

Irradiation effects on nerve conduction in *Lumbricus terrestris*

CORE QUESTION:

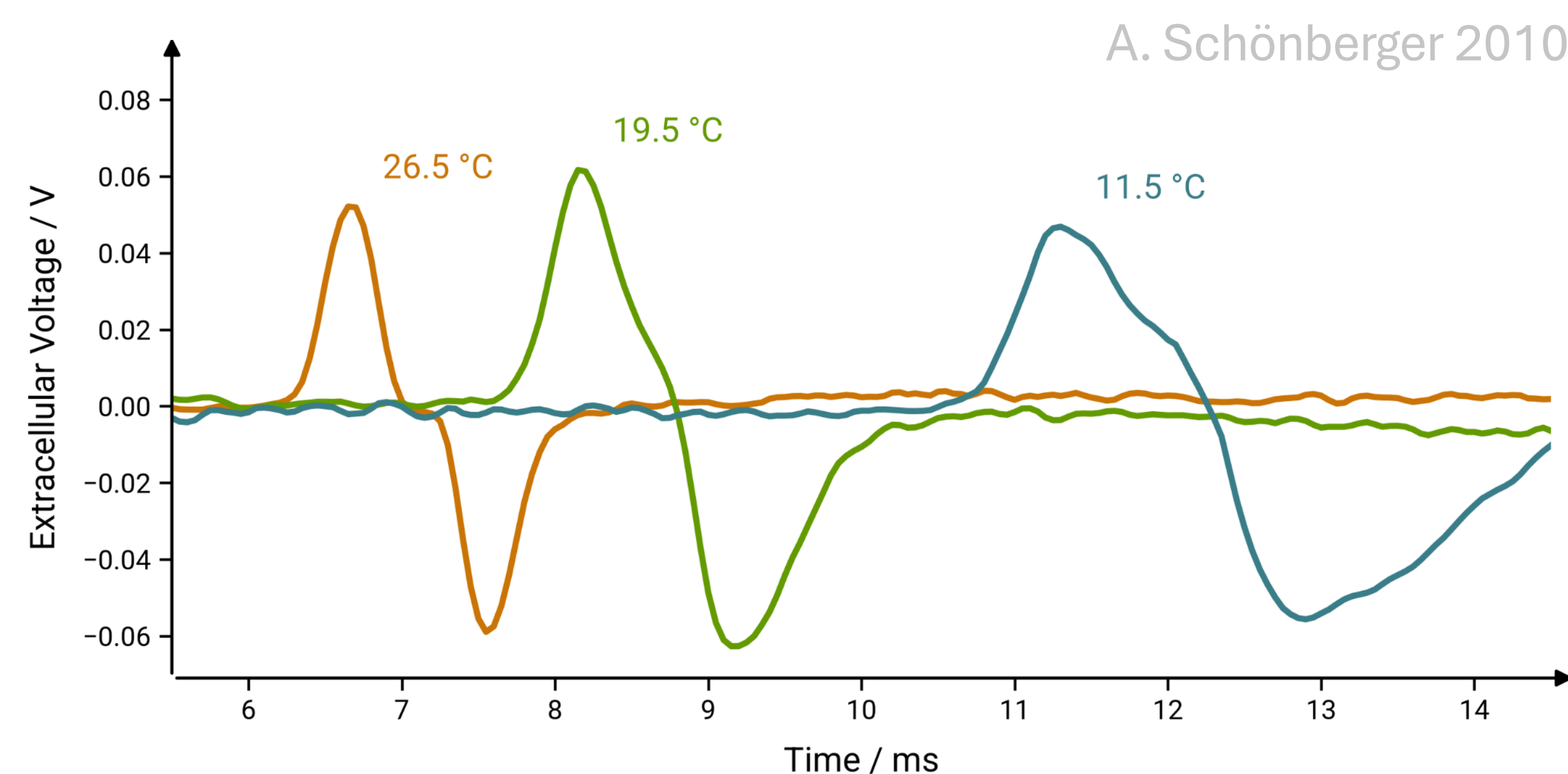
How do temperature acclimation and irradiation affect nerve excitability and conduction, and how do these effects relate to the membrane state?

Background & Motivation

Nerve conduction is coupled to the physical state of the membrane.

Conventional electrophysiology describes nerve excitation in terms of voltage-gated ion channels. The thermodynamic model proposes that nerve impulses propagate as density pulses near a membrane phase transition, coupling electrical, mechanical and thermal changes. The earthworm *Lumbricus terrestris* offers an accessible model for studying these processes through extra-cellular measurements from its giant nerve fibers. This project investigates how temperature acclimation and photon and proton irradiation affect nerve excitability and conduction, and how these changes relate to membrane properties. These experiments will provide a basis for subsequent investigations in cardiac cell models.

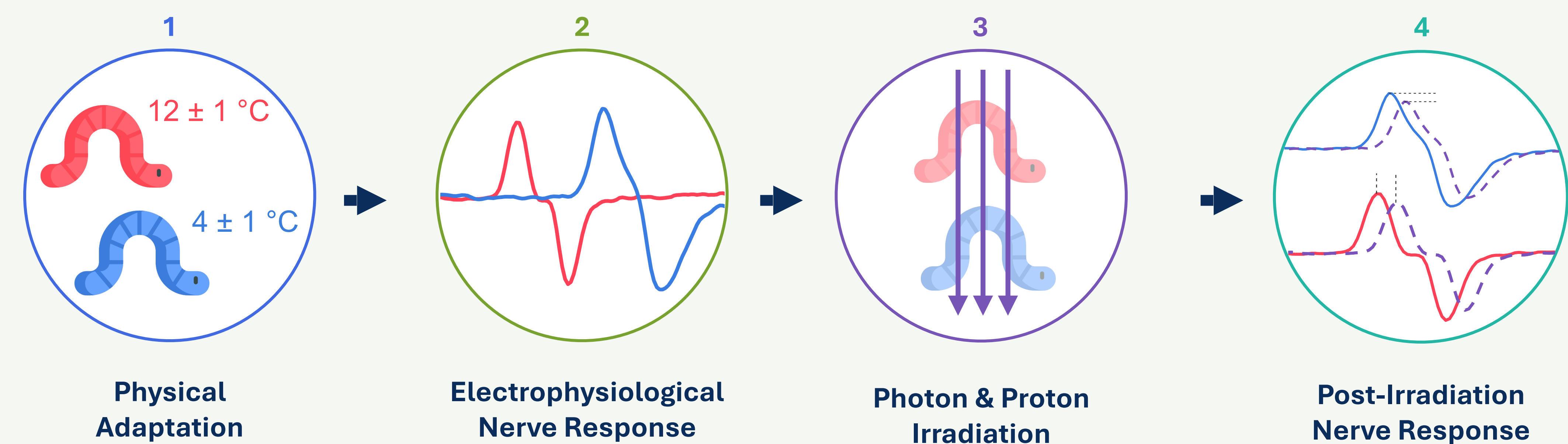
Temperature-dependent nerve responses



→ Propagation velocity increases with temperature

Experimental Approach

Nerve responses will be compared before and after irradiation in worms acclimated to different temperatures.



(1) Temperature acclimation establishes different physiological states to investigate the nerve function and irradiation response. **(2) Extracellular electrophysiology** characterizes these states by measuring the conduction velocity, excitation threshold, refractory period and heat-block temperature. **(3) Subsequent photon and proton irradiation at the West German Proton Therapy Centre in Essen (WPE)** introduces a defined physical perturbation to examine dose- and LET-dependent effect on nerve impulse conduction. **(4) Direct comparison** with the pre-irradiation state reveals changes in excitability and conduction as well as their disruption and reversibility. Complementary **fluorescence microscopy** may provide additional information on irradiation-induced structural or membrane-associated changes.

This experimental project is part of **AMTEC-PRO** (RTG 3043 - Advanced Methods and Technologies for Proton Therapy), a DFG-funded interdisciplinary research program investigating advanced methods and radiation effect to improve proton therapy. The worm model provides a basis for developing a reproducible electrophysiological measurement system, with the resulting insights supporting subsequent investigations of **irradiation effect in cardiac cells**.