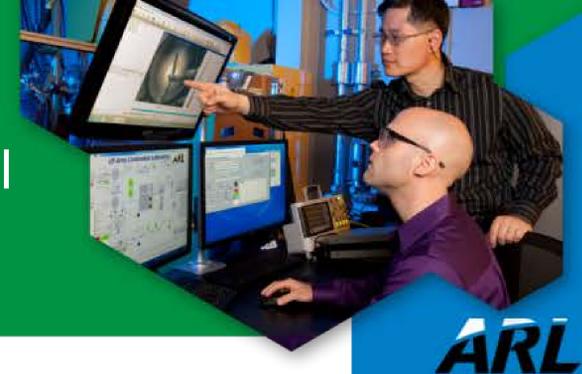


# Mechanisms of Brain Injury: Effect of different loading rates on mechanical/electrical/chemical responses in cells and tissue



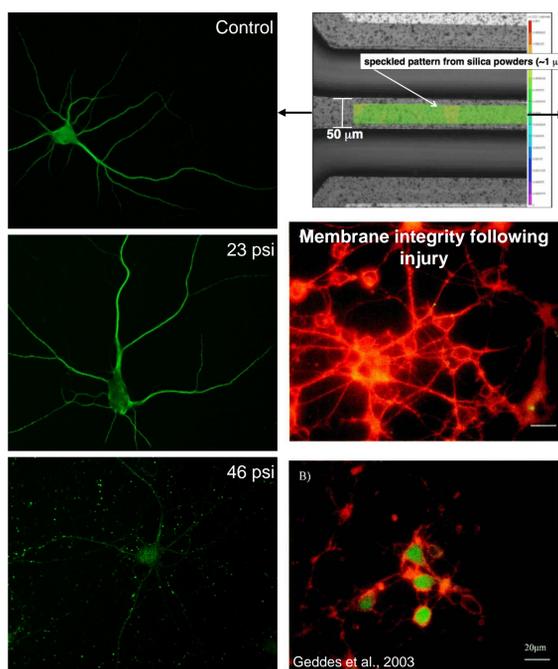
S&T Campaign: Sciences for Lethality & Protection  
Rate Dependent *Multi-scale Experimental Mechanics*

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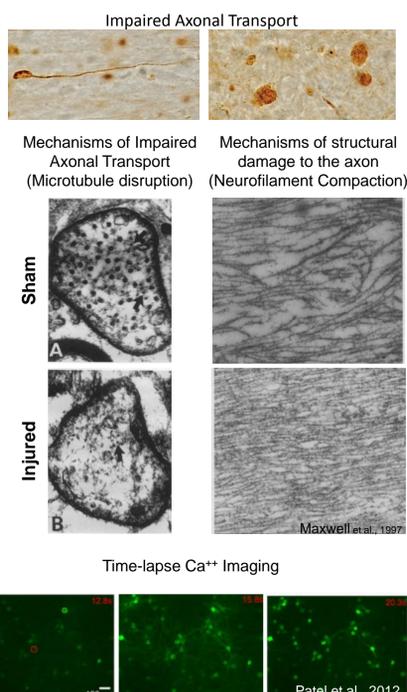
## Research Objective

1. **Develop** novel experimental methods to apply high rate loading at different length scales
2. **Systematically evaluate** the mechanical/electrical/chemical (MEC) response and associated mechanisms following controlled high-rate loading paradigms
3. **Formulate** of cellular injury criteria from MEC thresholds

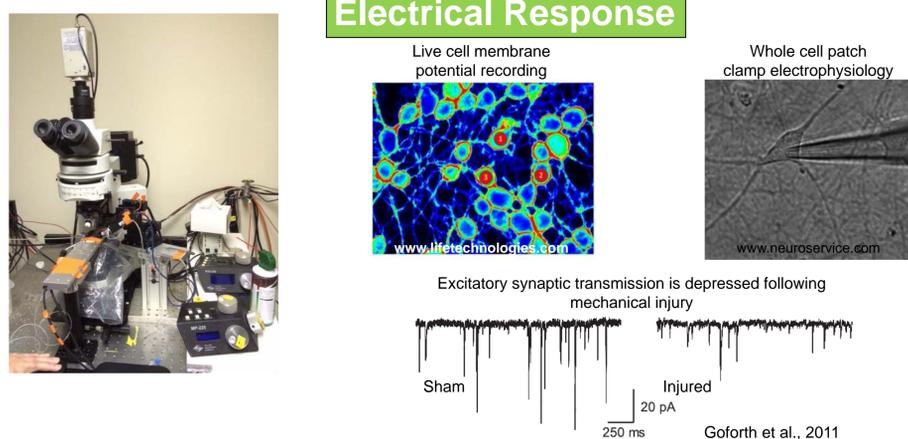
### Mechanical & Morphological Response



### Chemical Response

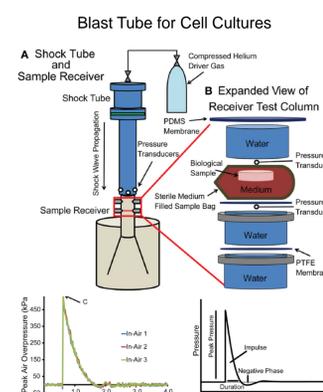
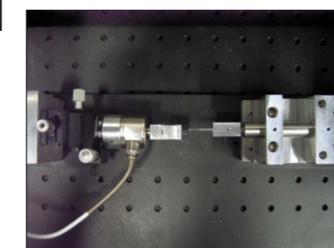
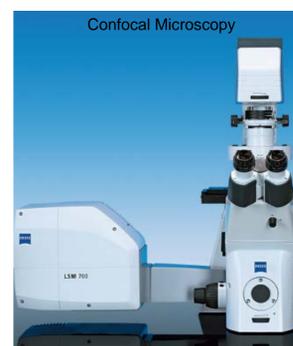
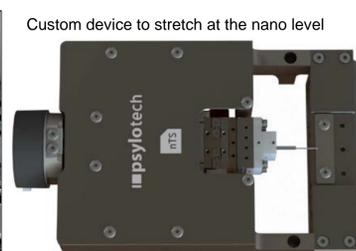


### Electrical Response



## ARL Facilities and Capabilities Available to Support Collaborative Research

- We are developing in situ experimental methods to monitor the **Mechanical** response of **cells** and **tissues** during and following various loading paradigms.
- Establishing techniques to measure the **Electrical** response from the cellular to network level following mechanical loading.
- Institute methodologies to evaluate **Chemical** response following mechanical loading.



## Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

## Challenges

- Novel in situ experimental methods are needed to understand the effects of different loading rates and stress-states on cells.
  - Mechanical/electrical/chemical response of cells is not fully understood.
  - MEC coupling is not understood.
- New mathematical models needed to relate MEC response to different rates of loading.
- Stress measuring methods do not exist.
- Visualizing cells in real time during injury.
- Response of cell and tissues to coupling of pressure and strain is not understood. New experimental methods are needed to understand the pressure-strain coupling.

- Modeling uncoupled and coupled MEC responses to rate dependent mechanical loading.
- Cell culturing methods.
- Novel staining methods to quantitatively evaluate cell and tissue response.
- Stress measuring methods at cellular scale.
- Micro-electrode arrays embedded in flexible substrates.
- Behavioral studies to correlate with measured MEC responses.

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