Active electrode compensation for single-electrode intracellular recordings

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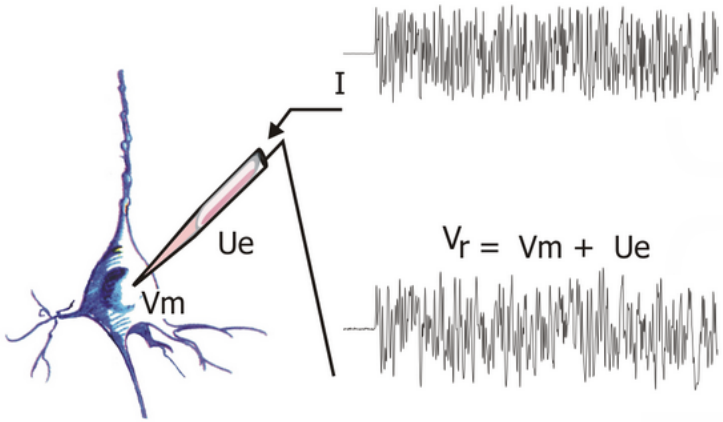
Single-electrode intracellular recording



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- Current clamp, fast fluctuations
- Dynamic clamp
- Voltage clamp

Especially hard situations: in vivo, dendritic or axonal recordings.

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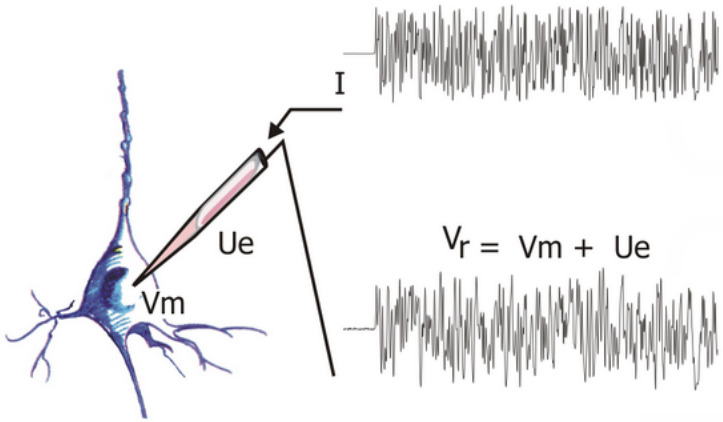

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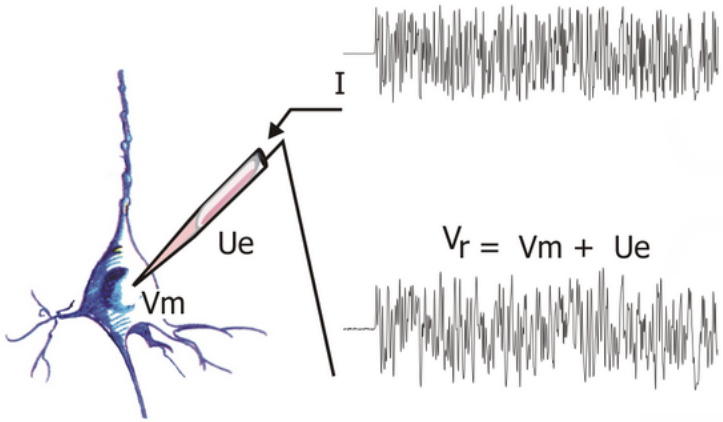

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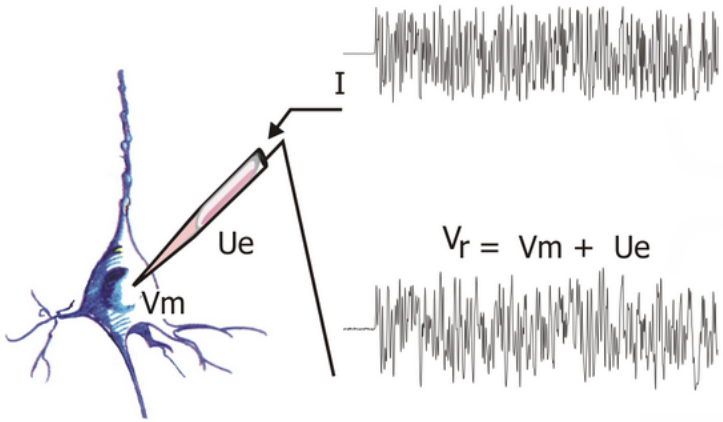

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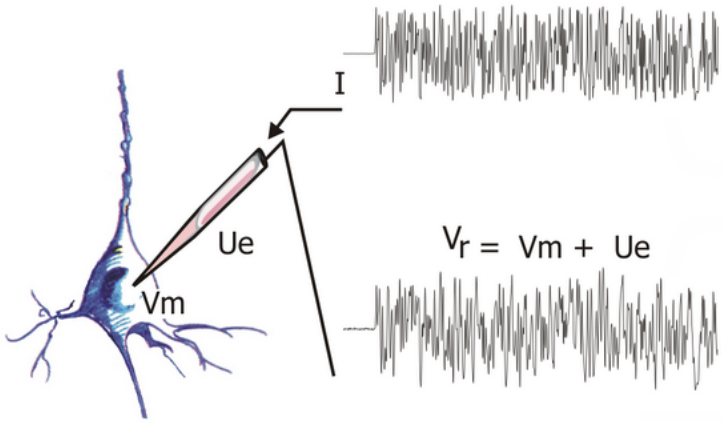

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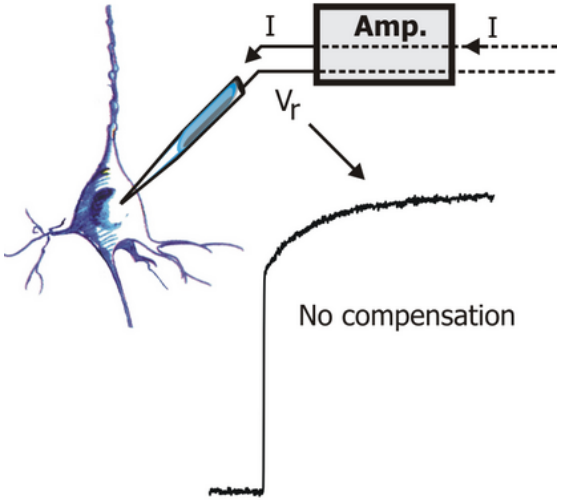

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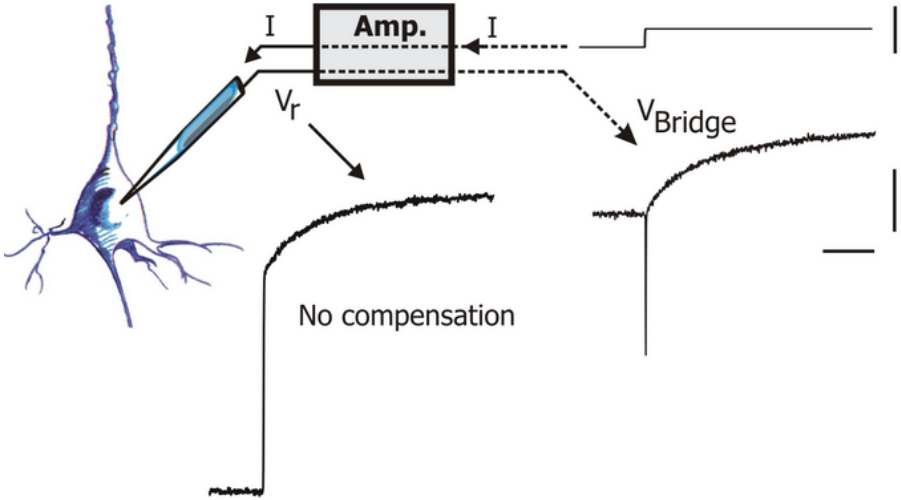

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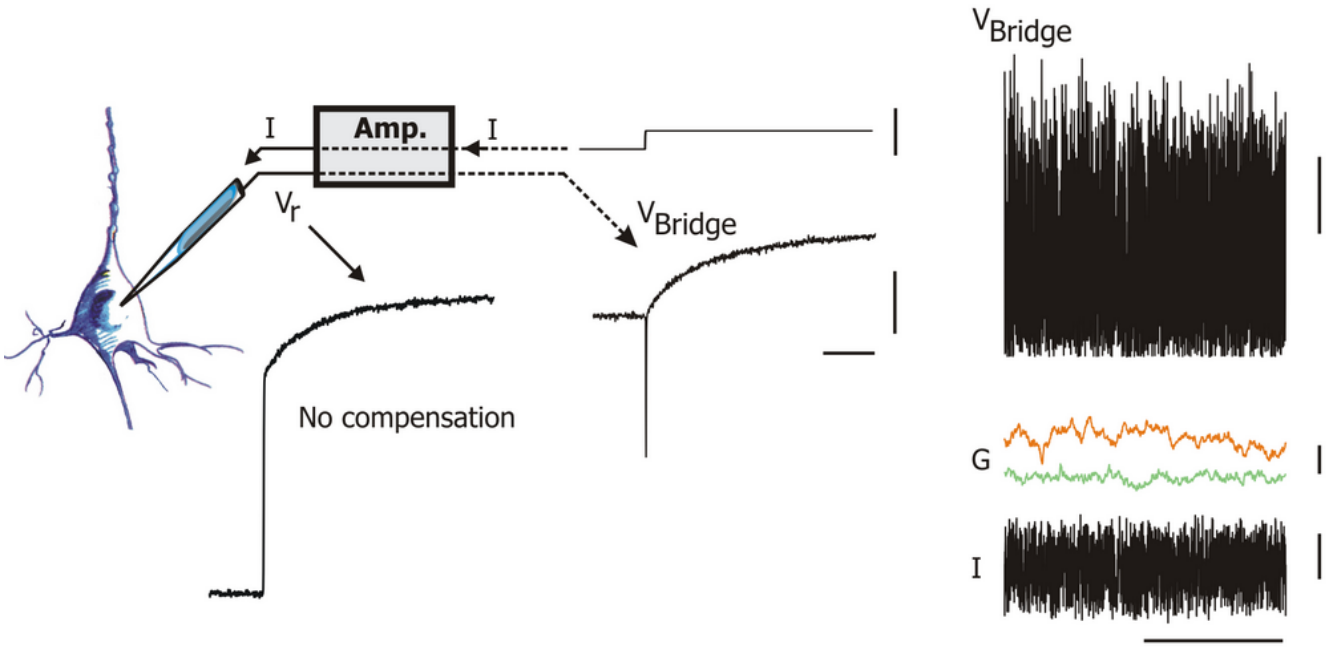

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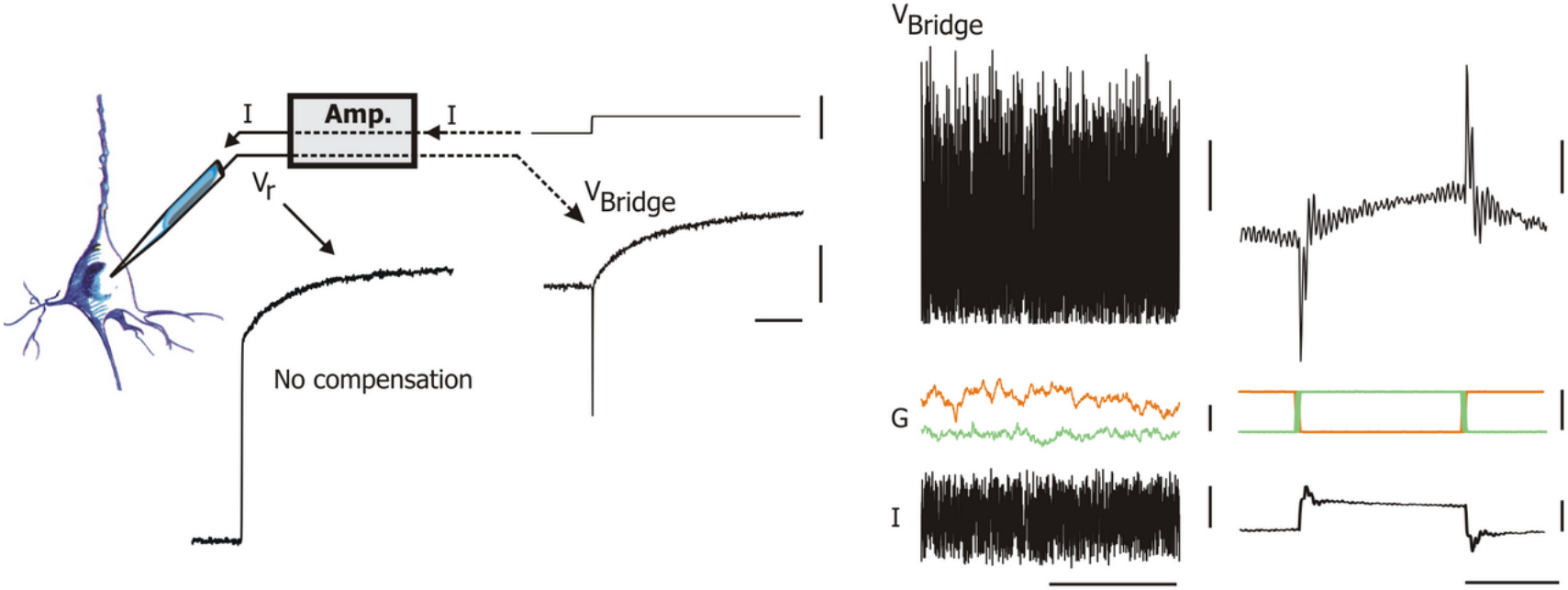

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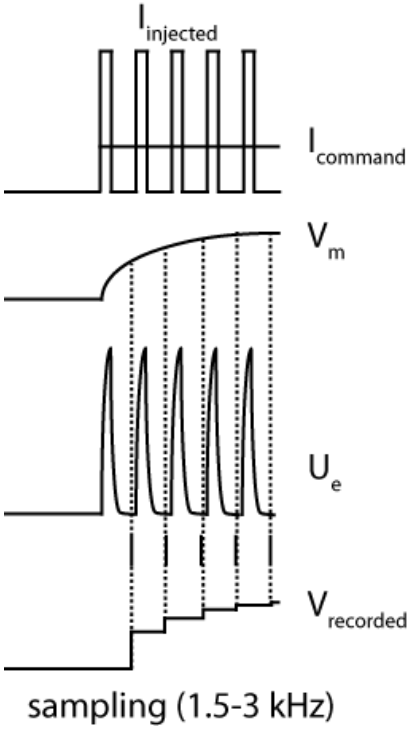

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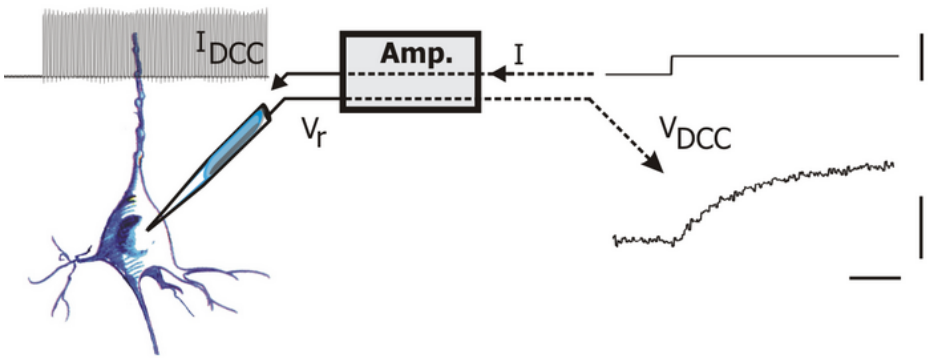

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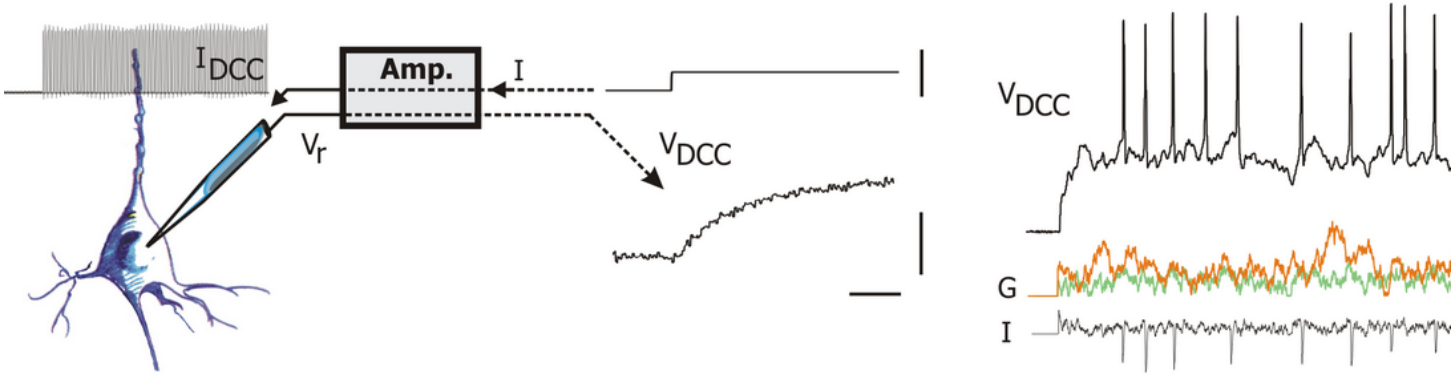

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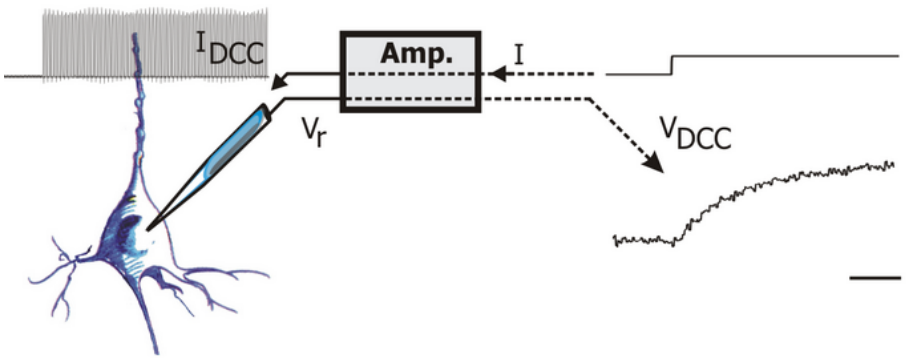

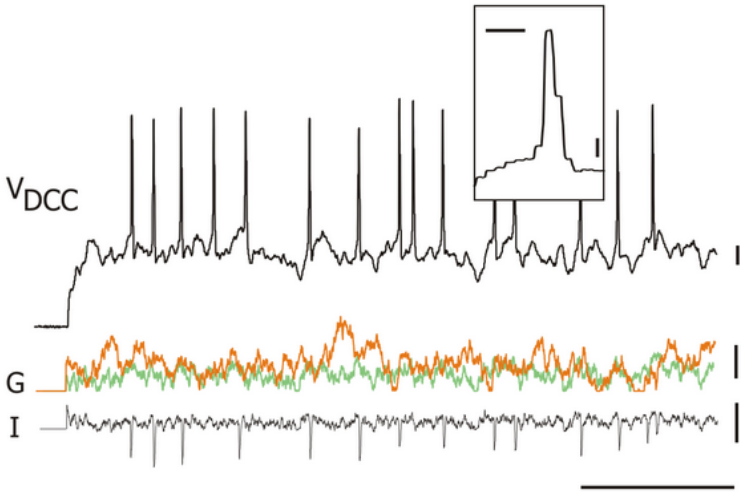

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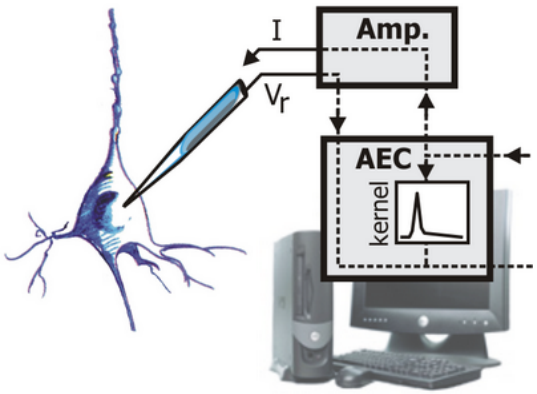

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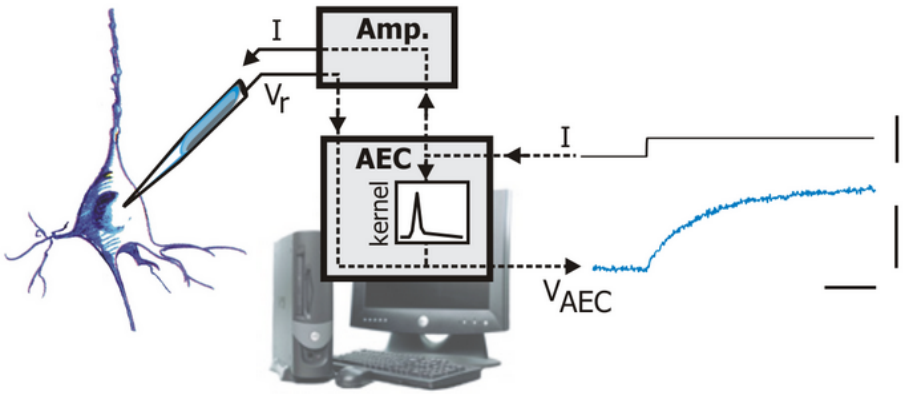

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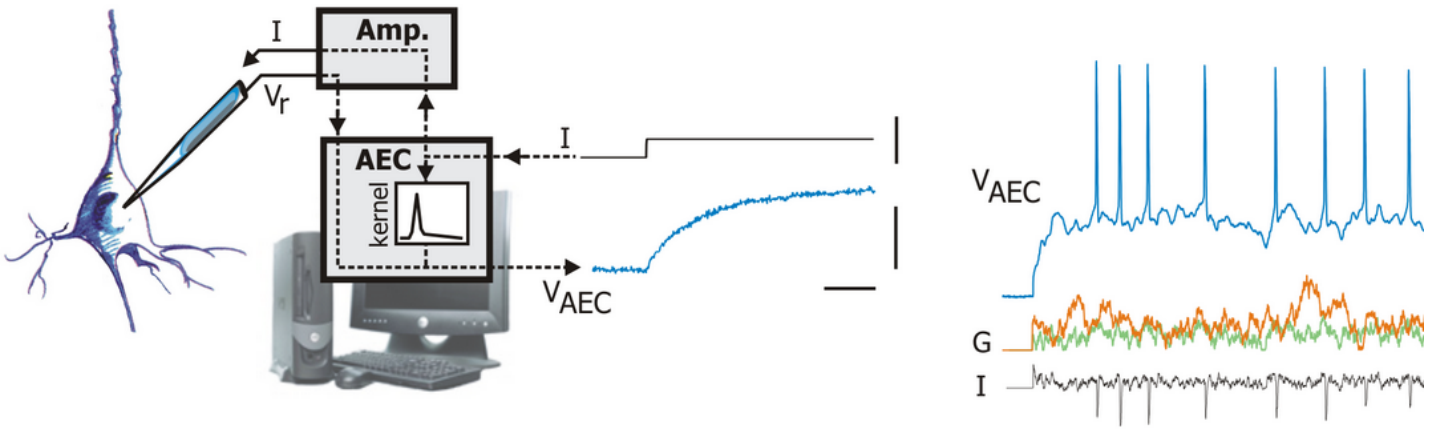

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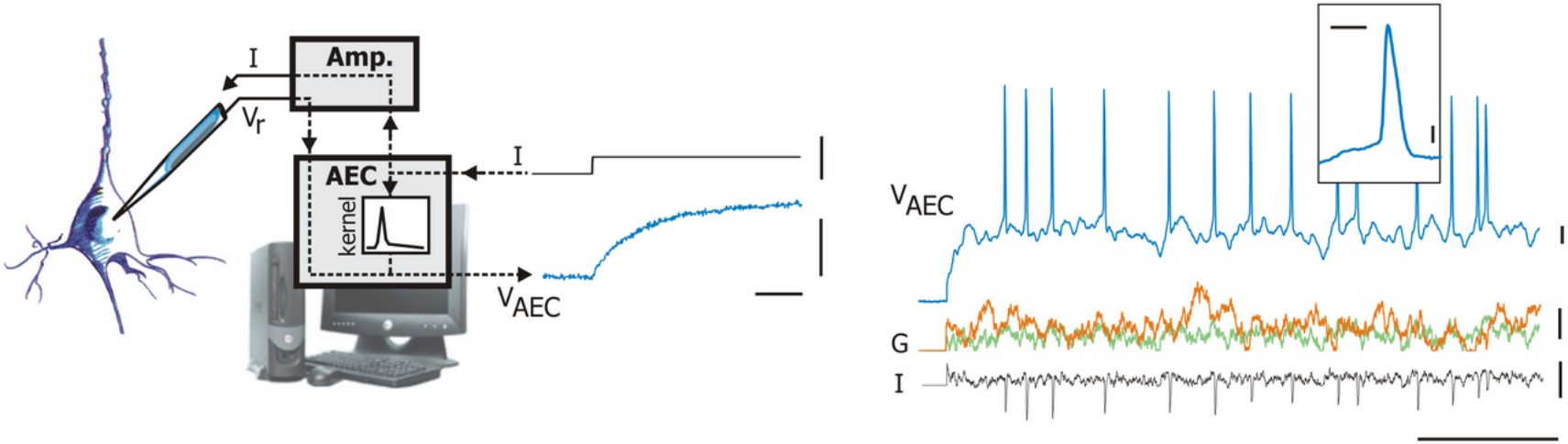

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- Hypothesis: electrode = arbitrary linear filter with kernel $K_e(t)$.
- Electrode response: $U_e(t) = \int_0^{+\infty} K_e(s) I(t-s) ds$.
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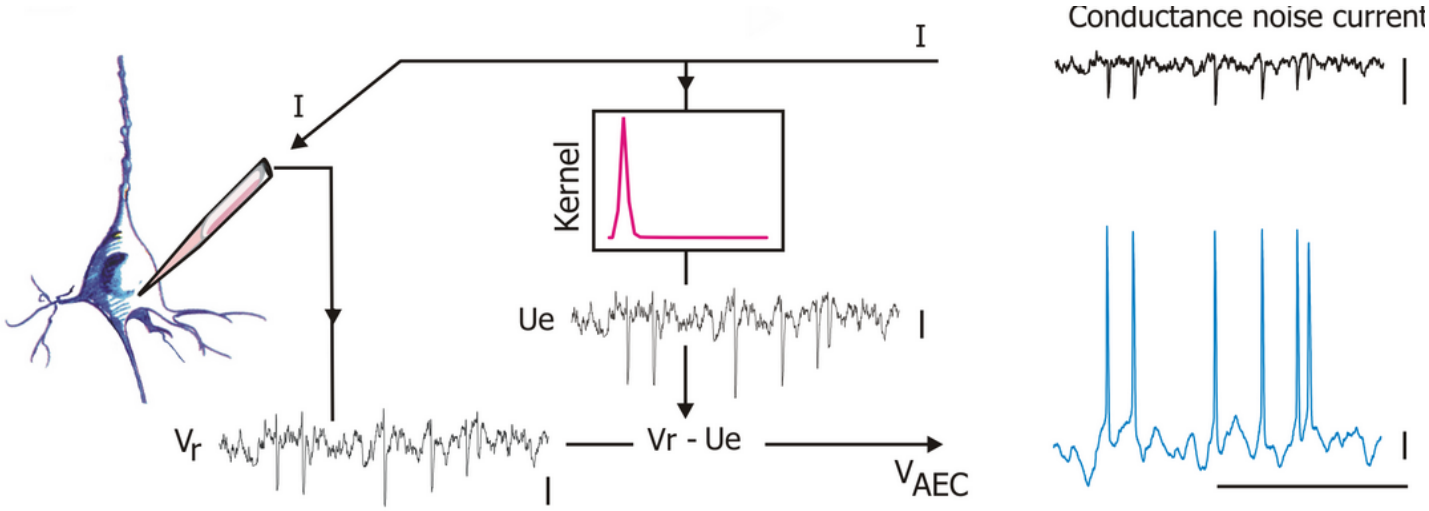
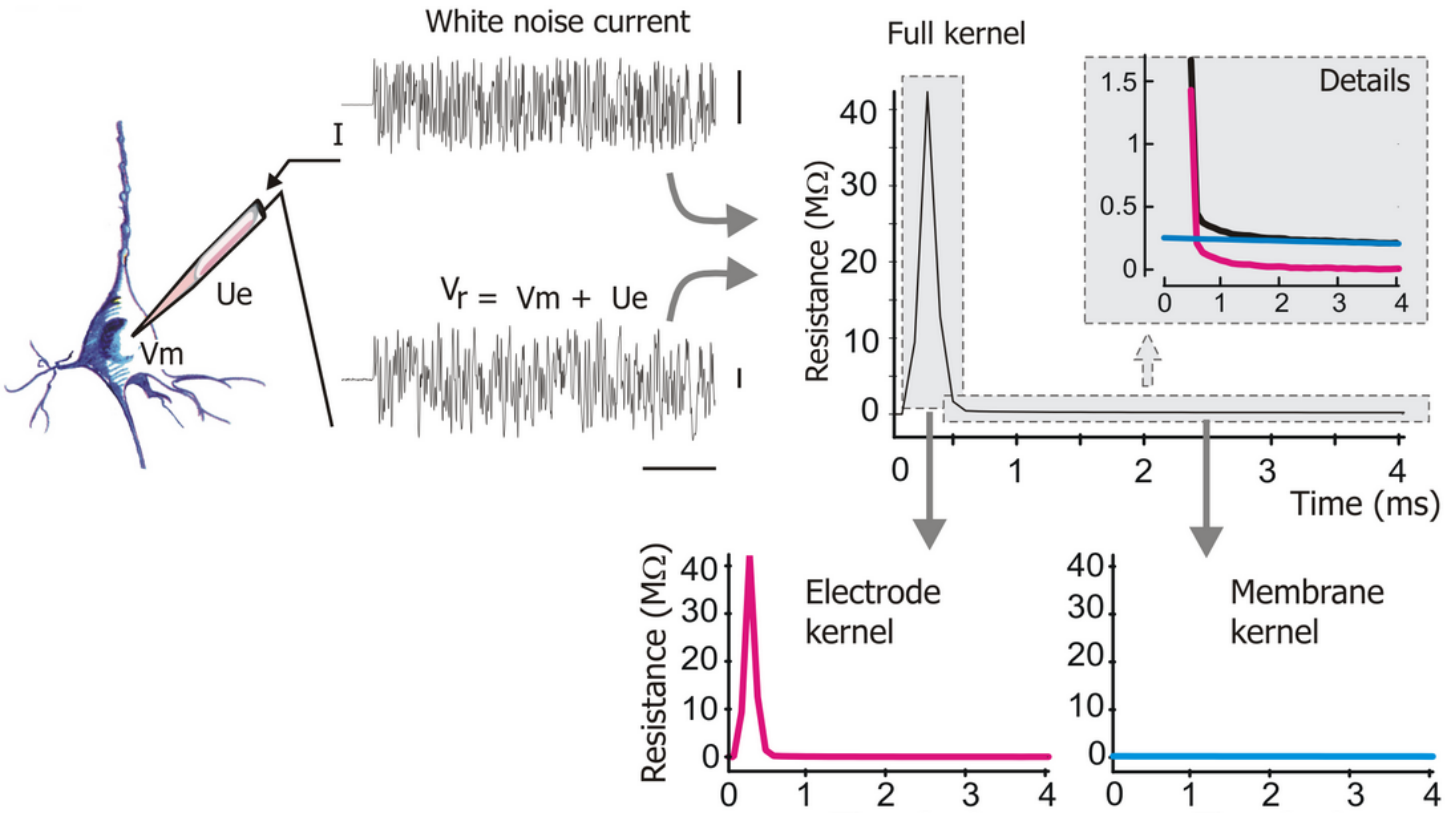


Finding the electrode kernel K_e



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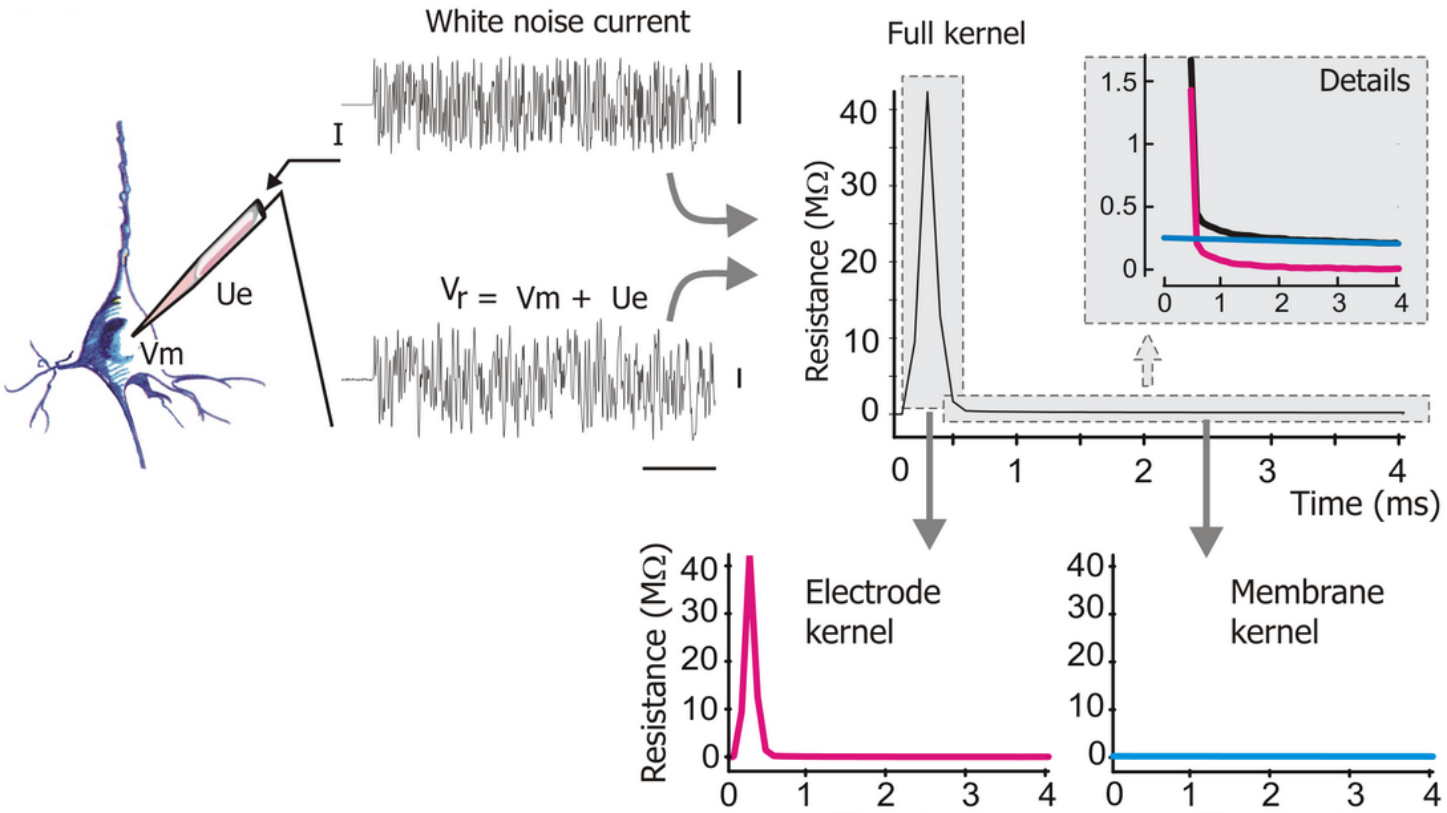

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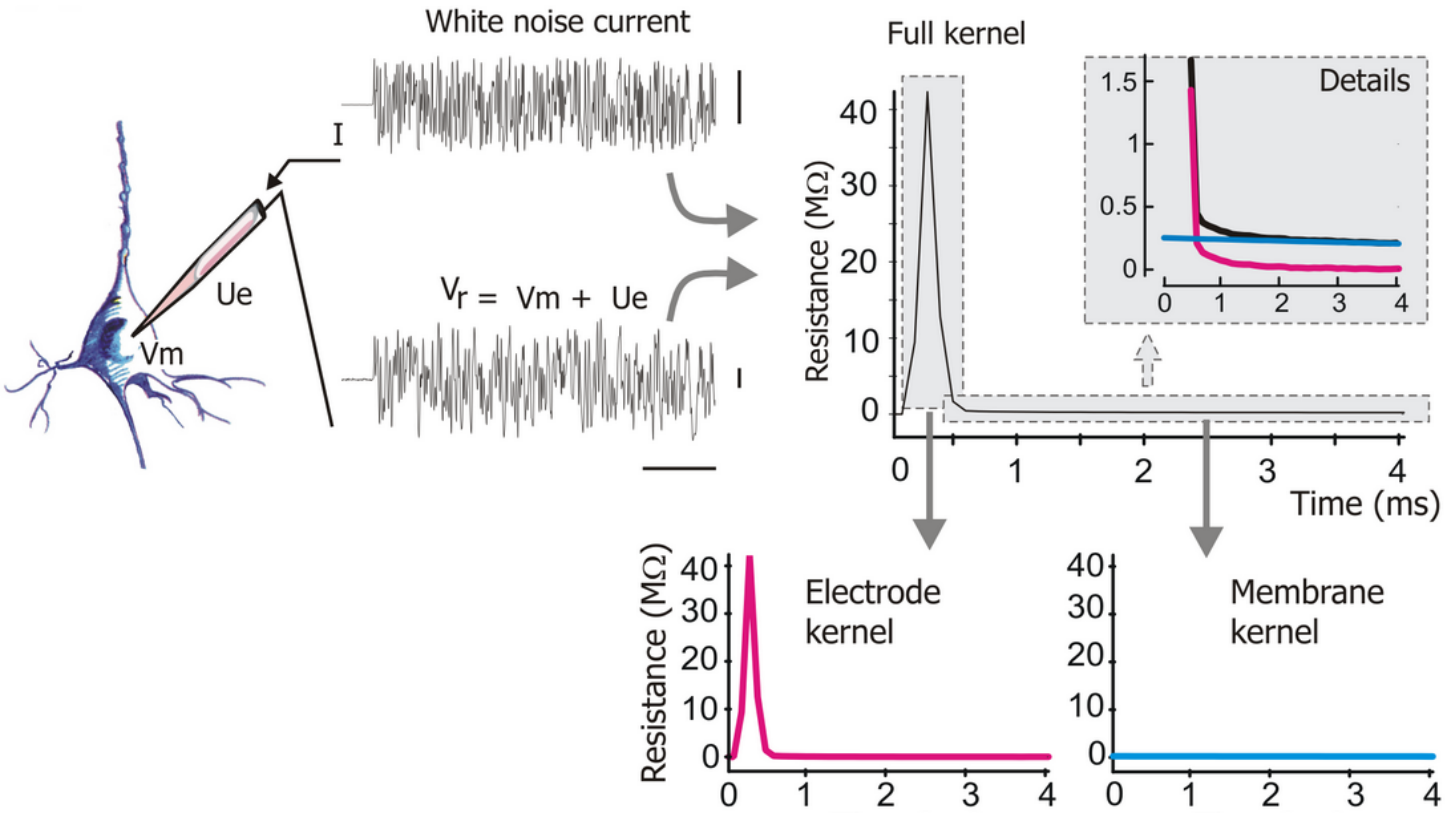

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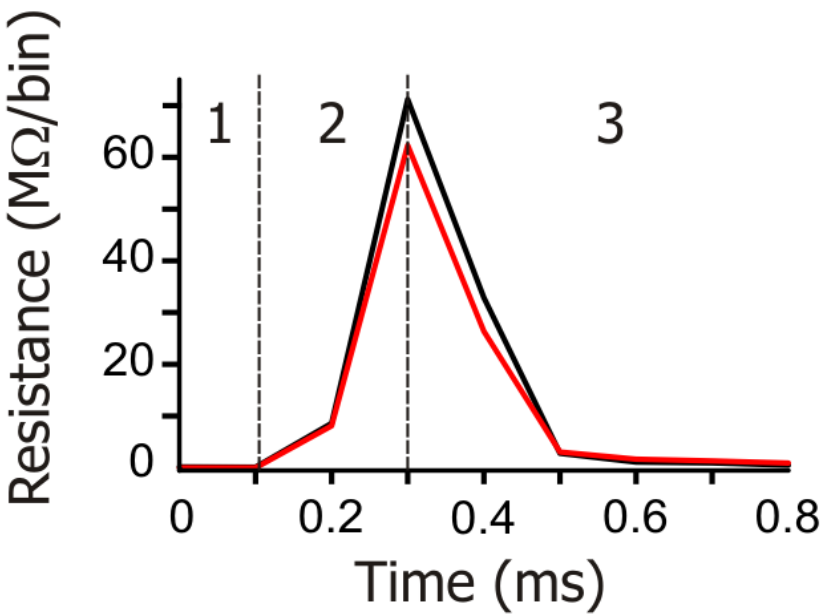

- The kernel changes after impalement.
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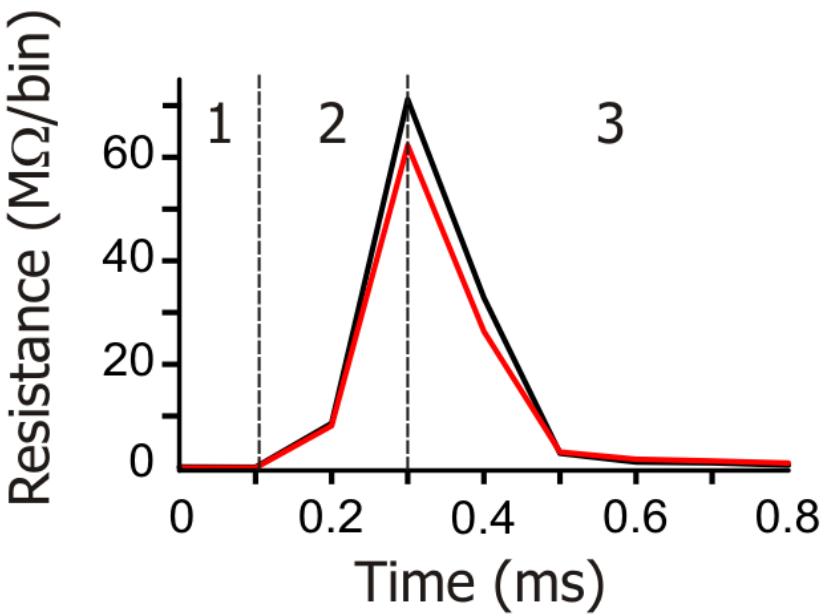

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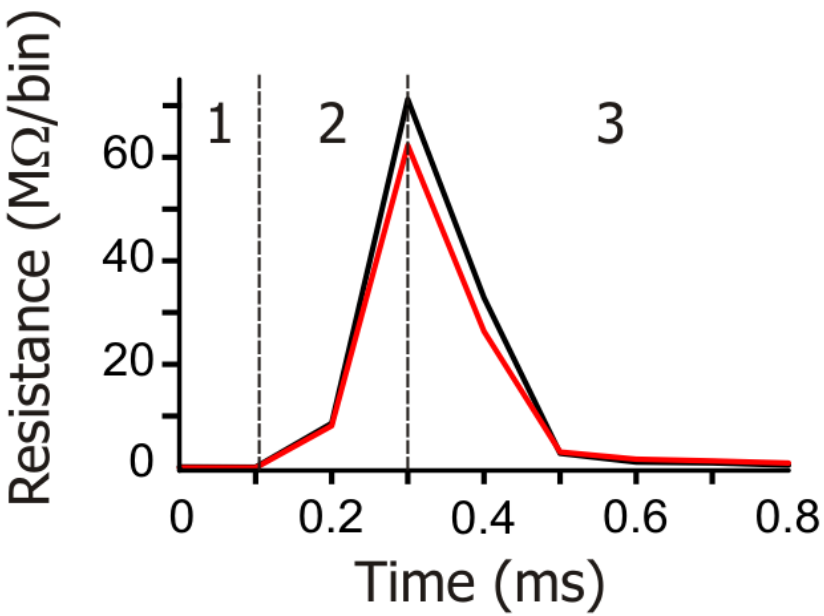

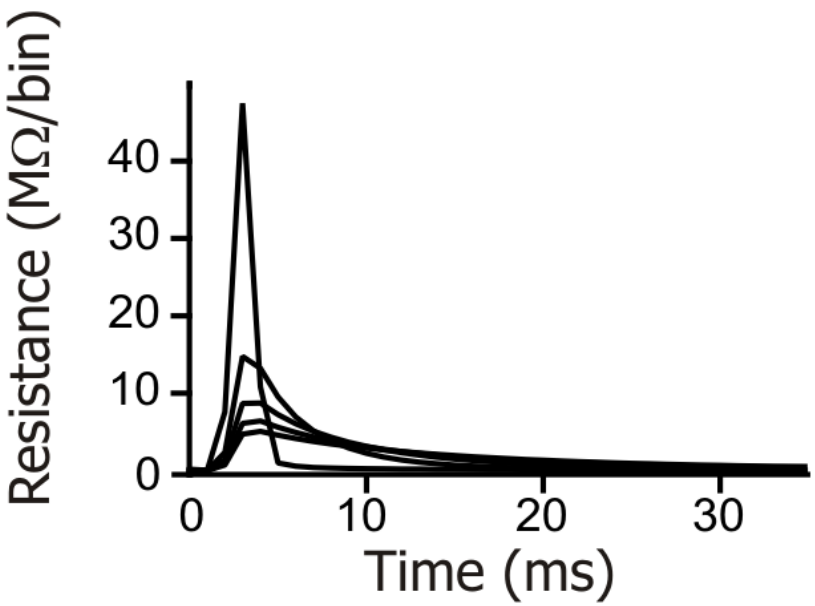

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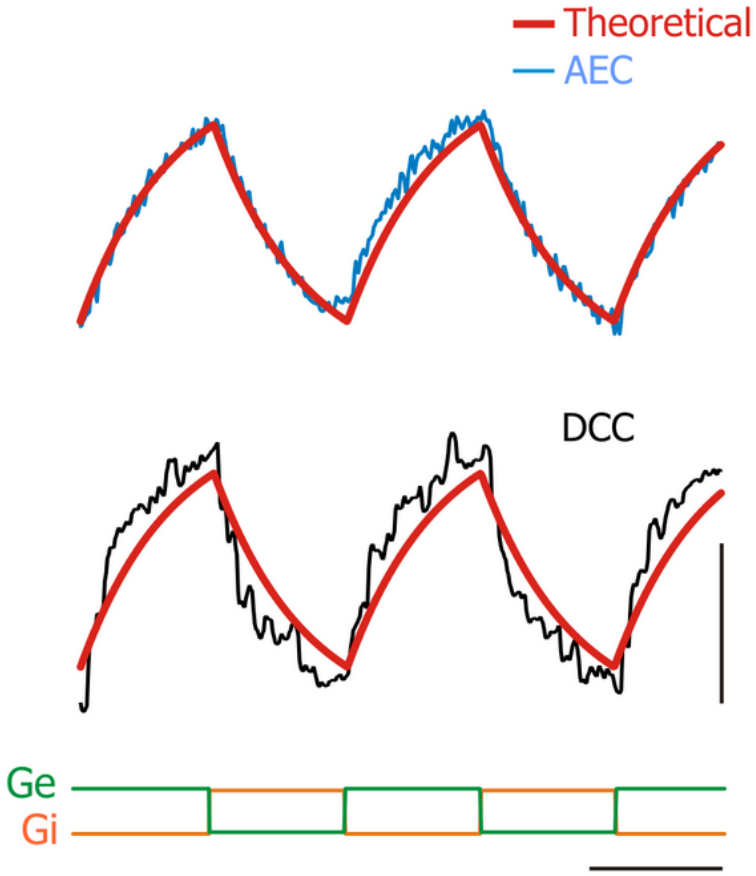

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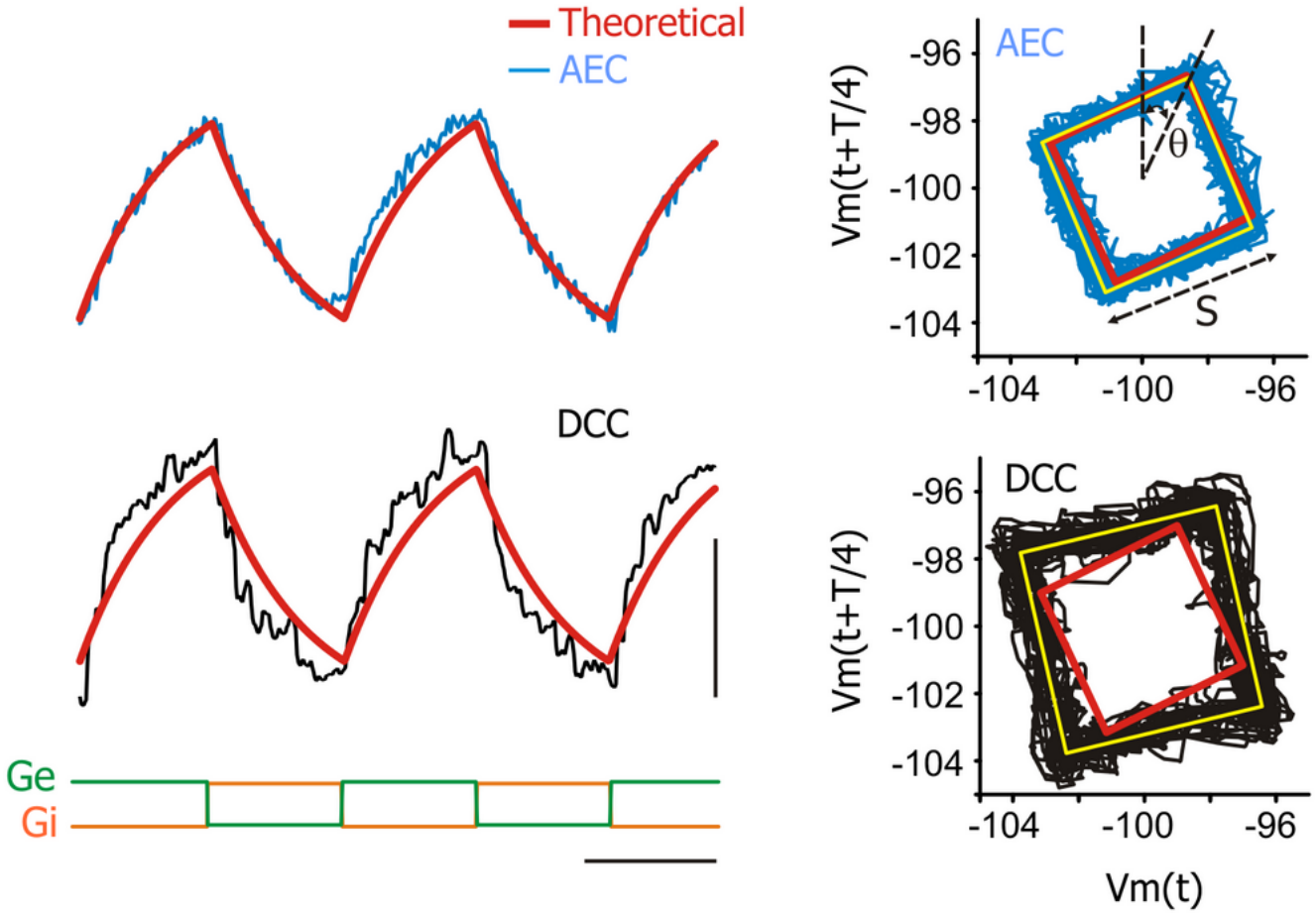

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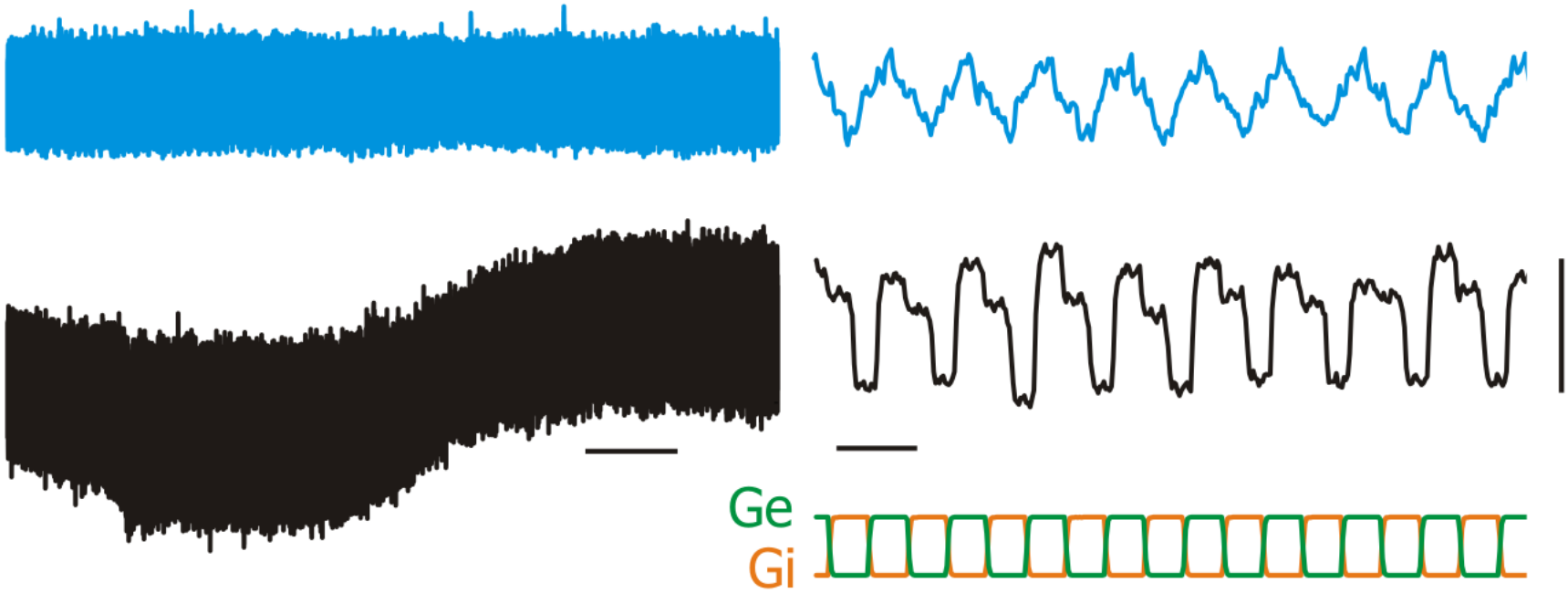

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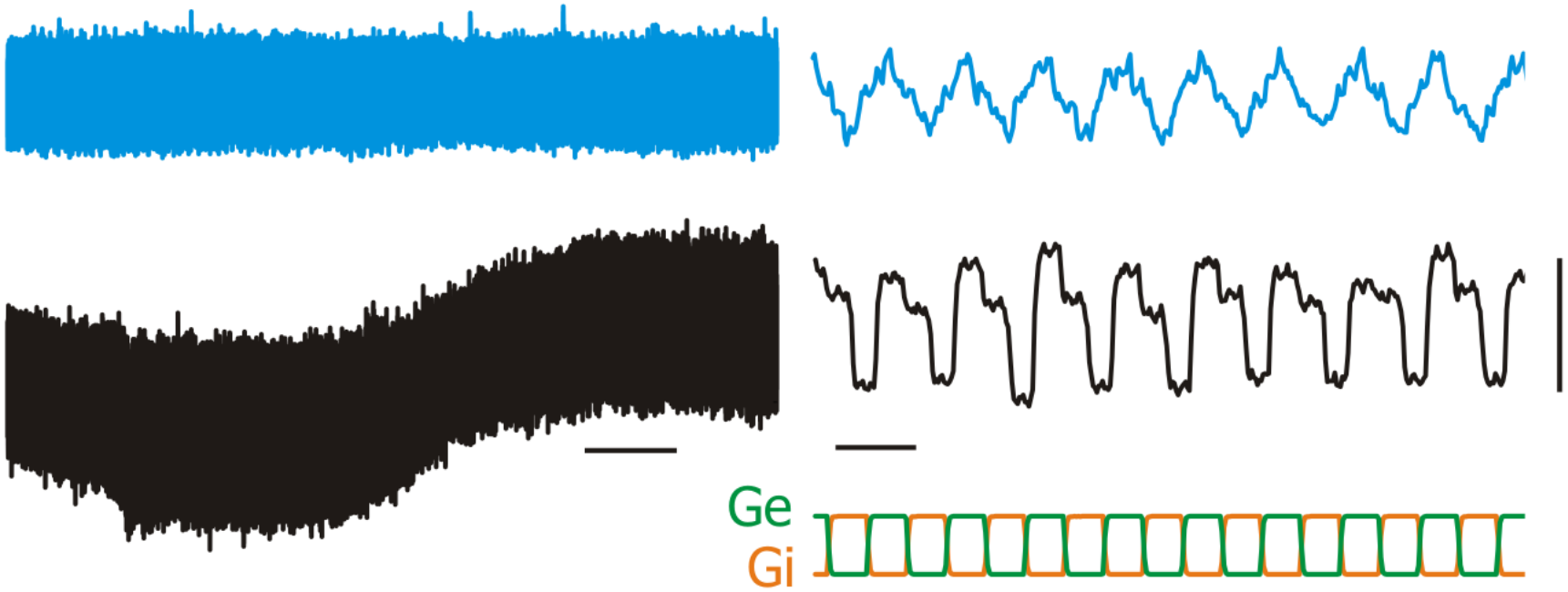

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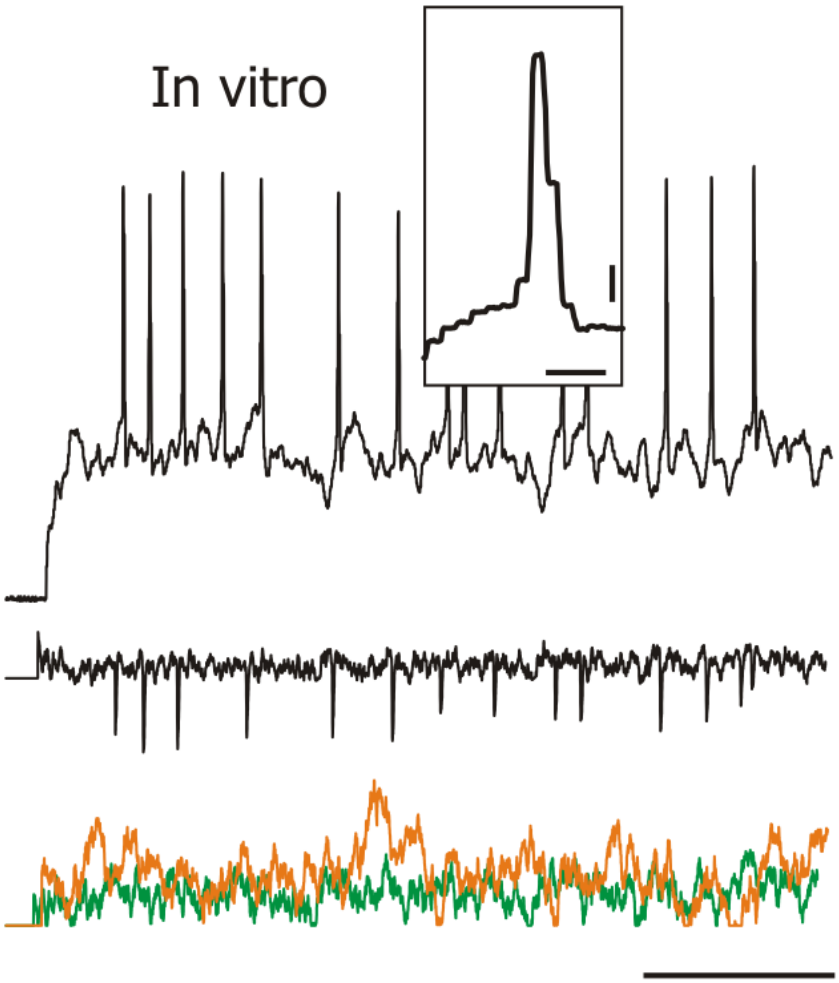

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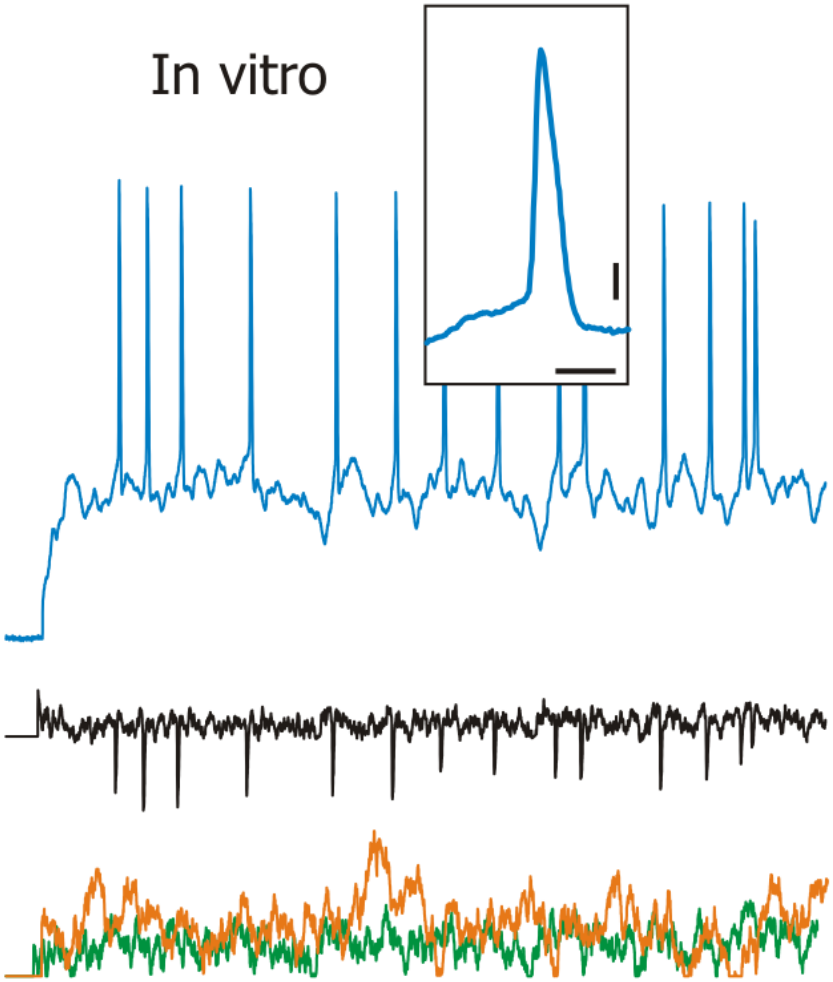

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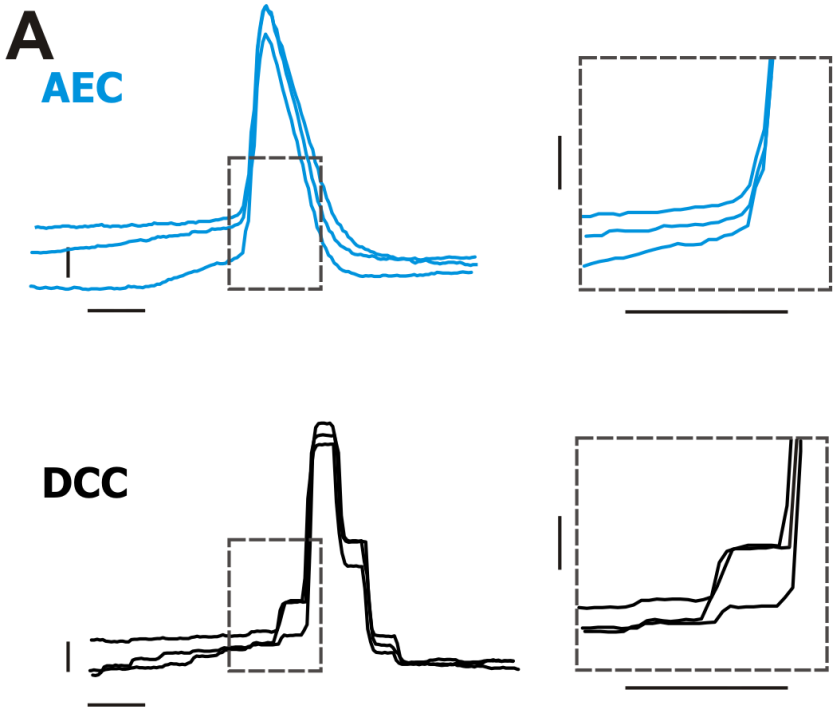

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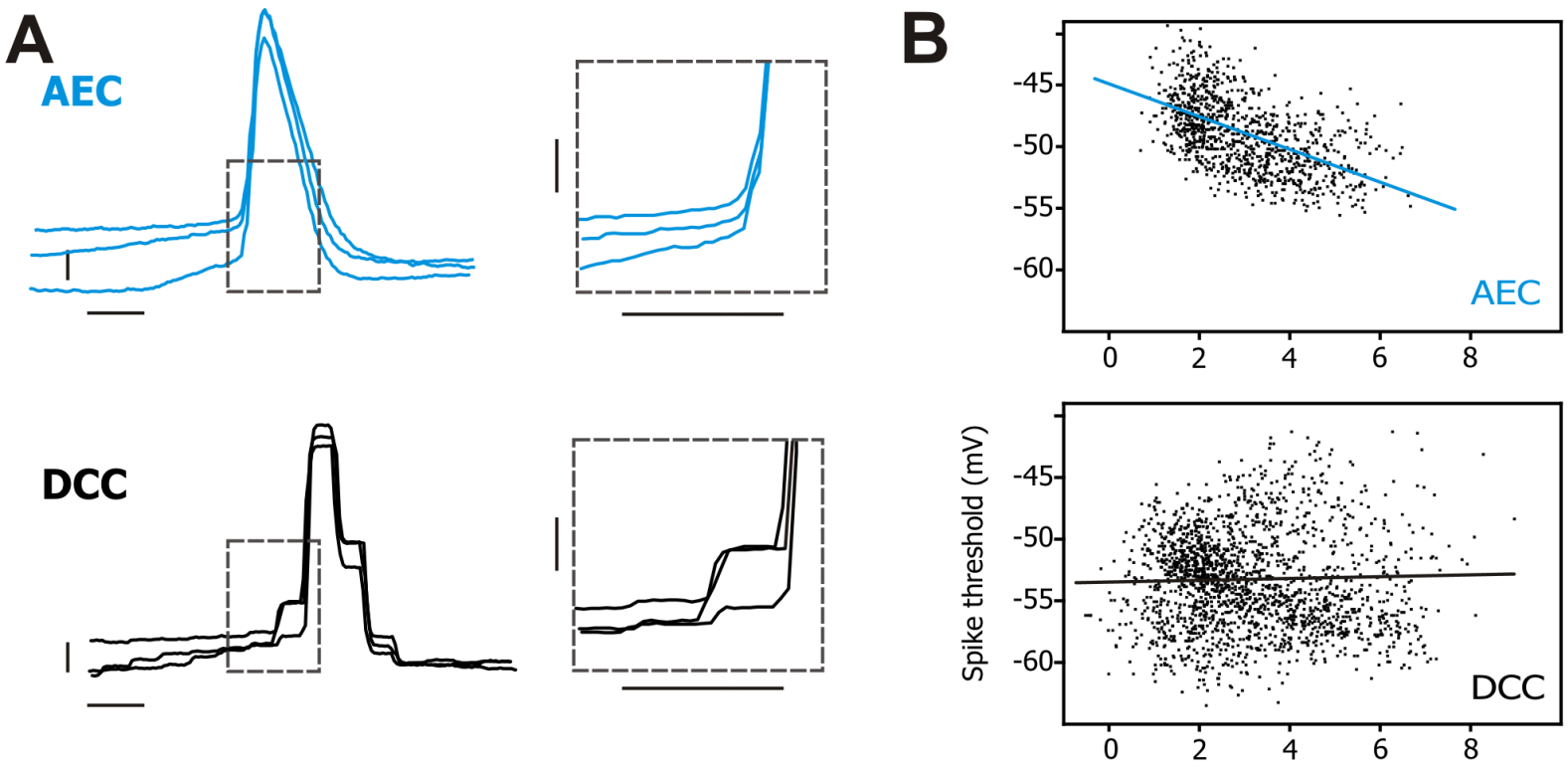

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White noise injection

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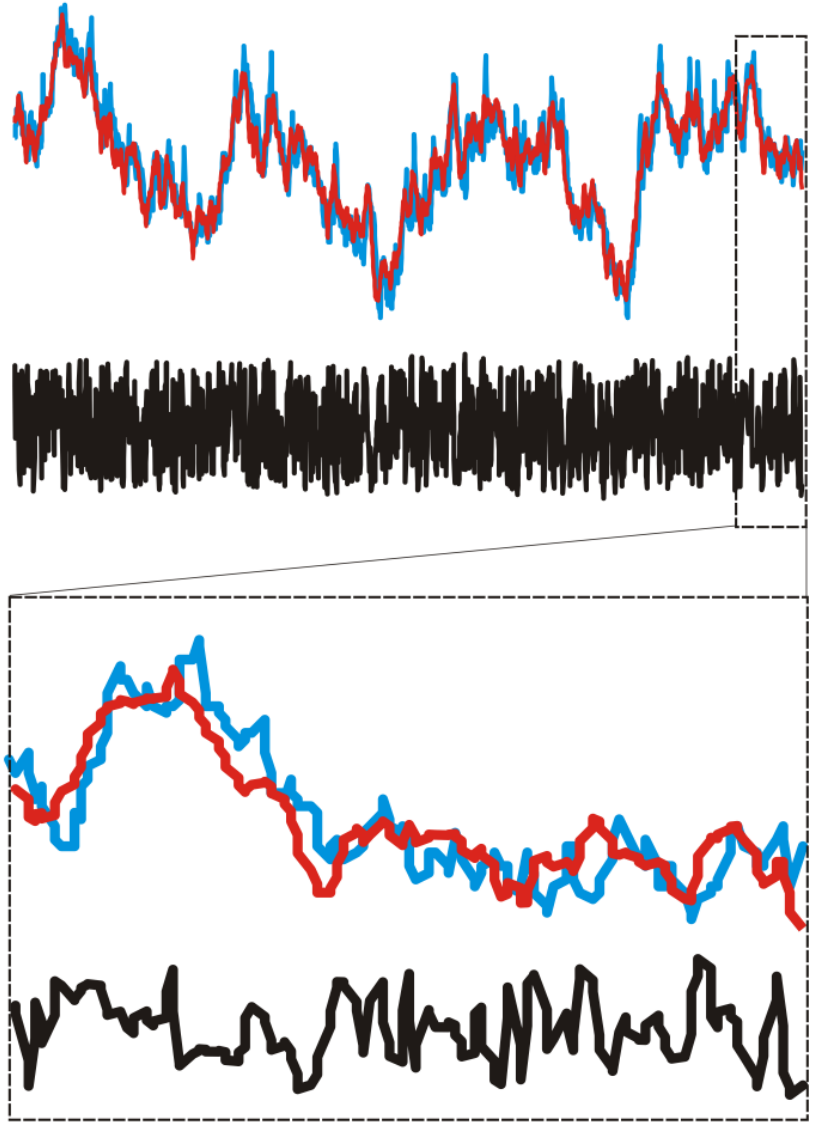

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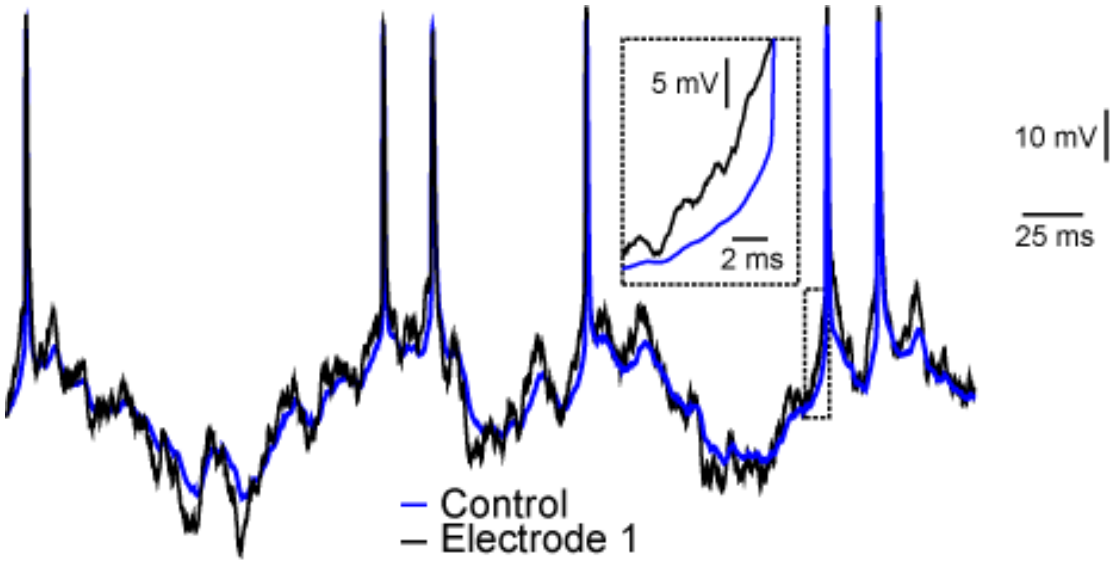

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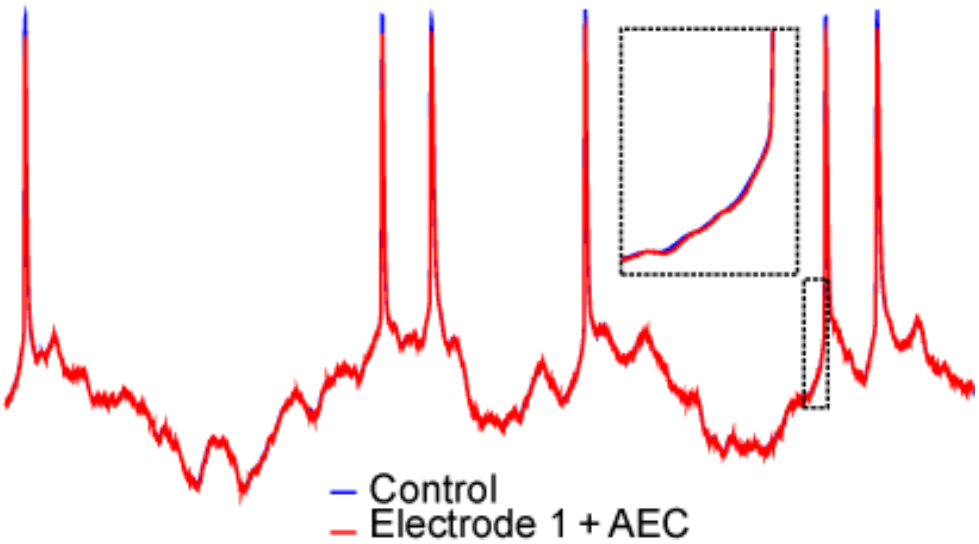

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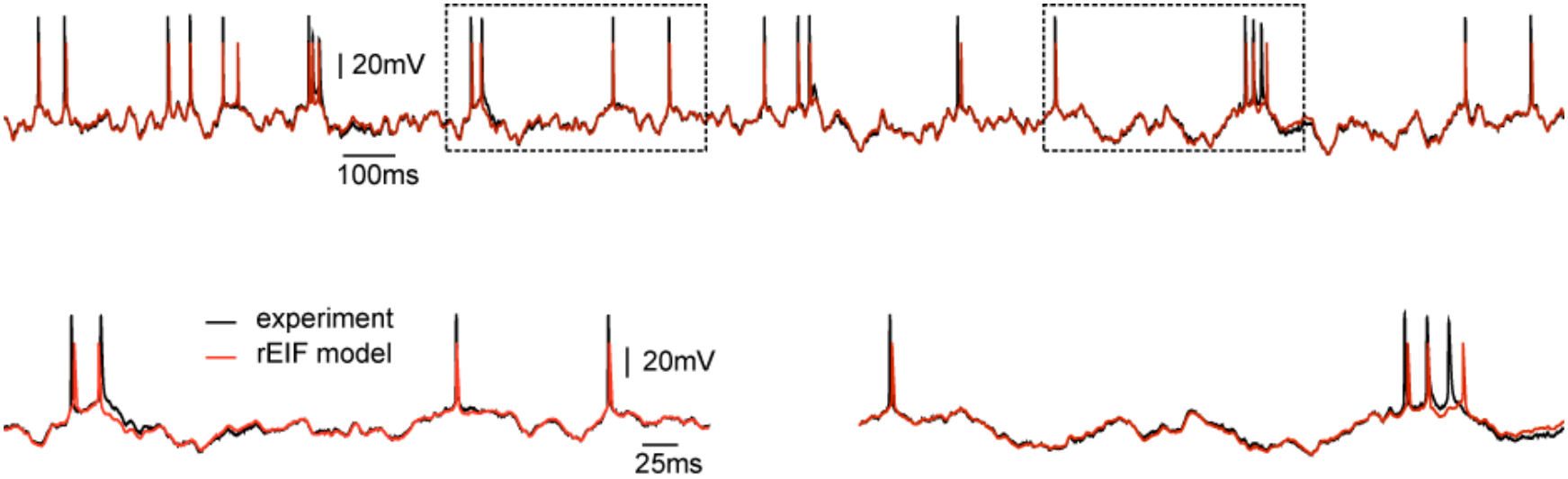

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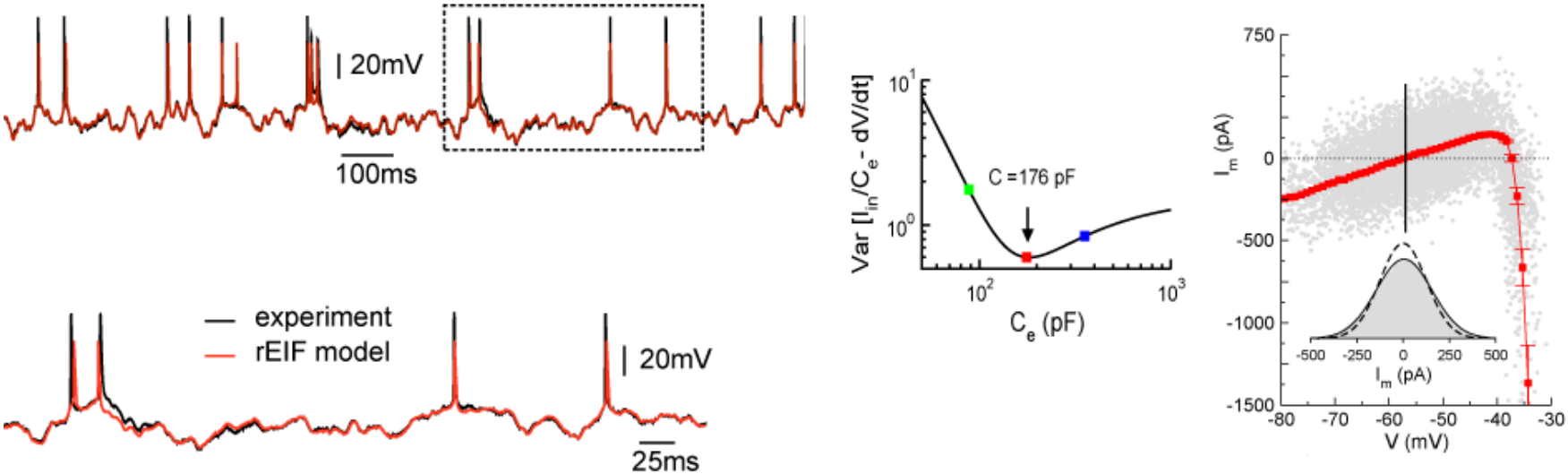

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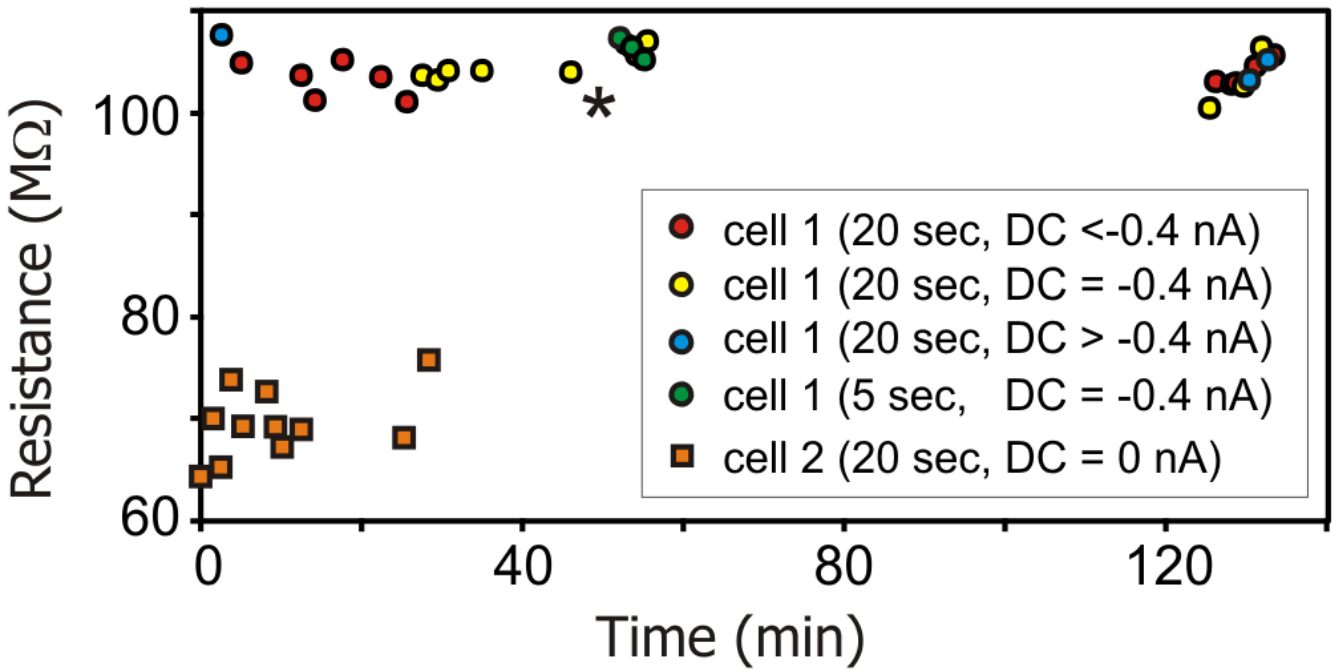

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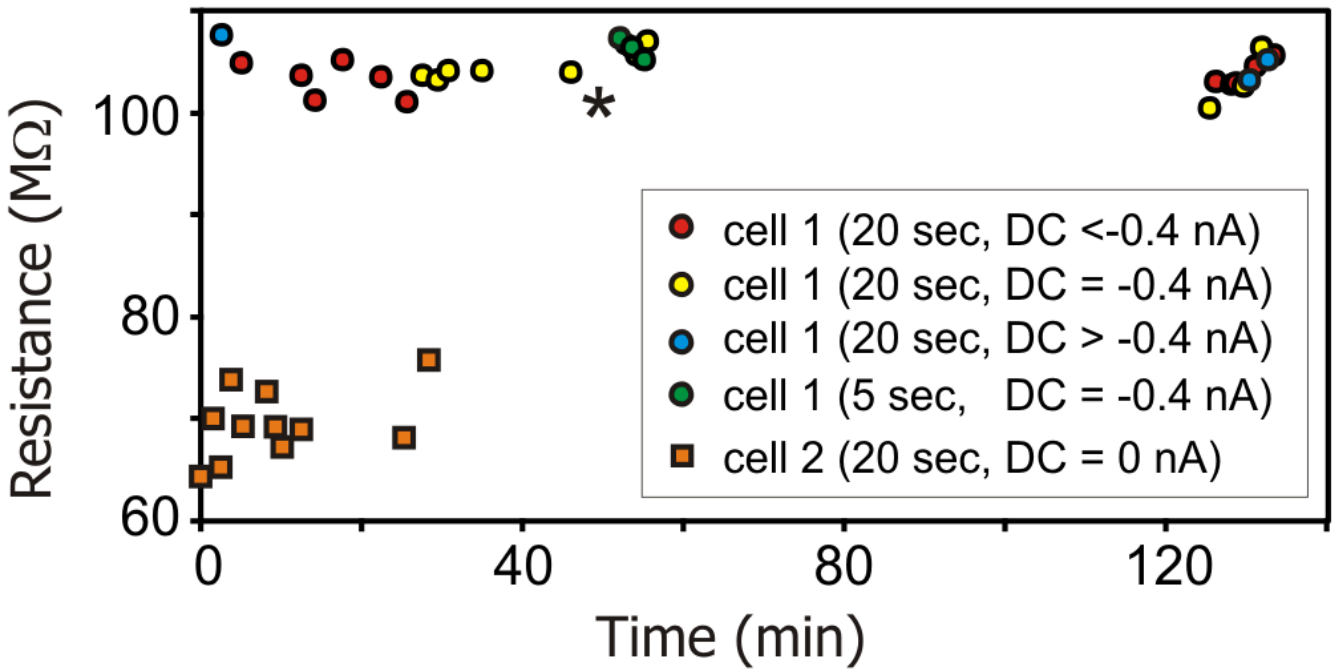

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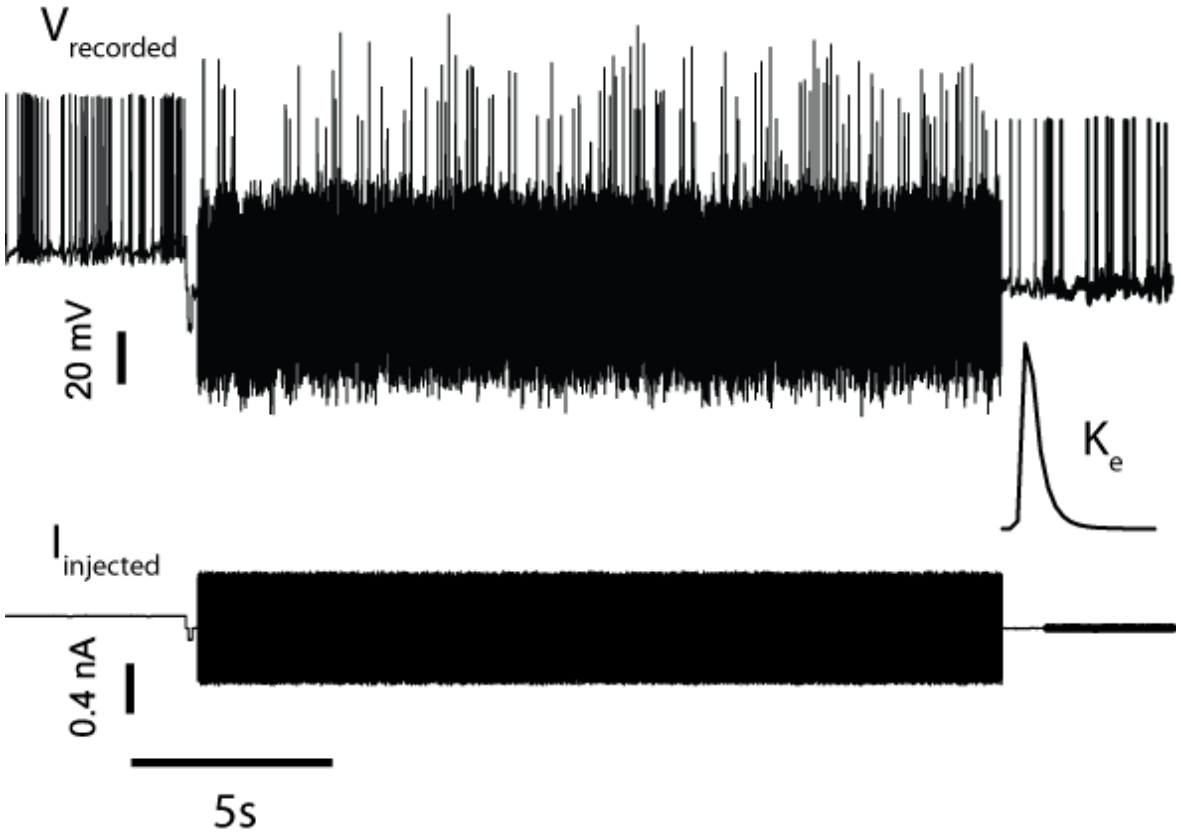
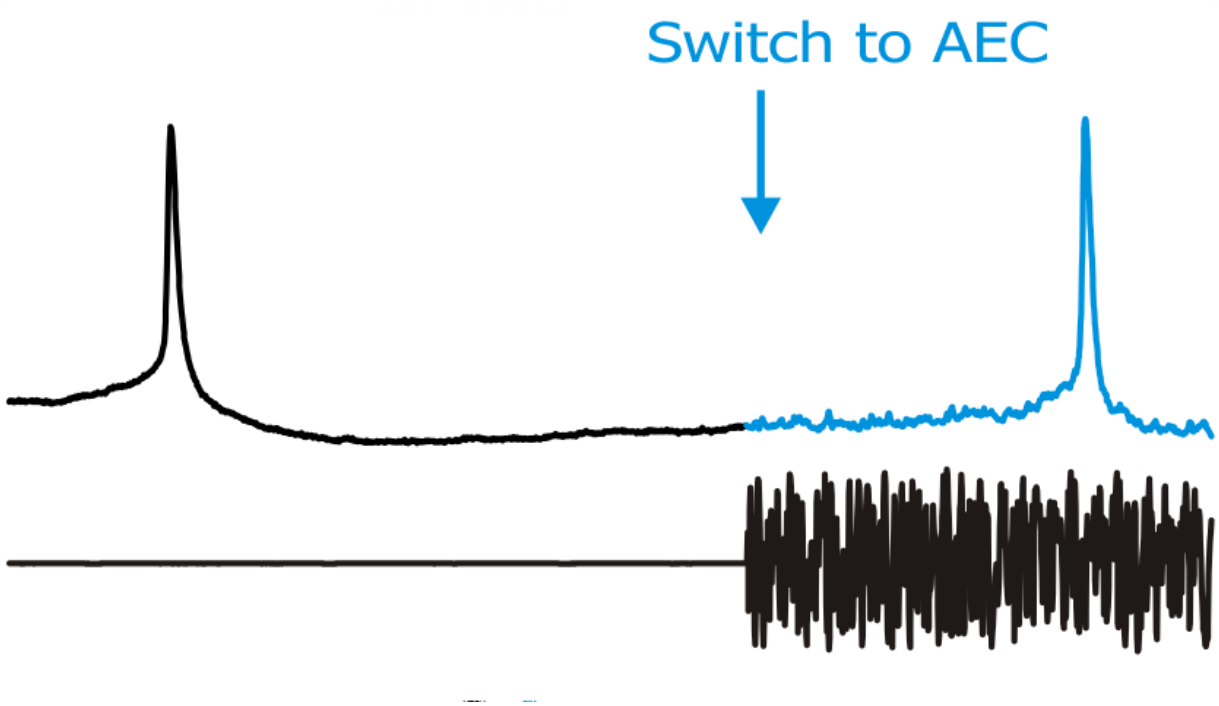


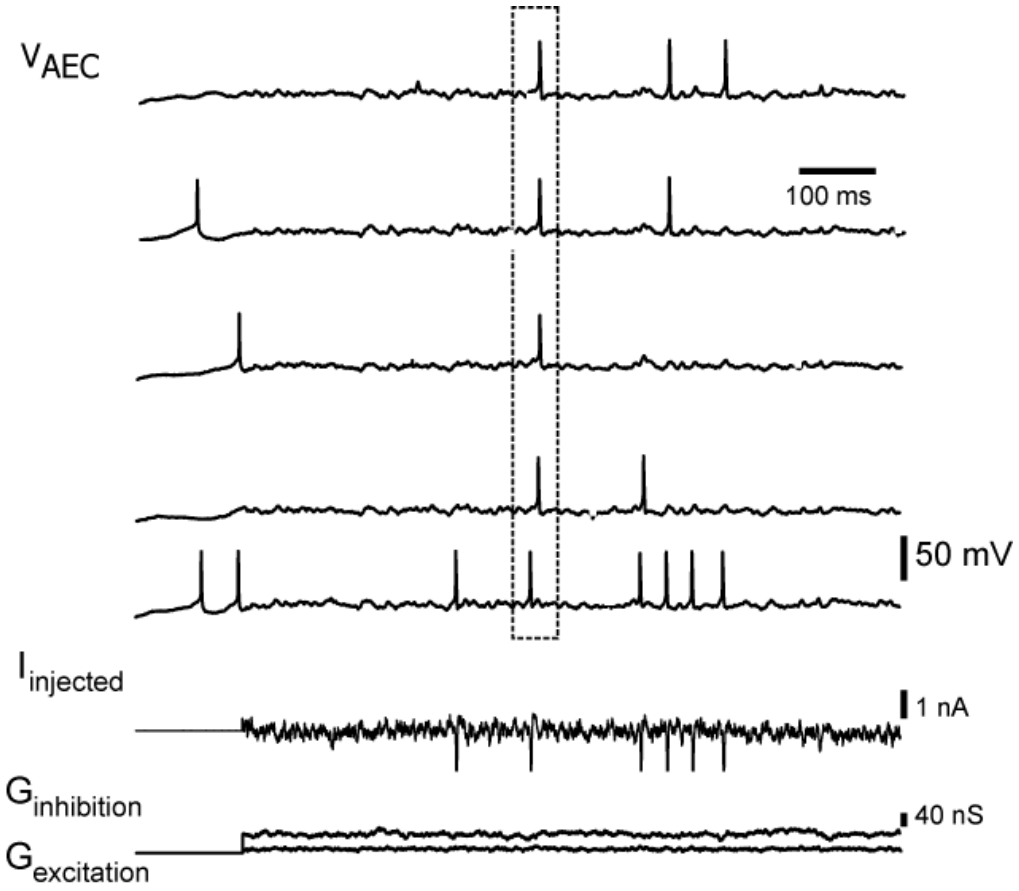
- The electrode kernel can be estimated during spiking activity.
- AEC compensation works *in vivo* (above: white noise).

AEC in vivo



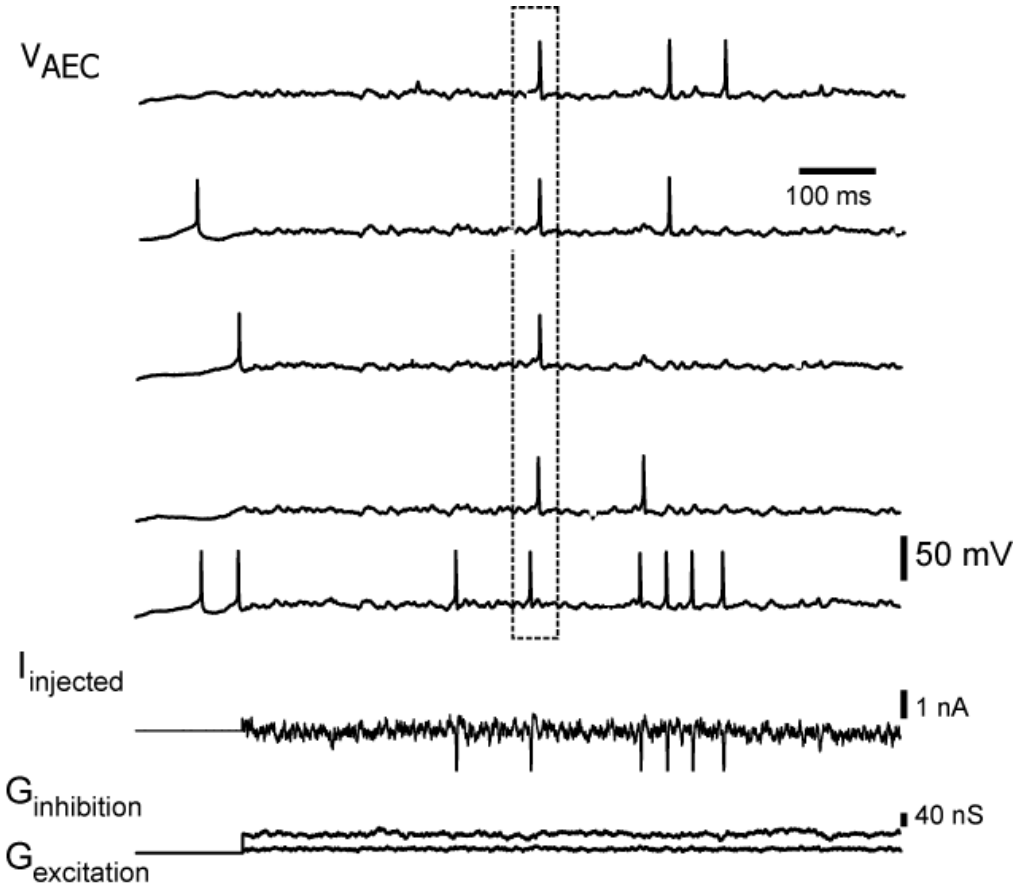
- The electrode kernel can be estimated during spiking activity.
- AEC compensation works *in vivo* (above: white noise).

AEC in vivo
Application: precision of spike timing



- Synaptic conductances can be injected *in vivo* (dynamic clamp) during spontaneous activity.
- Spike timing reliability can be assessed in realistic conditions.

AEC in vivo
Application: precision of spike timing



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Ongoing work and perspectives

Current and future work:

- Voltage-clamp (in progress, with José Gomez)
- Dendritic recordings
- Measurement of excitatory and inhibitory synaptic conductances

Code online:

http://www.di.ens.fr/~brette/HRCORTEX/AEC/

brette@di.ens.fr

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Thank you!