



DEEP DIVE FINDINGS

- VIOLATION IMPACT IS MINOR**
 - Violations explain only 7% of gap
 - Correction improves ratio from 3.80x to 3.58x
 - Still ~3.5x gap remains after correction
- THE 93% UNEXPLAINED GAP**
Main causes (in likely order of importance):
 - DECOMPOSITION APPROXIMATION**
Hierarchical method \neq global optimization
 - QUBO TRANSFORMATION**
Energy landscape differs from MIQP
 - LOCAL MINIMA**
Quantum annealing may not find global min
 - EMBEDDING NOISE**
Chain breaks and physical imperfections
- KEY INSIGHT**
Fixing violations would NOT make QPU competitive with Gurobi on solution quality. The fundamental gap is algorithmic, not due to constraint satisfaction failures.
- IMPLICATIONS**
 - Post-processing repair has limited value
 - Better decomposition strategies needed
 - Consider hybrid classical-quantum approaches