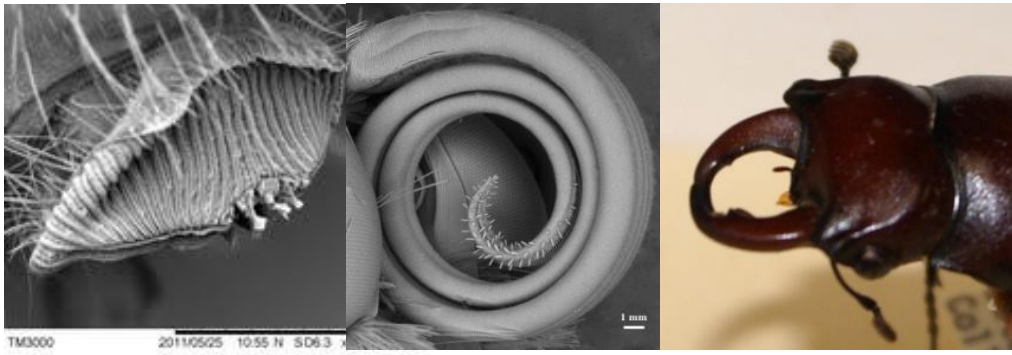
Arthropod Materials

Kornev's lab

- Strategic goal: Understanding materials organization in arthropodsfrom the nanoscale to the organismal scale and the relation of materials structure & property to the organism functionality

Current focus on

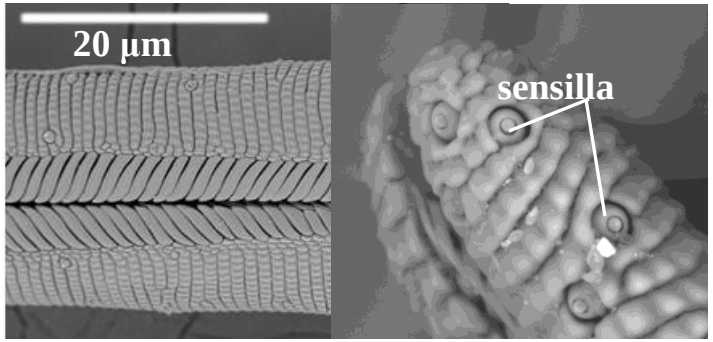
- Characterization of physical and chemical properties of arthropod exoskeleton
- Establishment of composition–microstructure–property relations
- Study on materials self organization at different scales
- Applications: Development of multifunctional materials that interweave nano and micro scales to make the materials functional, reconfigurable, and reactive to the environment.



Diversity of arthropod feeding habits: sponging, sucking and chewing mouthparts. Exoskeleton materials represent a wide variety of different combinations of six key properties: hardness, stiffness, strength, fracture toughness, density, and wettability. Our goal is to *correlate these properties with underlying structures and compositions*.

Materials multifunctionality:
flexibility, maneuverability, sensibility, wettability…

Butterfly proboscis is a remarkable example of multifunctional self-organizing material. When a butterfly emerges from a pupa, the galeas of the proboscis are separated. After the proboscis is "zipped" the cuticle hardens and galeas never come apart.



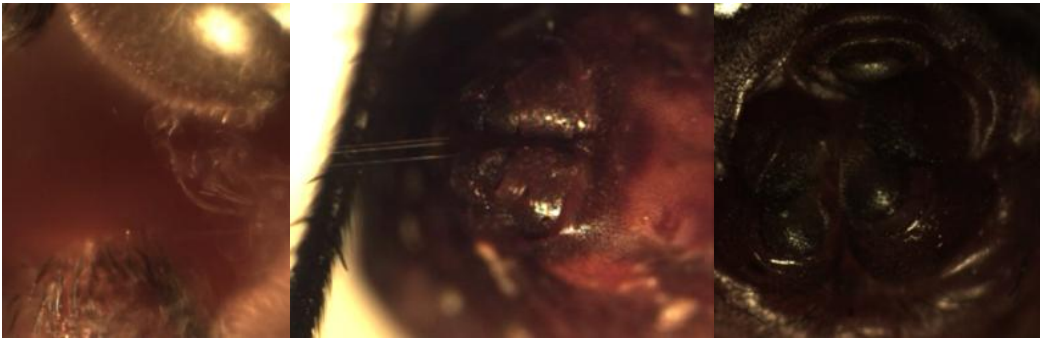
Proboscis morphology, properties, and functionality of the butterfly proboscis changes along its length.

The proboscis features large (~1 µm) slits between dorsal plates of the linkage device. Also this region contains sensilla – "lab-on-chip" detecting and analyzing food.

Silk production and use in Arthropod word

Kornev's lab

- Strategic goal: This research aims to understand the physical principles used by arthropods for making fine and superstrong fibers with useful multifunctional properties.
- Main challenge: Silks are composed of proteins based on relatively simple amino acid repeats. The key missing information is the relationship between the protein sequence and the mechanical properties of the fibers.
- Current focus on:
- Systematic study of the process of silk spinning
- Systematic study of the mechanical and physico-chemical properties of silks.
- Analyses of water –silk interaction



Many arthropods including spiders, moths, and related groups, produce silk to assist in capturing prey and filter-feeding, as well as many associated processes. Spiders spin steel-strong fibers that are deployed as capture nets in a wide variety of structural and compositional forms and environments.