Components of the forward models

A **forward model** returns the probability of a single event — the density $P(x \mid \theta)$ over the observable x given the model parameters θ. It is the one component that genuinely differs between the analyses in this gallery. Everything the analysis does *with* that density — building a likelihood, fitting, setting intervals or limits — is inference: a separate concern, tracked per analysis and left out of this page.

So the axis that organizes the gallery is not the physics domain but **how the single-event density is computed.** The analyses fall on a short ladder, from densities that are simply stored to densities that must be sampled. The detail for each one lives on its own page; this table is only the index.

Method	Computation of the single-event density P	Analyses
Bin lookup	P is a pre-computed histogram (templates); evaluation identifies the bin and reads or interpolates its value. The expensive simulation is already frozen in the released workspace.	atlas-higgs-discovery, atlas-public-likelihoods, belle2-knunu, belle2-ktautau
Closed-form amplitude	$P = \lvert\sum_a c_a A_a\rvert^2$, an algebraic expression built from standard primitives — Wigner D-functions, lineshapes, barrier factors, coherent sums. Simple / algebraic K-matrix belongs here.	besiii-zc3900, compass-3pi, lhcb-kstarmumu, lhcb-lambdac-pkpi
Analytic convolution	P is an integral chain evaluated by quadrature: flux × oscillation × cross-section × response, spectral components × instrument function, or a parametric signal / background PDF.	dayabay-theta13, icecube-deepcore, icecube-source-correlation, gerda-0nubb, wdm-xray
Integral-equation solve	$P = \lvert T\rvert^2$ with the amplitude T the numerical solution of an equation (Lippmann–Schwinger; kinetic / transport equations; Lüscher quantization), solved once per parameter point.	chiral-eft-nn, lattice-kmatrix, ngc1068
MC density estimation	P has no closed form; it is estimated by propagating many simulated particles / events and histogramming the result. Parameters are compared through the sampled density (e.g. KL divergence).	m51-transport, bamber-nonlinear-qed, solar-gamma-rays

The last two rows share a boundary. **lattice-kmatrix** has an algebraic (closed-form) K-matrix amplitude, but it is evaluated only through the Lüscher quantization condition $\det[K^{-1} - B] = 0$, a numerical root-find, so it is filed with the solves. Borderline calls like this are settled in the analysis's own notes as the work is done, not adjudicated here.

When the forward model isn't explicitly called

In all but one analysis the forward model is evaluated directly at each parameter point — including the reinterpretations (belle2-knunu), which call a reweighting response. The exception is icecube-source-correlation: the signal PDF is a genuine forward model called per event, but the *background* is estimated from

scrambled data rather than a parametric model, so half of the density is data-driven. This is the only place where a piece of the model is not a called forward evaluation.