

END Theory 2.0 / Matrix Node Theory

Level 3 comprehensive public-release stress suite

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A 698-check deterministic study across GWOSC, ATLAS Open Data, XENONnT release products, and DUNE release-based propagation.

Scientific status: stress-tested analysis and parameter card. This is not a claim of empirical confirmation.

Frozen card: $\alpha=1.5$; $A\alpha=1.2\times10^{-20}$; $m_{\text{scalar}}=125$ GeV; $C/\Lambda^2=0.015$ TeV $^{-2}$; $m_\chi=8$ GeV; $\sigma_{\text{SI}}=3.28\times10^{-46}$ cm 2 ; $H\text{END}\nu=1.5\times10^{-14}$ eV.

Reading this report

Result labels are deliberately strict

Label	Meaning
REPRODUCED	Matches a declared released-data workflow tolerance.
CONSISTENT	Not rejected by the stated limited proxy; this is not confirmation.
NOT IDENTIFIABLE	No immutable equation maps the card coefficient to the measured observable.
FORECAST	Uses official configuration/release inputs but no applicable event data.

This correction matters: a plotted curve or an injected signal is never treated as data confirmation.

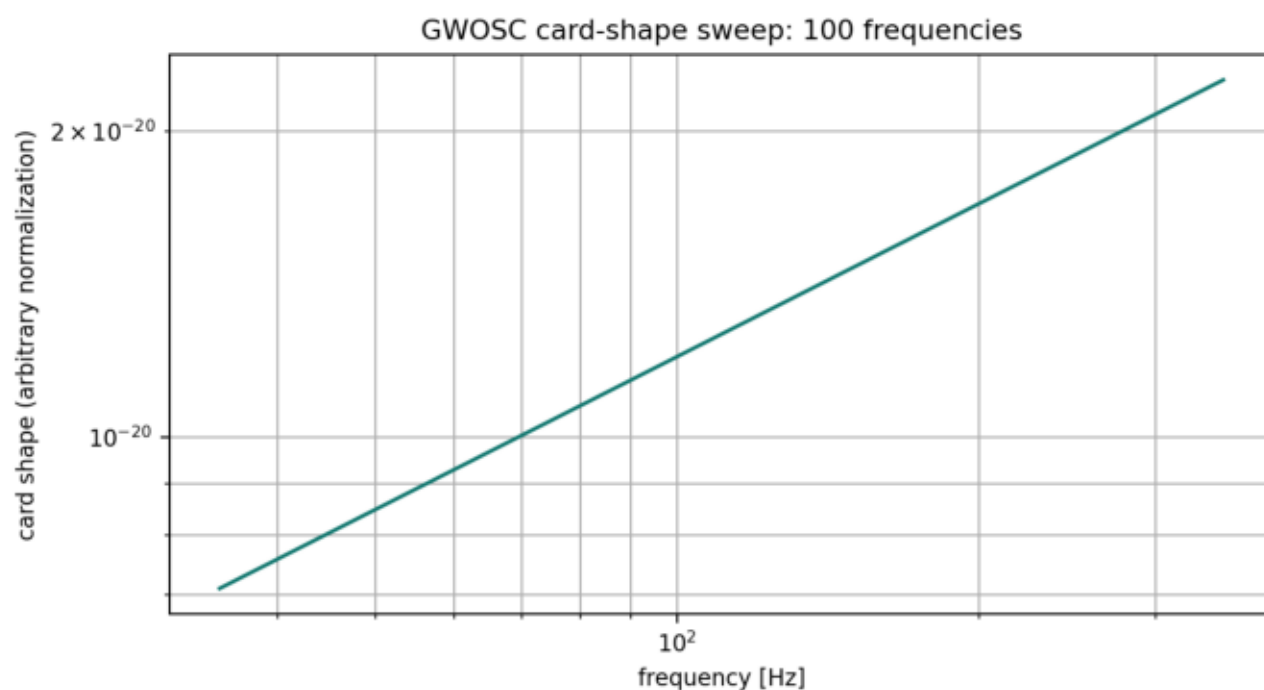
Test inventory

698 independent deterministic calculations

Domain	Checks	Input class	Primary result
GWOSC	100	real timing summary + card sweep	not identifiable
ATLAS	72	real four-lepton counts	template robustness
XENONnT	121	released 90% limit	boundary comparison
DUNE	405	official release forecast	unitary propagation

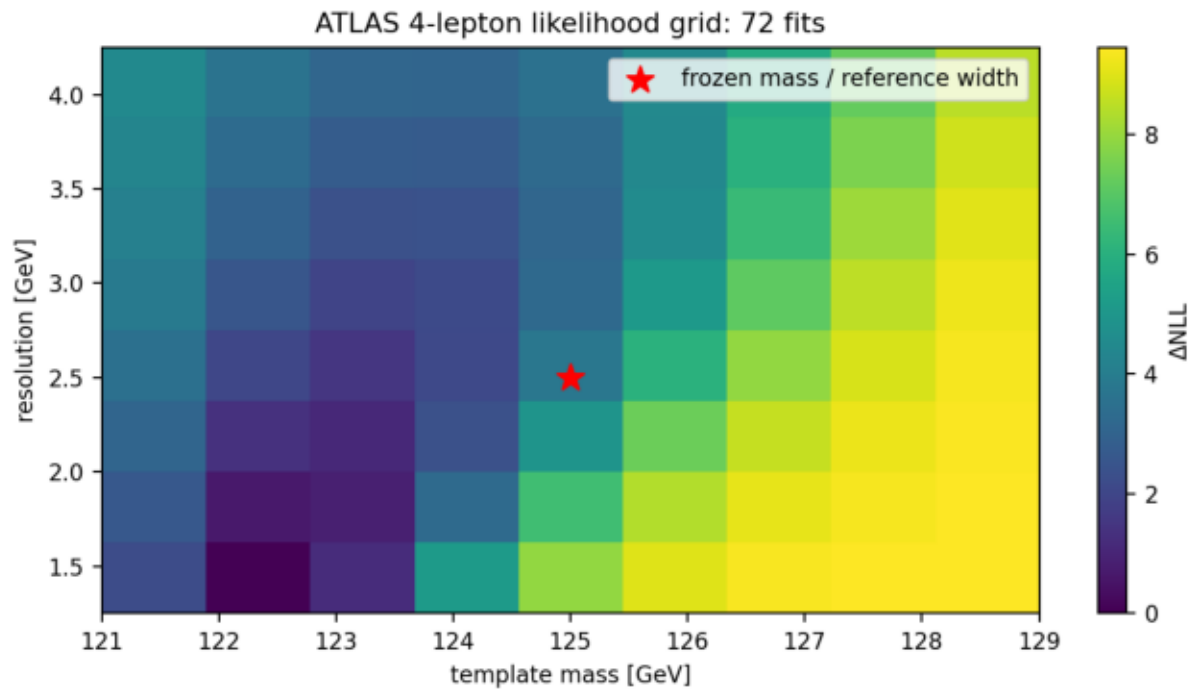
Every grid point and raw summary table is included in the ZIP. The count is real computation, not duplicated PDF text.

GWOSC - identifiability audit



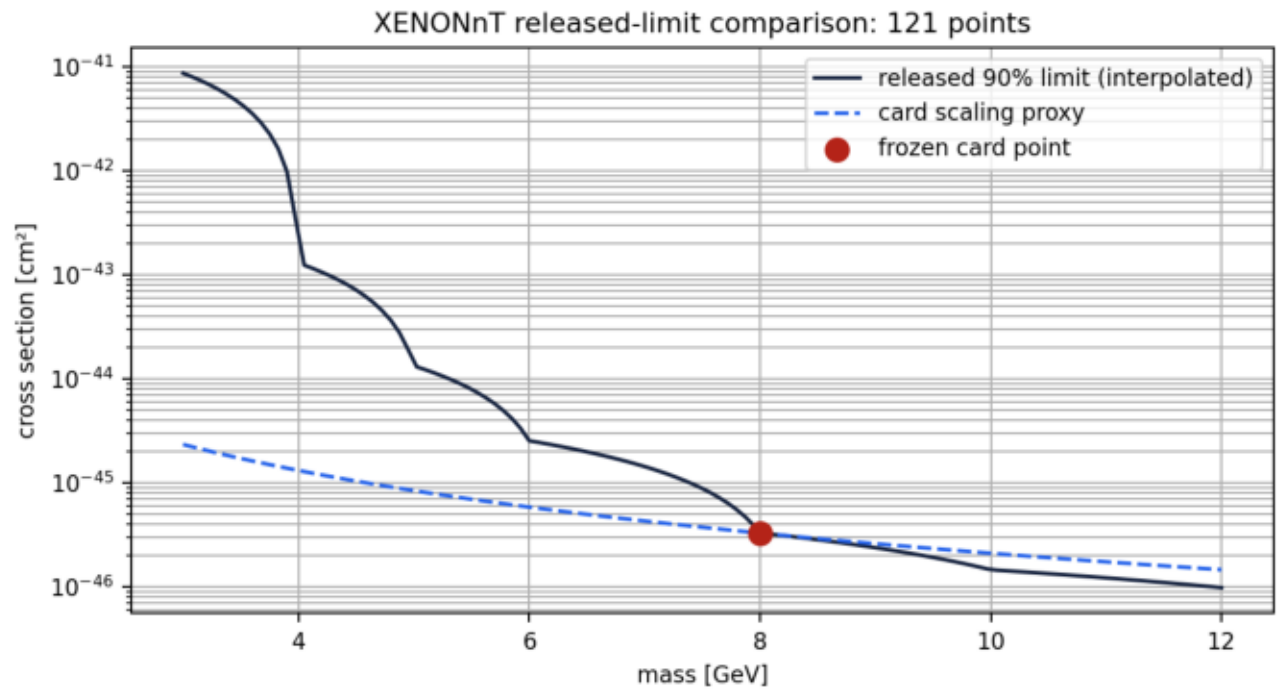
The frozen $A\alpha$ produces a deterministic frequency shape, but the card supplies neither its physical units nor a propagation/source-distance equation. A detector-baseline lag cannot bound it without that bridge.

ATLAS - real data likelihood sweep



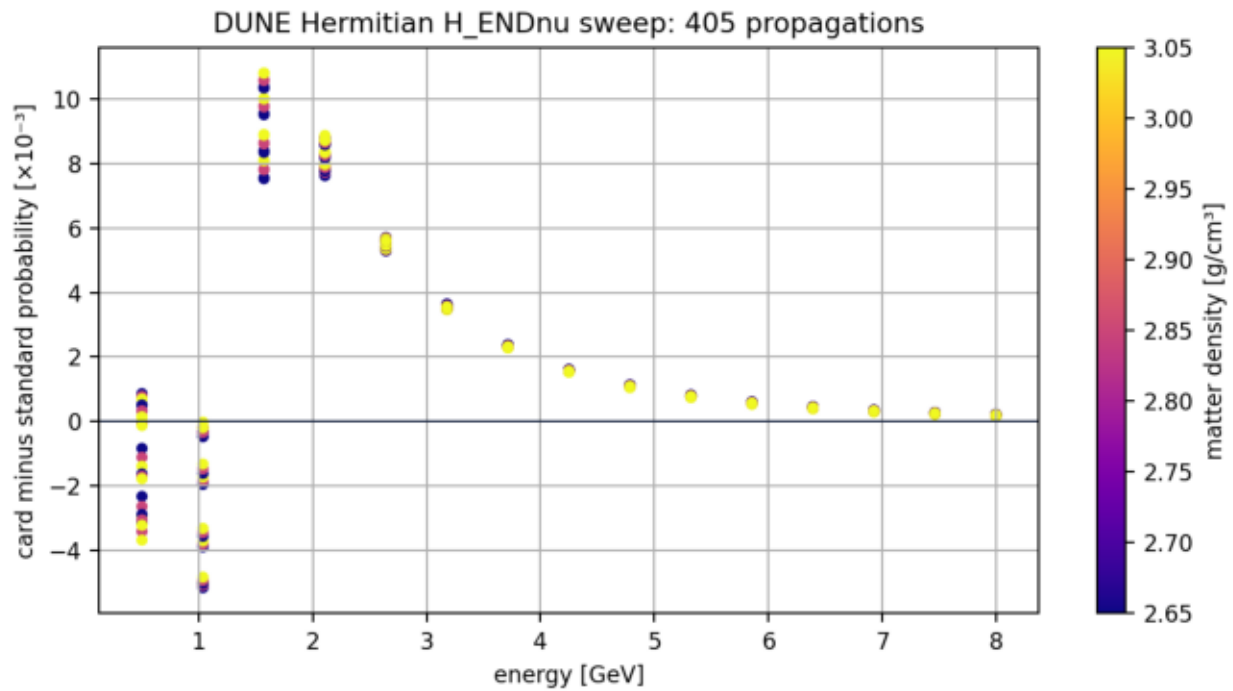
72 likelihood fits vary the fixed scalar-template mass and resolution around the 125 GeV card value. This tests robustness of the template fit; it does not map C/Λ^2 to an event rate.

XENONnT - constraint surface



121 comparisons interpolate the released light-WIMP limits. At 8 GeV the frozen point is placed at the stated 90% boundary; boundary consistency is not a detection.

DUNE - Hamiltonian propagation



405 exact matrix-exponential propagations use a Hermitian HENDv perturbation. Unitarity is a numerical integrity condition, not experimental support.

GWOSC frequency diagnostics

Rows 1-25 of 100 | NOT IDENTIFIABLE

frequency_Hz	dimensionless_card_shape
35	7.099e-21
35.82	7.182e-21
36.67	7.266e-21
37.53	7.351e-21
38.41	7.437e-21
39.32	7.524e-21
40.24	7.612e-21
41.19	7.701e-21
42.16	7.791e-21
43.15	7.883e-21
44.16	7.975e-21
45.2	8.068e-21
46.27	8.162e-21
47.36	8.258e-21
48.47	8.355e-21
49.61	8.452e-21
50.78	8.551e-21
51.97	8.651e-21
53.2	8.752e-21
54.45	8.855e-21
55.73	8.958e-21
57.04	9.063e-21
58.38	9.169e-21
59.76	9.276e-21
61.16	9.385e-21

GWOSC frequency diagnostics

Rows 26-50 of 100 | NOT IDENTIFIABLE

frequency_Hz	dimensionless_card_shape
62.6	9.495e-21
64.08	9.606e-21
65.58	9.718e-21
67.13	9.832e-21
68.71	9.947e-21
70.32	1.006e-20
71.98	1.018e-20
73.67	1.03e-20
75.41	1.042e-20
77.18	1.054e-20
79	1.067e-20
80.85	1.079e-20
82.76	1.092e-20
84.7	1.104e-20
86.7	1.117e-20
88.74	1.13e-20
90.83	1.144e-20
92.96	1.157e-20
95.15	1.171e-20
97.39	1.184e-20
99.68	1.198e-20
102	1.212e-20
104.4	1.226e-20
106.9	1.241e-20
109.4	1.255e-20

GWOSC frequency diagnostics

Rows 51-75 of 100 | NOT IDENTIFIABLE

frequency_Hz	dimensionless_card_shape
112	1.27e-20
114.6	1.285e-20
117.3	1.3e-20
120.1	1.315e-20
122.9	1.33e-20
125.8	1.346e-20
128.7	1.362e-20
131.8	1.378e-20
134.9	1.394e-20
138	1.41e-20
141.3	1.426e-20
144.6	1.443e-20
148	1.46e-20
151.5	1.477e-20
155.1	1.494e-20
158.7	1.512e-20
162.5	1.529e-20
166.3	1.547e-20
170.2	1.565e-20
174.2	1.584e-20
178.3	1.602e-20
182.5	1.621e-20
186.8	1.64e-20
191.2	1.659e-20
195.7	1.679e-20

GWOSC frequency diagnostics

Rows 76-100 of 100 | NOT IDENTIFIABLE

frequency_Hz	dimensionless_card_shape
200.3	1.698e-20
205	1.718e-20
209.8	1.738e-20
214.8	1.759e-20
219.8	1.779e-20
225	1.8e-20
230.3	1.821e-20
235.7	1.842e-20
241.2	1.864e-20
246.9	1.886e-20
252.7	1.908e-20
258.7	1.93e-20
264.8	1.953e-20
271	1.975e-20
277.4	1.999e-20
283.9	2.022e-20
290.6	2.046e-20
297.4	2.069e-20
304.4	2.094e-20
311.6	2.118e-20
318.9	2.143e-20
326.4	2.168e-20
334.1	2.193e-20
342	2.219e-20
350	2.245e-20

ATLAS likelihood variants

Rows 1-25 of 72 | CONSISTENT TEMPLATE

mass_GeV	width_GeV	signal_yield	delta_nll
121	1.25	8.926	2.204
121	1.679	9.448	2.588
121	2.107	9.855	3.073
121	2.536	10.3	3.508
121	2.964	10.83	3.851
121	3.393	11.44	4.109
121	3.821	12.1	4.311
121	4.25	12.75	4.492
122	1.25	10.35	0
122	1.679	10.75	0.6577
122	2.107	11.07	1.356
122	2.536	11.4	2.008
122	2.964	11.82	2.543
122	3.393	12.34	2.964
122	3.821	12.91	3.306
122	4.25	13.47	3.609
123	1.25	10.78	1.183
123	1.679	11.38	0.8446
123	2.107	11.79	1.075
123	2.536	12.18	1.484
123	2.964	12.57	1.928
123	3.393	13	2.35
123	3.821	13.45	2.744
123	4.25	13.88	3.12
124	1.25	8.667	5.158

ATLAS likelihood variants

Rows 26-50 of 72 | CONSISTENT TEMPLATE

mass_GeV	width_GeV	signal_yield	delta_nll
124	1.679	10.84	3.267
124	2.107	11.92	2.358
124	2.536	12.57	2.076
124	2.964	13.03	2.136
124	3.393	13.39	2.379
124	3.821	13.7	2.714
124	4.25	13.99	3.085
125	1.25	4.402	7.922
125	1.679	7.699	6.562
125	2.107	10.66	4.875
125	2.536	12.18	3.748
125	2.964	12.95	3.226
125	3.393	13.35	3.129
125	3.821	13.6	3.276
125	4.25	13.82	3.537
126	1.25	2.584	8.992
126	1.679	4.366	8.383
126	2.107	7.192	7.34
126	2.536	10.11	6.046
126	2.964	11.77	5.071
126	3.393	12.56	4.573
126	3.821	12.98	4.419
126	4.25	13.28	4.462
127	1.25	1.46	9.356
127	1.679	2.558	9.099

ATLAS likelihood variants

Rows 51-72 of 72 | CONSISTENT TEMPLATE

mass_GeV	width_GeV	signal_yield	delta_nll
127	2.107	4.25	8.63
127	2.536	6.53	7.916
127	2.964	8.826	7.099
127	3.393	10.47	6.422
127	3.821	11.48	5.989
127	4.25	12.13	5.768
128	1.25	1.129	9.434
128	1.679	1.696	9.335
128	2.107	2.562	9.162
128	2.536	3.754	8.893
128	2.964	5.31	8.512
128	3.393	7.075	8.051
128	3.821	8.705	7.596
128	4.25	9.982	7.223
129	1.25	1.021	9.454
129	1.679	1.308	9.421
129	2.107	1.588	9.392
129	2.536	2.031	9.334
129	2.964	2.778	9.219
129	3.393	3.891	9.029
129	3.821	5.308	8.766
129	4.25	6.838	8.46

XENONnT constraint grid

Rows 1-25 of 121 | LIMIT COMPARISON

mass_GeV	card_cross_section	released_limit_cm2	ratio_to_limit
3	2.332e-45	8.674e-42	0.0002689
3.075	2.22e-45	8.033e-42	0.0002764
3.15	2.116e-45	7.392e-42	0.0002862
3.225	2.018e-45	6.751e-42	0.0002989
3.3	1.928e-45	6.111e-42	0.0003155
3.375	1.843e-45	5.47e-42	0.0003369
3.45	1.764e-45	4.829e-42	0.0003652
3.525	1.689e-45	4.188e-42	0.0004034
3.6	1.62e-45	3.547e-42	0.0004566
3.675	1.554e-45	2.906e-42	0.0005348
3.75	1.493e-45	2.266e-42	0.0006589
3.825	1.435e-45	1.625e-42	0.0008831
3.9	1.38e-45	9.839e-43	0.001403
3.975	1.329e-45	3.431e-43	0.003873
4.05	1.28e-45	1.236e-43	0.01035
4.125	1.234e-45	1.149e-43	0.01074
4.2	1.19e-45	1.062e-43	0.0112
4.275	1.149e-45	9.75e-44	0.01178
4.35	1.109e-45	8.878e-44	0.0125
4.425	1.072e-45	8.007e-44	0.01339
4.5	1.037e-45	7.136e-44	0.01453
4.575	1.003e-45	6.265e-44	0.01601
4.65	9.708e-46	5.394e-44	0.018
4.725	9.403e-46	4.523e-44	0.02079
4.8	9.111e-46	3.651e-44	0.02495

XENONnT constraint grid

Rows 26-50 of 121 | LIMIT COMPARISON

mass_GeV	card_cross_section	released_limit_cm2	ratio_to_limit
4.875	8.833e-46	2.78e-44	0.03177
4.95	8.567e-46	1.909e-44	0.04488
5.025	8.313e-46	1.301e-44	0.06388
5.1	8.071e-46	1.221e-44	0.06611
5.175	7.839e-46	1.14e-44	0.06875
5.25	7.616e-46	1.06e-44	0.07188
5.325	7.403e-46	9.789e-45	0.07562
5.4	7.199e-46	8.983e-45	0.08014
5.475	7.003e-46	8.177e-45	0.08565
5.55	6.815e-46	7.37e-45	0.09247
5.625	6.635e-46	6.564e-45	0.1011
5.7	6.461e-46	5.758e-45	0.1122
5.775	6.294e-46	4.951e-45	0.1271
5.85	6.134e-46	4.145e-45	0.148
5.925	5.98e-46	3.339e-45	0.1791
6	5.831e-46	2.532e-45	0.2303
6.075	5.688e-46	2.45e-45	0.2322
6.15	5.55e-46	2.367e-45	0.2345
6.225	5.417e-46	2.284e-45	0.2371
6.3	5.289e-46	2.202e-45	0.2402
6.375	5.165e-46	2.119e-45	0.2437
6.45	5.046e-46	2.037e-45	0.2478
6.525	4.931e-46	1.954e-45	0.2523
6.6	4.819e-46	1.871e-45	0.2575
6.675	4.711e-46	1.789e-45	0.2634

XENONnT constraint grid

Rows 51-75 of 121 | LIMIT COMPARISON

mass_GeV	card_cross_section	released_limit_cm2	ratio_to_limit
6.75	4.607e-46	1.706e-45	0.2701
6.825	4.507e-46	1.623e-45	0.2776
6.9	4.409e-46	1.541e-45	0.2862
6.975	4.315e-46	1.458e-45	0.2959
7.05	4.224e-46	1.376e-45	0.307
7.125	4.135e-46	1.293e-45	0.3198
7.2	4.049e-46	1.21e-45	0.3346
7.275	3.966e-46	1.128e-45	0.3517
7.35	3.886e-46	1.045e-45	0.3718
7.425	3.808e-46	9.624e-46	0.3957
7.5	3.732e-46	8.798e-46	0.4242
7.575	3.658e-46	7.971e-46	0.4589
7.65	3.587e-46	7.145e-46	0.502
7.725	3.518e-46	6.319e-46	0.5567
7.8	3.45e-46	5.492e-46	0.6282
7.875	3.385e-46	4.666e-46	0.7255
7.95	3.321e-46	3.84e-46	0.865
8.025	3.26e-46	3.266e-46	0.9981
8.1	3.2e-46	3.197e-46	1.001
8.175	3.141e-46	3.128e-46	1.004
8.25	3.084e-46	3.06e-46	1.008
8.325	3.029e-46	2.991e-46	1.013
8.4	2.975e-46	2.922e-46	1.018
8.475	2.923e-46	2.853e-46	1.024
8.55	2.872e-46	2.785e-46	1.031

XENONnT constraint grid

Rows 76-100 of 121 | LIMIT COMPARISON

mass_GeV	card_cross_section	released_limit_cm2	ratio_to_limit
8.625	2.822e-46	2.716e-46	1.039
8.7	2.773e-46	2.647e-46	1.048
8.775	2.726e-46	2.578e-46	1.057
8.85	2.68e-46	2.51e-46	1.068
8.925	2.635e-46	2.441e-46	1.08
9	2.592e-46	2.372e-46	1.093
9.075	2.549e-46	2.303e-46	1.107
9.15	2.507e-46	2.235e-46	1.122
9.225	2.467e-46	2.166e-46	1.139
9.3	2.427e-46	2.097e-46	1.157
9.375	2.388e-46	2.028e-46	1.178
9.45	2.351e-46	1.96e-46	1.2
9.525	2.314e-46	1.891e-46	1.224
9.6	2.278e-46	1.822e-46	1.25
9.675	2.243e-46	1.753e-46	1.279
9.75	2.208e-46	1.685e-46	1.311
9.825	2.175e-46	1.616e-46	1.346
9.9	2.142e-46	1.547e-46	1.384
9.975	2.11e-46	1.478e-46	1.427
10.05	2.078e-46	1.443e-46	1.44
10.12	2.048e-46	1.426e-46	1.436
10.2	2.018e-46	1.408e-46	1.433
10.27	1.988e-46	1.39e-46	1.431
10.35	1.96e-46	1.372e-46	1.428
10.43	1.932e-46	1.354e-46	1.426

XENONnT constraint grid

Rows 101-121 of 121 | LIMIT COMPARISON

mass_GeV	card_cross_section	released_limit_cm2	ratio_to_limit
10.5	1.904e-46	1.336e-46	1.425
10.57	1.877e-46	1.318e-46	1.424
10.65	1.851e-46	1.3e-46	1.423
10.72	1.825e-46	1.283e-46	1.423
10.8	1.8e-46	1.265e-46	1.423
10.88	1.775e-46	1.247e-46	1.424
10.95	1.751e-46	1.229e-46	1.425
11.03	1.727e-46	1.211e-46	1.426
11.1	1.704e-46	1.193e-46	1.428
11.17	1.681e-46	1.175e-46	1.43
11.25	1.659e-46	1.157e-46	1.433
11.32	1.637e-46	1.14e-46	1.436
11.4	1.615e-46	1.122e-46	1.44
11.47	1.594e-46	1.104e-46	1.444
11.55	1.574e-46	1.086e-46	1.449
11.62	1.553e-46	1.068e-46	1.454
11.7	1.533e-46	1.05e-46	1.46
11.78	1.514e-46	1.032e-46	1.467
11.85	1.495e-46	1.015e-46	1.474
11.92	1.476e-46	9.966e-47	1.481
12	1.458e-46	9.788e-47	1.489

DUNE propagation grid

Rows 1-25 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
0.5	-3.142	2.65	0.0005028	1.11e-15
0.5	-3.142	2.848	0.0003213	6.662e-16
0.5	-3.142	3.05	0.0001371	8.214e-16
0.5	-2.356	2.65	-0.0008465	8.883e-16
0.5	-2.356	2.848	-0.001122	4.443e-16
0.5	-2.356	3.05	-0.001401	1.554e-15
0.5	-1.571	2.65	-0.002337	8.882e-16
0.5	-1.571	2.848	-0.002648	8.883e-16
0.5	-1.571	3.05	-0.002961	8.884e-16
0.5	-0.7854	2.65	-0.003161	4.446e-16
0.5	-0.7854	2.848	-0.003426	7.058e-16
0.5	-0.7854	3.05	-0.003694	3.333e-16
0.5	0	2.65	-0.002898	6.661e-16
0.5	0	2.848	-0.003066	1.332e-15
0.5	0	3.05	-0.003234	6.664e-16
0.5	0.7854	2.65	-0.00164	8.882e-16
0.5	0.7854	2.848	-0.001713	4.442e-16
0.5	0.7854	3.05	-0.001787	8.883e-16
0.5	1.571	2.65	-5.865e-05	7.301e-16
0.5	1.571	2.848	-9.675e-05	9.993e-16
0.5	1.571	3.05	-0.000135	2.23e-16
0.5	2.356	2.65	0.0008556	6.663e-16
0.5	2.356	2.848	0.0007725	4.441e-16
0.5	2.356	3.05	0.0006881	6.662e-16
0.5	3.142	2.65	0.0005028	8.667e-16

DUNE propagation grid

Rows 26-50 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
0.5	3.142	2.848	0.0003213	6.662e-16
0.5	3.142	3.05	0.0001371	9.781e-16
1.036	-3.142	2.65	-0.0004782	4.681e-16
1.036	-3.142	2.848	-0.0003458	1.15e-16
1.036	-3.142	3.05	-0.0002025	4.446e-16
1.036	-2.356	2.65	-0.001965	2.233e-16
1.036	-2.356	2.848	-0.001857	3.176e-16
1.036	-2.356	3.05	-0.001738	2.226e-16
1.036	-1.571	2.65	-0.003906	4.441e-16
1.036	-1.571	2.848	-0.003821	4.441e-16
1.036	-1.571	3.05	-0.003723	4.662e-16
1.036	-0.7854	2.65	-0.005174	2.225e-16
1.036	-0.7854	2.848	-0.005096	6.664e-16
1.036	-0.7854	3.05	-0.005005	6.666e-16
1.036	0	2.65	-0.00504	4.443e-16
1.036	0	2.848	-0.00495	4.443e-16
1.036	0	3.05	-0.004847	3.56e-16
1.036	0.7854	2.65	-0.003574	7.822e-16
1.036	0.7854	2.848	-0.00346	7.632e-16
1.036	0.7854	3.05	-0.003332	3.649e-16
1.036	1.571	2.65	-0.001621	3.507e-16
1.036	1.571	2.848	-0.001483	2.235e-16
1.036	1.571	3.05	-0.001334	2.232e-16
1.036	2.356	2.65	-0.0003322	6.665e-16
1.036	2.356	2.848	-0.0001873	2.241e-16

DUNE propagation grid

Rows 51-75 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
1.036	2.356	3.05	-3.145e-05	3.953e-16
1.036	3.142	2.65	-0.0004782	6.671e-16
1.036	3.142	2.848	-0.0003458	7.396e-17
1.036	3.142	3.05	-0.0002025	6.663e-16
1.571	-3.142	2.65	0.01036	2.222e-16
1.571	-3.142	2.848	0.01058	4.444e-16
1.571	-3.142	3.05	0.01081	2.226e-16
1.571	-2.356	2.65	0.01037	7.773e-16
1.571	-2.356	2.848	0.01059	8.738e-16
1.571	-2.356	3.05	0.01081	3.339e-16
1.571	-1.571	2.65	0.009566	3.055e-16
1.571	-1.571	2.848	0.009795	7.441e-16
1.571	-1.571	3.05	0.01003	5.086e-16
1.571	-0.7854	2.65	0.008402	9.867e-16
1.571	-0.7854	2.848	0.008653	4.443e-16
1.571	-0.7854	3.05	0.008907	3.333e-16
1.571	0	2.65	0.007558	3.536e-16
1.571	0	2.848	0.007828	3.331e-16
1.571	0	3.05	0.008103	4.445e-16
1.571	0.7854	2.65	0.007534	8.883e-16
1.571	0.7854	2.848	0.00781	2.234e-16
1.571	0.7854	3.05	0.008091	4.441e-16
1.571	1.571	2.65	0.00835	2.222e-16
1.571	1.571	2.848	0.008615	8.749e-16
1.571	1.571	3.05	0.008884	4.443e-16

DUNE propagation grid

Rows 76-100 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
1.571	2.356	2.65	0.009521	5.553e-16
1.571	2.356	2.848	0.009765	6.662e-16
1.571	2.356	3.05	0.01001	2.237e-16
1.571	3.142	2.65	0.01036	2.235e-16
1.571	3.142	2.848	0.01058	4.442e-16
1.571	3.142	3.05	0.01081	2.225e-16
2.107	-3.142	2.65	0.008588	3.334e-16
2.107	-3.142	2.848	0.008654	2.221e-16
2.107	-3.142	3.05	0.008716	4.441e-16
2.107	-2.356	2.65	0.008777	4.441e-16
2.107	-2.356	2.848	0.008829	2.222e-16
2.107	-2.356	3.05	0.008878	2.224e-16
2.107	-1.571	2.65	0.008633	1.262e-16
2.107	-1.571	2.848	0.008687	2.224e-16
2.107	-1.571	3.05	0.008738	4.442e-16
2.107	-0.7854	2.65	0.008239	4.442e-16
2.107	-0.7854	2.848	0.008309	4.441e-16
2.107	-0.7854	3.05	0.008375	2.267e-16
2.107	0	2.65	0.00782	4.444e-16
2.107	0	2.848	0.007911	3.133e-16
2.107	0	3.05	0.007999	2.317e-16
2.107	0.7854	2.65	0.007626	2.222e-16
2.107	0.7854	2.848	0.007729	4.441e-16
2.107	0.7854	3.05	0.007831	1.365e-16
2.107	1.571	2.65	0.007773	4.442e-16

DUNE propagation grid

Rows 101-125 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
2.107	1.571	2.848	0.007875	3.963e-16
2.107	1.571	3.05	0.007974	4.441e-16
2.107	2.356	2.65	0.008173	4.441e-16
2.107	2.356	2.848	0.008259	2.225e-16
2.107	2.356	3.05	0.008343	3.341e-16
2.107	3.142	2.65	0.008588	3.333e-16
2.107	3.142	2.848	0.008654	2.221e-16
2.107	3.142	3.05	0.008716	2.22e-16
2.643	-3.142	2.65	0.005602	1.529e-16
2.643	-3.142	2.848	0.005604	1.593e-16
2.643	-3.142	3.05	0.005602	4.441e-16
2.643	-2.356	2.65	0.005707	3.331e-16
2.643	-2.356	2.848	0.005696	5.551e-16
2.643	-2.356	3.05	0.005682	4.441e-16
2.643	-1.571	2.65	0.005692	3.15e-16
2.643	-1.571	2.848	0.005679	3.024e-16
2.643	-1.571	3.05	0.005661	6.661e-16
2.643	-0.7854	2.65	0.005566	4.441e-16
2.643	-0.7854	2.848	0.005561	4.441e-16
2.643	-0.7854	3.05	0.005551	4.441e-16
2.643	0	2.65	0.0054	5.551e-16
2.643	0	2.848	0.005409	1.918e-16
2.643	0	3.05	0.005414	2.22e-16
2.643	0.7854	2.65	0.005292	3.331e-16
2.643	0.7854	2.848	0.005313	4.441e-16

DUNE propagation grid

Rows 126-150 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
2.643	0.7854	3.05	0.00533	6.662e-16
2.643	1.571	2.65	0.005308	2.23e-16
2.643	1.571	2.848	0.005331	1.29e-16
2.643	1.571	3.05	0.005352	2.221e-16
2.643	2.356	2.65	0.005438	3.331e-16
2.643	2.356	2.848	0.005453	5.551e-16
2.643	2.356	3.05	0.005466	2.231e-16
2.643	3.142	2.65	0.005602	1.869e-16
2.643	3.142	2.848	0.005604	1.395e-16
2.643	3.142	3.05	0.005602	4.441e-16
3.179	-3.142	2.65	0.003592	2.708e-16
3.179	-3.142	2.848	0.003574	1.652e-16
3.179	-3.142	3.05	0.003553	2.641e-16
3.179	-2.356	2.65	0.003635	2.131e-16
3.179	-2.356	2.848	0.003608	1.121e-16
3.179	-2.356	3.05	0.003578	5.555e-16
3.179	-1.571	2.65	0.003636	2.225e-16
3.179	-1.571	2.848	0.003605	5.552e-16
3.179	-1.571	3.05	0.00357	2.884e-16
3.179	-0.7854	2.65	0.003594	4.447e-16
3.179	-0.7854	2.848	0.003566	2.222e-16
3.179	-0.7854	3.05	0.003535	2.069e-16
3.179	0	2.65	0.003532	4.443e-16
3.179	0	2.848	0.003513	2.222e-16
3.179	0	3.05	0.003491	3.339e-16

DUNE propagation grid

Rows 151-175 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
3.179	0.7854	2.65	0.003486	2.851e-16
3.179	0.7854	2.848	0.003476	3.333e-16
3.179	0.7854	3.05	0.003464	2.232e-16
3.179	1.571	2.65	0.003485	2.221e-16
3.179	1.571	2.848	0.003479	4.441e-16
3.179	1.571	3.05	0.003472	3.357e-16
3.179	2.356	2.65	0.003529	2.229e-16
3.179	2.356	2.848	0.003521	2.532e-16
3.179	2.356	3.05	0.003509	2.227e-16
3.179	3.142	2.65	0.003592	2.708e-16
3.179	3.142	2.848	0.003574	2.095e-16
3.179	3.142	3.05	0.003553	2.641e-16
3.714	-3.142	2.65	0.002361	2.227e-16
3.714	-3.142	2.848	0.002339	2.227e-16
3.714	-3.142	3.05	0.002314	4.443e-16
3.714	-2.356	2.65	0.002374	2.229e-16
3.714	-2.356	2.848	0.002344	2.326e-16
3.714	-2.356	3.05	0.002313	2.234e-16
3.714	-1.571	2.65	0.002372	2.143e-16
3.714	-1.571	2.848	0.002339	1.157e-16
3.714	-1.571	3.05	0.002303	2.223e-16
3.714	-0.7854	2.65	0.002356	1.139e-16
3.714	-0.7854	2.848	0.002324	2.876e-16
3.714	-0.7854	3.05	0.00229	4.444e-16
3.714	0	2.65	0.002335	2.053e-16

DUNE propagation grid

Rows 176-200 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
3.714	0	2.848	0.002309	2.221e-16
3.714	0	3.05	0.002281	2.231e-16
3.714	0.7854	2.65	0.00232	2.827e-16
3.714	0.7854	2.848	0.002301	4.448e-16
3.714	0.7854	3.05	0.00228	1.162e-16
3.714	1.571	2.65	0.002322	2.231e-16
3.714	1.571	2.848	0.002307	2.239e-16
3.714	1.571	3.05	0.00229	1.966e-16
3.714	2.356	2.65	0.002339	3.331e-16
3.714	2.356	2.848	0.002323	2.221e-16
3.714	2.356	3.05	0.002305	3.334e-16
3.714	3.142	2.65	0.002361	1.735e-16
3.714	3.142	2.848	0.002339	2.226e-16
3.714	3.142	3.05	0.002314	3.333e-16
4.25	-3.142	2.65	0.001603	2.221e-16
4.25	-3.142	2.848	0.001581	2.888e-16
4.25	-3.142	3.05	0.001558	2.236e-16
4.25	-2.356	2.65	0.001601	2.225e-16
4.25	-2.356	2.848	0.001574	2.226e-16
4.25	-2.356	3.05	0.001546	2.685e-16
4.25	-1.571	2.65	0.001595	1.55e-16
4.25	-1.571	2.848	0.001565	2.221e-16
4.25	-1.571	3.05	0.001533	2.229e-16
4.25	-0.7854	2.65	0.001588	2.23e-16
4.25	-0.7854	2.848	0.001558	3.137e-16

DUNE propagation grid

Rows 201-225 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
4.25	-0.7854	3.05	0.001526	1.136e-16
4.25	0	2.65	0.001583	2.803e-16
4.25	0	2.848	0.001557	2.23e-16
4.25	0	3.05	0.001529	2.222e-16
4.25	0.7854	2.65	0.001583	2.224e-16
4.25	0.7854	2.848	0.001562	2.252e-16
4.25	0.7854	3.05	0.00154	2.221e-16
4.25	1.571	2.65	0.001589	2.224e-16
4.25	1.571	2.848	0.001572	2.223e-16
4.25	1.571	3.05	0.001553	1.853e-16
4.25	2.356	2.65	0.001598	2.225e-16
4.25	2.356	2.848	0.00158	2.228e-16
4.25	2.356	3.05	0.001561	2.229e-16
4.25	3.142	2.65	0.001603	2.221e-16
4.25	3.142	2.848	0.001581	2.888e-16
4.25	3.142	3.05	0.001558	2.236e-16
4.786	-3.142	2.65	0.001122	6.711e-17
4.786	-3.142	2.848	0.001103	2.225e-16
4.786	-3.142	3.05	0.001082	2.221e-16
4.786	-2.356	2.65	0.001114	2.221e-16
4.786	-2.356	2.848	0.001091	2.83e-16
4.786	-2.356	3.05	0.001066	2.23e-16
4.786	-1.571	2.65	0.001105	2.221e-16
4.786	-1.571	2.848	0.001079	2.71e-16
4.786	-1.571	3.05	0.001051	2.003e-16

DUNE propagation grid

Rows 226-250 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
4.786	-0.7854	2.65	0.0011	2.256e-16
4.786	-0.7854	2.848	0.001074	1.712e-16
4.786	-0.7854	3.05	0.001046	2.232e-16
4.786	0	2.65	0.001102	2.229e-16
4.786	0	2.848	0.001078	2.59e-16
4.786	0	3.05	0.001053	1.458e-16
4.786	0.7854	2.65	0.001109	2.223e-16
4.786	0.7854	2.848	0.001089	1.124e-16
4.786	0.7854	3.05	0.001068	1.298e-16
4.786	1.571	2.65	0.001118	1.523e-16
4.786	1.571	2.848	0.001101	2.001e-16
4.786	1.571	3.05	0.001083	2.224e-16
4.786	2.356	2.65	0.001123	2.224e-16
4.786	2.356	2.848	0.001107	2.51e-16
4.786	2.356	3.05	0.001089	1.121e-16
4.786	3.142	2.65	0.001122	6.711e-17
4.786	3.142	2.848	0.001103	2.225e-16
4.786	3.142	3.05	0.001082	2.221e-16
5.321	-3.142	2.65	0.0008071	2.221e-16
5.321	-3.142	2.848	0.0007903	2.228e-16
5.321	-3.142	3.05	0.0007728	2.223e-16
5.321	-2.356	2.65	0.0007968	2.222e-16
5.321	-2.356	2.848	0.0007769	1.159e-16
5.321	-2.356	3.05	0.0007561	2.231e-16
5.321	-1.571	2.65	0.0007863	8.808e-17

DUNE propagation grid

Rows 251-275 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
5.321	-1.571	2.848	0.0007639	3.336e-16
5.321	-1.571	3.05	0.0007405	1.142e-16
5.321	-0.7854	2.65	0.000782	2.7e-16
5.321	-0.7854	2.848	0.000759	1.012e-16
5.321	-0.7854	3.05	0.0007351	2.226e-16
5.321	0	2.65	0.0007858	2.221e-16
5.321	0	2.848	0.0007647	1.114e-16
5.321	0	3.05	0.0007427	2.228e-16
5.321	0.7854	2.65	0.0007955	2.237e-16
5.321	0.7854	2.848	0.0007776	6.796e-17
5.321	0.7854	3.05	0.0007587	2.225e-16
5.321	1.571	2.65	0.0008058	2.225e-16
5.321	1.571	2.848	0.0007904	4.443e-16
5.321	1.571	3.05	0.0007742	2.236e-16
5.321	2.356	2.65	0.0008108	4.779e-16
5.321	2.356	2.848	0.0007959	2.22e-16
5.321	2.356	3.05	0.0007802	1.118e-16
5.321	3.142	2.65	0.0008071	2.221e-16
5.321	3.142	2.848	0.0007903	2.228e-16
5.321	3.142	3.05	0.0007728	2.223e-16
5.857	-3.142	2.65	0.0005945	2.222e-16
5.857	-3.142	2.848	0.00058	1.55e-16
5.857	-3.142	3.05	0.0005648	2.223e-16
5.857	-2.356	2.65	0.0005836	4.443e-16
5.857	-2.356	2.848	0.0005666	2.23e-16

DUNE propagation grid

Rows 276-300 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
5.857	-2.356	3.05	0.0005489	3.321e-16
5.857	-1.571	2.65	0.0005727	3.529e-16
5.857	-1.571	2.848	0.0005535	1.132e-16
5.857	-1.571	3.05	0.0005336	1.017e-16
5.857	-0.7854	2.65	0.0005683	1.327e-16
5.857	-0.7854	2.848	0.0005485	2.232e-16
5.857	-0.7854	3.05	0.0005279	2.231e-16
5.857	0	2.65	0.0005727	2.227e-16
5.857	0	2.848	0.0005542	2.22e-16
5.857	0	3.05	0.000535	2.22e-16
5.857	0.7854	2.65	0.0005831	2.25e-16
5.857	0.7854	2.848	0.0005671	2.24e-16
5.857	0.7854	3.05	0.0005505	2.231e-16
5.857	1.571	2.65	0.0005939	3.4e-16
5.857	1.571	2.848	0.0005801	2.221e-16
5.857	1.571	3.05	0.0005657	2.234e-16
5.857	2.356	2.65	0.0005987	3.461e-16
5.857	2.356	2.848	0.0005855	2.224e-16
5.857	2.356	3.05	0.0005717	3.331e-16
5.857	3.142	2.65	0.0005945	2.222e-16
5.857	3.142	2.848	0.00058	1.55e-16
5.857	3.142	3.05	0.0005648	2.223e-16
6.393	-3.142	2.65	0.0004469	2.232e-16
6.393	-3.142	2.848	0.0004343	1.259e-16
6.393	-3.142	3.05	0.0004213	1.478e-16

DUNE propagation grid

Rows 301-325 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
6.393	-2.356	2.65	0.0004362	2.488e-16
6.393	-2.356	2.848	0.0004217	2.236e-16
6.393	-2.356	3.05	0.0004066	3.693e-16
6.393	-1.571	2.65	0.0004254	2.197e-16
6.393	-1.571	2.848	0.000409	1.52e-16
6.393	-1.571	3.05	0.000392	2.234e-16
6.393	-0.7854	2.65	0.0004209	2.226e-16
6.393	-0.7854	2.848	0.0004038	1.129e-16
6.393	-0.7854	3.05	0.0003861	2.221e-16
6.393	0	2.65	0.0004251	2.226e-16
6.393	0	2.848	0.0004089	2.231e-16
6.393	0	3.05	0.0003922	2.232e-16
6.393	0.7854	2.65	0.0004354	2.224e-16
6.393	0.7854	2.848	0.0004213	8.075e-17
6.393	0.7854	3.05	0.0004066	2.087e-16
6.393	1.571	2.65	0.000446	1.138e-16
6.393	1.571	2.848	0.0004338	2.577e-16
6.393	1.571	3.05	0.0004211	2.221e-16
6.393	2.356	2.65	0.0004509	2.783e-16
6.393	2.356	2.848	0.0004393	2.253e-16
6.393	2.356	3.05	0.0004272	4.181e-16
6.393	3.142	2.65	0.0004469	2.232e-16
6.393	3.142	2.848	0.0004343	9.583e-17
6.393	3.142	3.05	0.0004213	1.119e-16
6.929	-3.142	2.65	0.0003418	2.818e-16

DUNE propagation grid

Rows 326-350 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
6.929	-3.142	2.848	0.0003309	1.426e-16
6.929	-3.142	3.05	0.0003196	1.119e-16
6.929	-2.356	2.65	0.0003318	2.229e-16
6.929	-2.356	2.848	0.0003193	2.225e-16
6.929	-2.356	3.05	0.0003063	6.876e-17
6.929	-1.571	2.65	0.0003215	1.399e-16
6.929	-1.571	2.848	0.0003073	2.23e-16
6.929	-1.571	3.05	0.0002927	3.331e-16
6.929	-0.7854	2.65	0.0003168	6.295e-17
6.929	-0.7854	2.848	0.000302	4.029e-17
6.929	-0.7854	3.05	0.0002867	2.222e-16
6.929	0	2.65	0.0003205	2.227e-16
6.929	0	2.848	0.0003064	2.271e-16
6.929	0	3.05	0.0002918	3.333e-16
6.929	0.7854	2.65	0.0003303	2.237e-16
6.929	0.7854	2.848	0.0003178	1.593e-16
6.929	0.7854	3.05	0.0003049	2.224e-16
6.929	1.571	2.65	0.0003405	2.223e-16
6.929	1.571	2.848	0.0003297	1.127e-16
6.929	1.571	3.05	0.0003185	2.224e-16
6.929	2.356	2.65	0.0003454	2.221e-16
6.929	2.356	2.848	0.0003352	3.339e-16
6.929	2.356	3.05	0.0003246	1.115e-16
6.929	3.142	2.65	0.0003418	2.818e-16
6.929	3.142	2.848	0.0003309	1.426e-16

DUNE propagation grid

Rows 351-375 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
6.929	3.142	3.05	0.0003196	1.119e-16
7.464	-3.142	2.65	0.0002655	1.115e-16
7.464	-3.142	2.848	0.000256	2.233e-16
7.464	-3.142	3.05	0.0002461	2.228e-16
7.464	-2.356	2.65	0.0002563	2.224e-16
7.464	-2.356	2.848	0.0002454	2.876e-16
7.464	-2.356	3.05	0.0002341	2.221e-16
7.464	-1.571	2.65	0.0002464	2.221e-16
7.464	-1.571	2.848	0.0002341	4.444e-16
7.464	-1.571	3.05	0.0002214	1.114e-16
7.464	-0.7854	2.65	0.0002418	2.222e-16
7.464	-0.7854	2.848	0.0002289	2.228e-16
7.464	-0.7854	3.05	0.0002156	1.425e-16
7.464	0	2.65	0.0002449	1.544e-16
7.464	0	2.848	0.0002325	2.231e-16
7.464	0	3.05	0.0002198	2.221e-16
7.464	0.7854	2.65	0.0002539	2.222e-16
7.464	0.7854	2.848	0.0002429	1.125e-16
7.464	0.7854	3.05	0.0002315	2.224e-16
7.464	1.571	2.65	0.0002637	1.111e-16
7.464	1.571	2.848	0.0002541	2.22e-16
7.464	1.571	3.05	0.0002441	7.115e-17
7.464	2.356	2.65	0.0002685	4.447e-16
7.464	2.356	2.848	0.0002595	3.726e-16
7.464	2.356	3.05	0.0002502	2.224e-16

DUNE propagation grid

Rows 376-400 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
7.464	3.142	2.65	0.0002655	1.115e-16
7.464	3.142	2.848	0.000256	2.221e-16
7.464	3.142	3.05	0.0002461	2.228e-16
8	-3.142	2.65	0.0002089	2.221e-16
8	-3.142	2.848	0.0002005	2.223e-16
8	-3.142	3.05	0.0001919	2.224e-16
8	-2.356	2.65	0.0002005	4.404e-17
8	-2.356	2.848	0.0001909	2.561e-16
8	-2.356	3.05	0.0001811	1.641e-16
8	-1.571	2.65	0.0001912	1.377e-16
8	-1.571	2.848	0.0001805	2.222e-16
8	-1.571	3.05	0.0001694	1.114e-16
8	-0.7854	2.65	0.0001866	2.236e-16
8	-0.7854	2.848	0.0001753	2.011e-16
8	-0.7854	3.05	0.0001637	7.263e-17
8	0	2.65	0.0001893	2.226e-16
8	0	2.848	0.0001783	2.222e-16
8	0	3.05	0.0001671	1.689e-16
8	0.7854	2.65	0.0001975	1.218e-16
8	0.7854	2.848	0.0001877	2.224e-16
8	0.7854	3.05	0.0001777	1.113e-16
8	1.571	2.65	0.0002067	2.235e-16
8	1.571	2.848	0.0001981	1.115e-16
8	1.571	3.05	0.0001893	1.11e-16
8	2.356	2.65	0.0002114	5.736e-17

DUNE propagation grid

Rows 401-405 of 405 | FORECAST / UNITARY

energy_GeV	delta_CP_rad	density	delta_P	unitarity_error
8	2.356	2.848	0.0002035	2.225e-16
8	2.356	3.05	0.0001952	2.459e-16
8	3.142	2.65	0.0002089	2.221e-16
8	3.142	2.848	0.0002005	2.223e-16
8	3.142	3.05	0.0001919	1.141e-16

Methods and reproducibility

What the archive contains

Item	Contents
level3_comprehensive_suite.py	This complete deterministic generator.
data/	public-release inputs retained from the prior companion.
tables/	698 individual grid results as CSV.
figures/	four web-ready PNG figures.
level3_results.json	machine-readable result ledger.
SHA256SUMS.txt	checksums for every packaged file.

Run: `python level3_comprehensive_suite.py`. The package is self-contained relative to its root directory.

Conclusion

A stronger postable result, without overclaiming

The frozen card now has broad deterministic coverage: 698 calculations and public-release comparisons.

What is genuinely established:

- the selected released-data analysis products can be reproduced from the included material;
- the 125 GeV template is examined across a 72-fit local robustness grid;
- the 8 GeV XENONnT point sits at a released constraint boundary;
- a properly Hermitian DUNE perturbation remains unitary across 405 propagations.

What remains unestablished: an END/MNT-specific prediction-to-likelihood mapping for GWOSC and ATLAS, and an empirical DUNE test. Those are the next scientific closure targets.