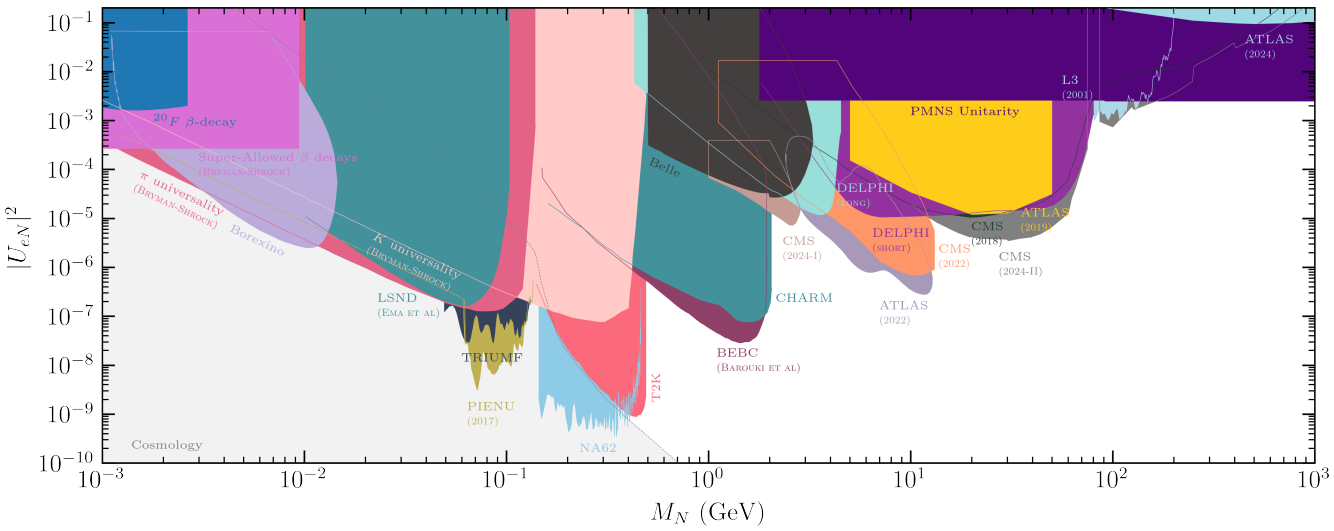

FIG. 1. Constraints on $|U_{eN}|^2$ as a function of the HNL mass m_N. Limits shown: K universality (Bryman-Shrock) [1], π universality (Bryman-Shrock) [1], ^{20}F β-decay [2], ATLAS (2019) [3], ATLAS (2022) [4], ATLAS (2024) [5], BEBC(Barouki et al) [6], Belle [7], Borexino [8], CHARM [9], CMS (2018) [10], CMS (2022) [11], CMS (2024-I) [12], CMS (2024-II) [13], Cosmology [14], DELPHI (long) [15], DELPHI (short) [15], L3 (2001) [16], LSND (Ema et al) [17], NA62 [18], PIENU (2017) [19], PMNS Unitarity [20], Super-Allowed β decays (Bryman-Shrock) [1], T2K [21], TRIUMF [22].

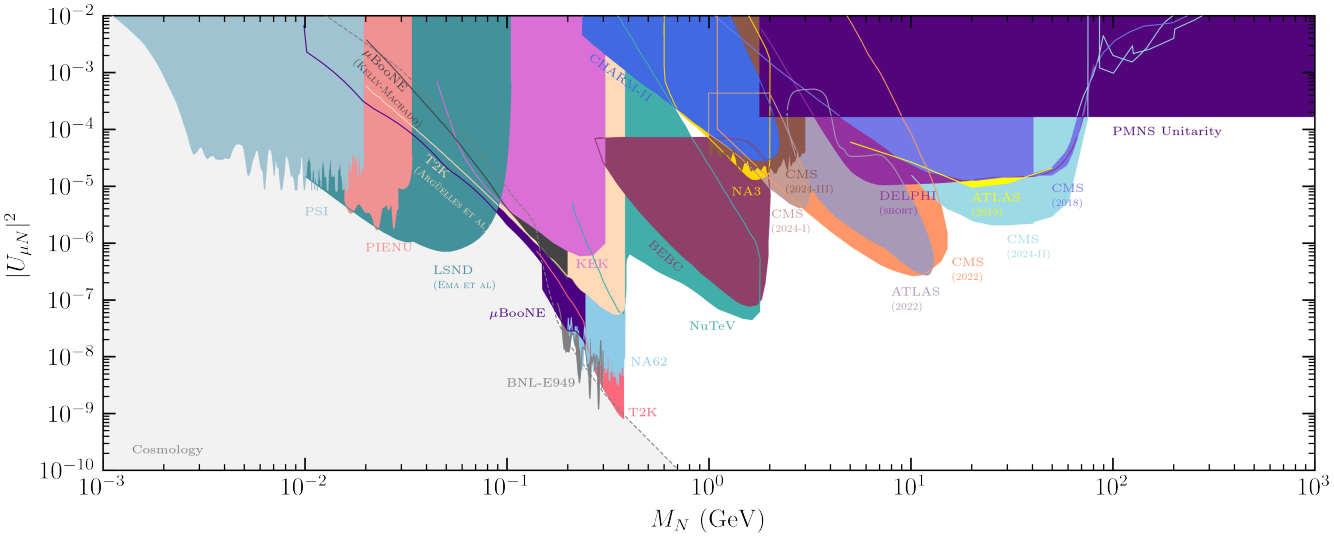

FIG. 2. Constraints on $|U_{\mu N}|^2$ as a function of the HNL mass m_N. Limits shown: μBooNE [**?**], μBooNE (Kelly-Machado) [23], ATLAS (2019) [3], ATLAS (2022) [4], BEBC [24], BNL-E949 [25], CHARM-II [26], CMS (2018) [10], CMS (2018-dilepton) [27], CMS (2022) [11], CMS (2024-I) [12], CMS (2024-II) [13], CMS (2024-III) [28], CMS (8TeV) [29], Cosmology [14], DELPHI (short) [15], KEK [1], LSND (Ema et al) [17], NA3 [30], NA62 [31], NuTeV [32], PIENU [33], PIENU(low μ energy) [33], PMNS Unitarity [20], PSI [34], T2K [21], T2K (Argüelles et al) [35].

[1] D. A. Bryman and R. Shrock, Phys. Rev. D **100**, 073011 (2019), arXiv:1909.11198 [hep-ph].
[2] J. Deutsch, M. Lebrun, and R. Prieels, Nucl. Phys. A **518**, 149 (1990).
[3] G. Aad *et al.* (ATLAS), JHEP **10**, 265 (2019), arXiv:1905.09787 [hep-ex].
[4] G. Aad *et al.* (ATLAS), Phys. Rev. Lett. **131**, 061803 (2023), arXiv:2204.11988 [hep-ex].
[5] G. Aad *et al.* (ATLAS), (2024), arXiv:2403.15085 [hep-ex].
[6] R. Barouki, G. Marocco, and S. Sarkar, SciPost Phys. **13**, 118 (2022), arXiv:2208.00416 [hep-ph].

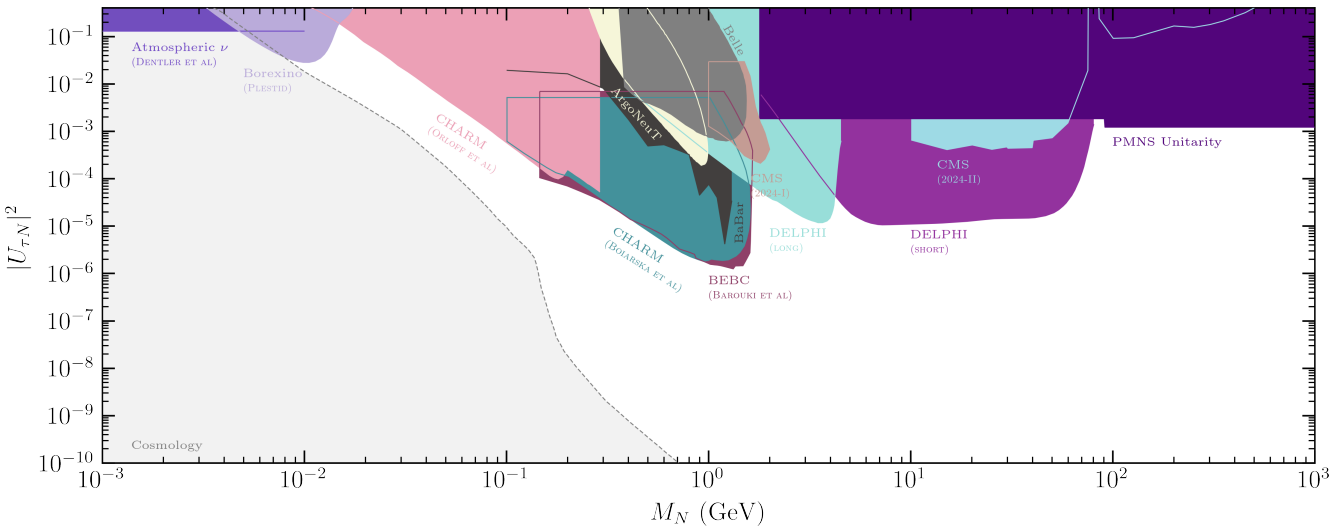

FIG. 3. Constraints on $|U_{\tau N}|^2$ as a function of the HNL mass m_N. Limits shown: ArgoNeuT [36], Atmospheric ν (Dentler et al) [37], BEBC(Barouki et al) [6], BaBar [38], Belle [39], Borexino (Plestid) [40], CHARM (Boiarska et al) [41], CHARM (Orloff et al) [42], CMS (2024-I) [12], CMS (2024-II) [13], Cosmology [14], DELPHI (long) [15], DELPHI (short) [15], PMNS Unitarity [20].

[7] D. Liventsev *et al.* (Belle), Phys. Rev. D **87**, 071102 (2013), [Erratum: Phys.Rev.D 95, 099903 (2017)], arXiv:1301.1105 [hep-ex].
[8] G. Bellini *et al.* (Borexino), Phys. Rev. D **88**, 072010 (2013), arXiv:1311.5347 [hep-ex].
[9] F. Bergsma *et al.* (CHARM), Phys. Lett. B **166**, 473 (1986).
[10] A. M. Sirunyan *et al.* (CMS), Phys. Rev. Lett. **120**, 221801 (2018), arXiv:1802.02965 [hep-ex].
[11] A. Tumasyan *et al.* (CMS), JHEP **07**, 081 (2022), arXiv:2201.05578 [hep-ex].
[12] A. Hayrapetyan *et al.* (CMS), (2024), arXiv:2402.18658 [hep-ex].
[13] A. Hayrapetyan *et al.* (CMS), (2024), arXiv:2403.00100 [hep-ex].
[14] N. Sabti, A. Magalich, and A. Filimonova, JCAP **11**, 056 (2020), arXiv:2006.07387 [hep-ph].
[15] P. Abreu *et al.* (DELPHI), Z. Phys. C **74**, 57 (1997), [Erratum: Z.Phys.C 75, 580 (1997)].
[16] P. Achard *et al.* (L3), Phys. Lett. B **517**, 67 (2001), arXiv:hep-ex/0107014.
[17] Y. Ema, Z. Liu, K.-F. Lyu, and M. Pospelov, JHEP **08**, 169 (2023), arXiv:2306.07315 [hep-ph].
[18] E. Cortina Gil *et al.* (NA62), Phys. Lett. B **807**, 135599 (2020), arXiv:2005.09575 [hep-ex].
[19] A. Aguilar-Arevalo *et al.* (PIENU), Phys. Rev. D **97**, 072012 (2018), arXiv:1712.03275 [hep-ex].
[20] M. Blennow, E. Fernández-Martínez, J. Hernández-García, J. López-Pavón, X. Marcano, and D. Naredo-Tuero, JHEP **08**, 030 (2023), arXiv:2306.01040 [hep-ph].
[21] K. Abe *et al.* (T2K), Phys. Rev. D **100**, 052006 (2019), arXiv:1902.07598 [hep-ex].
[22] D. I. Britton *et al.*, Phys. Rev. D **46**, R885 (1992).
[23] K. J. Kelly and P. A. N. Machado, Phys. Rev. D **104**, 055015 (2021), arXiv:2106.06548 [hep-ph].
[24] A. M. Cooper-Sarkar *et al.* (WA66), Phys. Lett. B **160**, 207 (1985).
[25] A. V. Artamonov *et al.* (E949), Phys. Rev. D **91**, 052001 (2015), [Erratum: Phys.Rev.D 91, 059903 (2015)], arXiv:1411.3963 [hep-ex].
[26] P. Vilain *et al.* (CHARM II), Phys. Lett. B **343**, 453 (1995).
[27] A. M. Sirunyan *et al.* (CMS), JHEP **01**, 122 (2019), arXiv:1806.10905 [hep-ex].
[28] A. Hayrapetyan *et al.* (CMS), (2024), arXiv:2403.04584 [hep-ex].
[29] V. Khachatryan *et al.* (CMS), JHEP **04**, 169 (2016), arXiv:1603.02248 [hep-ex].
[30] J. Badier *et al.* (NA3), Z. Phys. C **31**, 21 (1986).
[31] E. Cortina Gil *et al.* (NA62), Phys. Lett. B **816**, 136259 (2021), arXiv:2101.12304 [hep-ex].
[32] A. Vaitaitis *et al.* (NuTeV, E815), Phys. Rev. Lett. **83**, 4943 (1999), arXiv:hep-ex/9908011.
[33] A. Aguilar-Arevalo *et al.* (PIENU), Phys. Lett. B **798**, 134980 (2019), arXiv:1904.03269 [hep-ex].
[34] M. Daum, B. Jost, R. M. Marshall, R. C. Minehart, W. A. Stephens, and K. O. H. Ziock, Phys. Rev. D **36**, 2624 (1987).
[35] C. A. Argüelles, N. Foppiani, and M. Hostert, Phys. Rev. D **105**, 095006 (2022), arXiv:2109.03831 [hep-ph].
[36] R. Acciarri *et al.* (ArgoNeuT), Phys. Rev. Lett. **127**, 121801 (2021), arXiv:2106.13684 [hep-ex].
[37] M. Dentler, A. Hernández-Cabezudo, J. Kopp, P. A. N. Machado, M. Maltoni, I. Martinez-Soler, and T. Schwetz, JHEP **08**, 010 (2018), arXiv:1803.10661 [hep-ph].
[38] J. P. Lees *et al.* (BaBar), Phys. Rev. D **107**, 052009 (2023), arXiv:2207.09575 [hep-ex].
[39] M. Nayak *et al.* (Belle), (2024), arXiv:2402.02580 [hep-ex].

[40] R. Plestid, Phys. Rev. D **104**, 075028 (2021), [Erratum: Phys.Rev.D 105, 099901 (2022)], arXiv:2010.09523 [hep-ph].
[41] I. Boiarska, A. Boyarsky, O. Mikulenko, and M. Ovchynnikov, Phys. Rev. D **104**, 095019 (2021), arXiv:2107.14685 [hep-ph].
[42] J. Orloff, A. N. Rozanov, and C. Santoni, Phys. Lett. B **550**, 8 (2002), arXiv:hep-ph/0208075.