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A physical view of computational neurodynamics

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Main contents

- **Biophysical neuron models**
- **Contribution of astrocytes**
- **Synaptic plasticity**
- **Collective behavior in neural networks**
- **Open problems and suggestions**

Reliable neuron models

- Biophysical neuron models should be consider the effect of ion channels, autapse connection, astrocyte and even the occurrence of intrinsic electromagnetic induction and external electromagnetic radiation.
- Physical field variable should be included for direct estimation.
- Memristive synapse and synaptic plasticity should be involved and estimated.

Physical field in neuron

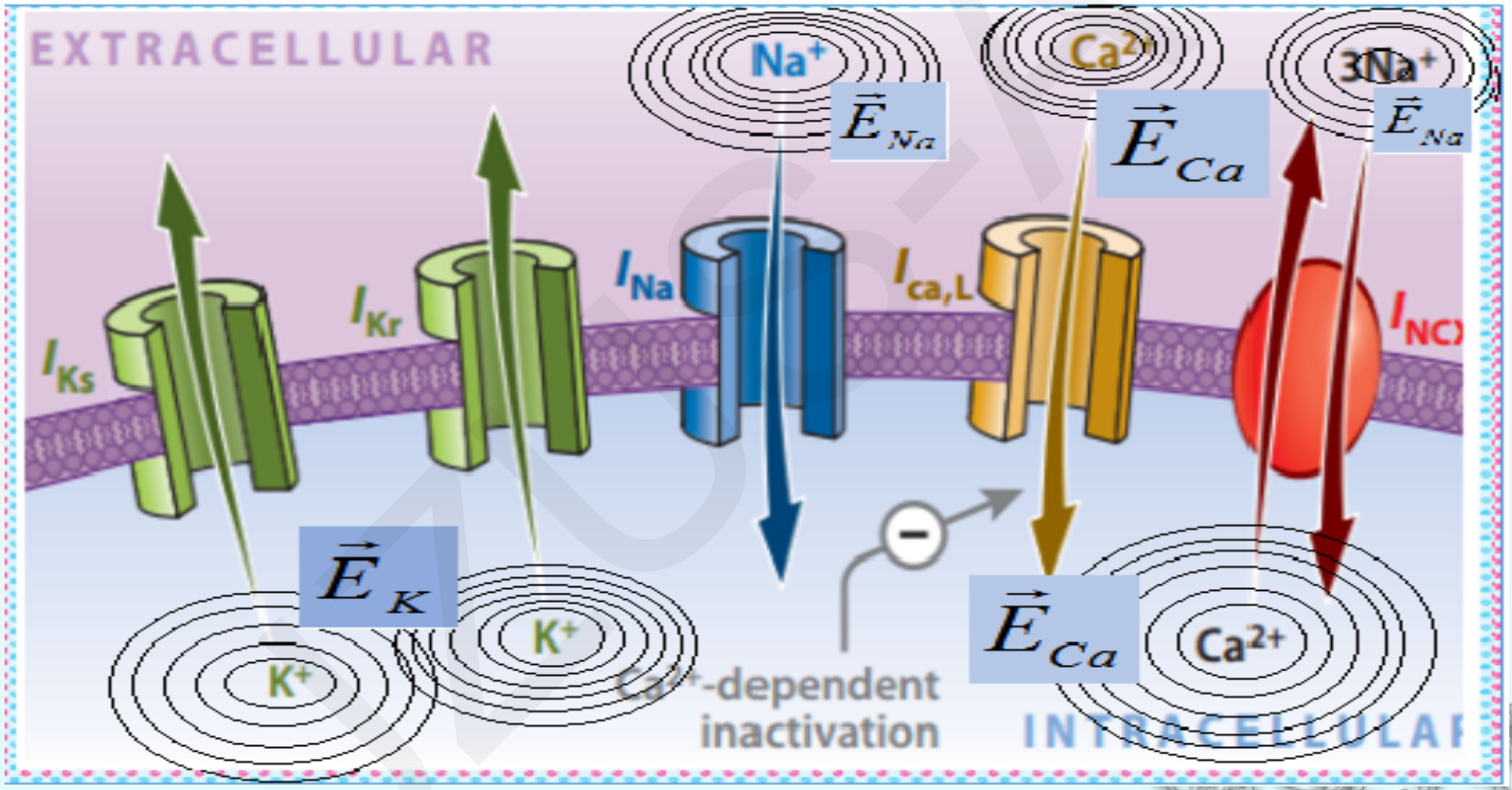


Fig.1 Ion propagation in a neuron cell and electric field is built during the exchange of calcium, potassium, sodium.

Hybrid synapse

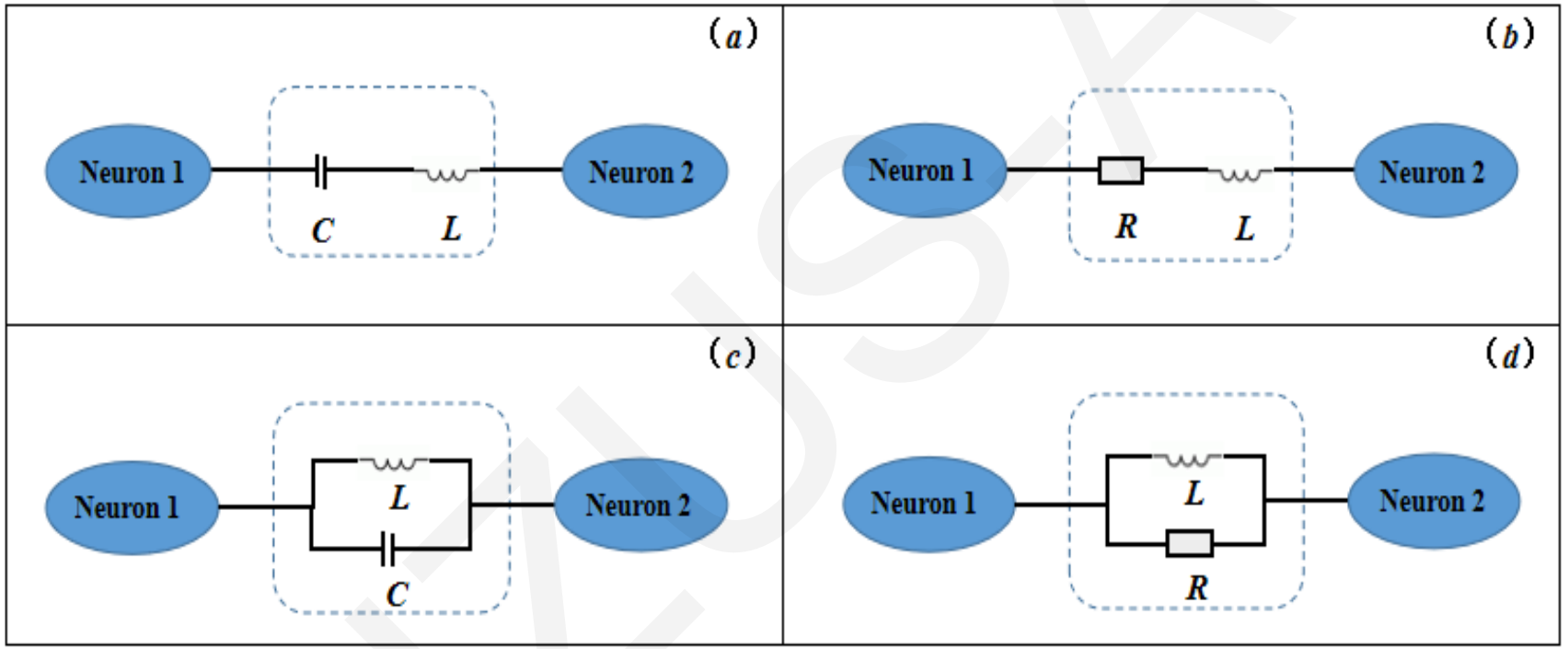
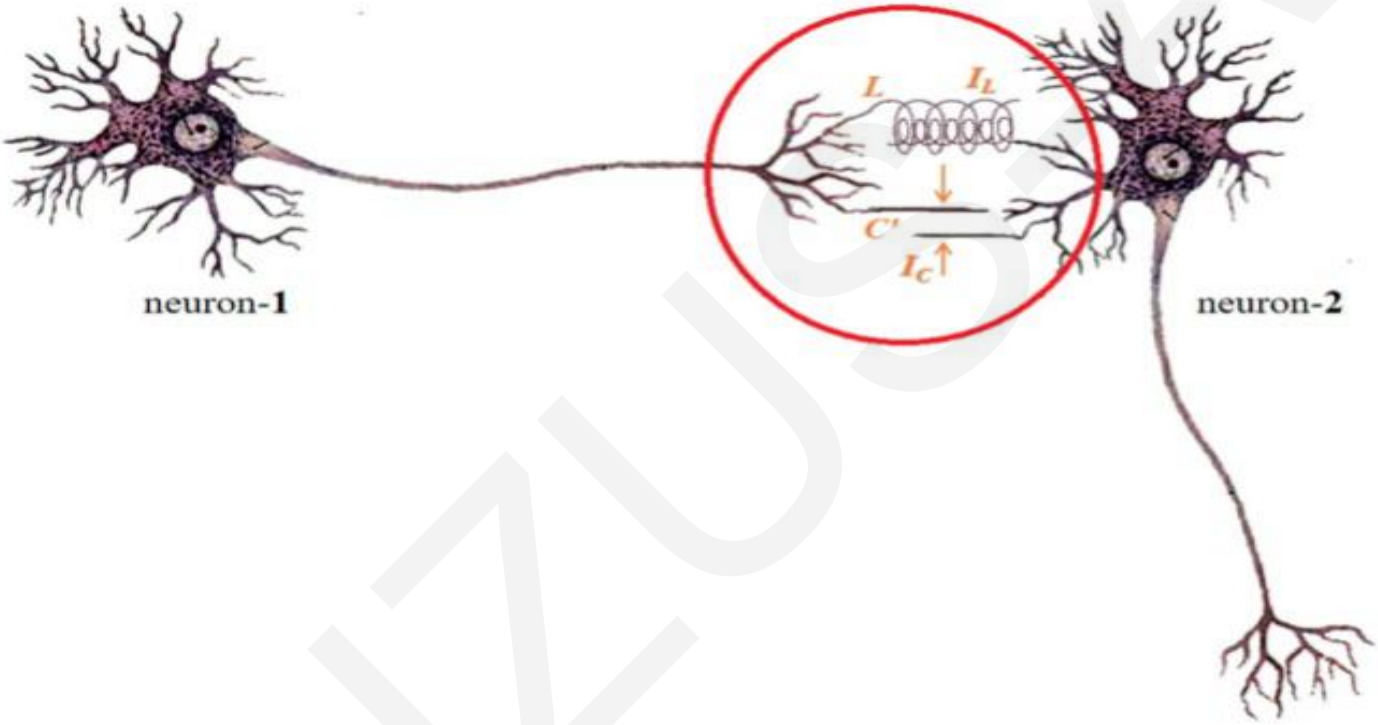


Fig.2 Electric synapse can be described by voltage coupling via linear resistor, while chemical synapse is realized by field coupling via induction coil.

Field coupling between neurons



- Fig.3 The physical mechanism for chemical synapse function is approached by field coupling, which pump field energy can regulate the collective neural activities.