Detailed closing report, OTKA K133046 project. Principal Investigator: T. Csörgő

„Discovering the vector and tensor glueballs at CERN LHC with the TOTEM and CMS experiments"

Our research proposal indicated, that we plan to flexibly adopt to the possible changes of the running scenarios of the LHC, by flexibly shifting the balances among the planned data taking, data analysis and theoretical modelling activities. Thus our research perfomance corresponds to this, fortunately flexible research plan, although we may note that the changes in the LHC running and data taking scenarios have been larger than expected, due to the COVID pandemic, that effected also the PI personally in the final academic year of the project.

Highlighted results and summary:

We have published 49 papers related to this NKFIH/OTKA project [1-49]. Some of these results reported about important milestones achieved at CERN LHC. These papers were not only published in leading (typically Q1 and D1) journals of the field (*Physical Review Letters, European Journal of Physics C, Universe etc*) but some of them **have already been highly cited and have attracted significant online attention scores** as well. In some cases, these papers induced a scientific debate that is expected to be concluded in the subsequent grant period. In particular:

- We have published the first measurement of the total proton-proton cross-section at sqrt(s) = 13 TeV, a paper submitted for a publication before the grant period but published at the beginning of the grant period [3]. **This result has attacted more than 100 citations by now.** F. Nemes acted as the corresponding author and T. Csörgő acted as the corresponding TOTEM editor for this work. This measurement has been repeated later by the ATLAS collaboration with significantly smaller errors and somewhat different central values, generating a wave of scientific discussions, that are expected to be concluded only after the end of this project.
- **Two of our papers were quoted between 50 and 99 times**: the current count of citations for refs. [8] and [11] are 95 and 94, respectively. Ref. [8] reports about the TOTEM measurement of the differential cross-section of elastic proton-proton collisions at sqrt(s) = 2.76 TeV, while ref. [11] is a joint paper of the D0 and TOTEM collaborations, published in August 2021, reporting on the observation of odderon exchange from a comparision of elastic proton-antiproton and proton-proton collisions at the TeV energy scale. The latter result relies on, among others, refs. [3] and [8], hence its validity is currently under scientific scrutinity. The ongoing clarifications are expected to be published only after the end of this project. Note that ref. [11] was reported in Nature Reviews Physics by E. Leader: *Discovery of the odderon.* *Nat Rev Phys* **3**, 680 (2021). The same paper [11] was also listed as the first physics discovery at LHC during 2021 in the annual LHC evaluation report entitled *Relive 2021 at CERN.*
- We have published **18 additional well cited papers** with the support of this grant, that were very well cited (between 10 and 49 times) before the finalization of this closing report. These papers include our few-authored publications, reporting on the observation of odderon-exchange:
    - Our paper published by 5 authors in a Hungarian-Swedish collaboration in February 2021 [10] was recognized as a particle physics milestone achieved at LHC by CORDIS, the science monitoring agency of the European Commission. This manuscript reported on a new scaling and a re-analysis of public domain, already published data. It received high online attention, being in the top 5 % of research outputs ever scored by Altmetric.com. The statistical significance of odderon exchange is at least 6.26 σ. Our priority for the first statistically significant observation of odderon exchange is

protected clearly by a refereed conference contribution at ISMD 2019, Santa Fe, NM, USA, published in 2020 [6].

- Our odderon exchange discovery paper [10] was seconded by a theoretical paper of the PI and I. Szanyi [11], published in July 2021, that increased the statistical significance of odderon exchange to above 7 σ [12]. The statistical significance of odderon exchange has been further increased by us [20], by taking into account the well-cited and new 8 TeV data from TOTEM [18]. We found that the probability of odderon exchange can be expressed by more than 300 times the digit 9 that follow the decimal point after the leading integer 0: this number is practically 1. Thus odderon exchange is characterized in any practical terms not by a certainty [20].
- We have found a statistically significant hollowness in elastic proton-proton collisions at the top LHC energies, in another well-cited few-authors paper [9].
- We have performed various searches for new (beyond standard model) physics with the help of joint CMS and TOTEM papers [7, 19, 26, 27, 31]. We have also published the first paper that prepares the way for the search for tensor glueball in central exclusive proton-proton collisions at LHC, searching for charged kaon and pion pairs in central exclusive production [36]. Although this result published in 2024 needs more time for achieving significant amount of citations, we mention it here as it points towards one of our important project goals and milestones.
- Due to the COVID-related delays in datataking at LHC we have also made significant effort to analyze data taken before, following the flexible strategy mentioned in our research proposal. In particular, we have analyzed data taken at Brookhaven National Laboratory in the framework of the PHENIX Collaboration. Some of the papers published with PHENIX become well-citated already: refs. [31,32,33,49] achieved at least 10 citations before the finalization of this closing report. It is important to mention, that [33] is a well-cited erratum to a paper prepared by our group, which has been followed up by a centrality dependent determination of in-medium mass modification of the η' meson in sqrt(s(NN)) = 200 GeV Au+Au collisions [41]. This indirect measurement seems to be the first observation by an experimental collaboration of an important and theoretically well established restoration of the $U_A(1)$ symmetry in hot and dense hadronic matter: due to this reason, although [41] is currently only availble in a preprint form, submitted to Physical Review C, we plan to organize a press release after this milestone result becomes published in its final form.

In addition**, three dissertations** were produced [50,51,52]: G. Kasza succesfully defended his PhD thesis in Physics at the Eötvös University, Budapest [50]. I. Szanyi presented his PhD thesis in a successful home defense at HUN-REN Wigner RCP, Budapest, a preparatory step for a PhD defense at the Eötvös University in 2024/25 [51]. T. Novák submitted his habilitation thesis to the University of Debrecen (expected defense in fall 2024) [52].

Finally let us mention that during 2023 we have organized a world-class conference, ISMD 2023 in Gyöngyös, Hungary. The conference report has been published in Nuclear Physics News [53].

Many of us have recently migrated from TOTEM to the CMS collaboration. The CMS participation of our research group has resulted in a large number of high quality (mostly Q1) publications of the PI and his team. **These additional 406 publications as members of the CMS collaboration only (in addition to the common CMS-TOTEM papers, subject of the present grant) are neither listed nor**

reported here, as they are funded from different other projects. Nevertheless, we make the list of these additional publications available at the following link:

https://inspirehep.net/literature?sort=mostrecent&size=25&page=1&q=a%20csorgo%20and%20cn%20CMS%20and%20not%20cn%20TOTEM

Due to two reasons, we have asked for the extension of the closing time of this project, without additional FTE requirements and without additional funding. First, at the end of 2023, the Principal Investigator (PI) became COVID positive and recovered slowly, due to this reason we have asked a deadline extension up to February 28, 2024. The second reason was due to the fact, that editing the conference proceedings volume of ISMD 2023 lasted longer than expected, due to some delayed conference contributions. We had to save some of the funds for the costs of article processing charge (APC) for two conference papers that were evaluated at the Q1 journal MDPI Universe, that published the ISMD 2023 proceedings. In the last moment, after acceptance, the APC has been waived, and we have refunded the corresponding savings to the NKFIH/OTKA office.

We have made two milestone discoveries that are expected to have lasting impact on high energy particle and nuclear physics, among the high number of more regular publications and scientific results. The first of these milestone results is the discovery of odderon-exchange, which implies the existence of several odd-gluon bound states, the so-called glueballs, the lowest-lying state being the vector glueball [34]. We have published the first manuscript that prepares the s-channel observation of the tensor glueball [36] but more time is needed for the completion of publications of several internal CMS and TOTEM presentations. However, we have observed and submitted for a publication, for the first time based on a dedicated Bose-Einstein correlation measurement by an experimental collaboration, the indirect observation of $U_A(1)$ symmetry restoration in hot and dense hadronic matter. After acceptance and publication in a final form, this result is expected by us to be the second milestone result from our research project [41].

In this K0133046 NKFIH project, we have thus over-achieved our project goals and plans, that included flexibility and planned changes, adopting the project to the expected (mostly COVID related) modifications of the running plans of the Large Hadron Collider (LHC) at the European Organization of Nuclear Research (CERN). This is also clear from the list of awards and recognitions to the members of our research during the period of this grant, listed below.

Awards and honors to our papers and members of the group, received during the grant period:

2020:

CMS Collaboration Achievement Award to our colleague, Frigyes János Nemes. He won this award for: "his innovative, original and careful determination of the LHC optics from the PPS data, a key ingredient for all analyses based on PPS information."

2021:

T. Csörgő, the PI of this project was recognized as an Outstanding Referee by APS, the American Physical Society, in February 2021. https://journals.aps.org/OutstandingReferees

I. Szanyi was recognized by the Márton Áron Medallion of the Márton Áron Szakkollégium of Eötvös University, partly due to his participation in the discovery of odderon exchange, In September 2021: https://martonaron.elte.hu/szakkollegium/dijak-elismeresek

The Director General of MATE Károly Róbert Campus presented a Certificate of Recognition for the Discovery of the Odderon as published on February 23, 2021 in the European Physical Journal C 81, 180 (2021) to all five members of the Hungarian – Swedish team, in November 2021.

T. Novák received the Prima Prize of Heves County, Hungary, in December 2021.

In December 2021, I. Szanyi received a Prize of Distinction (különdíj) of the Hungarian Council of Subcarpathia, Ungvár, Ukraine.

2022:

In November 2022, Christophe Royon, a member of our project team, was awarded the 2022 gold medal of the Mexican Physical Society, Division of Particles and Fields, among others "for his leadership in the discovery of odd-gluon state odderon from elastic proton–proton and proton–positron collisions at the TOTEM and DØ detectors". https://cds.cern.ch/record/2843734

The paper supported by this NKFIH/OKTA K0133046 project, by G. Kasza, L. P. Csernai and T. Csörgő: *Entropy* **24** (2022) 4, 514, https://doi.org/10.3390/e24040514 , Q1, IF = 2.738, was recognized as „Feature Paper" during 2022.

The earlier paper of T. Csörgő, G. Kasza, M. Csanád and Z.-F. Jiang: *Universe* **4**, (2018), 69, https://doi.org/10.3390/universe4060069 , Q1, IF = 2.738 was recognized as „Editor's Choice" during 2022 and was also recognized as „Feature Paper", also during 2022.

2023:

T. Csörgő and T. Novák were both honored by the 2023 Research Excellence Pilot Programme of University MATE, Gödöllő, Hungary, https://research.uni-mate.hu/hu/researchers

2024:

T. Csörgő was granted a Flagship Research Group with the support of the Research Excellence Programme of University MATE, Gödöllő, Hungary, G. Kasza, T. Novák and I. Szanyi were each honored by the 2024 Research Excellence Programme of MATE, https://research.uni-mate.hu/hu/class-of-2024

Conferences organized with the support of the NKFIH/OTKA project K133046:

2020:

On October 29, 2020 we have organized the 6th Day of Femtoscopy in Gyöngyös, Hungary. It was an international conference with online participation due to the COVID pandemic. We had 18 participants from Hungary, The Netherlands, India, Sweden, Switherland and the US.

2021:

On October 28, 2021 we have organized the 7th Day of Femtoscopy in Gyöngyös, Hungary. It was an international conference with 18 participants from Hungary, The Netherlands, Sweden, Switzerland and the US.

2022:

On November 15, 2022 we have organized the 8th Day of Femtoscopy in Gyöngyös, Hungary. It was an international conference with 16 participants from Hungary, The Netherlands, Poland, Sweden, Switzerland, Ukraine and the US. https://indico.cern.ch/event/1219208/

2023:

A world-class conference, the 52th International Symposium on Multiparticle Dynamics has been organized by us in Gyöngyös, Hungary, August 21-26, 2023. 129 physicists from 32 countries across 5 continents attended ISMD 2023, that was held on the Károly Róbert Campus of the Hungarian University of Agriculture and Life Sciences in Gyöngyös, Hungary. Over the one-week period, a total of 128 scientific reports were delivered at the international conference was chaired by the Principal Investigator (PI) of this NKFIH K0133046 project, and the local and international organizing committee included the team members of the same project. The conference report was published in Nuclear Physics News [53].

The proceedings has been published as a Special Issue on Multiparticle Dynamics by the MDPI Journal Universe (Q1, IF 2.8), containing 22 refereed papers with new results [46]. The conference report has been published in Nuclear Physics News and also an online proceedings with 32 papers [47] (including the 22 new results published in the Special Issue and also several arXiv.org e-prints and other publications) were also made public. The organization of ISMD 2023 in Gyöngyös, Hungary was a success and indicated the international recognition of our research results.

Three out of the ten main ISMD 2023 topics attracted particularly large interest. The greatest international interest was generated by the latest research results concerning the subatomic particle candidate known as X17, which had been discovered at the Hungarian Research Network Institute for Nuclear Research (ATOMKI) located in Debrecen, Hungary. The nearly perfect fluid behavior, observed experimentally in high energy collisions of elementary proton-proton and heavy ion collisions has drawn also great attention, both of the best young speaker prizes of ISMD 2023, sponsored by the publisher, the MDPI Journal Universe (Q1), went to speakers on this topic. The third highlighted topic of ISMD 2023 was related to the solution of a nearly 50 years old particle physics puzzle, the statistically significant experimental observation of odderon exchange [10,11,12]. More details about ISMD 2023 (both in English and Hungarian) are avaiable at https://indico.cern.ch/event/1258038/

On October 30-31, 2023 we have also organized the 9th Days of Femtoscopy in Gyöngyös, Hungary. This international meeting attracted 14 participants from Hungary, Japan, The Netherlands, Ukraine and US. The second day was dedicated to exploring possible applications of femtoscopic methods outside the domain of high energy physics.

In addition, during the grant period we have regularly participated in the International Advisory Committes (IAC) of the annual ISMD and WPCF travelling international conference series, as well as in the local organization committes (LOC) of the Zimányi Schools in December 2019, 2020, 2021, 2022 and 2023. The description of these international conference organization activities goes beyond the scope of this closing grant report.

We hope that with the high impact publications, the list of several international and local awards and achievements and with a clear dissemination and conference organization strategy, the results and achievements of this NKFIH / OTKA project can be clearly evaluated.

List of publications for the closing report – with numbering fixed for the closing report:

	szerzők neve	megjelenés éve	Dokumentum típusa	ISPIREHEP hivatkozás
1.	F. Nemes, for the TOTEM Collaboration: ***Elastic and Total Cross-Section Measurements by TOTEM***, PoS DIS2019 (2019) 065, 2019	2019	Konferencia közlemény	4
2.	T. Csörgő for the ALICE, ATLAS, CMS, LHCb, LHCf and TOTEM Collaborations:: ***Recent Results on Soft Diffraction at LHC, invited review talk presented at ISMD 2021, Santa Fe,***, ISMD 2019, Santa Fe, USA, Sept 2019 és Zimányi Winter School on Relativistic Heavy Ion Collisions, December 2019, 2019	2019	Konferencia közlemény	0
3.	TOTEM Collaboration: G. Antchev, ..., M. Csanád, T. Csörgő, F. Nemes, T. Novák et al: ***Elastic differential cross-section measurement at sqrt(s) = 13 TeV by TOTEM***, Eur.Phys.J.C 79 (10), 861, 2019	2019	folyóiratcikk	112
4.	T. Csörgő, R. Pasechnik and A. Ster: ***Model-Independent Femtoscopic Lévy Imaging for Elastic Proton-Proton Scattering***, Phys.Part.Nucl. 51, 3, 227-231, 2020	2020	Konferencia közlemény	8
5.	T. Csörgő, R. Pasechnik and A. Ster: ***Lévy imaging of elastic scattering and proton hollowness at 13 TeV***, PoS EPS-HEP2019, 532, 2020	2020	Konferencia közlemény	0
6.	T. Csörgő, T. Novák, R. Pasechnik, A. Ster and I. Szanyi: ***Proton Holography - Discovering Odderon from Scaling Properties of Elastic Scattering***, EPJ Web Conf. 235, 06002, 2020	2020	Konferencia közlemény	2
7.	CMS and TOTEM Collaborations: A. M. Sirunyan, ... M. Csanád, T. Csörgő, F. Nemes, T. Novák et al (2367 co-authors): ***Measurement of single-diffractive dijet production in proton-proton collisions at \sqrt{s} = 8 TeV with the CMS and TOTEM experiments***, Eur.Phys.J.C 80 (12) 1164, 2020	2020	folyóiratcikk	18
8.	TOTEM Collaboration: G. Antchev. ..., T. Csörgő, ... T. Novák et al (75 authors): ***Elastic differential cross-section dσ/dt at \sqrt{s}=2.76 TeV and implications on the existence of a colourless C-odd three-gluon***, Eur.Phys.J.C 80 (2020) 2, 91, 2020	2020	folyóiratcikk	95
9.	T.Csörgő, T. Pasechnik, A. Ster: ***Proton structure and hollowness from Lévy imaging of pp elastic scattering***, Eur.Phys.J.C 80 (2), 126, 2020	2020	folyóiratcikk	24
10.	T. Csörgő, T. Novák, R. Pasechnik, A. Ster and I. Szanyi: ***Evidence of Odderon-exchange from scaling properties of elastic scattering at TeV energies***, Eur. Phys. J. C (2021) 81: 180, 2021	2021	folyóiratcikk	41
11.	D0 and TOTEM Collaborations: V. M. Abazov, ... T. Csörgő, F. Nemes, T. Novák, I. Szanyi et al (463 co-authors): ***Odderon Exchange from Elastic Scattering Differences between pp and pbarp Data at 1.96 TeV and from pp Forward Scattering Measurements***, Phys. Rev. Lett. 127 (2021) 6, 062003, 2021	2021	folyóiratcikk	94
12.	T. Csörgő and I. Szanyi: ***Observation of Odderon Effects at LHC energies - A Real Extended Bialas-Bzdak Model Study***, Eur. Phys. J. C (2021) 81: 611, 2021	2021	folyóiratcikk	17
13.	T. Csörgő and G. Kasza: ***New, multipole solutions of relativistic, viscous hydrodynamics***, Gribov-90 Memorial Volume, pp. 297-318 (2021), 2021	2021	könyvfejezet	6
14.	TOTEM and CMS Collaborations: A. M. Shiruyan, ... T. Csörgő et al. (2422 authors): ***Hard color-singlet exchange in dijet events in proton-proton collisions at s√= 13 TeV***, Phys.Rev.D 104 (2021) 032009, 2021	2021	folyóiratcikk	18
15.	T. Csörgő, T. Novák, R. Pasechnik, A. Ster, I. Szanyi: ***Scaling of High-Energy Elastic Scattering and the Observation of Odderon***, Gribov-90 Memorial Volume, pp. 69-80 (2021), 2021	2021	könyvfejezet	3
16.	Christophe Royon, for the D0 and TOTEM Collaborations: ***Comparison of differential elastic cross sections in pp and pbarp collisions as evidence of the existence of the colourless CC-odd three-gluon state***, PoS ICHEP2020 (2021) 496, 2021	2021	Konferencia közlemény	2
17.	F. Nemes for the D0 and TOTEM Collaborations: ***The first experimental observation of odderon exchange***, PoS LHCP2021 (2021) 280, 2021	2021	Konferencia közlemény	0
18.	G. Antchev, ... T. Csörgő. F. Nemes, T. Novák, et al, TOTEM Collaboration: ***Characterisation of the dip-bump structure observed in proton–proton elastic scattering at \sqrt{s} = 8 TeV***, Eur. Phys. J. C 82, 263, 2022	2022	folyóiratcikk	12

19.	CMS and TOTEM Collaborations:A. Tumasyan, ... T. Csörgő, ... et al, (2412 authors): ***First Search for Exclusive Diphoton Production at High Mass with Tagged Protons in Proton-Proton Collisions at \sqrt s s = 13 TeV***, Phys.Rev.Lett. 129, 1, 011801, 2022	2022	folyóiratcikk	46
20.	I. Szanyi and T. Csörgő: ***The ReBB model and its H(x) scaling version at 8 TeV: Odderon exchange is a certainty***, Eur.Phys.J.C 82 (9), 827, 2022	2022	folyóiratcikk	6
21.	G. Kasza, L. P. Csernai and T. Csörgő: ***New, Spherical Solutions of Non-Relativistic, Dissipative Hydrodynamics***, MDPI Entropy 24 (4), 514, 2022	2022	folyóiratcikk	1
22.	L. Jenkovszky, R. Schicker, I. Szanyi: ***Regge Models of Proton Diffractive Dissociation Based on Factorisation and Structure Functions***, MDPI Entropy 24 (7), 1001, 2022	2022	folyóiratcikk	2
23.	Jenkovszky László, Spenik Sándor, Szanyi István, Turóci-Sütő Jolika: ***Rugalmas és diffraktív szórás az LHC korában: a Pomeron, az Odderon és a Gluonlabdák***, Autdon-Shark kiadó, Ungvár-Budapest, 2021, 2022	2022	könyv	0
24.	I. Szanyi and T. Csörgő: ***The ReBB model at 8 TeV: Odderon exchange is not a probability, but a certainty***, Acta Phys. Polon. Supp. 16 (2023) 5, 2, Diffraction and Low-x 2022 volume,, 2023	2023	Konferencia közlemény	0
25.	T. Csörgő, T. Novák, R. Pasechnik, A. Ster and I. Szanyi: ***Model-independent Odderon results based on TOTEM data on elastic proton-proton scattering at 8 TeV***, Acta Phys. Polon. Supp. 16 (2023) 5, 10, Diffraction and Low-x 2022 issue, 2023	2023	Konferencia közlemény	0
26.	CMS and TOTEM Collaborations: A. Tumasyan, ... T. Csörgő et al (2441 co-authors): ***Search for high-mass exclusive γγ→WW and γγ→ZZ production in proton-proton collisions at sqrt(s) = 13 TeV***, JHEP 07, 229, e-Print: 2211.16320 [hep-ex], 2023	2023	folyóiratcikk	18
27.	CMS and TOTEM Collaborations: A. Tumasyan, ... T. Csörgő et al. (2446 co-authors): ***Proton reconstruction with the CMS-TOTEM Precision Proton Spectrometer***, JINST 18, 09, P09009 e-Print: 2210.05854 [hep-ex], 2023	2023	folyóiratcikk	15
28.	PHENIX Collaboration (N.J. Abdulameer, ..., T. Csörgő et al, 321 authors): ***Transverse single-spin asymmetry of midrapidity of pi0 and eta mesons in p + Au and p + Al collisions at sqrt(s(NN)) = 200 GeV***, Phys. Rev. D 107 (2023) 11, 112004 e-Print: 2303.07190 [nucl-ex], 2023	2023	folyóiratcikk	2
29.	PHENIX Collaboration (N.J. Abdulameer, ..., T. Csörgő et al, 322 authors): ***Transverse single-spin asymmetry of charged hadrons at forward and backward rapidity in polarized p + p , p + Al , and p + Au collisions at sqrt(s(NN)) = 200 GeV***, Phys.Rev.D 108 (2023) 7, 072016, e-Print: 2303.07191 [hep-ex], 2023	2023	folyóiratcikk	5
30.	PHENIX Collaboration (N.J. Abdulameer, ..., T. Csörgő et al, 571 authors): ***Highlights from the PHENIX Experiment***, Acta Phys. Polon. Supp. 16 (2023) 1, 7-A7, e-Print: 2212.08215 [nucl-ex], 2023	2023	Konferencia közlemény	0
31.	PHENIX Collaboration (N.J. Abdulameer, ..., T. Csörgő et al, 433 authors): ***Low- p_T direct-photon production in Au + Au collisions at sqrt(s(NN)) = 39 and 62.4 GeV***, Phys.Rev.C 107 (2023) 2, 024914 and e-Print: 2203.12354 [nucl-ex], 2023	2023	folyóiratcikk	20
32.	PHENIX Collaboration (N.J. Abdulameer, ..., T. Csörgő et al, 322 authors): ***Measurement of Direct-Photon Cross Section and Double-Helicity Asymmetry at sqrt(s) = 510 GeV in pp + pp Collisions***, Phys.Rev.Lett. 130 (2023) 25, 251901 • e-Print: 2202.08158 [hep-ex], 2023	2023	folyóiratcikk	10
33.	PHENIX Collaboration (A. Adere, ..., T. Csörgő et al, 454 co-authors):: ***Erratum: Lévy-stable two-pion Bose-Einstein correlations in sqrt(s(NN)) = 200 GeV Au + +Au collisions***, Phys.Rev.C 97 (2018) 6, 064911, Phys.Rev.C 108 (2023) 4, 049905 (erratum), 2023	2023	folyóiratcikk	12
34.	I. Szanyi, T. S. Biró and L. Jenkovszky: ***Nonlinear Regge trajectories and saturation of the Hagedorn spectrum***, Phys.Rev.C 107 (2023) 2, 024904 and e-Print: 2302.00838 [hep-ph], 2023	2023	folyóiratcikk	1
35.	CMS and TOTEM Collaborations: A. Tumasyan, ... T. Csörgő, ... F. Nemes et al. (2432 authors): ***A search for new physics in central exclusive production using the missing mass technique with the CMS detector and the CMS-TOTEM precision proton spectrometer***, Eur. Phys. J. C 83 (2023) 827, 2023	2023	folyóiratcikk	8
36.	TOTEM and CMS Collaborations, A. Hayrapetyan, ... T. Csörgő, ... F. Nemes et al, 2398 authors: ***Nonresonant central exclusive***	2024	folyóiratcikk	1

	production of charged-hadron pairs in proton-proton collisions at sqrt(s) = 13 TeV, Phys. Rev. D 109 (2024) 11, 112013, 2024			
37.	CMS and TOTEM Collaborations: A. Tumasyan, ... T. Csörgő, ... F. Nemes et al. (2422 authors): ***Search for high-mass exclusive diphoton production with tagged protons in proton-proton collisions at sqrt(s) = 13 TeV***, Phys. Rev. D 110 (2024) 1, 012010, 2024	2024	folyóiratcikk	11
38.	CMS and TOTEM Collaborations: A. Tumasyan, ... T. Csörgő, ... F. Nemes et al. (2456 authors): ***Search for central exclusive production of top quark pairs in proton-proton collisions at sqrt(s) = 13 TeV with tagged protons***, JHEP 06 (2024) 187, 2024	2024	folyóiratcikk	3
39.	T. Csörgő, T. Novák, R. Pasechnik, A. Ster and I. Szanyi: ***Model-Independent Odderon Results Based on New TOTEM Data on Elastic Proton–Proton Collisions at 8 TeV***, Universe 10 (2024) 6, 264, 2024	2024	folyóiratcikk	0
40.	T. Csörgő, S. Hegyi and I. Szanyi: ***Simple Lévy α-Stable Model Analysis of Elastic pp and p-antip low-*** $\|t\|$ ***Data from SPS to LHC Energies***, Universe 10 (2024) 3, 127, 2024	2024	folyóiratcikk	0
41.	PHENIX Collaboration (N.J. Abdulameer, ... T. Csörgő et al, 398 authors): ***Centrality dependence of Lévy-stable two-pion Bose-Einstein correlations in sqrt(s(NN)) =200 GeV Au + Au collisions***, e-Print: 2407.08586 [nucl-ex], submitted for a publication to the Physical Review C, 2024	2024	egyéb	0
42.	PHENIX Collaboration: N.J. Abdulameer et al, 533 authors: ***Jet modification via pi0 -hadron correlations in Au + +Au collisions at sqrt(s(NN)) =200 GeV***, e-Print: 2406.08301 [nucl-ex], 2024	2024	egyéb	0
43.	PHENIX Collaboration: N.J. Abdulameer, ... T. Csörgő et al, 481 authors: ***Identified charged-hadron production in p + Al, 3He + Au, and Cu + Au collisions at sqrt(s(NN)) = 200 GeV and in U + U collisions at sqrt(s(NN)) = 193 GeV***, Phys. Rev. C 109 (2024) 5, 054910, 2024	2024	folyóiratcikk	0
44.	L. Jenkovszky, R. Schicker and I. Szanyi: ***Dip-Bump Structure in Proton's Single Diffractive Dissociation at the Large Hadron Collider***, Universe 10 (2024) 5, 208, 2024	2024	folyóiratcikk	0
45.	G. Kasza: ***Describing the thermal radiation in Au+Au collisions at sNN=200 GeV by an analytic solution of relativistic hydrodynamics***, Int.J.Mod.Phys.A 39 (2024) 01, 2450006, 2024	2024	folyóiratcikk	0
46.	M. Csanád, T. Csörgő and T. Novák (editors): ***https://www.mdpi.com/journal/universe/special_issues/3R2XYDMCV9***, Special Issue on Multiparticle Dynamics, with 22 refereed and published papers, Proceedings of ISMD 2024, August 21-26, Gyöngyös, Hungary, 2024	2024	szerkesztett mű	0
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