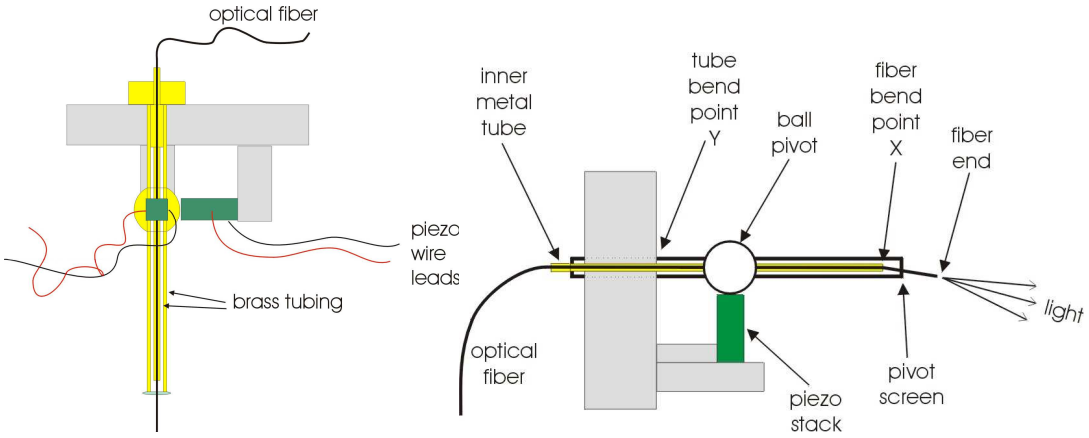
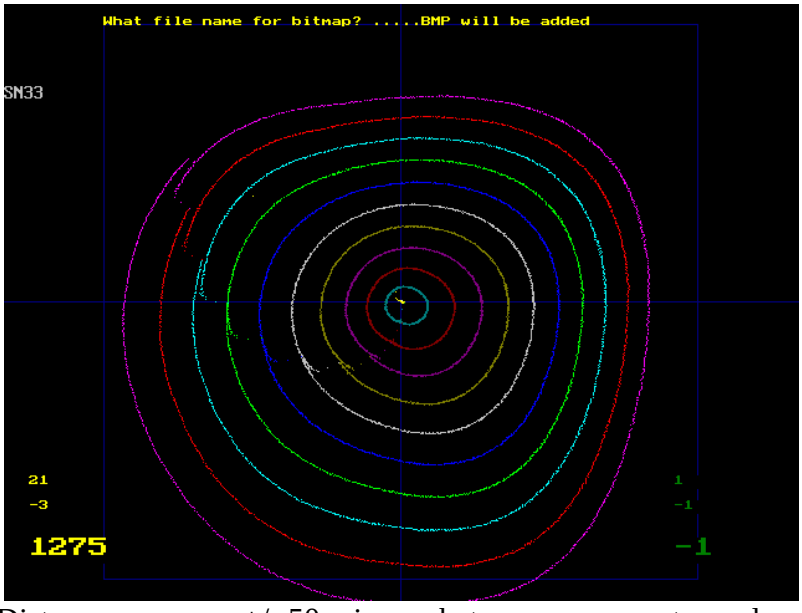
Principles of wiggler operation are described in US Patent 7,274,451 B2. The main advantages of wigglers over other beam-steering devices are small size, light weight, inexpensive parts, and fast response. They also have high efficiency in delivering light from an optical fiber

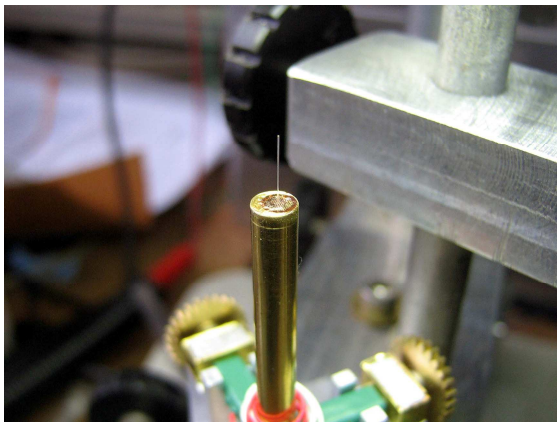


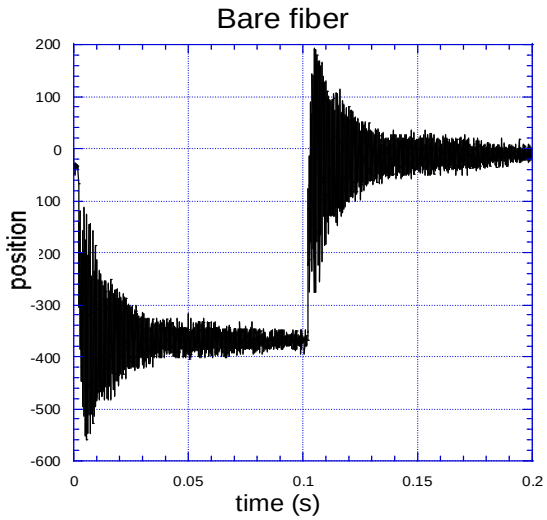
A wiggler amplifies piezo motion with a double lever system comprising a moving outer metal tube, a stationary inner metal tube, and (inside of the inner tube) a glass optical fiber that bends near its tip. The outer tube carries an electroformed screen with square holes. The fiber sits in the corner of one such hole and is deflected there by movements in the outer tube. The fiber bends at "*point-X*" where it is clamped by the inner tube. It has a short segment that tilts between the outer and inner tubes, plus an external lever section that amplifies that tilt. Thus the fiber tip movement becomes ~10 times larger than the piezo movement. We use two piezo stacks to push the fiber in orthogonal directions. A figure below tracks tip displacement when the two axes are driven with sine and cosine waveforms of increasing amplitudes. Ideally the paths would be circles.



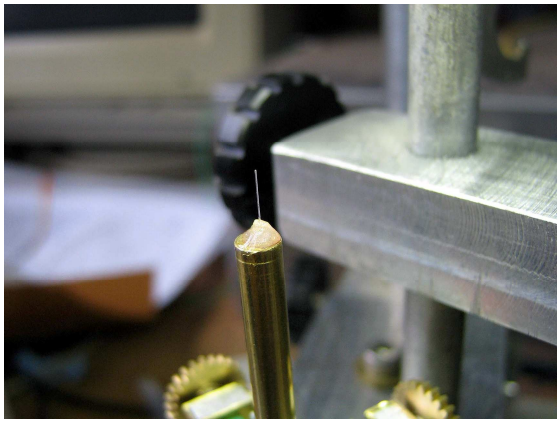
Distance measures +/- 50 microns between cross center and outer dark-blue lines. Outside path is for piezos driven by 150 volts amplitude. Each circle has a period of 1

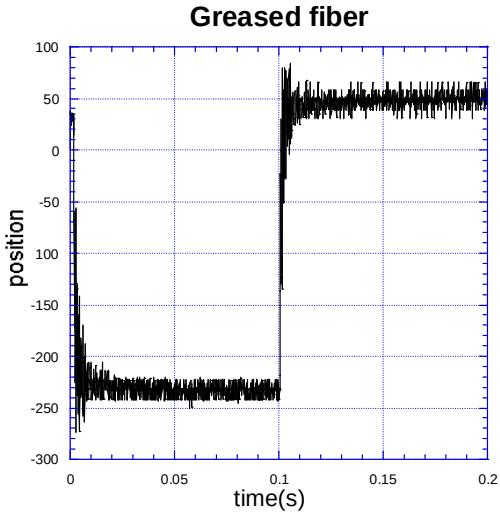
second There is a strong tendency for the fiber to ring when its position is changed in a step. The resonant frequency of the fiber is about 2500 Hz and so the initial response occurs in a quarter cycle or ~100 usec. However the settling time for ringing may be around 100 cycles which is 50 ms.



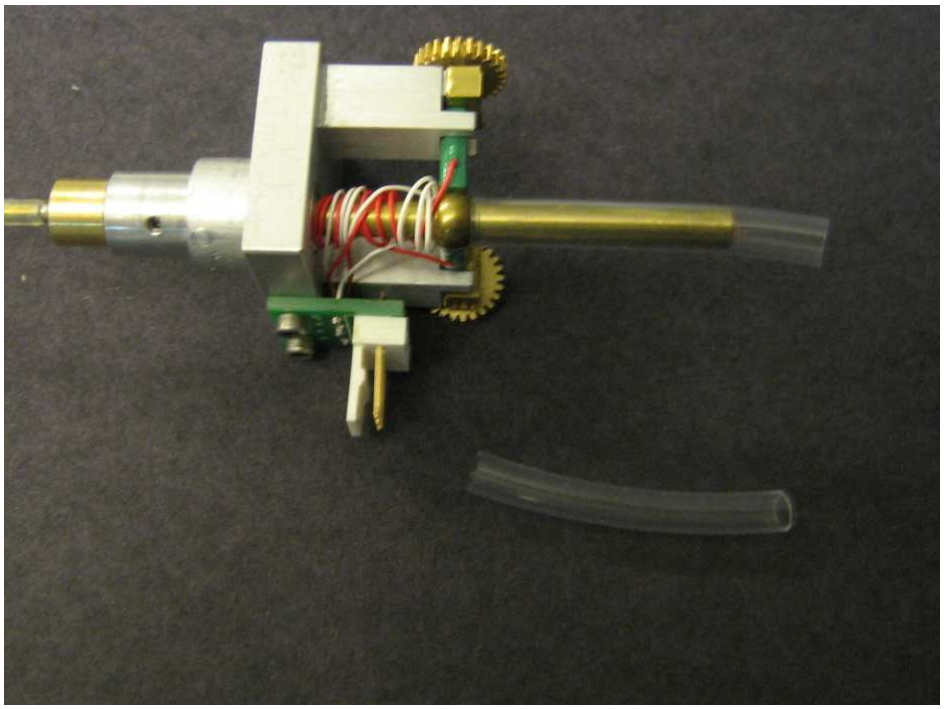


That problem is ameliorated by applying a glob of silicone vacuum grease to the fiber where it exits the pivot screen. Now the ringing dissipates in ~10 cycles or 5 ms.

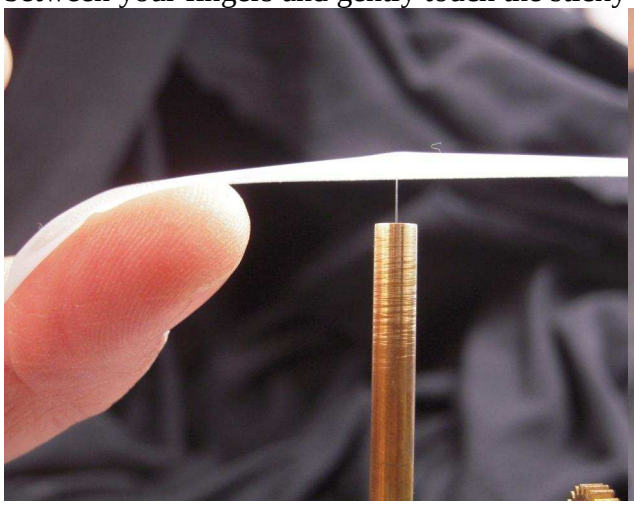


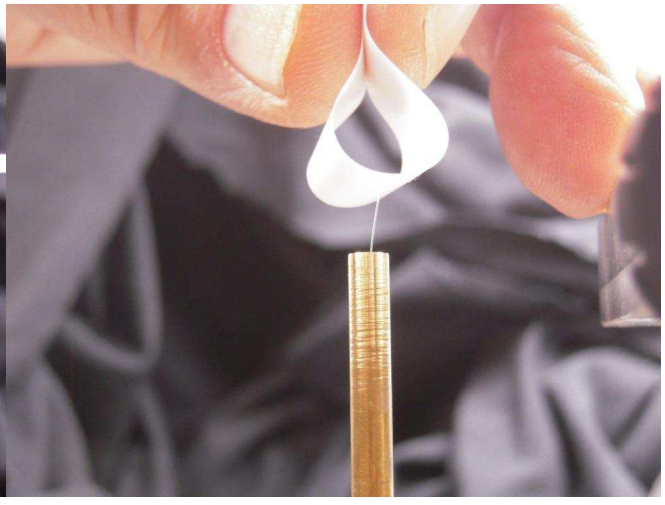


The exposed fiber is easily broken or damaged during shipment. Therefore a piece of vinyl tubing is usually placed over the brass tube to protect the fiber end. Be careful when removing the shipping tube that you do not get silicone grease on the end of the optical fiber. Such grease will distort the light emission. No known solvent removes silicone grease from glass.

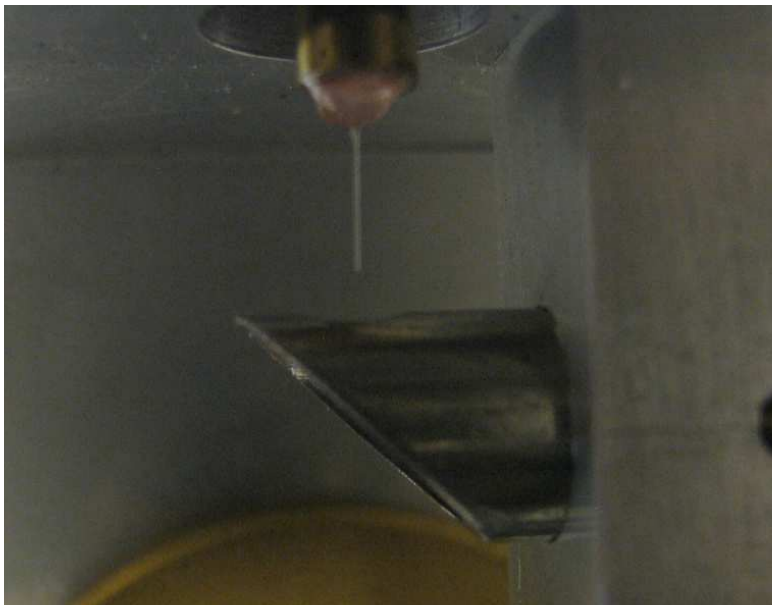


To remove ordinary dust or dirt, try using Scotch Magic Tape. Stretch 10 cm of tape between your fingers and gently touch the sticky side onto the fiber end.





To install the wiggler in a miniTweezers instrument, see the document “How to Change a Fiber Wiggler”. Note that inside the instrument head the end of the fiber comes very close to the light-lever pickoff tube (see figure below). Start installation with the 3 adjustment screws fully retracted on the mount that holds the wiggler. Then lower the fiber slowly with the 3 screws while checking the focus with an indicator card (see document). The fiber end may need to be as close as 1 mm from the pickoff tube for proper focus.



An alternate way to install the wiggler is to cut the shipping tube so it is even with the end of the fiber and then leave the shipping tube inside the instrument. This method helps protect the fiber from accidental damage during placement and focusing.