

# 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_H0.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.