Investigate fiber as model material

**Fundamental understanding of fiber response and Mechanism**

**Materials** - level mechanisms during impact with Kevlar KM2 - based Approach - Design Process

How We Fit

- Fundamental understanding of fiber response and fiber-level mechanisms during impact with Kevlar KM2 as model material
- Investigate the role of multiaxial loading during impact

**Key Goals**

**Technical Approach**

- Fiber-scale 3D FE models of single fiber and yarn transverse impact
- Multilayer fabric impact
- Individual yarn impact
- Single fiber impact

- Validation constitutive and failure model for single fibers

**Key Accomplishments**

- Developed validated constitutive model for KM2 single fibers in transverse compression. Applied to UHMWPE up to 25% true strain
- Developed multiaxial loading failure criterion for single fibers with degradation experiments
- Developed fiber-scale 3D FE models of yarn impact
- MD modeling of multiaxial loading

**Major Results**

- Induces multiaxial loading and fiber spreading
- Inelastic response in transverse direction of fibers in contact under projectile
- Fibers subjected to different levels of degradation
- Failure strain follows Weibull weakest link based on gage length
- Progressive failure of fibers
- Flexural waves in the fiber resulting in axial compressive kinking

- Projectile-fiber contact strain concentration over small lengths

**Future Directions in 2017**

- Extend to larger strains for UHMWPE constitutive models
- Apply failure theory to UHMWPE multiaxial loading
- Fibril-scale modeling of multiaxial loading experiments
- High strain rate behavior of single fibers in transverse compression

**Impact**

- Improved understanding of energy absorbing mechanisms during impact
- Will lead to improved protection materials while decreasing the cost and time for development of new lightweight energy absorbing materials