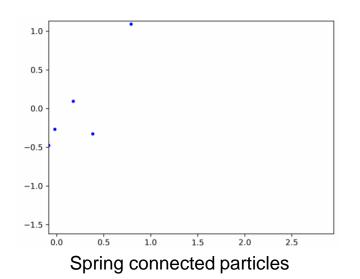
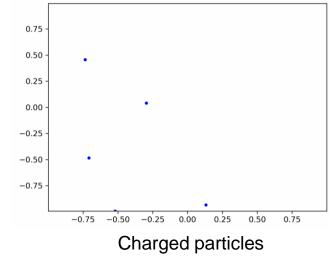
### **Learning System Dynamics without Forgetting (MS-GODE)**

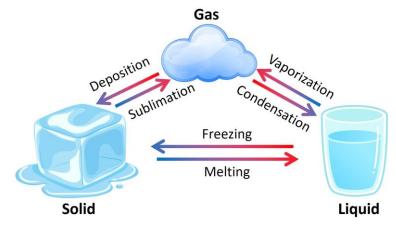
## Task: Trajectory Prediction over Multiple Systems with Different Dynamics

- A system contains multiple objects.
- Certain types of interactions exist among the objects, which determines the dynamics with environmental factors.
- A machine learning model is expected to predict the future trajectories based on the given observation of previous trajectories.





# **Challenge: System Dynamics are Varying**



- Dynamics of the same system is subject to change (e.g. due to environmental factor changes).
- Model may need to learn over multiple systems with diverse dynamics.
- These lead to catastrophic forgetting issue.

### **Learning System Dynamics without Forgetting (MS-GODE)**

#### Pipeline of MS-GODE Simulated **Training and Inference** prediction (1) Feed partial observations to model Mask Pool (2) Initailize a mask (3) Generate the past predictions (4) Mode-switching based on objective (3) $\mathbf{M} = \arg \max_{\mathbf{M}_s \in \mathbb{M}} \text{ELBO}(\mathbf{M}_s)$ Encoder Generator (5) Fetch mask Decoder Feed all observations to model 4 2 Save masks (Training only) **ELBO** Generate the future prediction **Objective Function** Calculate the objective function **Mask Inference Future Prediction** Future Prediction **Encoder & Generator & Decoder** Masked Decoder $\mathbf{M}_D$ Mask Pool $\mathbf{M}_{G}$ **Masked Interaction Masked Decoder** Network Prediction Observations ODE Solver

Masked Encoder

## **Evaluation Scenarios: Physical & Biological Systems**

