

Explicit-qT: Search Log for Quantum Tanner Codes

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1 Purpose

This document logs the best Quantum Tanner codes found by our search scripts.

For each group (and local-code choice), we want to record:

- **Quantum code:** (n, k) and best distance upper bound d_{ub} returned by QDistRnd, plus the number of trials / steps used.
- **Construction data:** the group G , generator multisets A and B , and the permutations used for the local codes.
- **Classical slice Tanner codes:** the 4 associated classical Tanner codes (two A-slice codes and two B-slice codes), with their parameters and distance-estimation settings.
- **Artifacts:** paths to saved parity-check matrices for the quantum code and for the 4 classical codes.

2 Folder convention for best-code artifacts

All matrices + metadata for the best codes should be stored under:

`best_codes/`

with one subfolder per saved code (or per “milestone”).

Recommended structure:

- `best_codes/meta/<CODE_TAG>.json` (all metadata: group, A/B, perms, trials, etc.)
- `best_codes/matrices/<CODE_TAG>_HX.mtx`
- `best_codes/matrices/<CODE_TAG>_HZ.mtx`
- `best_codes/matrices/<CODE_TAG>_classical_A_HO.mtx`, etc. (4 classical matrices)

Naming suggestion for <CODE_TAG>:

`G=<group>_n=<n>_k=<k>_dub=<dub>_<timestamp>_A=<A_id>_B=<B_id>`

(avoid spaces; keep it filesystem-friendly).

3 Current best results recorded

3.1 Group $G = C_2 \times C_2 \times C_2$ (order 8), length $n = 288$

This matches the “ $n = 36|G|$ ” regime (e.g., local codes of length 6 on both sides), hence $n = 36 \cdot 8 = 288$.

Best quantum codes found so far (from the reported table).

k	best d_{ub}	when_found(eval)	A_id	B_id
4	20	20260121T101724Z(2745)	Ap11_0-0-1-2-2-7	Bp11_0-0-1-2-4-5
8	20	20260121T060647Z(769)	Ap11_0-0-1-2-2-6	Bp6_0-1-2-4-5-7
12	17	20260121T034427Z(49)	Ap11_0-1-2-4-5-6	Bp6_0-1-2-3-4-7
16	16	20260121T043945Z(361)	Ap6_0-1-2-3-4-6	Bp6_0-1-2-4-5-7

Pending details to add for each row (to be filled automatically by scripts). For each of the above, we still want to record:

- explicit A and B as multisets of G elements (not only the IDs),
- the local-code permutations: **permA**, **permB**,
- classical slice code parameters (4 codes):
 - A-slice (primal): $(H0 \otimes I; (H1 \otimes I)LA)$
 - A-slice (dual): $(G0 \otimes I; (G1 \otimes I)LA)$
 - B-slice (primal): $(G0' \otimes I; (G1' \otimes I)RB)$
 - B-slice (dual): $(H0' \otimes I; (H1' \otimes I)RB)$
- paths to matrices saved under **best_codes/**.

4 Next automation step (to implement in scripts)

Whenever a new best quantum code is found (according to our rules):

- write a JSON metadata file into **best_codes/meta/**,
- export all parity-check matrices (quantum HX/HZ and the 4 classical ones) into **best_codes/matrices/**,
- append (or regenerate) the corresponding TeX table entry here.