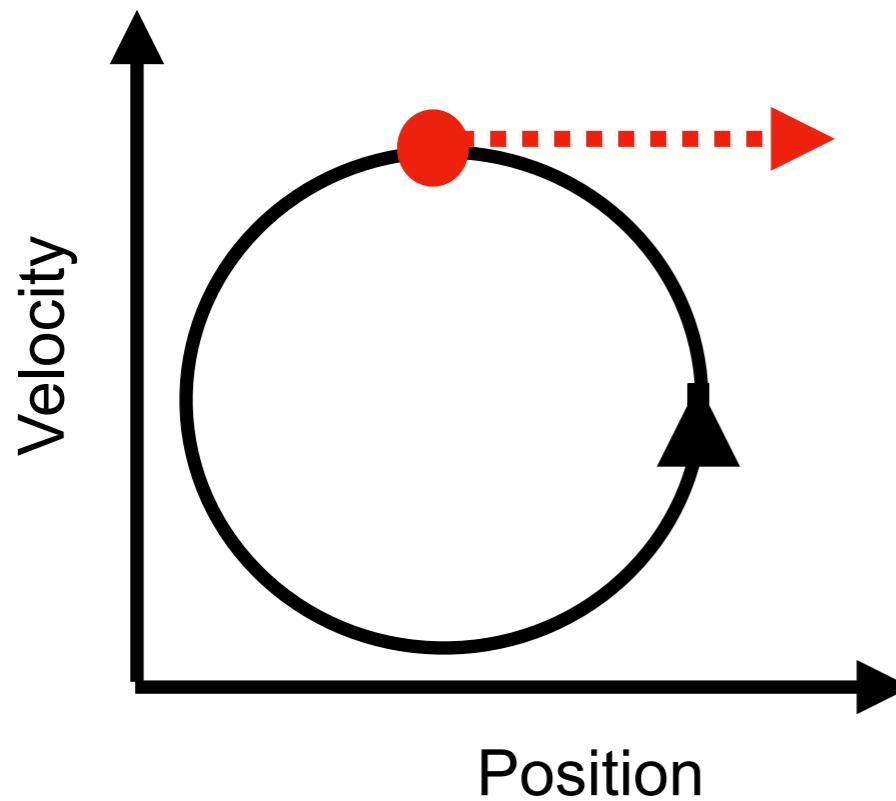
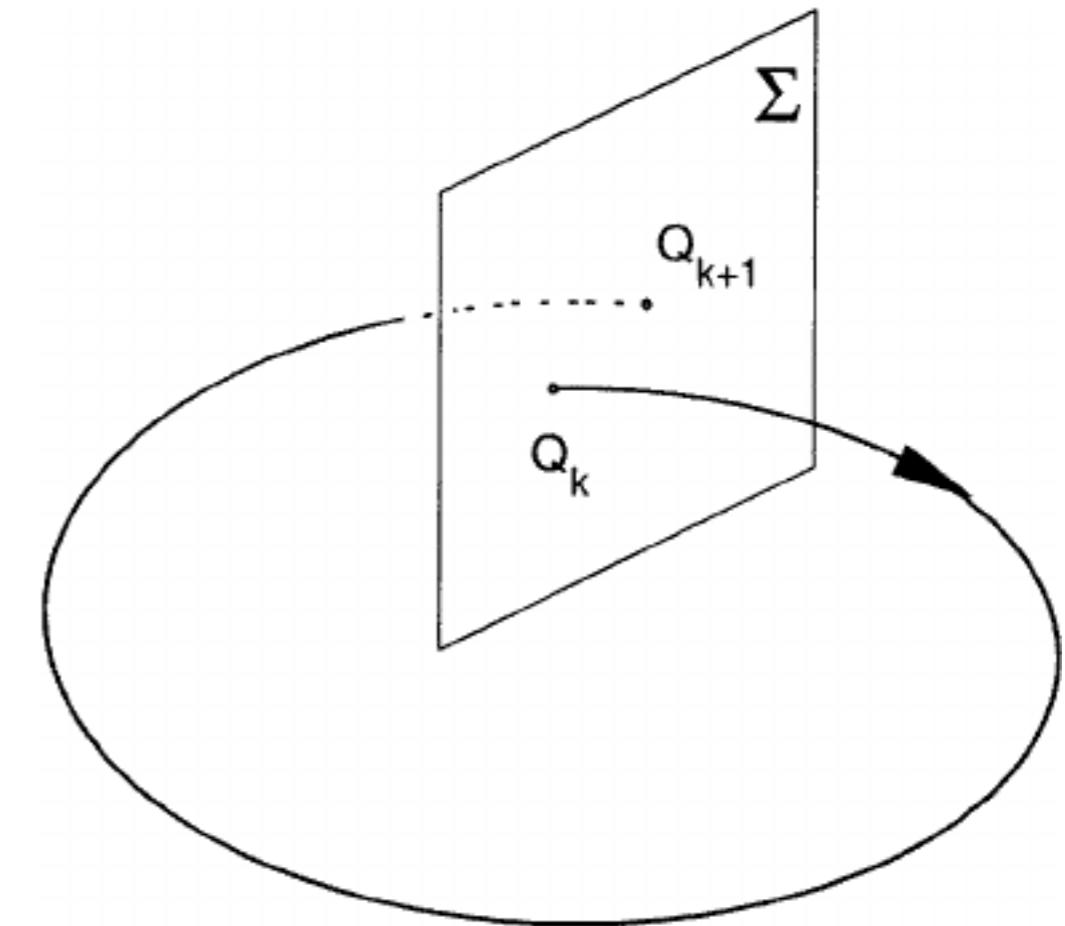
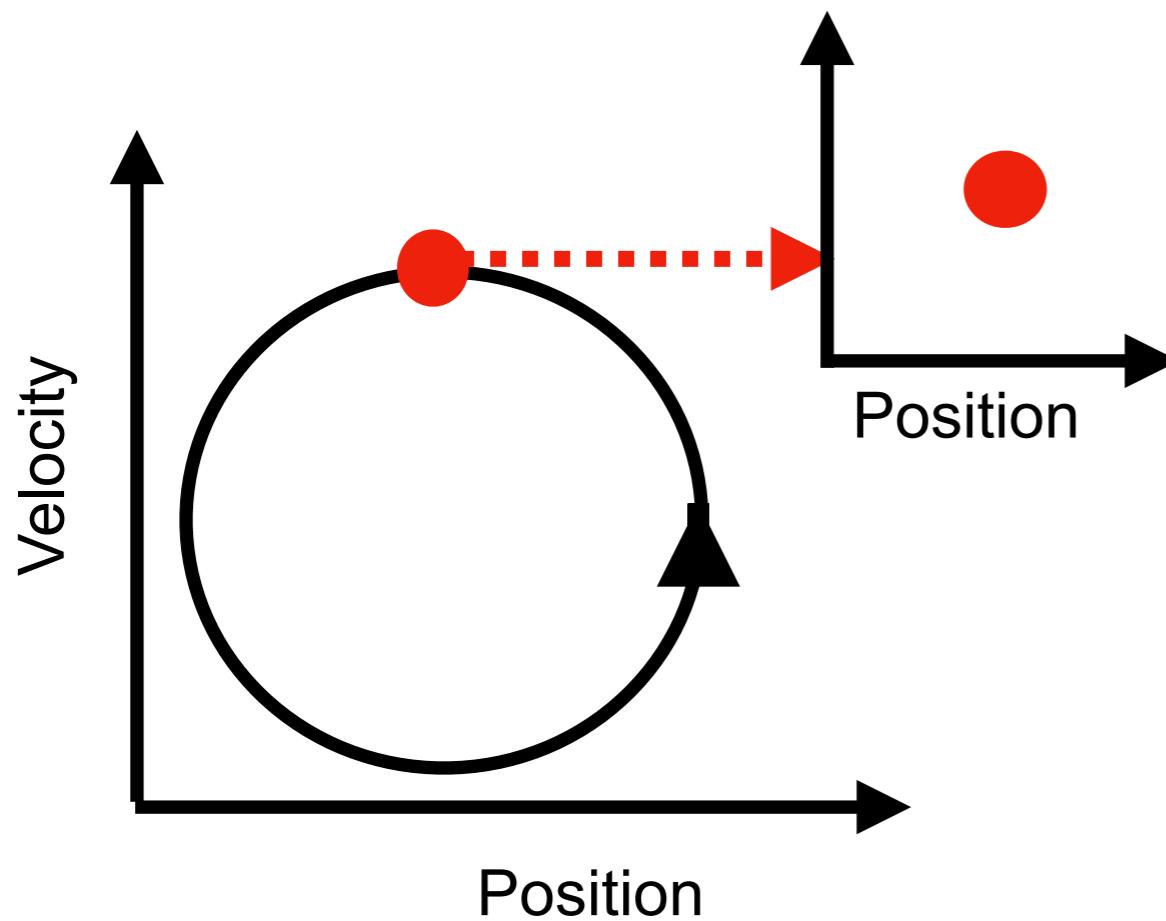


# Poincare Map



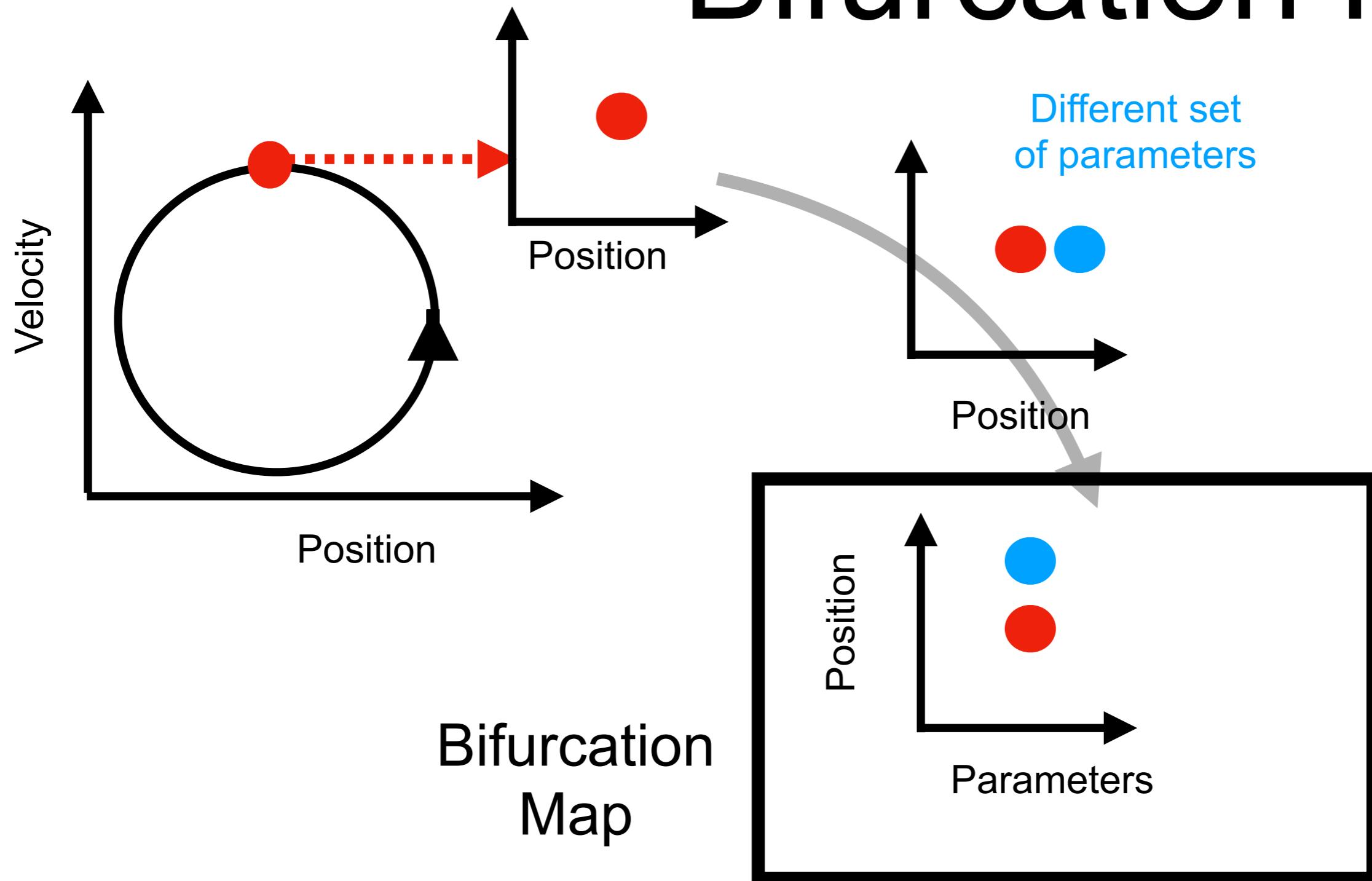
- Looking at the evolution for a fixed velocity or position point that a trajectory oscillates through defines a poincare map

# Poincare Map



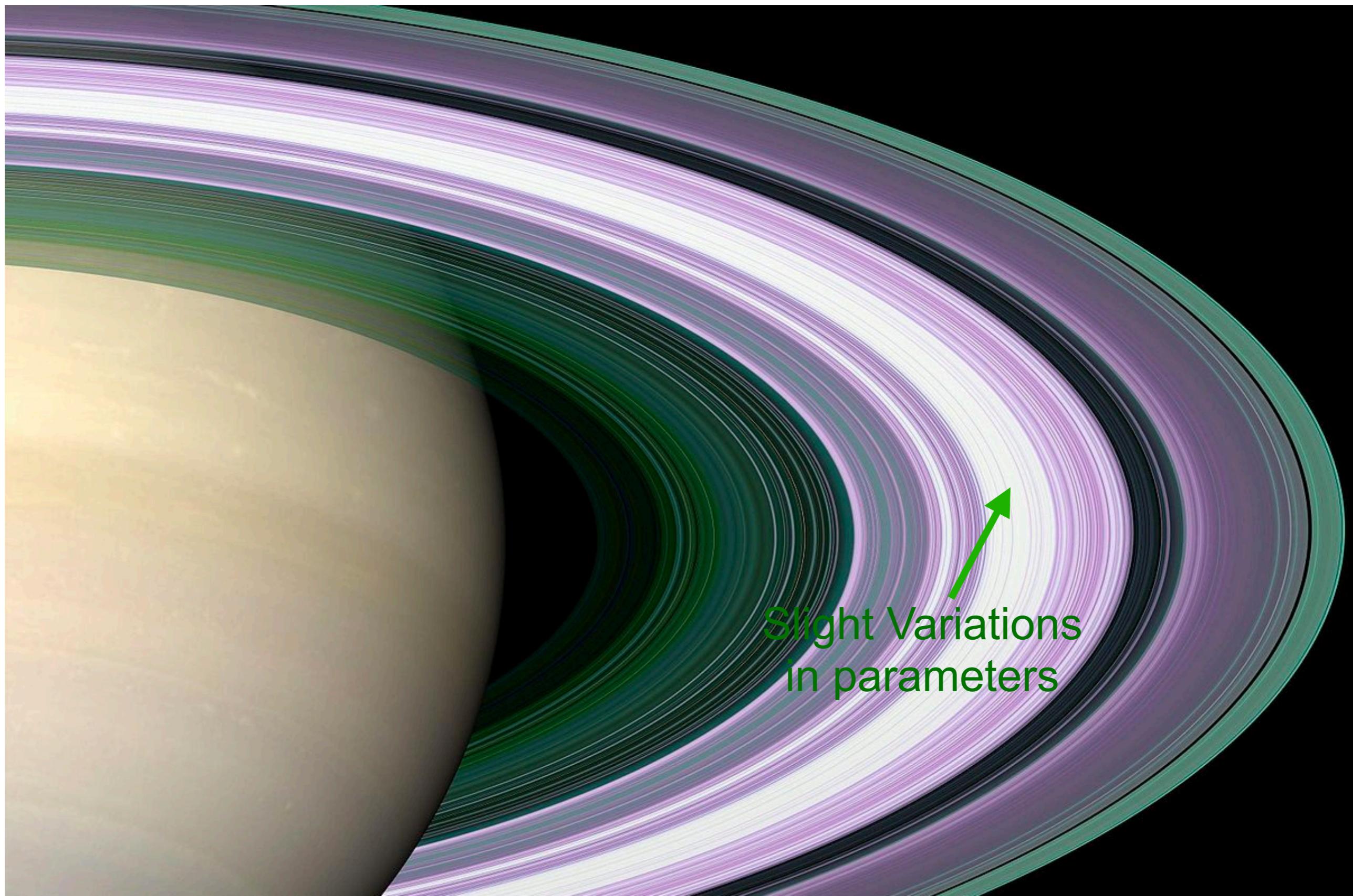
- Looking at the evolution for a fixed velocity or position point that a trajectory oscillates through defines a poincare map

# Bifurcation Map



- We can look at behavior over parameters

# Saturn's Rings



# Machine Learning Diffeq

- Recently within ML community :
  - The concept of Physics informed ML emerged

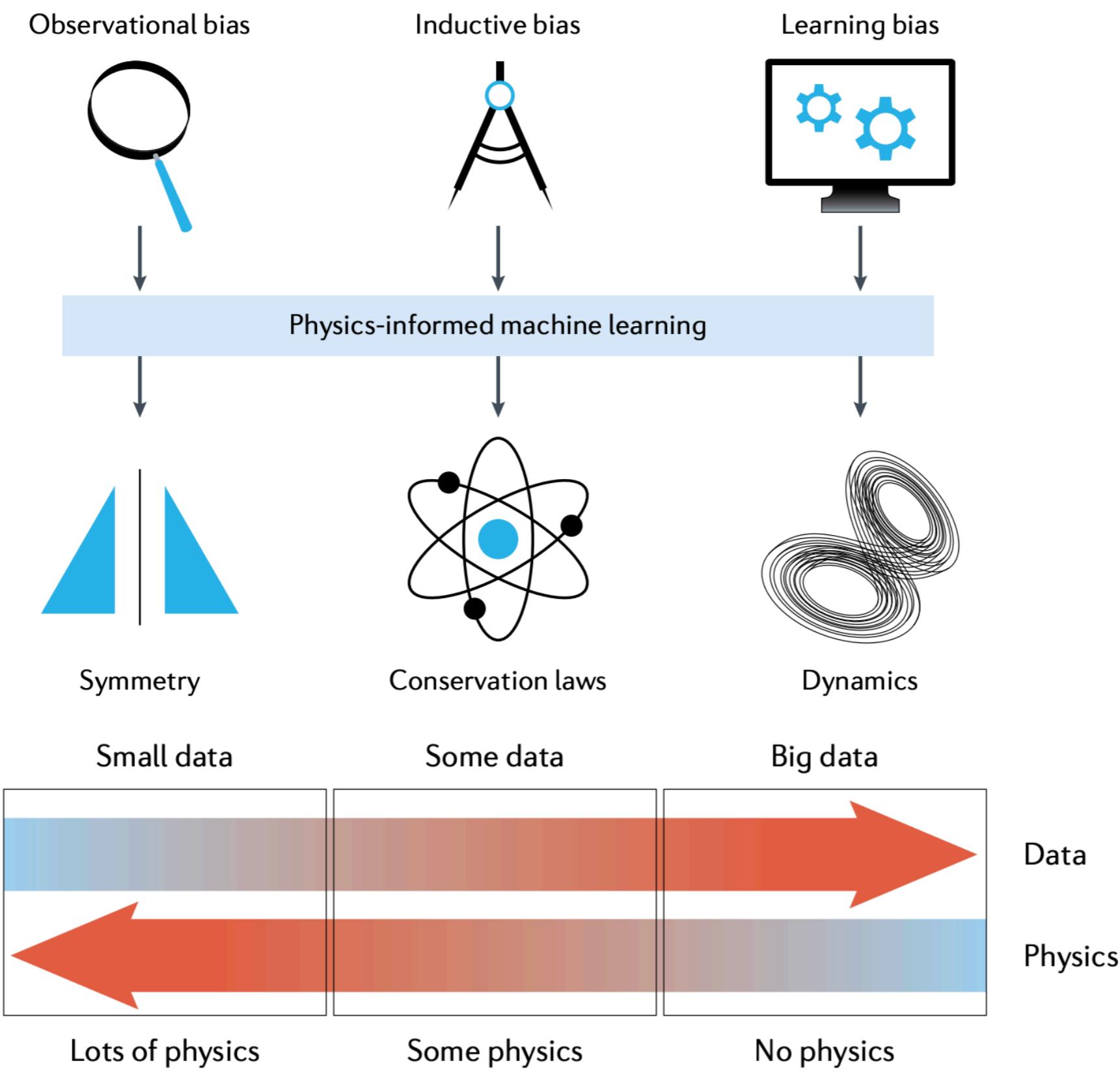
Strategy:  $\mathcal{L}_{total} = \mathcal{L}_{NN} + \mathcal{L}_{Diffeq}$

$$\ddot{\theta} + \mu\dot{\theta} + k\theta = 0$$

$$\mathcal{L}_{Diffeq} = (\ddot{\theta} + \mu\dot{\theta} + k\theta)^2$$

Constraint on Differential Equation  
Aim to approximate learning

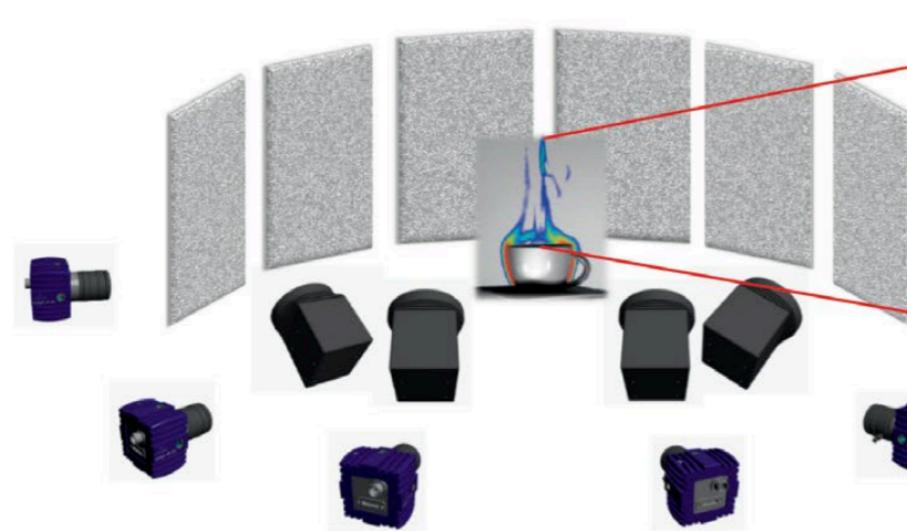
# Physics Informed ML



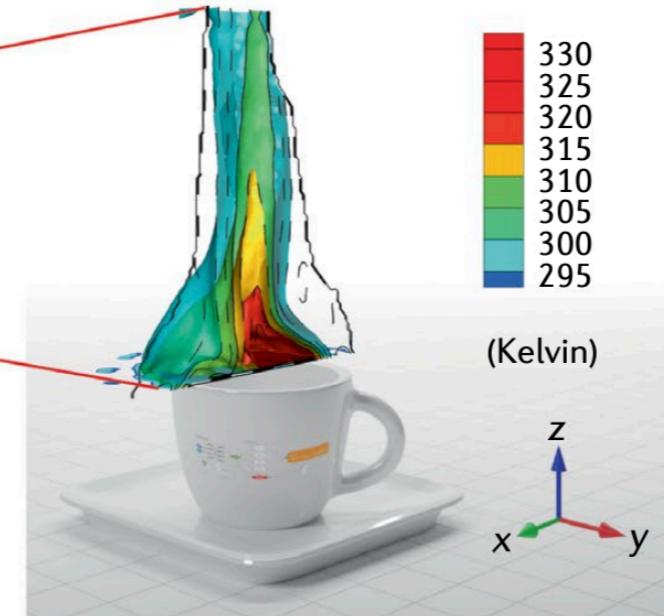
# Physics Informed ML

**a**

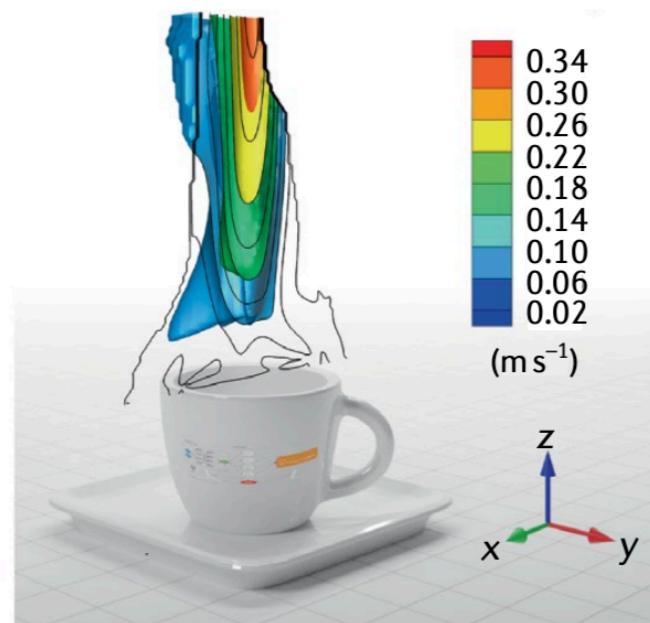
Tomo-BOS setup

**b**

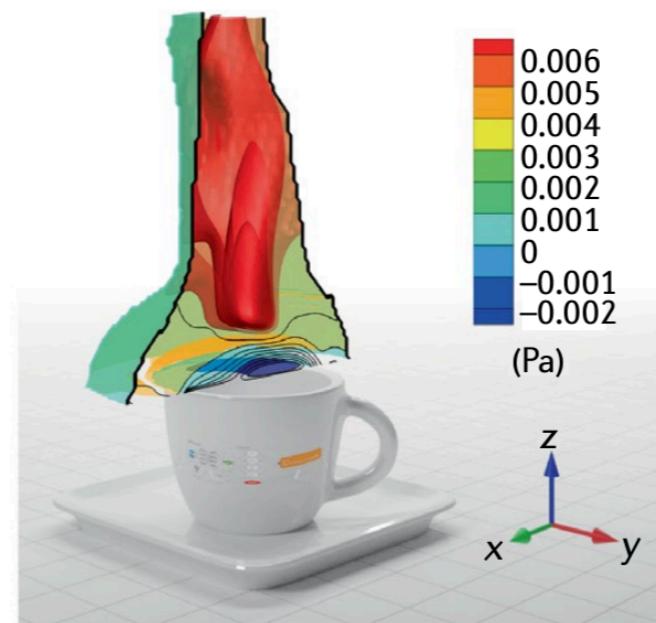
3D temperature data

**c**

3D velocity



3D pressure



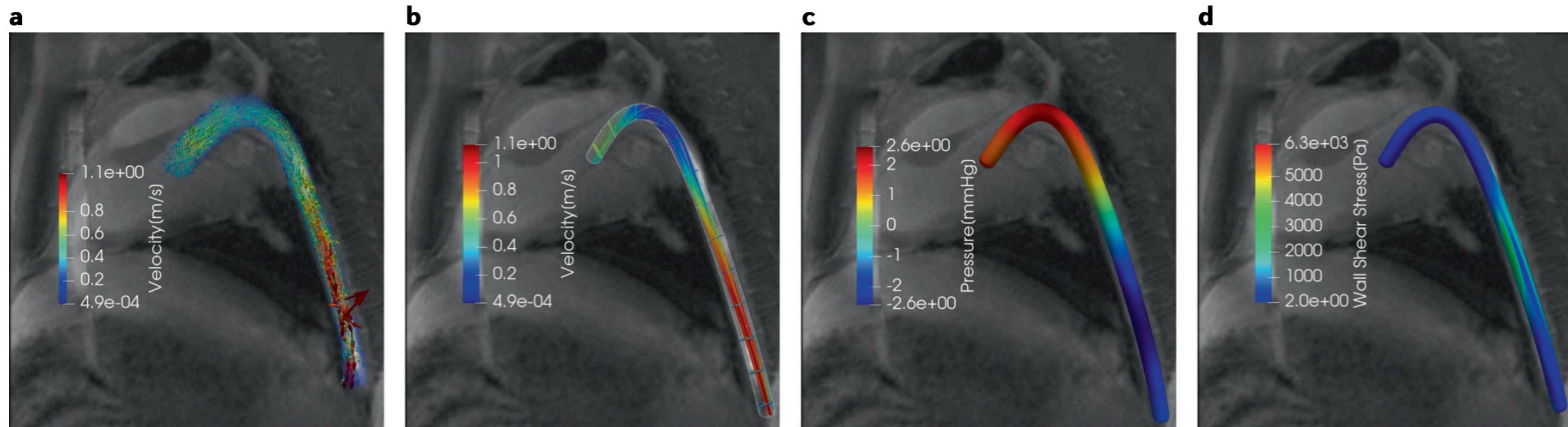
Given the  
Laws of fluid flow

How do we model flow?

Physics-informed  
neural network

These give us  
Physics informed ML

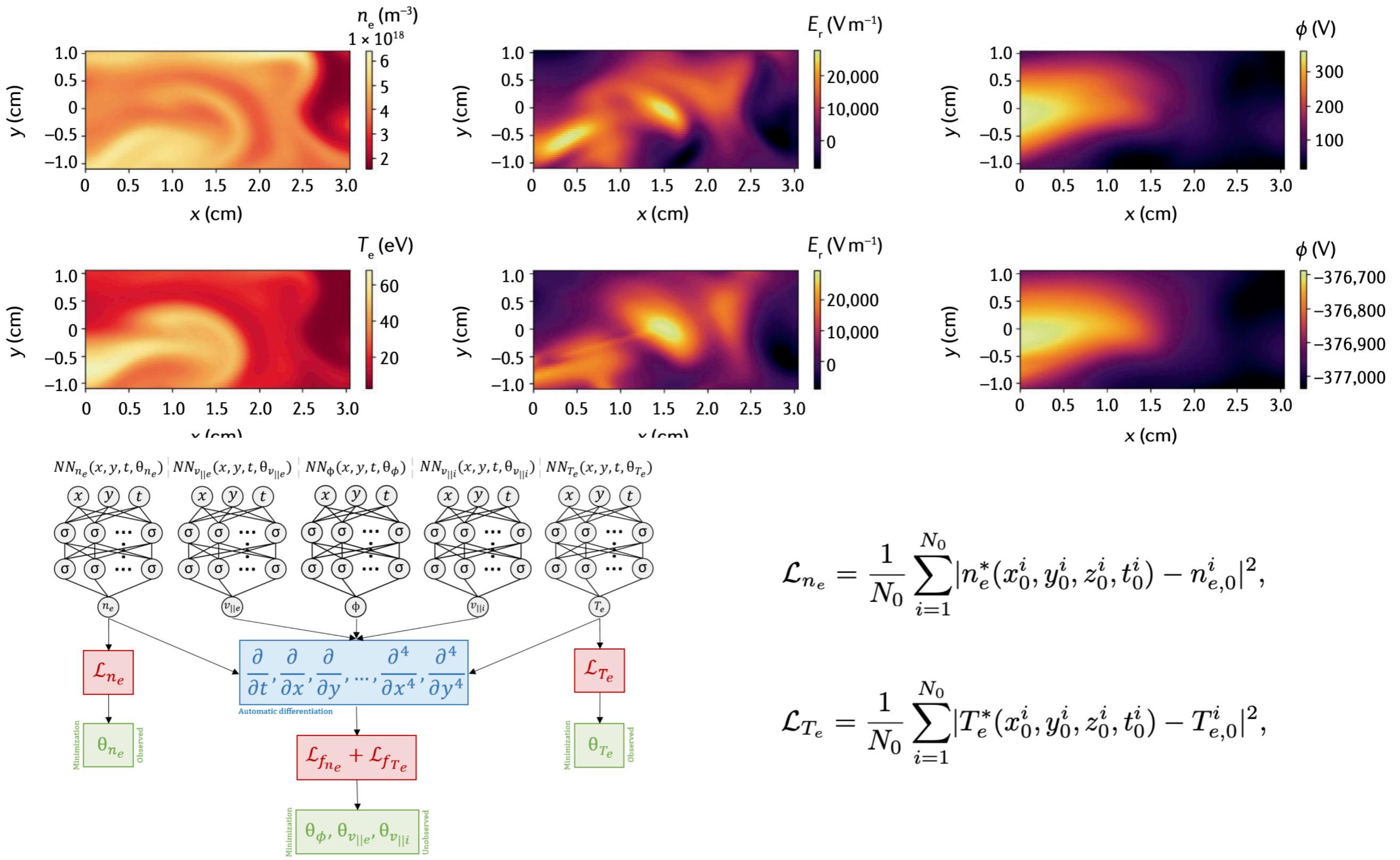
# Physics Informed ML



Navier Stokes equation to extrapolate blood flow in system

Navier Stokes equation to extrapolate blood flow in system

# Physics Informed ML



# Image Sources

**image**

link:

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