Two key questions of quantum model order reduction (QMOR) :

(1) When is a physical system NOT running a quantum computation?

(2) Can all such systems be simulated with polynomial resources?

Kähler-manifold QMOR in a nutshell:

$$
\begin{aligned}
|\Psi\rangle = \; & \begin{bmatrix} {}^{1}c^{1}_{+j} \\ \vdots \\ {}^{1}c^{1}_{-j} \end{bmatrix} \otimes \begin{bmatrix} {}^{1}c^{2}_{+j} \\ \vdots \\ {}^{1}c^{2}_{-j} \end{bmatrix} \otimes \begin{bmatrix} {}^{1}c^{3}_{+j} \\ \vdots \\ {}^{1}c^{3}_{-j} \end{bmatrix} \otimes \ldots \otimes \begin{bmatrix} {}^{1}c^{n}_{+j} \\ \vdots \\ {}^{1}c^{n}_{-j} \end{bmatrix} \\
& + \begin{bmatrix} {}^{2}c^{1}_{+j} \\ \vdots \\ {}^{2}c^{1}_{-j} \end{bmatrix} \otimes \begin{bmatrix} {}^{2}c^{2}_{+j} \\ \vdots \\ {}^{2}c^{2}_{-j} \end{bmatrix} \otimes \begin{bmatrix} {}^{2}c^{3}_{+j} \\ \vdots \\ {}^{2}c^{3}_{-j} \end{bmatrix} \otimes \ldots \otimes \begin{bmatrix} {}^{2}c^{n}_{+j} \\ \vdots \\ {}^{2}c^{n}_{-j} \end{bmatrix} \\
& + \ldots \\
& + \begin{bmatrix} {}^{r}c^{1}_{+j} \\ \vdots \\ {}^{r}c^{1}_{-j} \end{bmatrix} \otimes \begin{bmatrix} {}^{r}c^{2}_{+j} \\ \vdots \\ {}^{r}c^{2}_{-j} \end{bmatrix} \otimes \begin{bmatrix} {}^{r}c^{3}_{+j} \\ \vdots \\ {}^{r}c^{3}_{-j} \end{bmatrix} \otimes \ldots \otimes \begin{bmatrix} {}^{r}c^{n}_{+j} \\ \vdots \\ {}^{r}c^{n}_{-j} \end{bmatrix}
\end{aligned}
$$

$\langle \delta\Psi | H - i\partial_t | \Psi \rangle = 0$ (Dirac-Frenkel projection)

… model noise as a covert measurement process.

A1: Symmetric systems

- Group theory

A2: Low-energy systems

- Variational calculus

A3: Averaged systems

- Statistical mechanics
- Master equations

A4: Noisy systems

- Model order reduction by Dirac-Frenkel projection onto Kähler manifolds
- System noise modeled as covert measurement.

The best-suited (yet least-studied) method for emulating large asymmetric high-temperature quantum systems.

What these systems have in common:

- They reduce the system complexity class from EXP to P.
- They are linked to beautiful physics, deep mathematics and virtualization.