Lefschetz thimbleの変形による
複素Langevin法の改善

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complex Langevin process

complex Langevin (CL)

\[
\frac{dz}{dt} = -\frac{\partial S(z)}{\partial z} + \eta
\]

stochastic quantization for complex actions

- sometimes gives wrong answers
- not well understood for an action involving a log term

\[ S(x) = -\beta \cos x + \log(\cos x) \] (e.g.)

\( \text{CL} \overset{\sim}{\Rightarrow} \) importance sampling on Lefschetz thimbles (steepest descent paths)
Improved Langevin dynamics

- Improved Langevin dynamics modify two thimbles
  - One thimble agrees with the analytic result

Graphs showing the transition from two thimbles to one thimble.