The molecular motors that work in parallel in the functional unit of muscle, the half-sarcomere, are mechanically linked through the myosin and the actin filament. To understand properly the cooperative action of the motors it is necessary to define the mechanical properties of both filaments. It is still an open question whether the myofilaments behave as a pure elastic element or exhibit a viscoelasticity related to force dependent structural changes. The aim of these experiments was to test the response of the myofilaments both during a rapid force increase (100μs) and the subsequent force recovery (2ms later) elicited by a step length change superimposed on the isometric tetanic contraction (force T_0), and at a steady level of force maintained by means of steady shortening (force < T_0) or lengthening (force > T_0) of the fiber. Comparison between the length responses in the different protocols will establish if the myofilament are purely elastic or viscoelastic.

The length response of the myofilament has been measured by collecting 2D patterns on the FReLoN CCD detector with a 2.3m camera, from both frog and dogfish muscle fibres at 4°C and 2.2 μm sarcomere length. The maximal force during isometric contraction, T_0, was about 170kPa in both species. To collect patterns with an adequate signal to noise ratio it has been necessary to mount bundles of two-three fibres each, and 8 pixels binning of the detector along the axis perpendicular to the fibre was necessary. The spacing changes of the M6 reflection at ~7.2nm along the axis parallel to the fibre are associated with the length changes of the myosin filament in response to force changes in the active fibre. The spacing changes of the layer lines at ~5.1nm and ~5.9nm are associated with the length changes of the actin filament. Differential changes of the two spacings indicate a change in the helical symmetry of the actin filament. The data for the M6 spacing as a function of force lie on the same linear relation for the two protocols and for both species, with a slope 0.27% /T_0 in the region 0.1-1.8 T_0. The data for the actin filament show that for forces > 0.5 T_0 the lengthening is almost linear, with a slope 0.17%/T_0 and there are no differences between species or protocols. At forces lower than 0.5 T_0, further data must be collected. These findings indicate that the myosin filament, and the actin filament for forces > 0.5 T_0, behave as a pure elastic element and exclude a viscoelastic component.
The experimental visit moreover demonstrated for the first time the possibility to use dogfish fibres for investigation on structural dynamics of skeletal muscle. behave as a pure elastic element and exclude a significant viscoelastic component. The experimental visit moreover demonstrated for the first time the possibility to use dogfish fibres for investigation on structural dynamics of skeletal muscle. The details of filament structure and organization are different for these two species, as are the physiological properties, enabling a new comparative approach to determine structure function relations in skeletal muscle.