The job [1] is to transform the signal time series into noise. This helps the model learn to reverse the signal, removing the noise to reconstruct the signal.

$$q(x_t|x_0) = \mathcal{N}(x_t; \sqrt{\bar{\alpha}_t}x_0, (1 - \bar{\alpha}_t)\mathbf{I})$$

Where:

x_t: the state of the signal at diffusion step t.

x_0: the original signal.

$\bar{\alpha}_t$: how much signal is preserved at each step.

$\mathcal{N}$: the gaussian.

$\mathbf{I}$: the identity matrix.

References

[1] Gabriel Sasseville, Probabilistic Interpolation of Sagittarius A*'s Multi-Wavelength Light Curves Using Diffusion Models, 2026.