Surface Inteference

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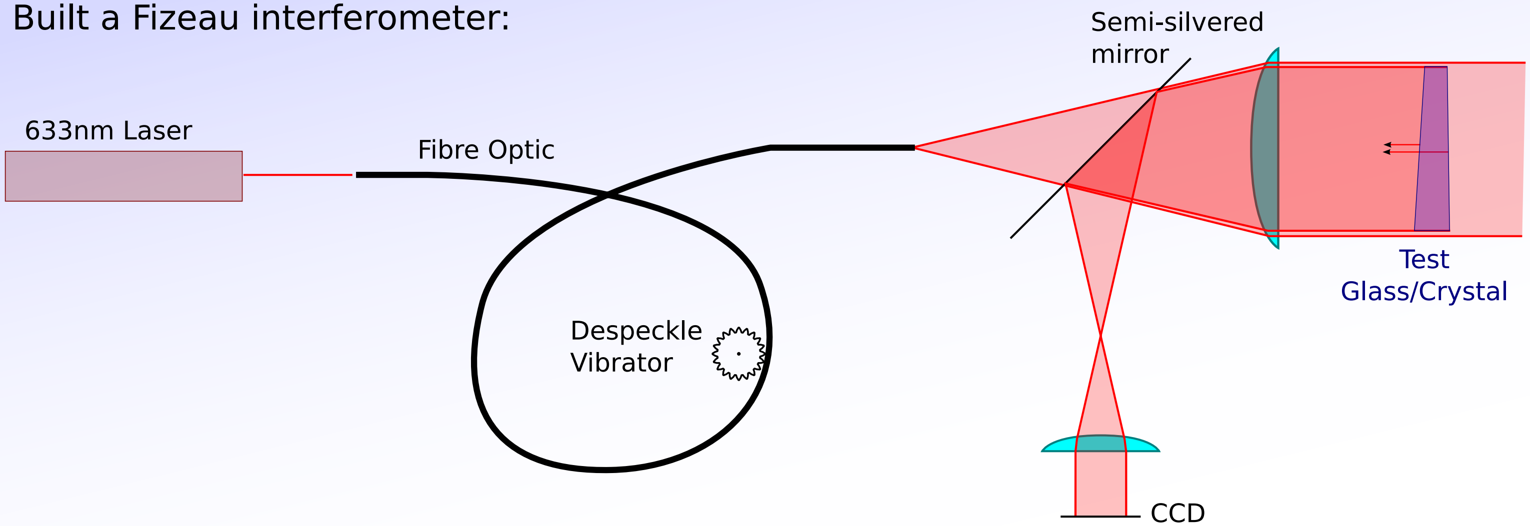
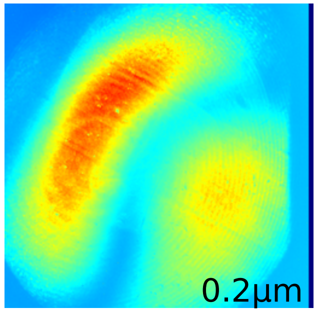
Built a Fizeau interferometer:



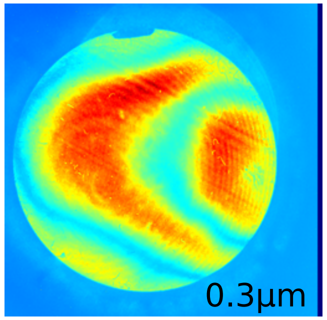
1 fringe = $\lambda/2$ wave change in thickness.
$(ne + no)/2 = 1.6$
$\lambda_0 = 633nm$
λ in crystal = 394nm

1 fringe ~ 200nm

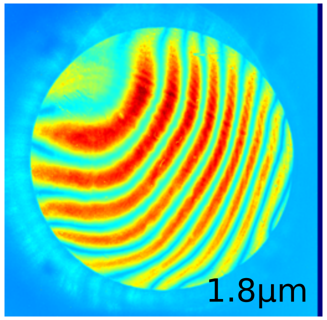
"λ/10" Glass substrate
(For reference)



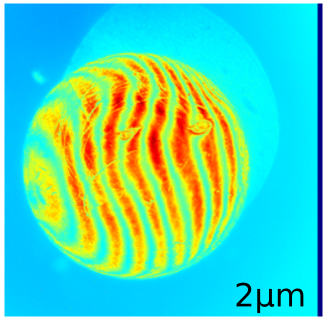
United Crystals
45° ø35mm 3.8mm (A)



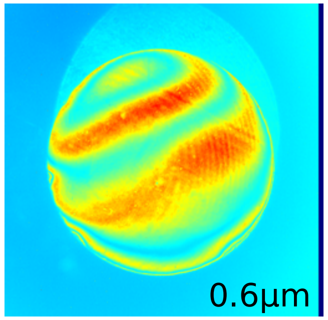
United Crystals
45° ø35mm 3.8mm (B)



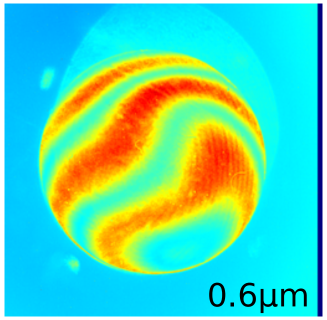
(CLaser?) Savart
±45° ø30mm 2x3.8mm



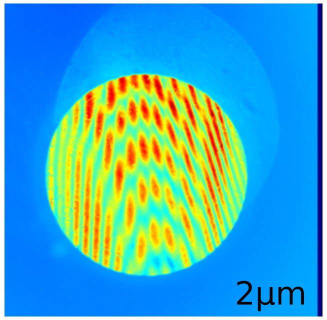
(CLaser?) Displacer
45° ø30mm 5.4mm



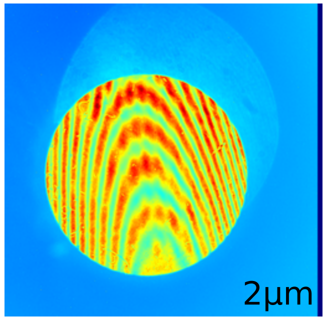
(CLaser?) Delay
90° ø30mm 1.2mm



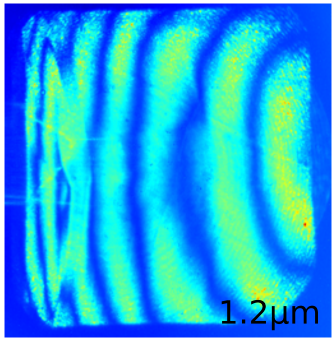
FLC (off)



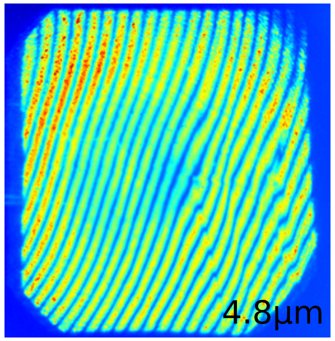
FLC (on)



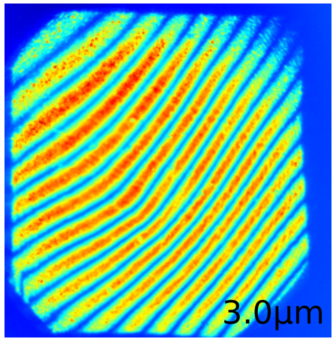
Bluebean
90° 40x40x10mm



United Crystals
90° 40x40x10mm



United Crystals
45° 40x40x5.4mm



Interferometric vs Birefringence

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Compare the birefringent phase-based measurements with those of the Fizeau interferometer.
From the birefringent phase difference, calculate a thickness difference:

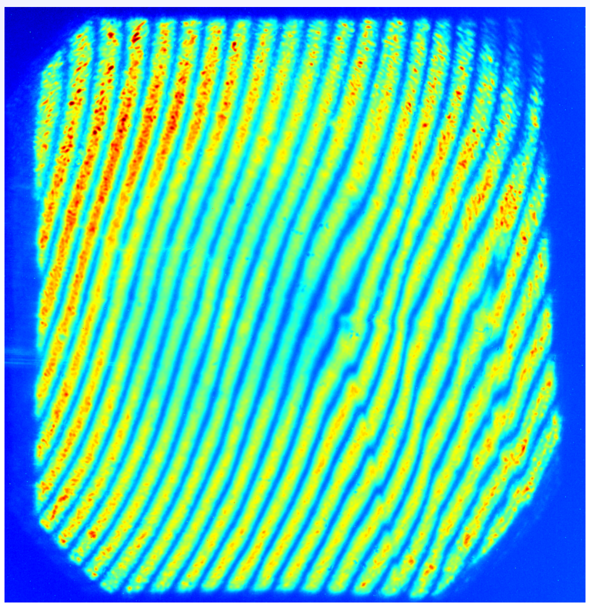
$$\Delta L = \Delta\varphi / 2\pi * 653nm / (ne - no)$$

and then convert to a number of waves at 633nm

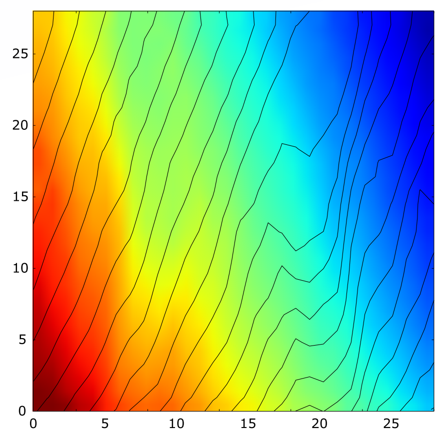
$$f = \Delta L * 2 \text{ passes} * (ne+no)/2 / 633nm$$

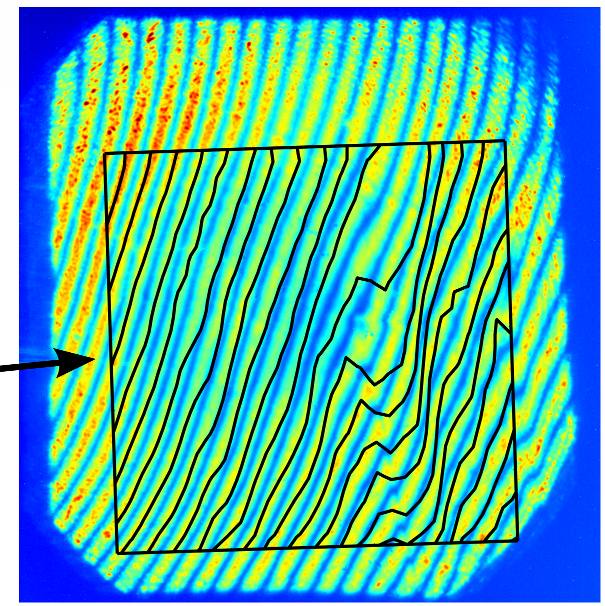
United Crystals
90° 40x40x10mm

Fizeau fringes:



Birefringent phase





The agreement is very good, so the problem results from the path length, not from any effect of the optic axis. Polarisation has no effect on the Fizeau fringe frequency, so proves this.

There are now two possibilities: Parallelism / Surface deformation, or refractive index inhomogeniety. The former is much more likely.

Over the cental 28mm (70%), this crystal has 3.3µm of thickness variation.
That is 24 arcseconds, 4x worse then the specified 6", but just within the 30" given by all other companies.