Dear Reviewer,

We sincerely appreciate your valuable comments and suggestions for improving our manuscript. Below are our detailed responses to your specific concerns:

1. Regarding the size of Figure 1

Reviewer’s comment:

I would recommend increasing the size of Figure 1. At its present size, it is difficult to read without zooming in very closely.

Our response:

We greatly appreciate your feedback regarding the size of Figure 1. We agree that the current size might affect readability, and we will adjust the figure size in the revised manuscript to ensure that the fonts and data points are more clearly visible. Additionally, we will optimize the resolution of the figure legend and annotations to better present the data and dynamic behavior.

2. Definition of parameter a (Line 88)

Reviewer’s comment:

In line 88, is the parameter aa just a numerical parameter, or does it have a name or definition?

Our response:

Thank you for your comment on the definition of parameter a. We would like to clarify that a is a control parameter introduced in the normalized model referenced from Agop et al. (2012). It is used to describe the nonlinear characteristics of the system, and its specific roles include:

Determining the range of the negative differential resistance (NDR) region;

Controlling the possibility of bistability in the system;

Influencing the formation of bifurcation points and hysteresis phenomena.

In this study, we adopted this theoretical model and used a as a normalized control parameter to illustrate the relationship between negative differential resistance and critical transitions. However, our study does not involve detailed physical derivations or mechanisms of a, as the focus is on its role in describing the conditions for critical transitions.

To avoid potential misunderstandings, we will supplement the following clarification about aa in the revised manuscript:

a is a key parameter controlling the strength of nonlinear feedback and critical bifurcation behaviors in the system, determining the possibility of bistability and its triggering conditions;

In our analysis, a is adopted from an existing theoretical model and is not the main focus of this study.

3. Clarification of “certain state” and “certain limit” (Lines 91-93)

Reviewer’s comment:

In lines 91-93, the change in potential profile against current is discussed in Figure 1. Within these lines, there is mentioned a

″certain state″ and a ″certain limit,″ as well as a ″completely different state″ before reaching steady state. Be more specific with what these thresholds and states really are, and if possible postulate on how they might come to be.

Our response:

Thank you for pointing this out. We realize that our description of “certain state” and “certain limit” in the current text may lack clarity. Below, we provide a more specific explanation of these terms and their corresponding thresholds and states:

1. **″Certain state″**:

This refers to the system’s initial stable state (e.g., point A in Figure 1), where the channel current monotonically increases with voltage, and the system remains in a single stable state.

2. **″Certain limit″**:

This refers to specific threshold values of voltage or current (e.g., points B and D in Figure 1) where the system undergoes bifurcation, transitioning from one stable state to another. These limits correspond to the critical points of the system’s dynamics.

3. **″Completely different state″**:

This refers to the new stable state reached after bifurcation (e.g., point C in Figure 1), where the current-voltage relationship changes significantly, and the system transitions to a distinctly different stable state.

Regarding the mechanism behind these states and limits, the analysis in this study is based on the theoretical model referenced. Below is a brief explanation of their physical implications:

In the negative differential resistance region ($\frac{d\varphi}{dJ} < 0$), the system exhibits a dynamically unstable region (represented by the dashed line in Figure 1), where unstable states cannot persist.

Within this region, the system can exist in two possible stable states, depending on the historical path or initial conditions.

This behavior is a hallmark of hysteresis: as voltage gradually increases, the system remains in the initial stable state (e.g., point A) until it reaches a critical point (e.g., point B), where it transitions to another stable state (e.g., point C). Conversely, as voltage decreases, the system stays in the higher stable state until it reaches another critical point (e.g., point D), where it returns to the initial stable state (e.g., point A).

In the revised manuscript, we will provide a clearer description of these phenomena and explicitly annotate the stable states, critical points, and hysteresis behavior in Figure 1's caption.

Summary

We greatly appreciate your valuable feedback, which has helped us improve the clarity and scientific rigor of our manuscript. In the revised version, we will:

Adjust the size and resolution of Figure 1 to enhance its readability;

Supplement the background and role of parameter aa in our analysis;

Clarify the physical meaning of “certain state,” “certain limit,” and “completely different state” in both the text and Figure 1’s caption.

We hope these revisions address your concerns. If you have any further suggestions, we would be grateful to consider them.

Sincerely, On behalf of all co-authors