Rate matrix for an MG-style codon model

$$(\text{Rate})_{X,Y}(dt) = \begin{cases} \alpha & \pi_t dt & , & \text{one-step, synonymous substitution,} \\ \beta & \pi_t dt & , & \text{one-step, non-synonymous substitution,} \\ 0 & & , & \text{multi-step.} \end{cases}$$

X,Y = AAA...TTT (excluding stop codons),
π_t - frequency of the target nucleotide.

Example substitutions:
AAC→AAT (one step, synonymous - Asparagine)
CAC→GAC (one step, non-synonymous - Histidine to Aspartic Acid)
AAC→GTC (multi-step).

αR_{CT}
βR_{CG}

α (syn. rate) and **β** (non-syn. rate) are the key quantities for all selection analyses

Illuminating the darkness in molecular evolution