Bifurcations affect our ability to **learn parameters** of dynamical systems.

Parameter inference in dynamical systems with co-dimension 1 bifurcations

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INTRO

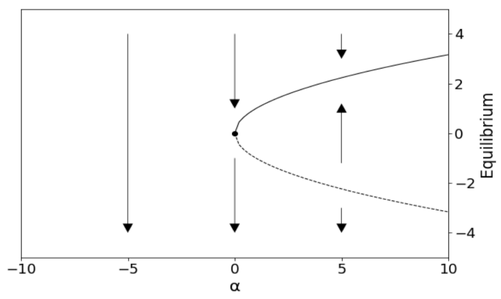
- We want to gain **mechanistic insights** into dynamical systems via **reverse engineering**:
  1. develop **models**
  2. design discriminatory **experiments**
  3. make testable **predictions**
- It is important to understand in which cases reverse engineering methods work well.
- Here, we evaluate the ability to perform parameter inference in respect to qualitative model dynamics.

METHODS

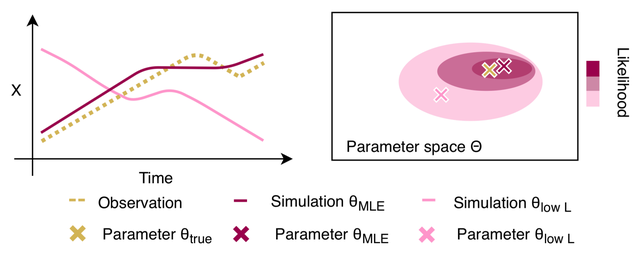
- A dynamical system is often described via a **ordinary differential equation** (ODE).

$$\frac{\partial X}{\partial t} = \alpha - X^2$$

- Here, we us ODEs to describe dynamical systems with **bifurcations**.



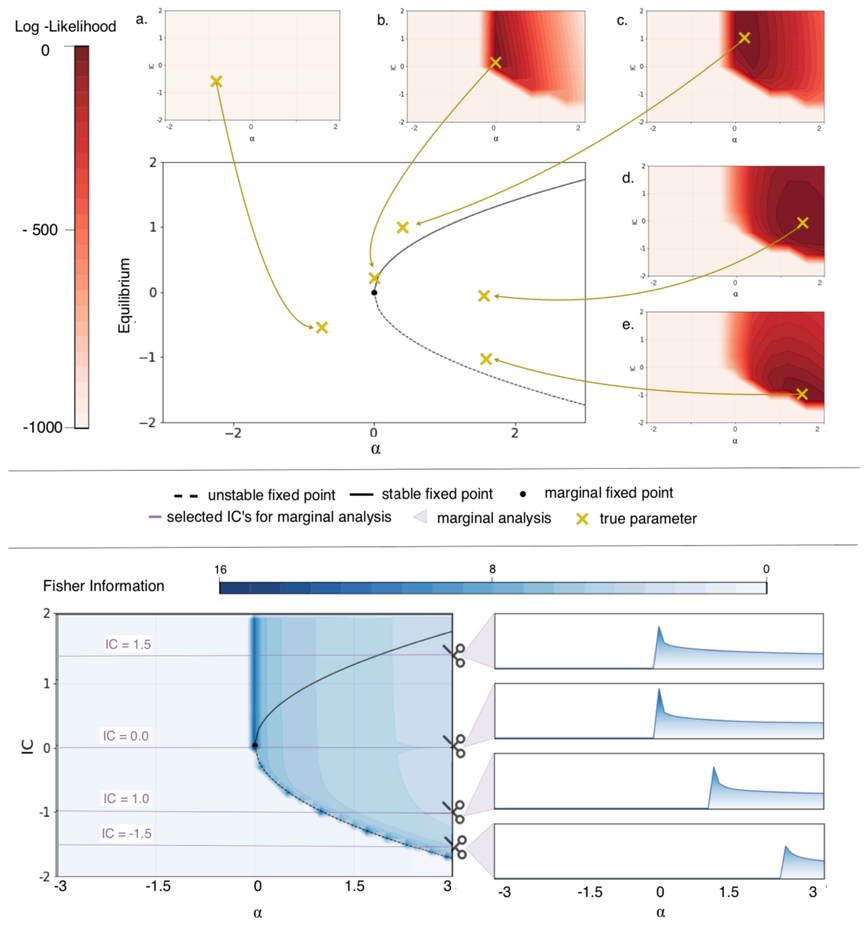
- We use the **maximum likelihood estimate** (MLE) to identify which parameters of the bifurcating systems explain **observed data** well.



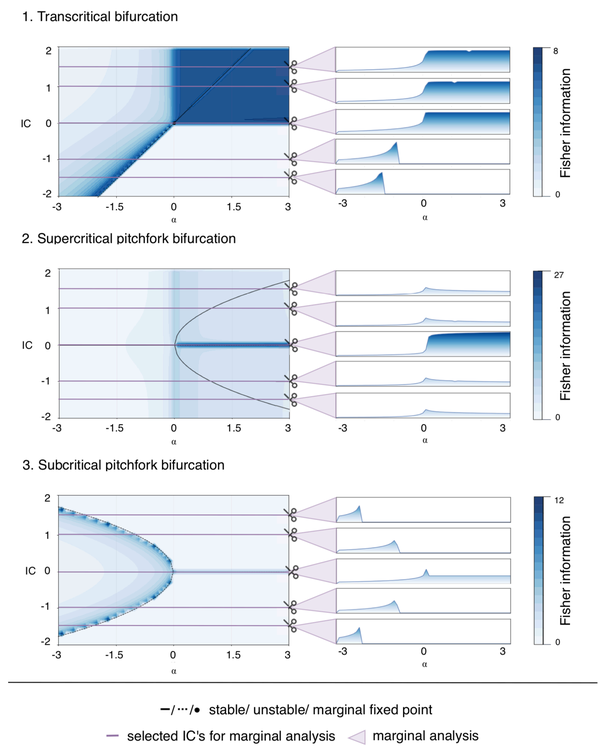
RESULTS + DISCUSSION

- We analyse four dynamical with distinct **co-dimension 1** bifurcations.
- We infer bifurcation parameters and initial conditions using the MLE.
- We evaluate the performance by investigating the **observed Fisher information**.
- For all bifurcations, the **global** stability properties affect our ability to perform parameter inference.
- Our analysis suggests that some parameters will be **systematically** more difficult to infer than others.

Parameter inference of the **Saddle node bifurcation**



Parameter inference of **three co-dimension 1 bifurcations**



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