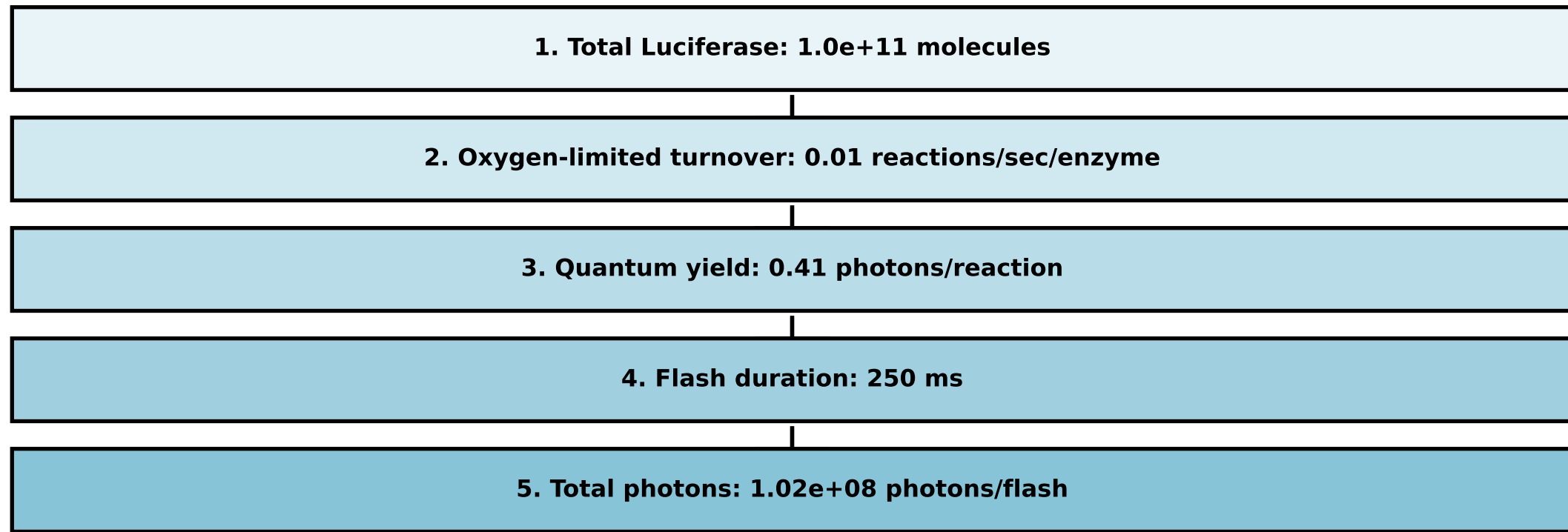


Firefly Bioluminescence: Energy Budget Analysis



ATP BUDGET CHECK:

- Energy per photon: 2.22 eV
- ATP per photon: 7.4 molecules
- Total ATP consumed: 7.57×10^8 molecules
 - Cellular [ATP]: 3.0 mM
- Total ATP available: 1.81×10^{14} molecules
 - Fraction used: 0.0% ✓ PLAUSIBLE

HISTORICAL MEASUREMENT (Ives & Coblenz 1924): 3.26×10^{14} photons
DISCREPANCY: 3176417× overestimate (6.5 orders of magnitude)