

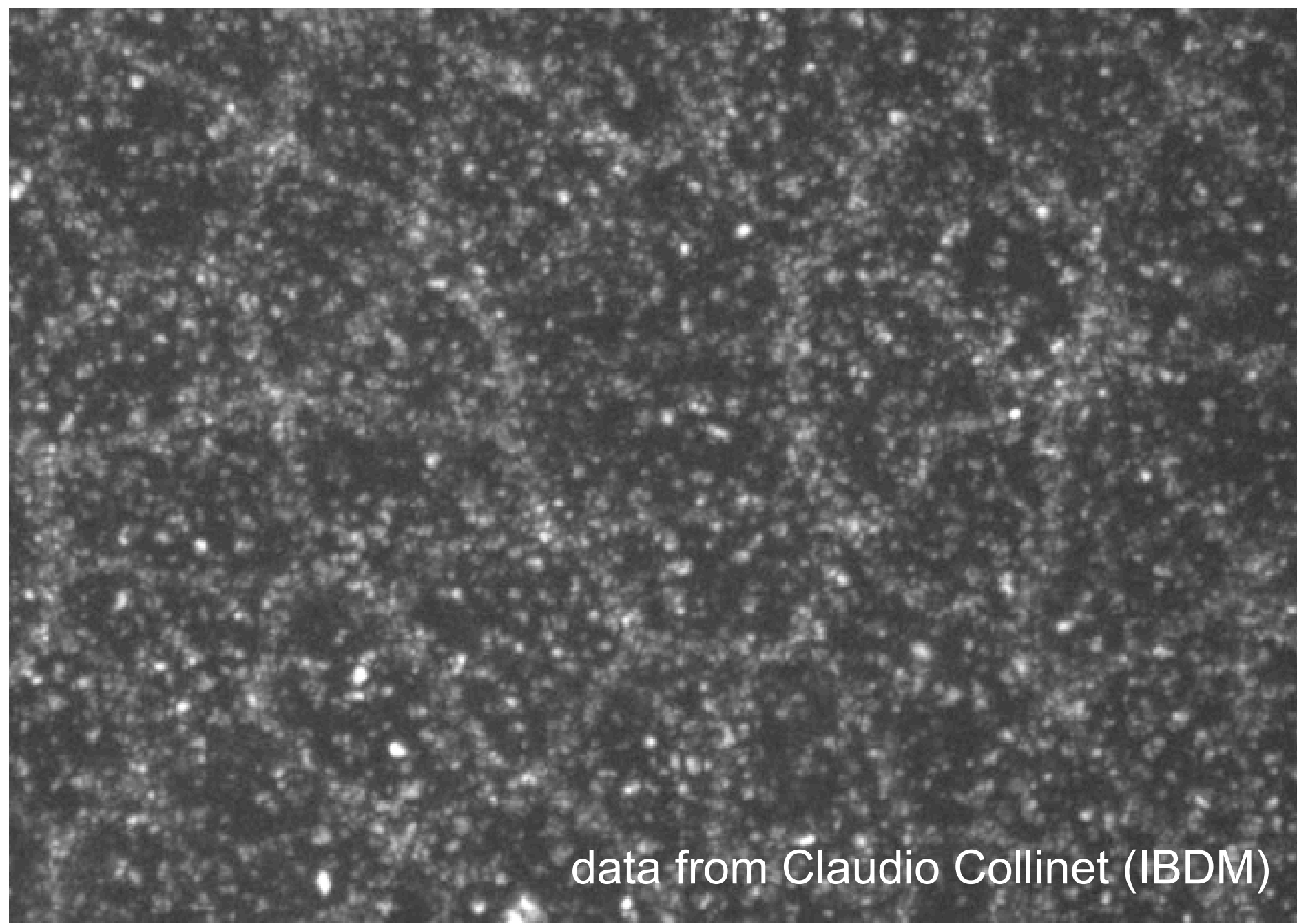
Measuring intracellular dynamics in-vivo through large language and stochastic modelling

Piyush Mishra (1,2), Philippe Roudot (2)

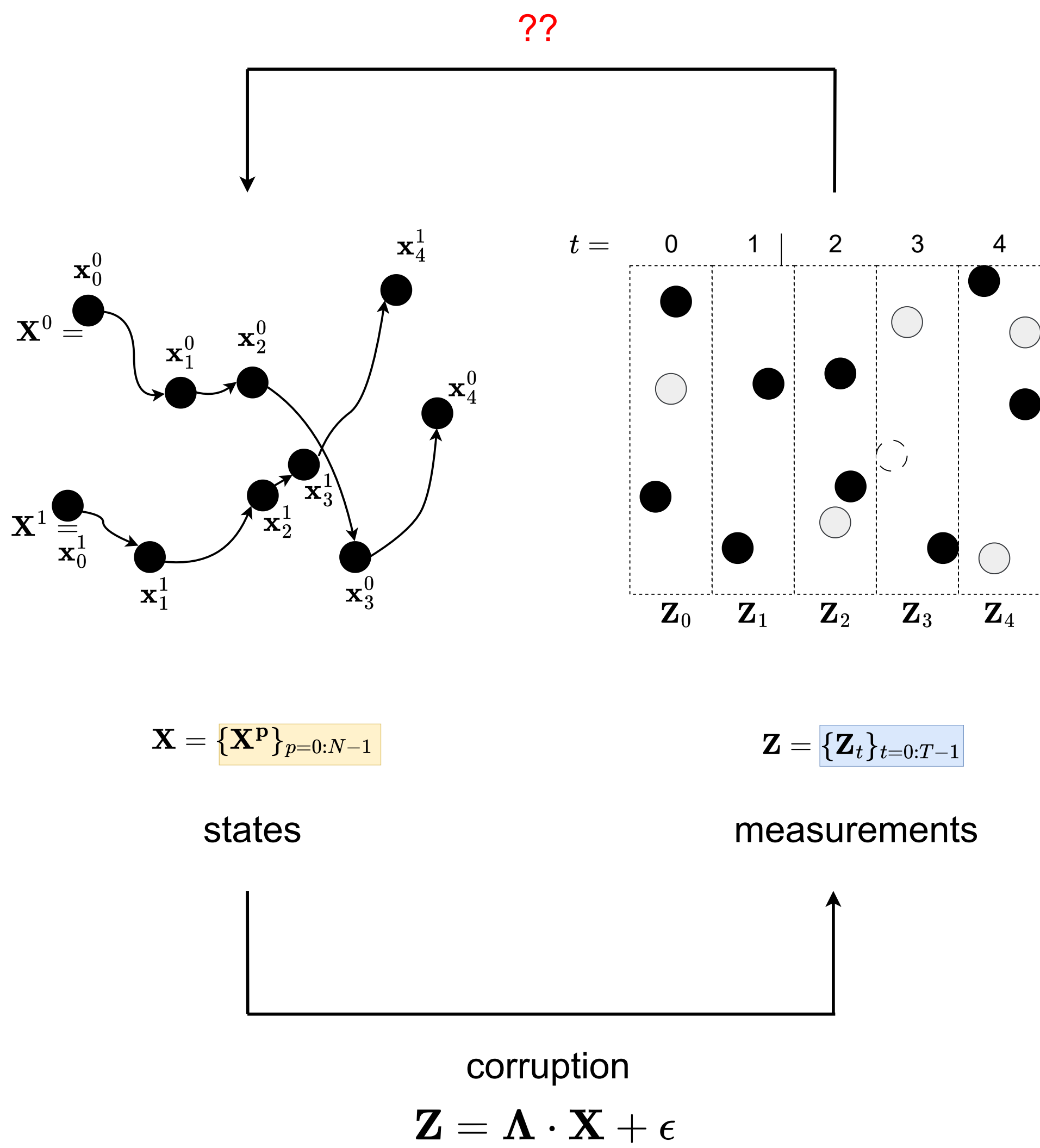
- 1. Aix Marseille Univ, CNRS, I2M, Turing Centre for Living Systems
- 2. Aix Marseille Univ, CNRS, Centrale Med, Institut Fresnel, Turing Centre for Living Systems



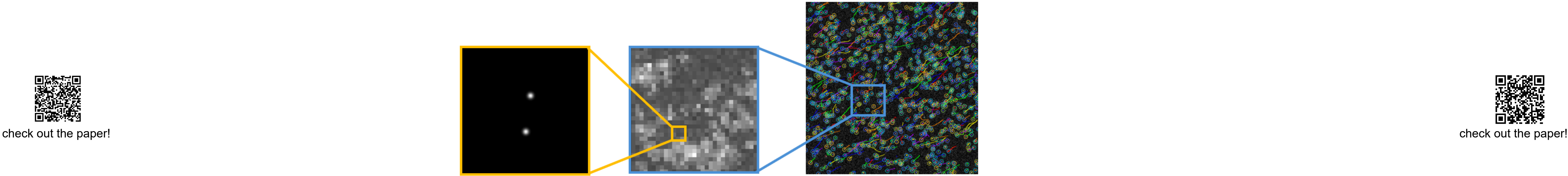
Motivation Particle tracking is a hard inverse problem



- Subcellular particle movement underpins:
- how diseases progress
 - how drugs work
 - how our bodies function

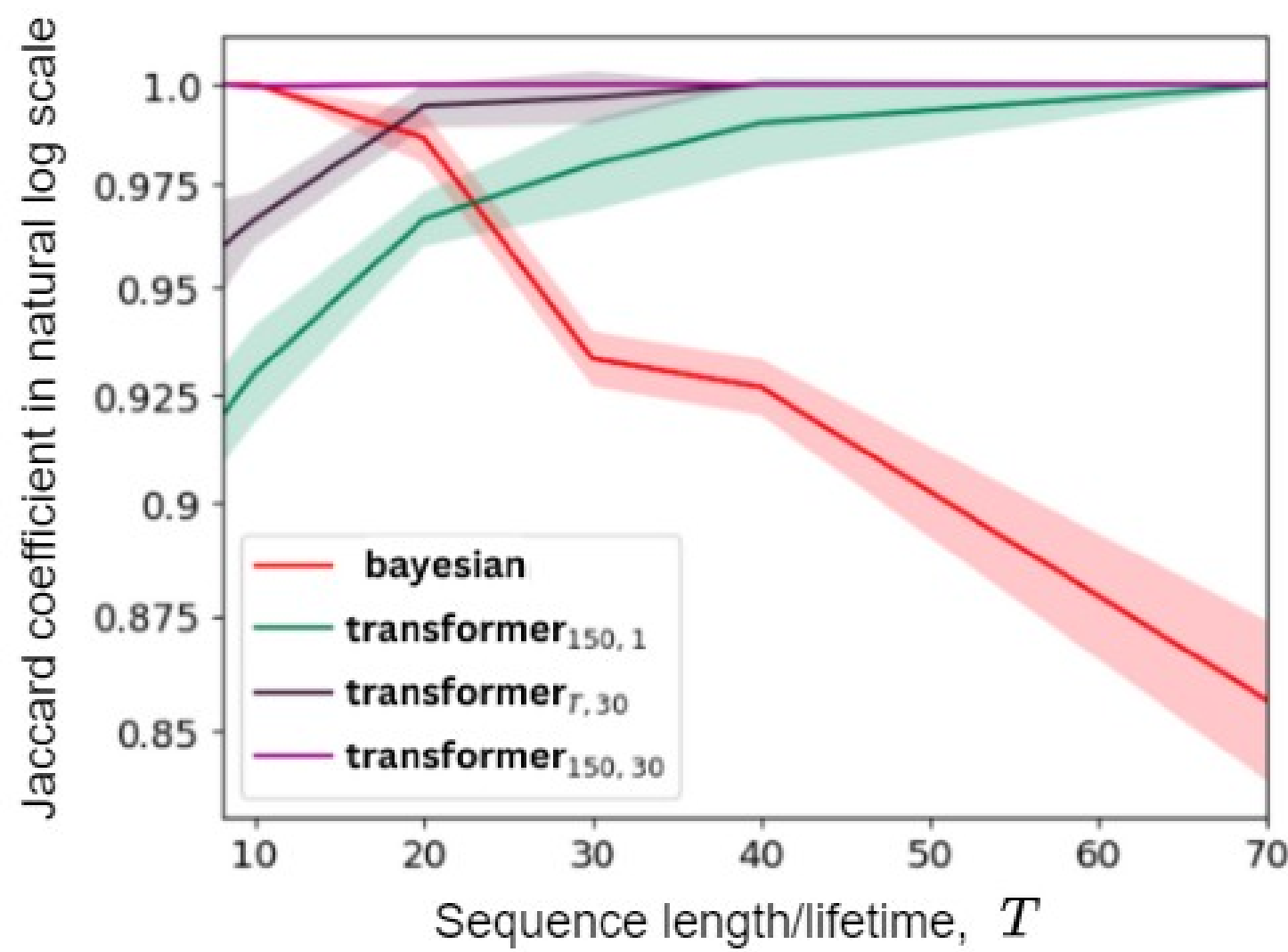


Methods & Results Prove it small, then go big

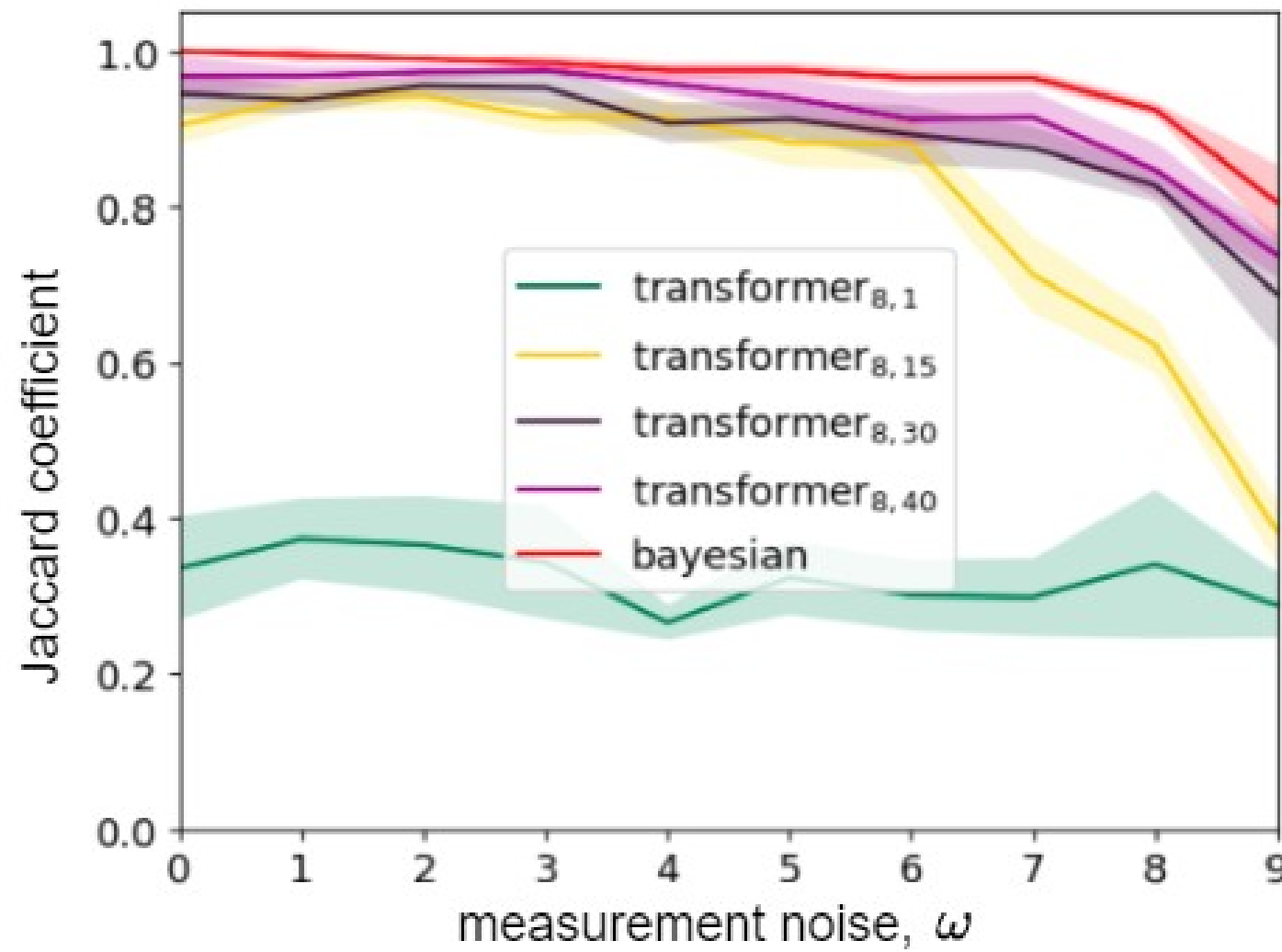


For 2 particles undergoing Brownian motion, are LLMs robust to increasing hypothesis set [1]?

Robust for large sets



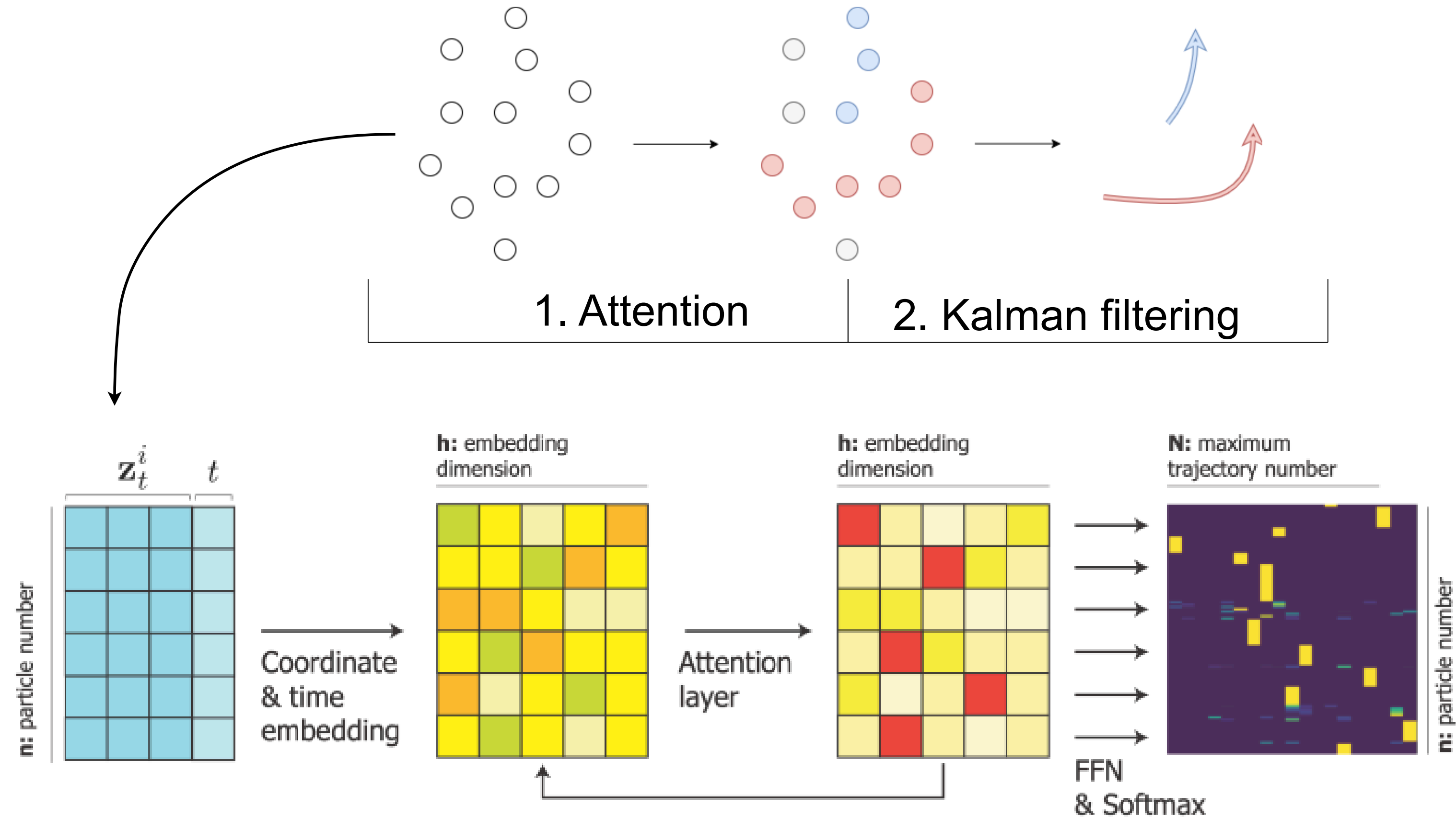
But suboptimal for small sets



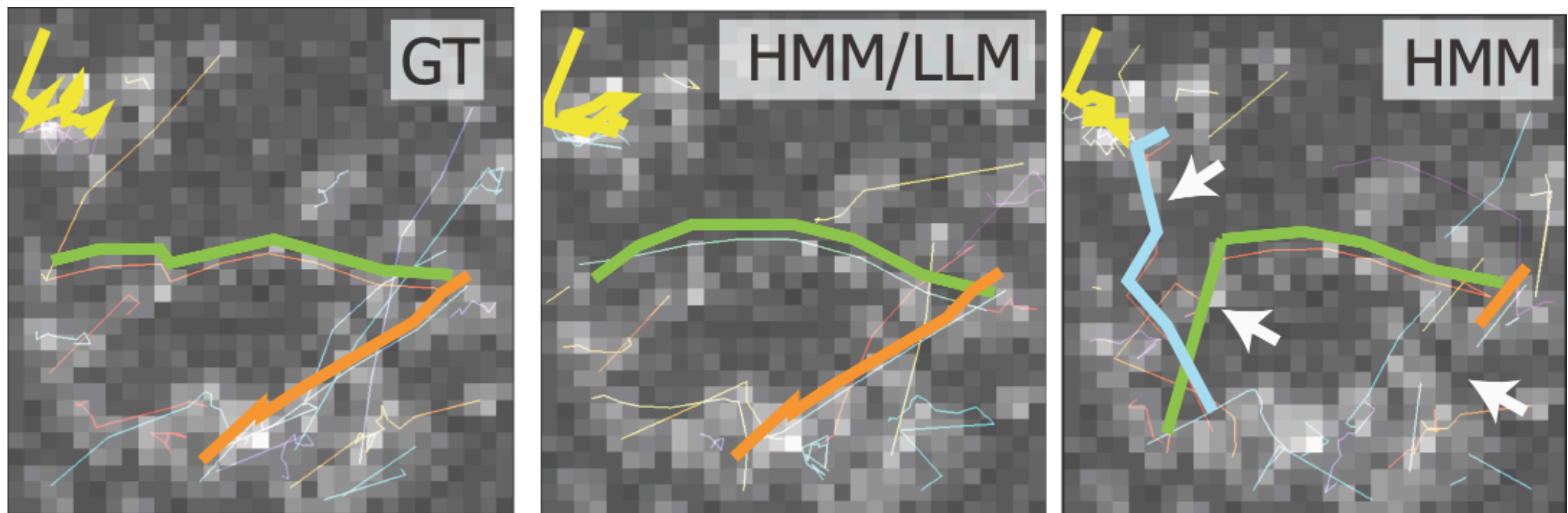
The transformer excels at pruning the hypothesis set but the conventional Bayesian approach is optimal for filtering

Using these insights, how can we make a robust but interpretable tracking tool [2]?

Split the problem into specialised tasks:



Both quantitative & qualitative reduction in tracking artefacts



TGOSPA = 2.116 TGOSPA = 5.743

About me

I am a 3rd year PhD student developing deep interpretable approaches for particle tracking at the nanoscale. I am also interested in sustainable AI.



check out my work!

References

- Mishra & Roudot, Comparative study of transformer robustness for multiple particle tracking without clutter, EUSIPCO, 2024
- Mishra & Roudot, Attention-Bayesian Hybrid Approach to Modular Multiple Particle Tracking, arXiv, 2025