

# **Monday Meeting**

**15.09.25 Meeting**

# Research Summary

- Characterization of the tests to be performed on the Analog-to-Spike chip
- Implementation of the Multi-scale neuron on Brian2 -> Towards Neuromorphic PLL
- SSCS PICO Open-Source Chipathon 2025 -> Layout Programming using GLayout (Python)
- Summer School on ASIC Design + SOCN Summer School

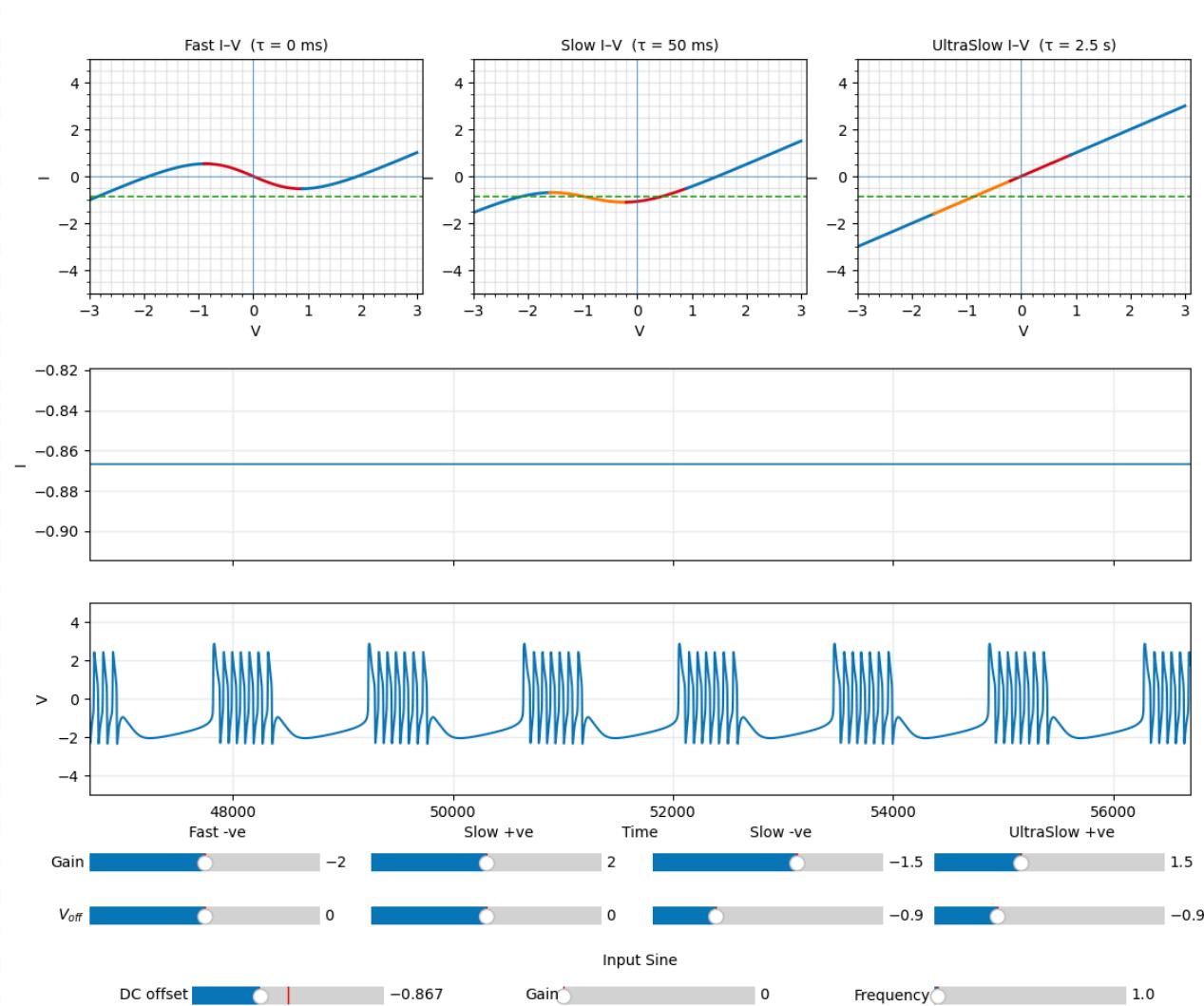
# Characterization of the tests of the chip

- Test the Digital Programming Chain
- Characterize amplifiers frequency response (Bode plot) + added linearities
- Quantify leakage observed in simulation (if happens on physical chip)
- DPI Neuron firing rate characterization (FI curve) + V-I Converter characterization
- Per taxel Power Consumption + Total chip Power Consumption
- FPGA, PCB ... specs

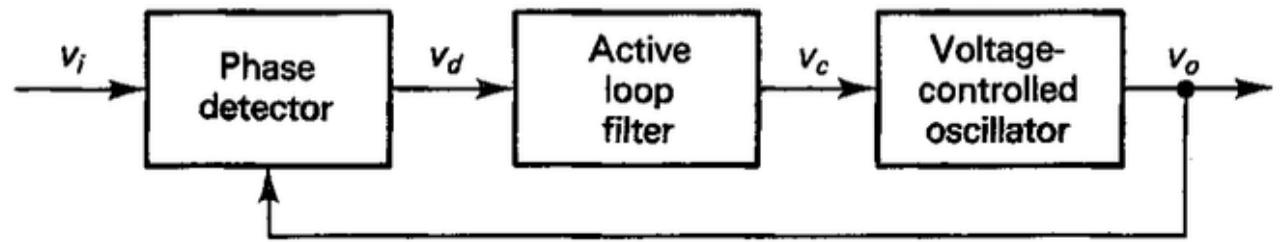
# Implementation of the Multi-Scale neuron on Brian2

$$\left\{ \begin{array}{l} \tau \frac{dV}{dt} = -V - I_f^- - I_s^+ - I_s^- - I_u^+ + I_{app} \\ I_f^- = \alpha_f^- * \tanh(V - \delta_f^-) \\ I_s^- = \alpha_s^- * \tanh(V_s^- - \delta_s^-) \\ \tau_s \frac{dV_s^-}{dt} = V - V_s^- \\ I_s^+ = \alpha_s^+ * \tanh(V_s^+ - \delta_s^+) \\ \tau_s \frac{dV_s^+}{dt} = V - V_s^+ \\ I_u^+ = \alpha_u^+ * \tanh(V_u^+ - \delta_u^+) \\ \tau_u \frac{dV_u^+}{dt} = V - V_u^+ \end{array} \right.$$

# Implementation of the Multi-Scale neuron on Brian2



# Towards Neuromorphic PLL



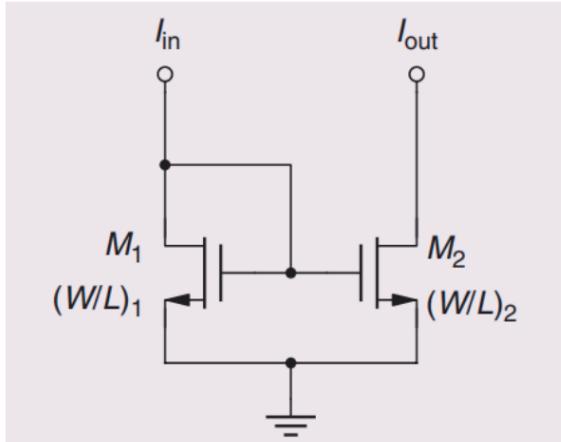
- **Phase Detector:** Type-III neuron that spikes at input zero-crossing (or offset)
- **Active Loop Filter:** Injects small perturbation on fast-timescale and tunes slower-timescales gain
- **Voltage-Controlled-Oscillator (VCO):** Multi-scale neuron

# Neuromorphic PLL : Next Steps

- Read about Phase-Response curves + Looking at paper [R. Schmetterling, F. Forni, A. Franci and R. Sepulchre, "Neuromorphic Control of a Pendulum"]
- Derive bandwidth of such a PLL to construct multi-PLLs in parallel system for texture recognition

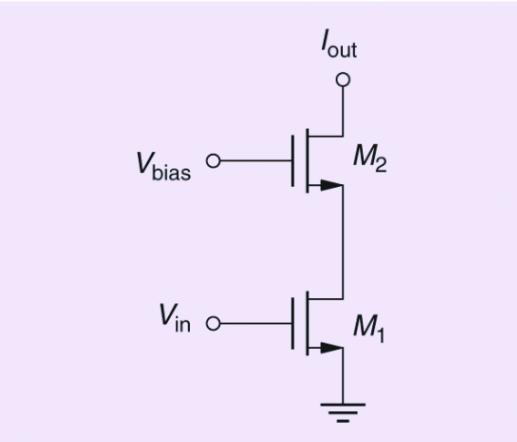
# Chipathon on Analog Chip Design

Current Mirror



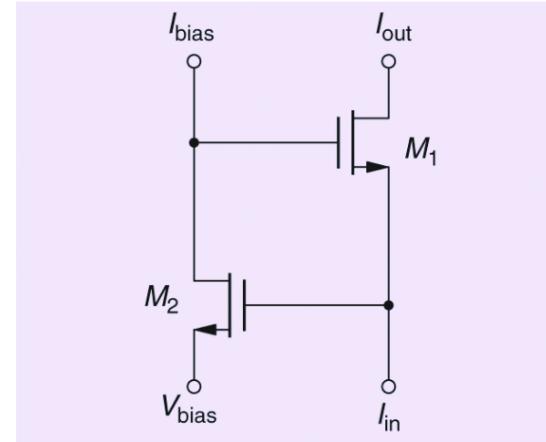
(Circuit 7)

Cascoded common-source



(Circuit 11)

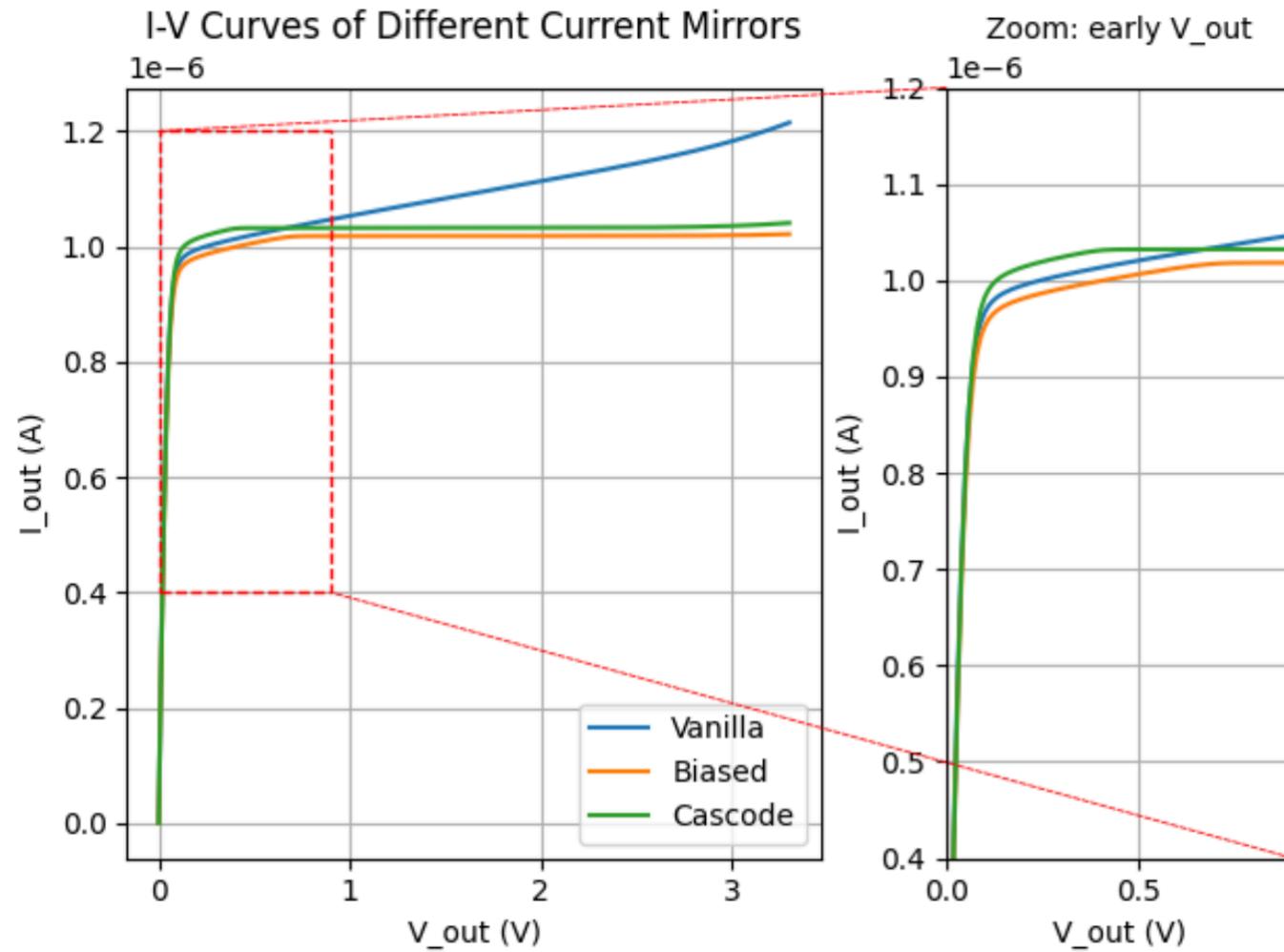
Regulated Cascode



(Circuit 48)

# Chipathon on Analog Chip Design

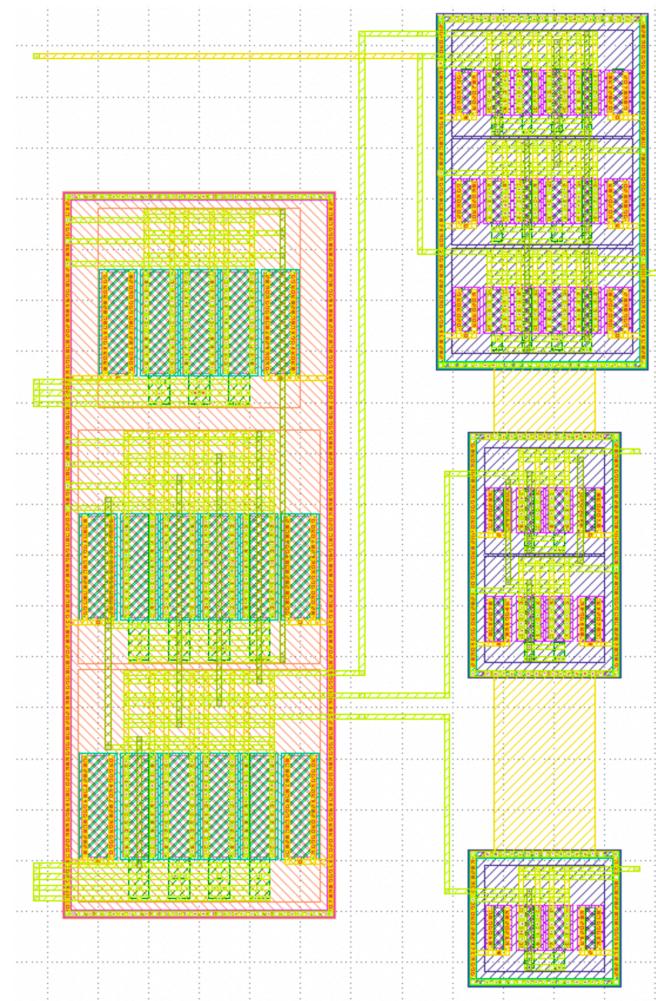
Input current of 1 uA  
Bias current  $I_{aux}$  of 1nA



# Chipathon on Analog Chip Design

- Layout is done using GLayout -> using Python code to generate MOS instances in layout
- Ability to generate layout blocks with transistors sizes as parameters -> reusability of design
- Not available for TECH\_XP018\_HD PDK yet but supports SKY130 and Global Foundries 180

# Chipathon on Analog Chip Design



# **Summer School on ASIC Design + SOCN Summer School**

- **ASIC:**
  - Introduction to Analog/Digital chip design workflow
  - Good practice for chip design
- **SOCN:**
  - Introduction to Port-Hamiltonian Systems (grasped the idea but not deep details)

## Planned Journal Submission / Conferences

- ?