of the research group

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Name	Part time (p) or full (f)	date of birth sex	academic degree	During 2016-18:
Csörgő, Tamás (leader of the research group)	f, 2012-	1963.10.03 M	MAE, DSc, PhD	active= green
Csernai, László	р, 2012-13	1949.09.14 M	MAE, Ext. MHAS	part time=yellow
Jenkovszky, László	р, 2012-13	1942.05.02 M	Ext. MHAS	not active $=$ red
Lukács, Béla	f, 2012-13	1947.01.02 M	DSc.	in the period of 2016-18
Lucsányi, Dávid	f, 2013 -16	1990.12.05 M	MSc, PhD student	
Nemes, Frigyes János	f, 2013-	1974.05.31 M	PhD.	Below 35 years of age
Kasza, Gábor	f, 2015-	1991.09.27 M	MSc, PhD student	
Kincses, Dániel	p, 2015, 2017-	1994.05.02 M	MSc, PhD student	
Ster, András	f, 2012-	1957.11.29 M	MSc, PhD student	
Szanyi, István	f, 2018-	1997.07.21 M	MSc	
Vargyas, Márton	f, 2012-13	1990.04.01 M	MSc	
Vértesi, Róbert	р, 2012-16	1978.12.24 M	PhD.	
Sziklai, János	f, 2012-16	1950.05.15 M	CSci.	_

Please underline the authors belonging to the research group				
	2018	Impact factor of the journal in the previous year		
1	Creation of quark–gluon plasma droplets with three distinct geometries , Nature Physics (2018) https://doi.org/10.1038/s41567-018-0360-0, by the PHENIX Collaboration: Aidala C., Csanád M., <u>Csörgő T.,</u> Imrek J., Kincses D., Kurgyis B., Lökös S., Lovasz K., Majoros T., <u>Novák T.</u> , Novitzky N., <u>Sziklai</u> 1., et al. ) 320 authors, 9 pages, 19 citations)	22.727		
2	First determination of the total cross-section of pp collisions at sqrt(s) = 13 TeV with the TOTEM experiment at CERN LHC. Eur. Phys. J. C (2019) in Press, e- Print: arXiv:1712.06153 [hep-ex] TOTEM Collaboration: G. Antchev, M. Csanád, T. Csörgő, F. Nemes, T. Novák, J. Sziklai, et al. ( 87 authors, 41 citations). Corresponding TOTEM author: F. Nemes, corresponding TOTEM editor: T. Csörgő	5.172		
3	Lévy-stable two-pion Bose-Einstein correlations in Vs(NN) =200 GeV Au++Au collisions Phys.Rev. C97 (2018) no.6, 064911, e-Print: arXiv:1709.05649 [nucl-ex] (PHENIX Collaboration: A. Adare, <u>M. Csanád, <b>T. Csörgő, G. Kasza,</b> <u>T. Novák, J. Sziklai</u> et al) 448 authors, 22 pages, 12 citations, PHENIX internal paper preparation group included T. Csörgő).</u>	3.304		
4	Odderon and proton substructure from a model-independent Lévy imaging of elastic pp and pp <sup>-</sup> collisions <u>T. Csörgő</u> , R. Pasechnik and <u>A. Ster</u> , e-print: arXiv:1807.02897 [hep-ph] Eur. Phys. J C in press . (3 authors, 46 pages, 12 citations)	5.172		
5	Accelerating hydrodynamic description of pseudorapidity density and the initial energy density in p+p, Cu + Cu, Au + Au, and Pb + Pb collisions at energies available at the BNL Relativistic Heavy Ion Collider and the CERN Large Hadron Collider. <b>Phys.Rev. C97 (2018) no.6, 064906</b> , DOI: 10.1103/PhysRevC.97.064906, <b>e-Print:</b> arXiv:1711.10740 [nucl-th], Jiang Ze-Fang, Yang Chun-Bin, M. Csanád, <u>T. Csörgő</u> (4 authors, 9 pages, 6 citations).	3.304		
	2017	Impact factor of the journal		
1	Measurements of azimuthal anisotropy and charged-particle multiplicity in dd++Au collisions at vs(NN) =200, 62.4, 39, and 19.6 GeV, Phys.Rev. C96 (2017) no.6, 064905, DOI: 10.1103/PhysRevC.96.064905, e-Print: arXiv:1708.06983 [nucl-ex] by the PHENIX Collaboration: C. Aidala M. Csanád, T. Csörgő, T. Novák, J. Sziklai et al. (246 authors, 21 pages, 18 citations). T. Csörgő is member of the Internal Review Committee	3.304		
2	Measurement of long-range angular correlations and azimuthal anisotropies in high-multiplicity p+Au collisions at vs(NN) =200 GeV Phys.Rev. C95 (2017) no.3, 034910, DOI: 10.1103/PhysRevC.95.034910, e-Print: arXiv:1609.02894 [nucl-ex] by the PHENIX Collaboration: C. Aidala M. Csanád, T. Csörgő, T. Novák, J. Sziklai et al. (309 authors, 10 pages, 32 citations).	3.304		
3	Diamond Detectors for the TOTEM Timing Upgrade JINST 12 (2017) no.03, P03007 , DOI: 10.1088/1748-0221/12/03/P03007, e-Print: arXiv:1701.05227 [physics.ins-det]. TOTEM Collaboration: G. Antchev, et al. (82 authors, 28 pages, 10 citations). T. Csörgő: TOTEM Editor for arXiv.org.	1.310		
4	Initial energy density of vs = 7 and 8 TeV p+p collisions at the LHC . Universe 3 (2017) no.1, 9 DOI: 10.3390/universe3010009, e-Print: arXiv:1609.07176 [hep ph] by M. Csanád, T. Csörgő, Ze-Fang Jiang, Chun-Bin Yang (4 authors, 12 pages, 13 citations)	<b>2.</b> 513 (est.)		
5	Proceedings, 10th Bolyai-Gauss-Lobachevsky Conference on Non-Euclidean Geometry and its Applications (BGL10) : Gyöngyös, Mátra, Hungary, August 21- 26, 2017. (Edited by M. Csanád, T. Csörgő and T. Novák, 2017). BGL10 Special Issue of the MDPI Journal Universe. https://www.mdpi.com/journal/universe/special issues/BGL2017 (3 editors, includes 26 papers that received 22 citations)	special issue, edited proceedings		

	2016	Impact factor of the journal
1	Measurement of elastic pp scattering at sV=8 TeV in the Coulomb–nuclear interference region: determination of the ρ-parameter and the total cross-section, Eur. Phys. J. C76 (2016) no.12, 661, DOI: 10.1140/epjc/s10052-016-4399-8, e-Print: arXiv:1610.00603 [nucl-ex] by the TOTEM Collaboration: G. Antchev, M. Csanád, T. Csörgő, F. Nemes, T. Novák, J. Sziklai et al. (89 authors, 31 pages, 70 citations)	5.172
2	Observables and initial conditions for rotating and expanding fireballs with spheroidal symmetry, Phys.Rev. C93 (2016) no.2, 024916 , DOI: 10.1103/PhysRevC.93.024916 , e-Print: arXiv:1511.02593 [nucl-th], <u>T. Csörgő</u> , M.I. Nagy and I.F. Barna (3 authors, 13 pages, 10 citations)	3.820
3	Simple solutions of fireball hydrodynamics for rotating and expanding triaxial ellipsoids and final state observables, Phys.Rev. C94 (2016) no.6, 064906, DOI: 10.1103/PhysRevC.94.064906, e-Print: arXiv:1606.09160 [hep-ph], by M.I. Nagy, T. Csörgő (2 authors, 18 pages, 3 citations)	3.820
4	Centrality-dependent modification of jet-production rates in deuteron-gold collisions at Vs(NN) = 200 GeV Phys.Rev.Lett. 116 (2016) no.12, 122301, DOI: 10.1103/PhysRevLett.116.122301, e-Print: arXiv:1509.04657 [nucl-ex], by the PHENIX Collaboration: A. Adare, M. Csanád, <u>T. Csörgő, T. Novák,</u> R. Vértesi, <u>J. Sziklai</u> et al. (484 authors, 9 pages, 42 citations).	8.462
5	Evidence for Non-Exponential Differential Cross-Section of pp Elastic Scattering at Low  t  and \s = 8 TeV by TOTEM Published in <b>EPJ Web Conf. 120 (2016) 02004</b> , <b>DOI:</b> 10.1051/epjconf/201612002004 , <b>e-Print:</b> arXiv:1602.00219 [hep-ex], <u>T. Csörgő</u> for the TOTEM collaboration. (1+81 authors, 6 pages, 4 citations)	invited talk in a conference proceedings

Year of winning the Grant	Name of the Grant	Publisher of the Call	Total budget of the Grant
2012	NK-11438: Search for the critical point and for a new domain of QCD in PHENIX at RHIC and in TOTEM at LHC (PI: T. Csörgő)	OTKA/NKFIH	95.692 MHUF
2016	Hungarian Academy of Sciences - Ukrainian Academy of Science bilateral grant NKM-082/2016	Hungarian and Ukrainian Academies of Sciences	0.7 MHUF
2017	FK-123959: Consortional assoc.: Systematic investigation of the strongly interacting matter from SPS through RHIC to LHC energies (PIs: Máté Csanád and László András, T.Csörgő, G. Kasza, S. Lökös, T. Novák, I. Szanyi, A. Ster, are participants)	NKFI-6	18.9 MHUF
2017	EFOP 3.6.1-16-2016-00001 grant (PI: Papp József, EKE, T. Csörgő, G. Kasza, T. Novák participants)	EFOP	1.180.000 MHUF
2017	Hungarian Academy of Sciences - Ukrainian Academy of Science bilateral grant NKM-092/2017 (PI: T. Csörgő)	Hungarian and Ukrainian Academies of Sciences	0.8 MHUF
2017	Hungrian Academy of Sciences – Grant for the Organization of the BGL 2017 conference (PI: T. Csörgő)	Hungarian Academy of Sciences	0.5 MHUF
2018	Real and virtual photon production in pp, pA and AA collisions at RHIC and LHC (STSM for T. Csörgő at the University of Lund)	THOR project funded by COST	0.5 MHUF (est).
2018	ÚNKP-18-2 New National Excellence Program (for I. Szanyi, MSc, supervisor: T. Csörgő)	Hungarian Ministry of Human Capacities	1.0 MHUF (est)
2018	A novel model independent method to estimate source sizes and initial energy densities in high energy heavy ion and proton-proton collisions (STSM for A. Ster to the University of Lund)	THOR project funded by COST	0.5 MHUF (est).

#### Corporate/business relations (financial income)

During 2017, the Eszterházy Károly University sponsored our TOTEM research with 24 kCHF. During 2018, our outreach and research activity in the CERN LHC experiment TOTEM was supported by a private association, the Circles of Knowledge Club (Hungary).

2017		24 kCHF					
2018		7.340 MHUF					
Intellectual property rights (patents)							
VOLUNTARY REGISTER OF WORKS	Kiállítva	3555	Y1400587	Csörgő Tamás Ferenc	Constituents Of The Universe, In Your Hands On Rubik's Void, 4x4, 3x3, 2x2 And 1x1 Cubes		2014.10.28
VOLUNTARY REGISTER OF WORKS	Kiállítva	1854	Y1100418	Csörgő Judit ; Csörgő Tamás Ferenc ; Török Csaba	RÉSZECSKÉS KÁRTYAJÁTÉK, ELEMI RÉSZECSKÉK - JÁTÉKOSAN		2011.12.19
VOLUNTARY REGISTER OF WORKS	Kiállítva	1392	Y1000421	Török Csaba ; Csörgő Tamás ; Csörgő Judit	ELEMI RÉSZECSKÉK - JÁTÉKOSAN		2010.11.03

IP rights valid in the evaluated period 3 intellectual properties, registered in the voluntary register of works the period of 2010-2014, are valid in the evaluation period of 2016-18.

### Social usefulness, social services

Our group leader is regularly organizing a Science Summer Camp as a social event. Typically these were attended by about 25 secondary school students predominantly from the Berze Secondary Grammar School of Gyöngyös, Hungary, but they were open for nearby primary and secondary school students, their teachers as well as their parents including other senior citizens as well. These summer camps became social events, where researchers, teachers, students and parents meet and discuss predominantly science education and culture related topics. In the period of 2016-18, the following events were organized: 9. BerzeTÖK Science Camp, July 2016, Visznek, Hungary (5 days, 30 science outreach talks including practice, T. Csörgő, chair and organizer, speakers including T. Csörgő, G. Kasza, D. Kincses and T. Novák); https://indico.kfki.hu/event/420/

10. BerzeTÖK Science Camp, July 2017, Visznek, Hungary (5 days, 32 science outreach talks, T. Csörgő, chair and organizer, speakers including T. Csörgő, Zefang Jiang, G. Kasza and D. Kincses); https://indico.kfki.hu/event/553/

11. BerzeTÖK Science, July 2018, Mátraszentimre, Hungary, (5 days, 36 science outreach talks, T. Csörgő chair and organizer, speakers included T. Csörgő and G. Kasza); https://indico.kfki.hu/event/863/

3 BerzeTÖK Science Club Camps Alltogether 15 days, 98 science outreach talks, that reached about 100 students in the reporting period of 2016-2018.

### Dissemination / Public education / Science communication

2016, 2017, 2018: CERN Open Days at Wigner RCP of HAS, Budapest, Hungary (TOTEM and Particle Card Game exhibitions and hands-on practice with elementary particles).

10th Bolyai-Gauss-Lobachevsky Conference, EKE KRC, Gyöngyös, Hungary (T. Csörgő, Chair)

2016, 2017, 2018: Days of Femtoscopy, Gyöngyös, Hungary (T. Csörgő, Chair)

2016, 2017, 2018: Zimányi Winter School and Workshop on Relativistic Heavy Ion Collisions, Budapest, Hungary (T. Csörgő, Chair of IAC, A. Ster, G. Kasza members of LOC),

http://zimanyischool.kfki.hu/16/, http://zimanyischool.kfki.hu/17/, http://zimanyischool.kfki.hu/18/

2018.12.04. CsoPa – Wigner Science Cafe with T. Csörgő, entitled "Higgs boson- made at home."

10 Science dissemination, communication These events reached of the order of 600 persons, from various age groups, including 130 PhD students from the total of 281 participants of the Zimányi Winter and PhD schools Schools in the period of 2016, 2017 and 2018.

National cultural heritage

This point is generally not relevant for our research in the international environment of high energy particle and nuclear physics. However, particularly, let us note that we have organized one event that had to do with the Hungarian cultural heritage, namely the **10th Bolyai-Gauss-Lobachevsky Conference in Gyöngyös, Hungary during August 20-26, 2017**, https://indico.cern.ch/event/586799/, where Ms. Anna Oláh presented a talk entitled "From an unmarked tomb to UNESCO world herigate", that discussed how **J. Bolyai's Appendix made it to one of the (currently 7) Hungarian entries into the cultural heritage of the world.** Appendix is the primary document of the epoch-making discovery of János Bolyai, a turning point in geometric research. For over two thousand years many of the best mathematicians tried to prove Euclid's parallel postulate (or axiom). **János Bolyai not only created an entirely new settings for the problem by creating absolute geometry,** that is independent of parallelism, but he also had a vision about how the geometry should be fused with physics. Our conference was the first of the Bolyai-Gauss-Lobachevsky conference series where the dream of Bolyai was seen to become explicitely realized with sections reporting about the observation of gravitational waves, recently discovered by the LIGO and the VIRGO collaborations.

scientific directors or scientific officers (or equivalent), and will send the report sheets meant for research groups to the leaders of the such groups. The director general will fill in the report sheets concerning the research centre as a whole only with regard to the organisational units not subordinated to any of the institutes within the centre, and will additionally outline there the significant scientific and economic

# Report sheets for research groups

send them to the director general (or to the director in the case of an independent institute), who will forward them to the evaluators.

requested to provide the last three years' relevant data (publications, grants, etc.), as it is prearranged in the sheet.

from MTMT and attached to the sheet.

publications) can be added in free text format in the dedicated text boxes of the sheets, or in the 3sentence part on achievements and plans.

## Report sheets for research institutes

• In case of research centres it is the scientific directors who are required to complete the report sheets, in case of an independent institute it is the director who will complete them.

Since the annual reports contain the institutes' statistical data, institutes are requested to provide the relevant data (publications, grants, etc.) only for the year 2018, as it is prearranged in the sheets. attached to the sheet.

publications) can be added in free text format in the dedicated text boxes of the sheets, or in the 10sentence part on achievements and plans.

# Report sheets for research centres

director general.

Two different sets of data are requested in the report sheets:

of the organisational units belonging directly to the director general (research groups, core-facilities, administration, etc.).

issues that are of interest to the research centre as a whole. This is the part where the most important points, of relevance to the whole centre, can be outlined.