DIAMOND RADIATORS

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UCONN

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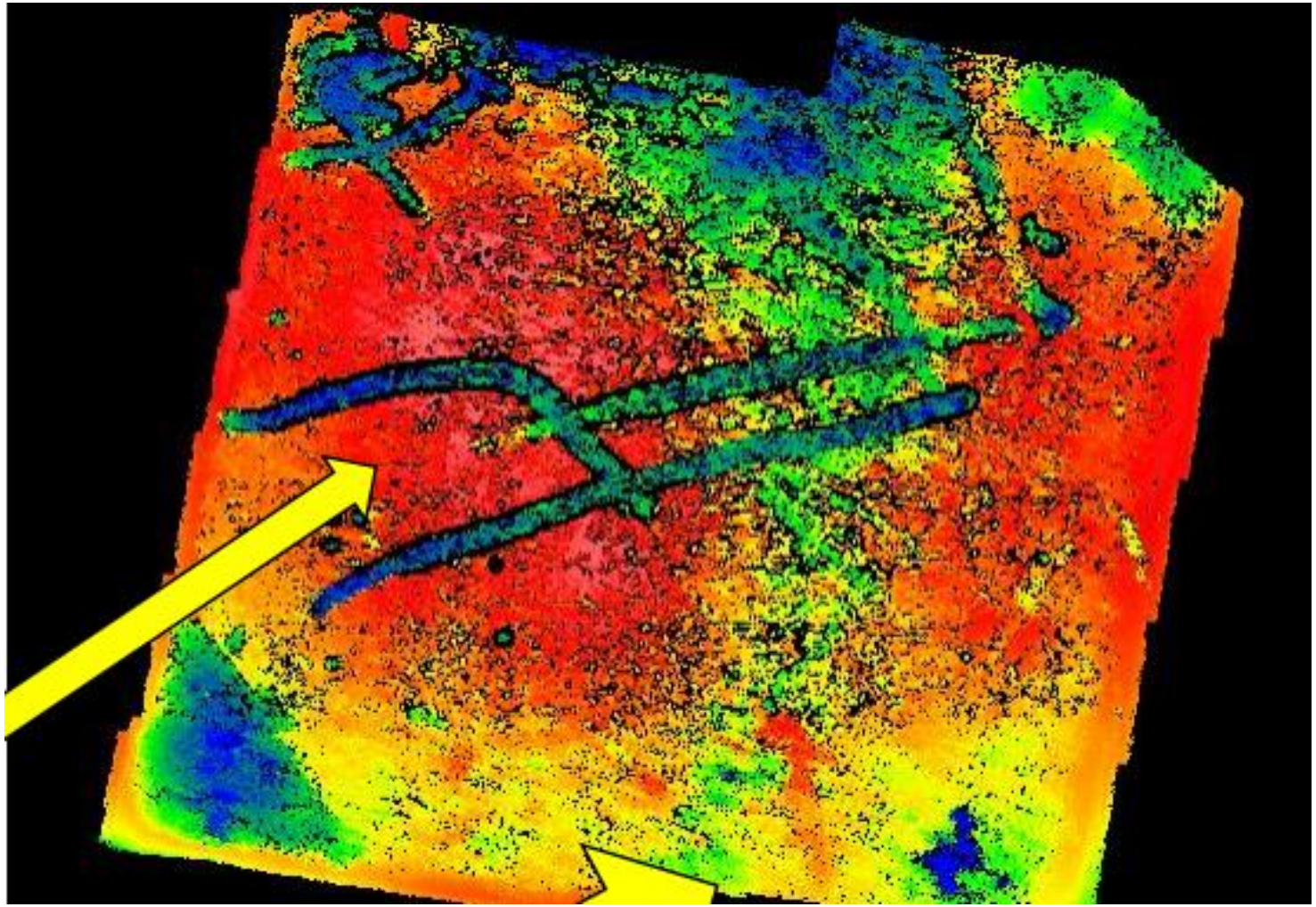
OUTLINE:

- Status of ablation-ready diamond samples
- Review of first article from Applied Diamond
- Diamond Ablation upgrades
- Timeline

CHESS

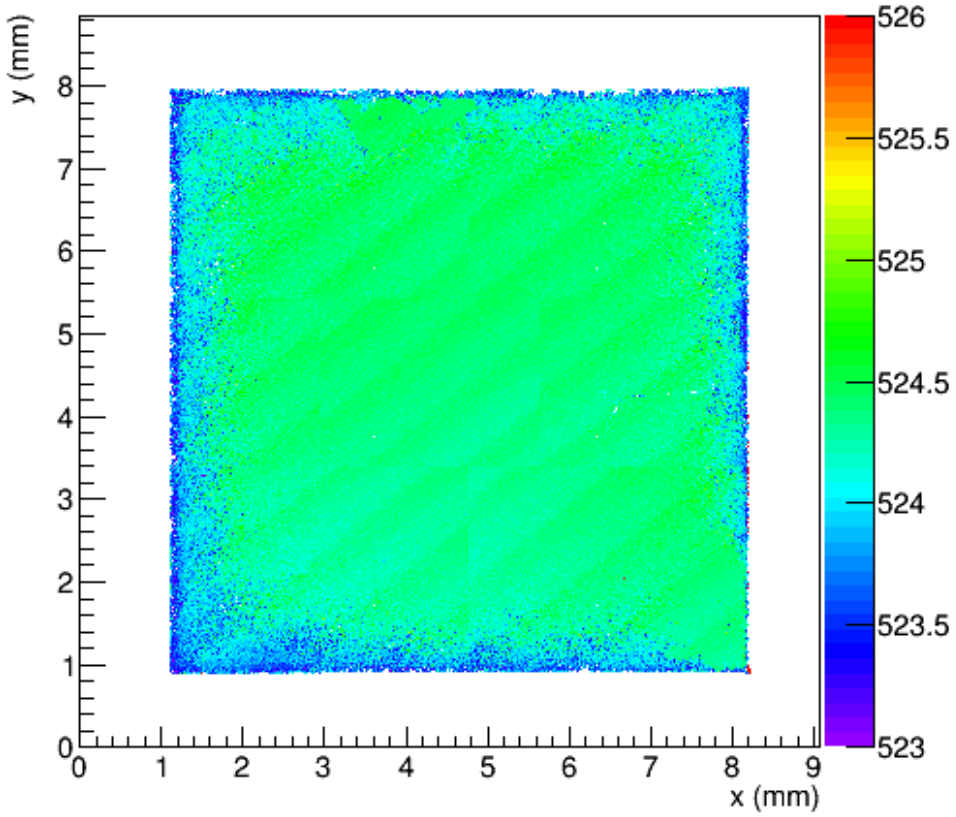
WHERE WE WERE WITH SINMAT: JD70S



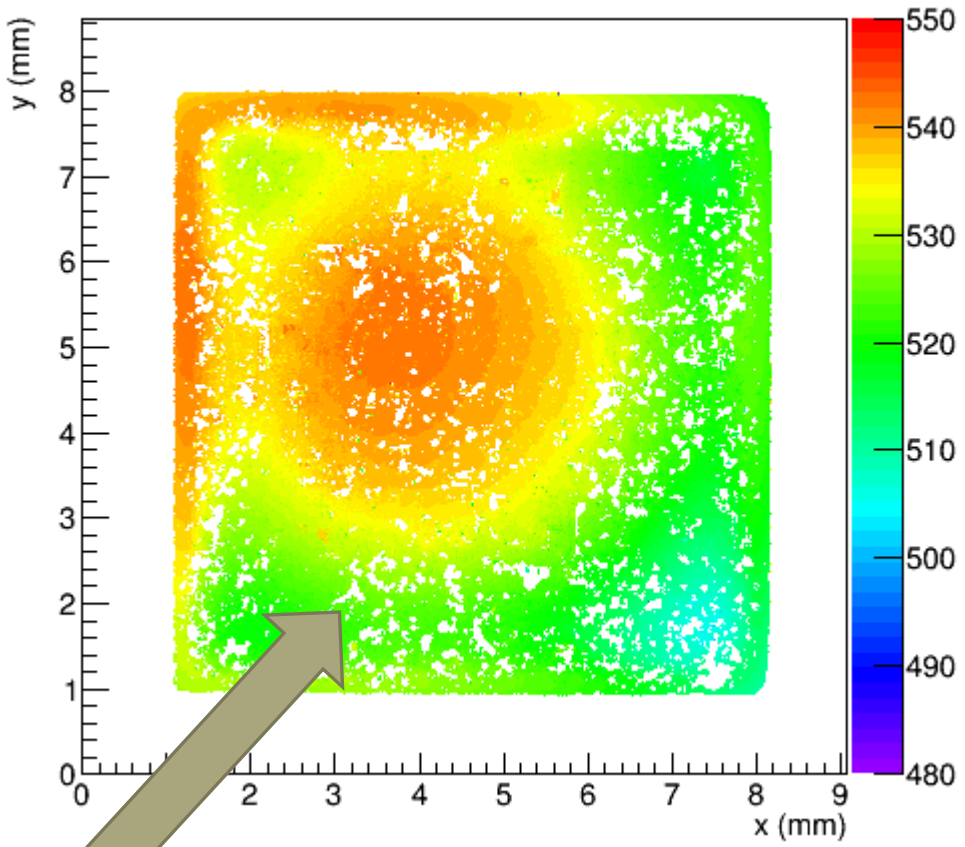
- Pitting
- Trenches
- Broken edges
- Irregular thickness
- NO GOOD

RECEIVED THINNED JD70 SAMPLES FROM SINMAT LAST FRIDAY

JD70-2-smooth



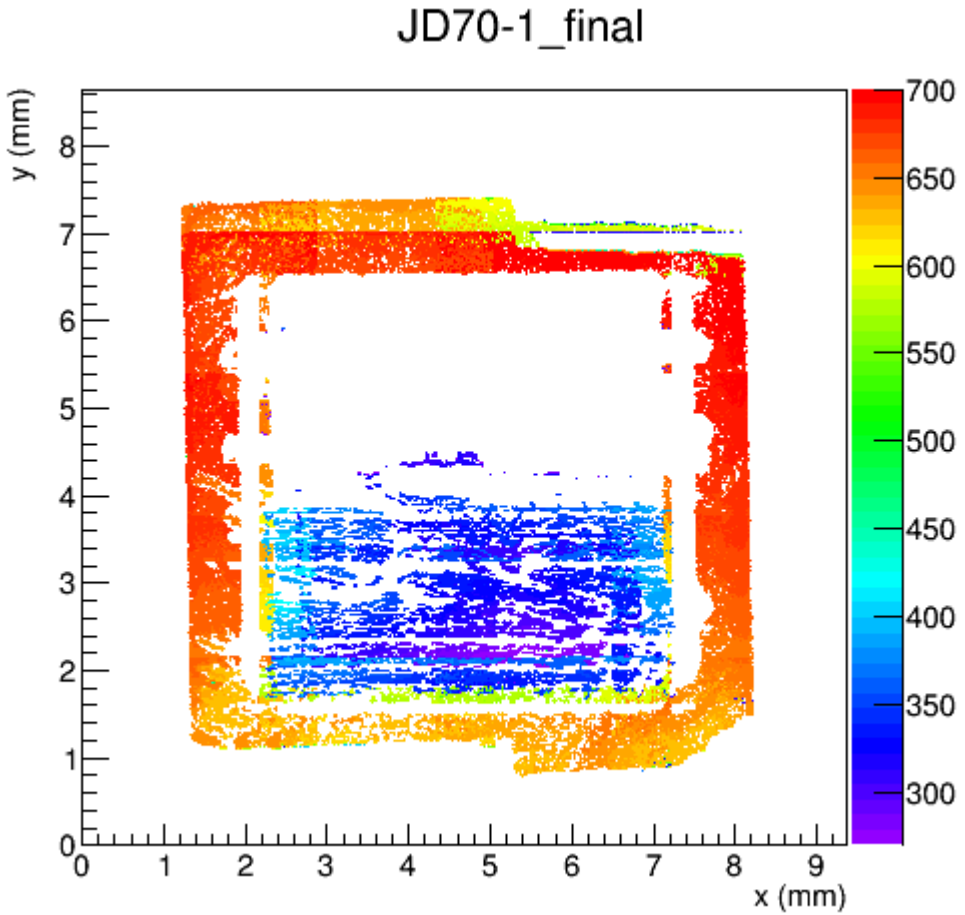
JD70-2-crater



Same pitting and wedge behavior

DIAMOND ABLATION: JD70-1 FINAL

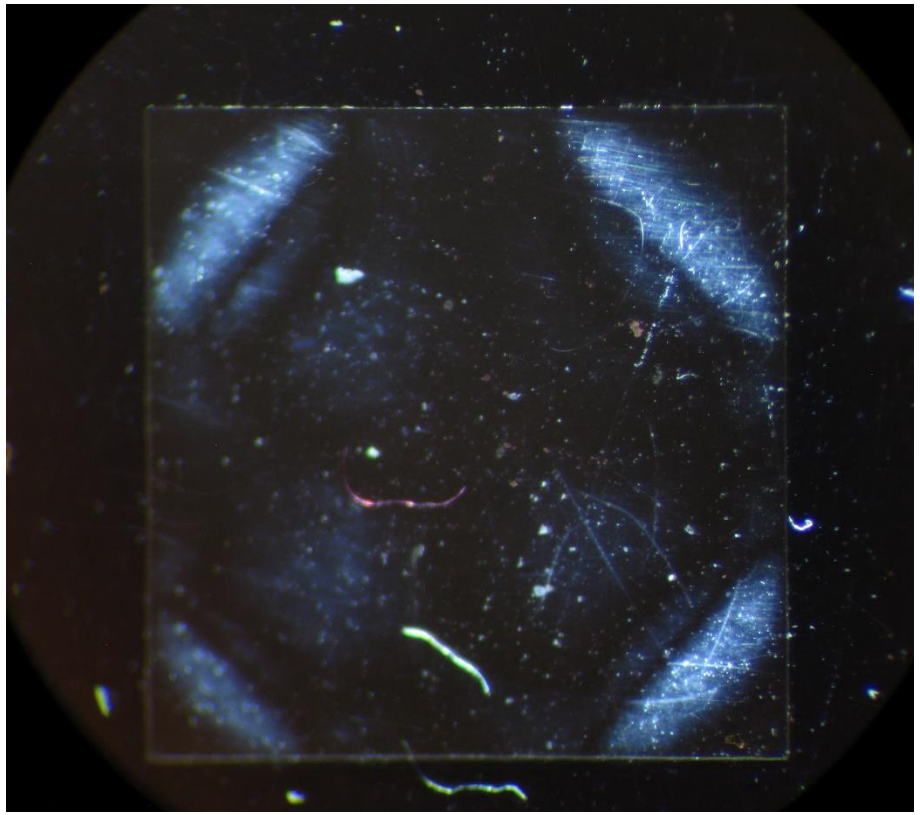
- Attempted and succeeded to mill to 20μm.
- Limited rectangular region dropped out on last pass.
- We believe this to be caused by the deep grooves and pits left by Sinmat's etching process.



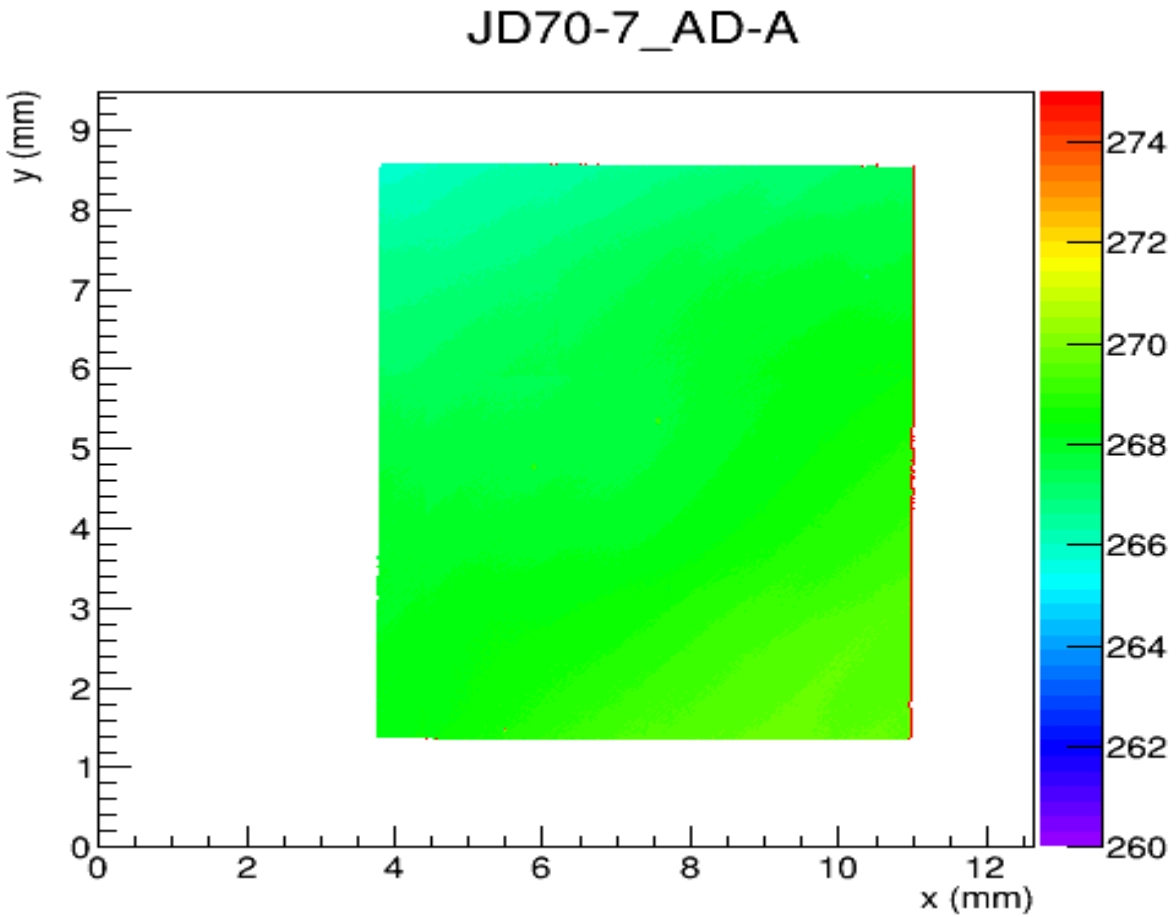
JD70-7 (7.1 X 7.1 X 1.2 MM^3)

- Applied diamond to slice 1.22mm thick JD70-7 into three separate 250µm pieces with parallel, polished surfaces.
- First Article to assess the quality of their work before commissioning the last 7mm diamonds for thinning.
- Use birefringence to reveal crystal quality of individual piece in comparison with CHESS results taken last May of JD70-7

JD70-7-A

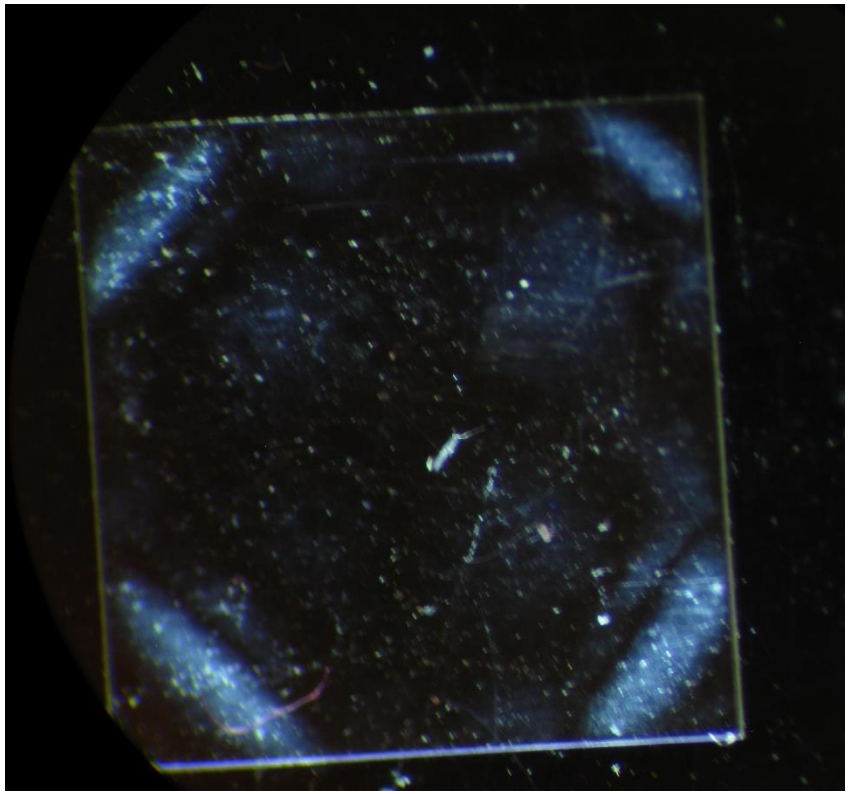


birefringence image taken under microscope

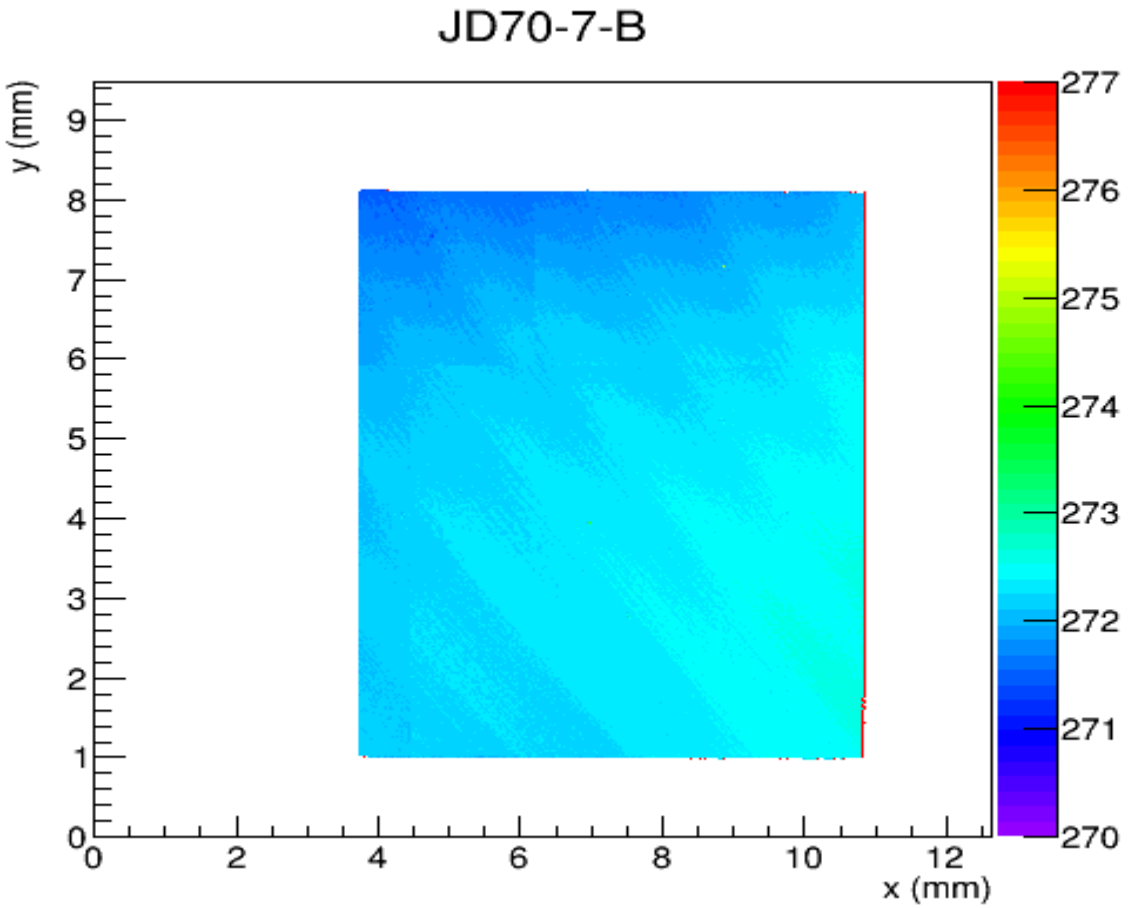


Zygo interferometer surface profile

JD70-7-B

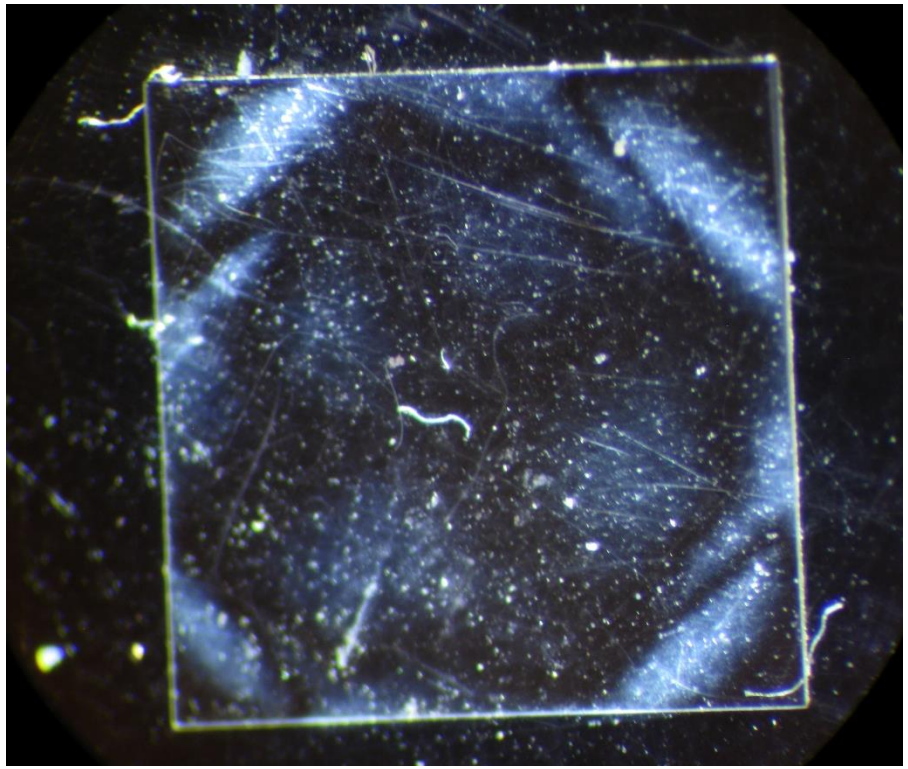


birefringence image taken under microscope

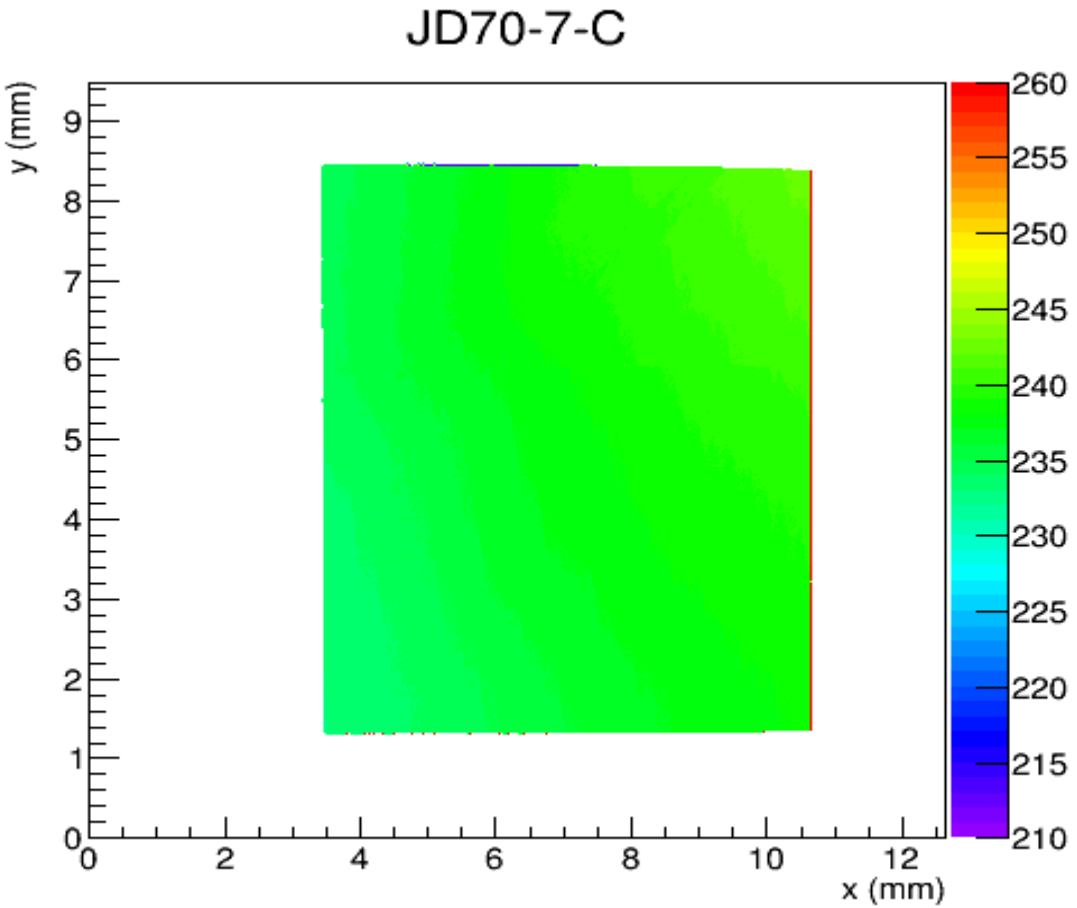


Zygo interferometer surface profile

JD70-7-C

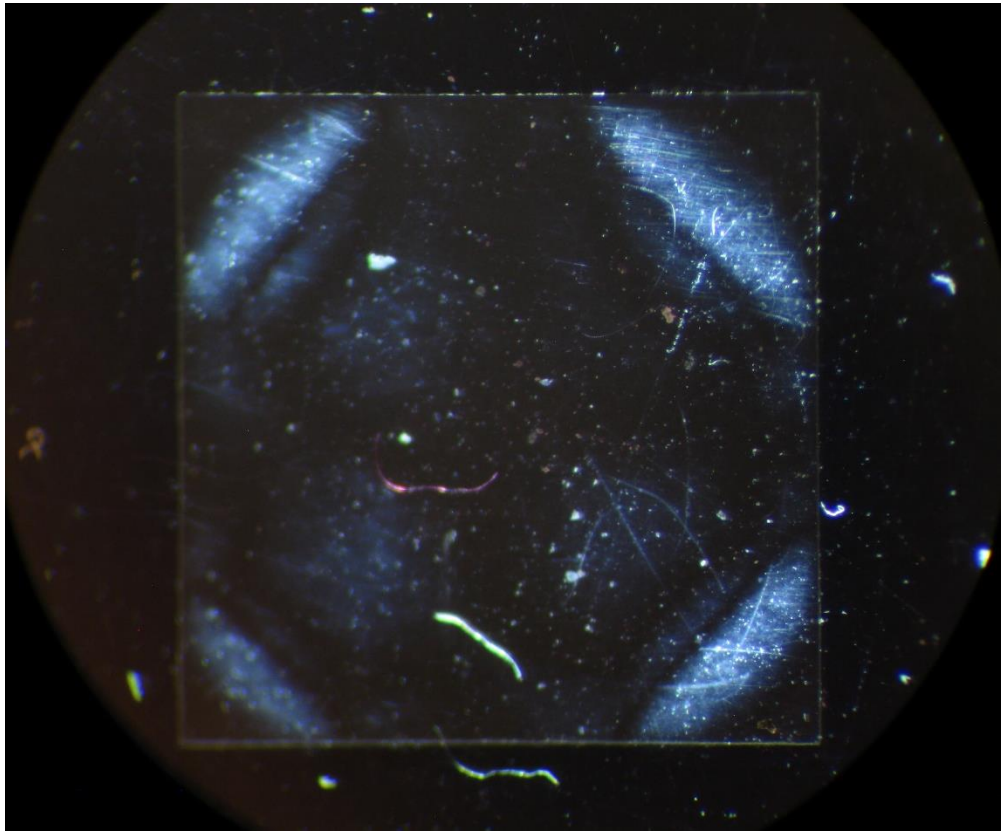


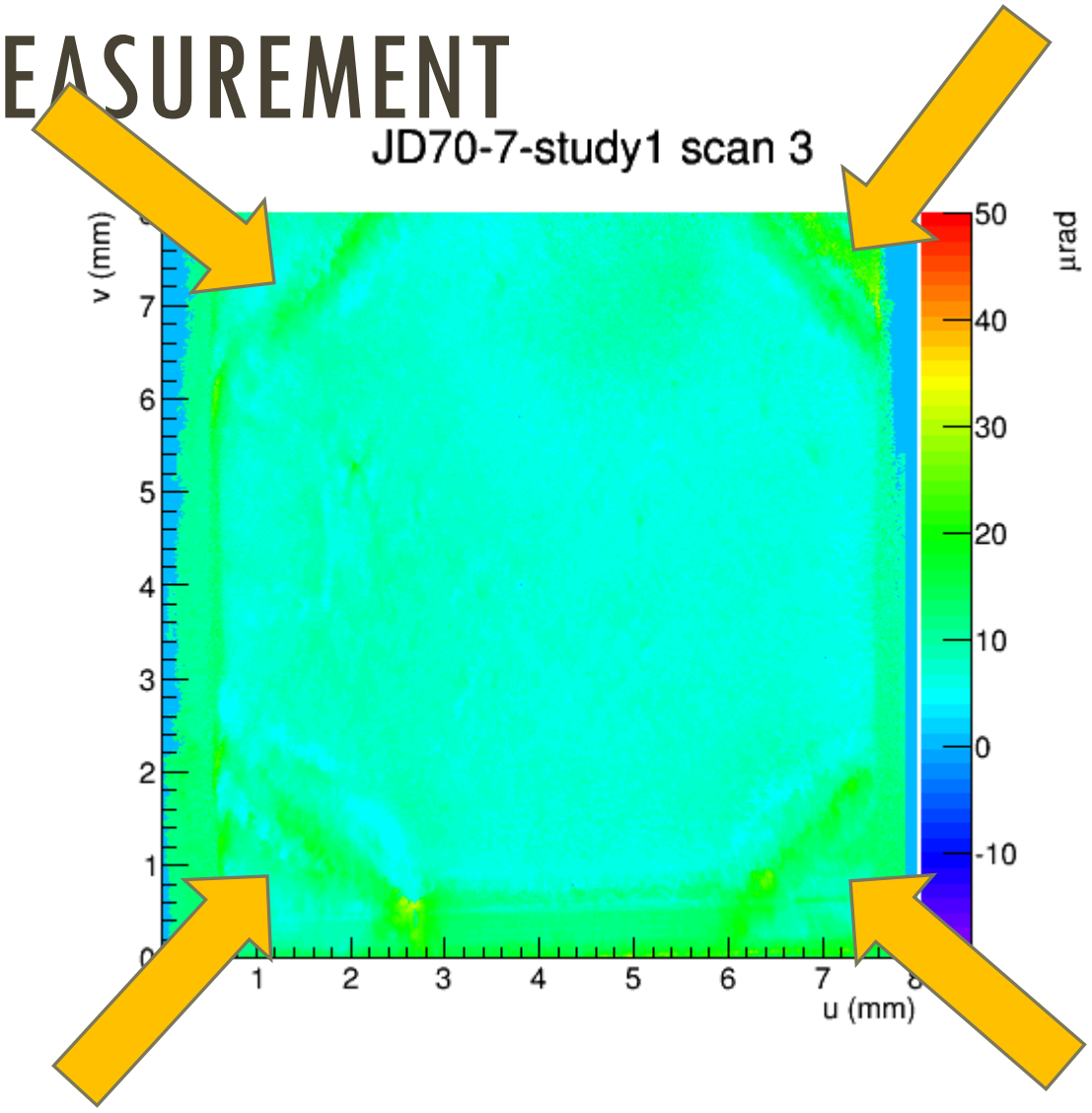
birefringence image taken under microscope



Zygo interferometer surface profile

JD70-7-A VS. CHESS ROCKING CURVE MEASUREMENT





CONCLUSIONS

- Initial measurements shows little to no change in crystal structure from Applied Diamonds process
- The order is out for Applied Diamond to process the other (6) 7mm diamonds left in our inventory.
- Will begin laser ablating the 3 diamonds we have now.
- Also ordering an electronic-grade diamond (7 x 7 x 0.4 mm^3) from Microwave Industries

LASER ABLATION UPGRADES: CUT RATE CONTROL

Ideal case

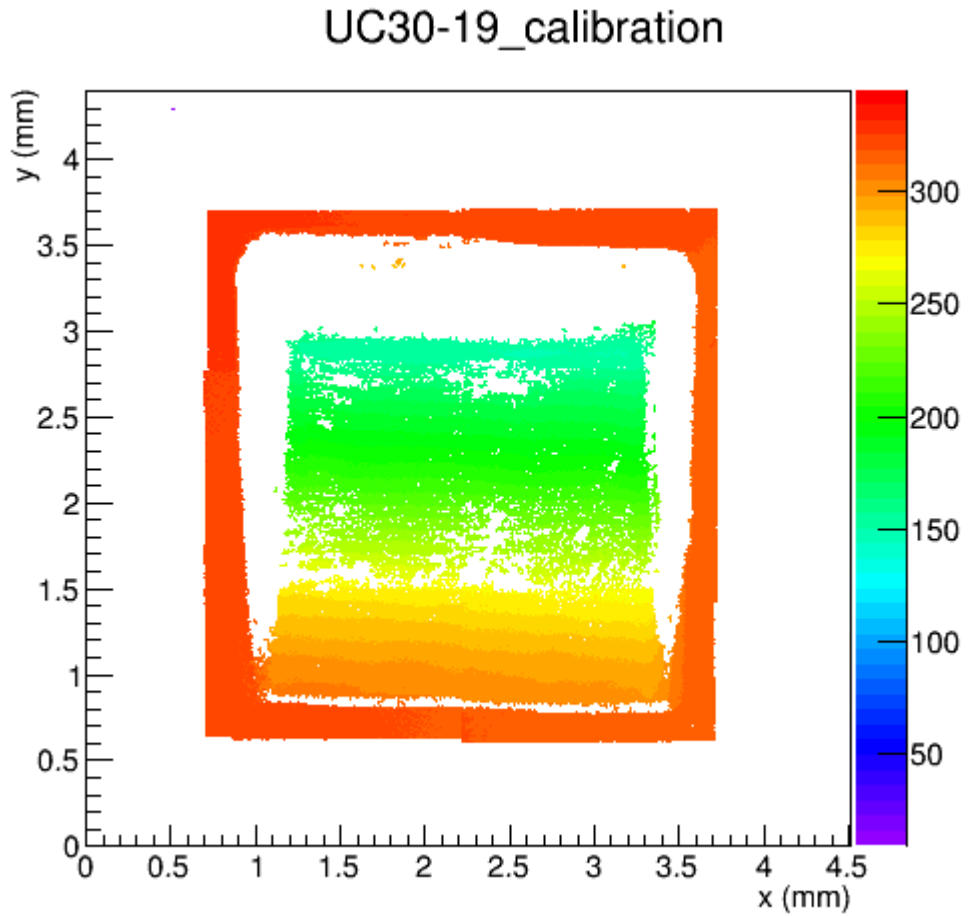
Using X-stage motor velocity, Y step is constant

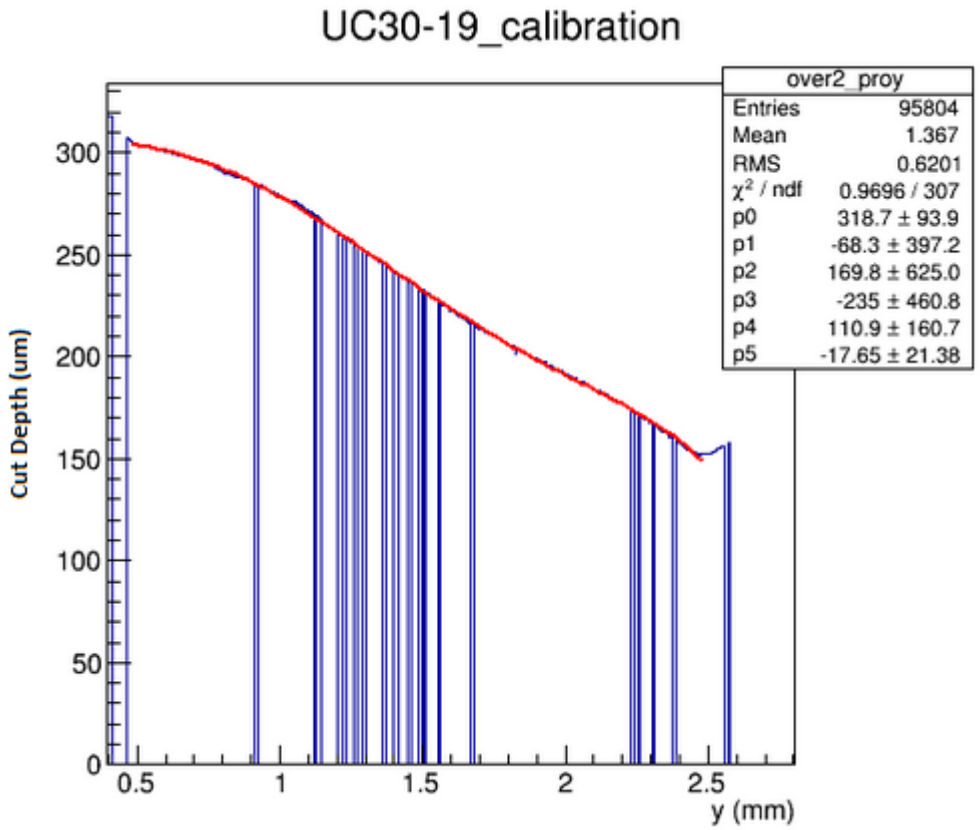
OLD

Using Y-stage step size, X velocity is constant

NEW

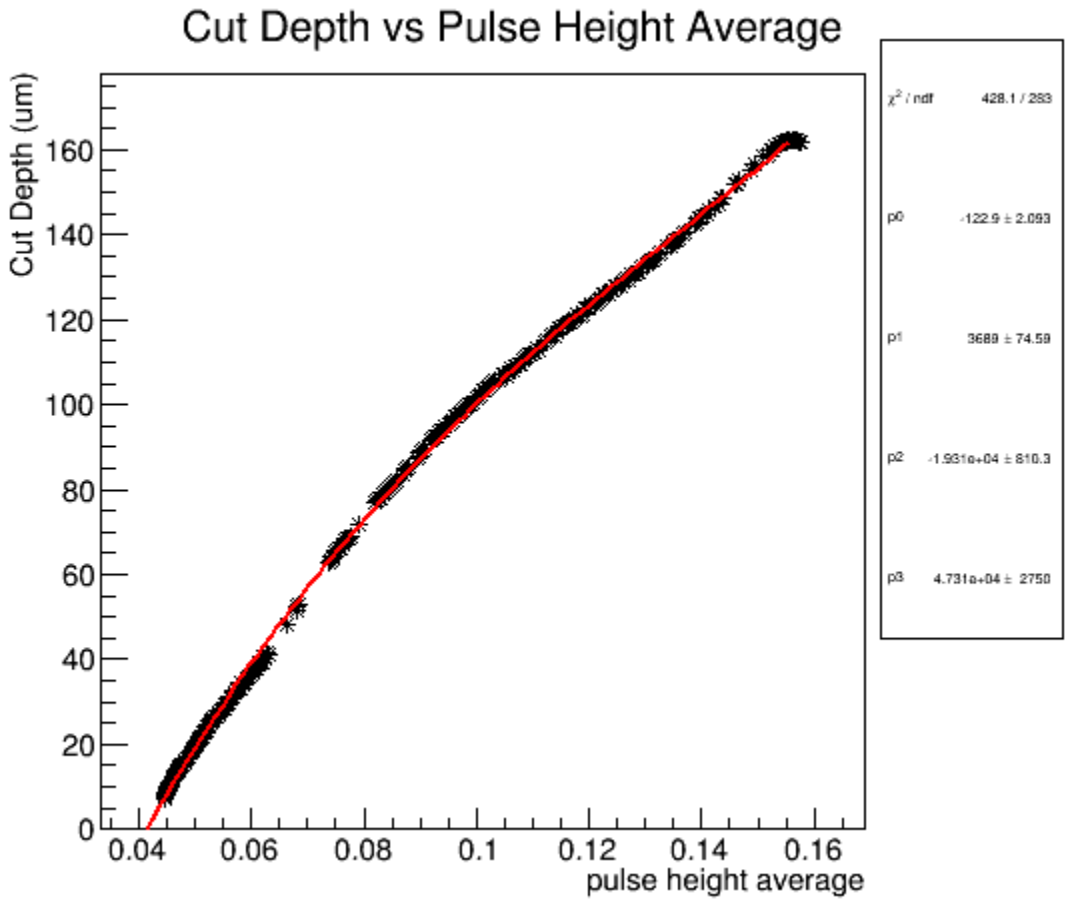
MEASURE CUT DEPTH VS. LASER ENERGY:



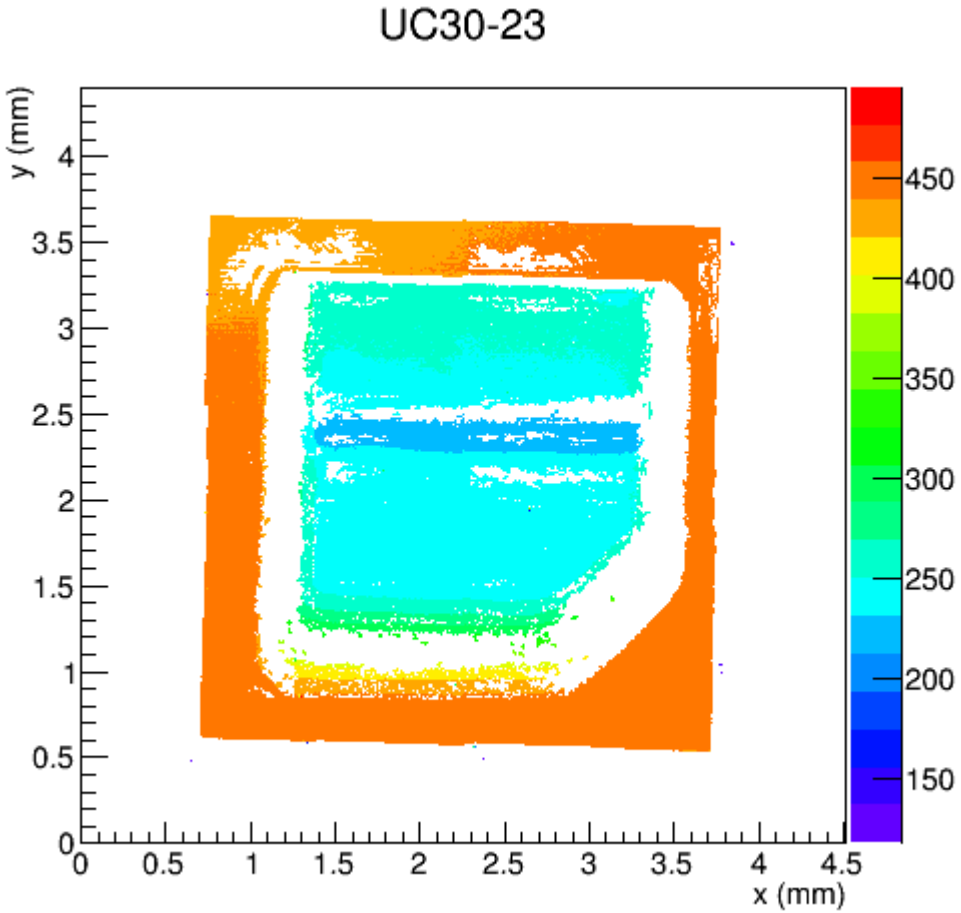


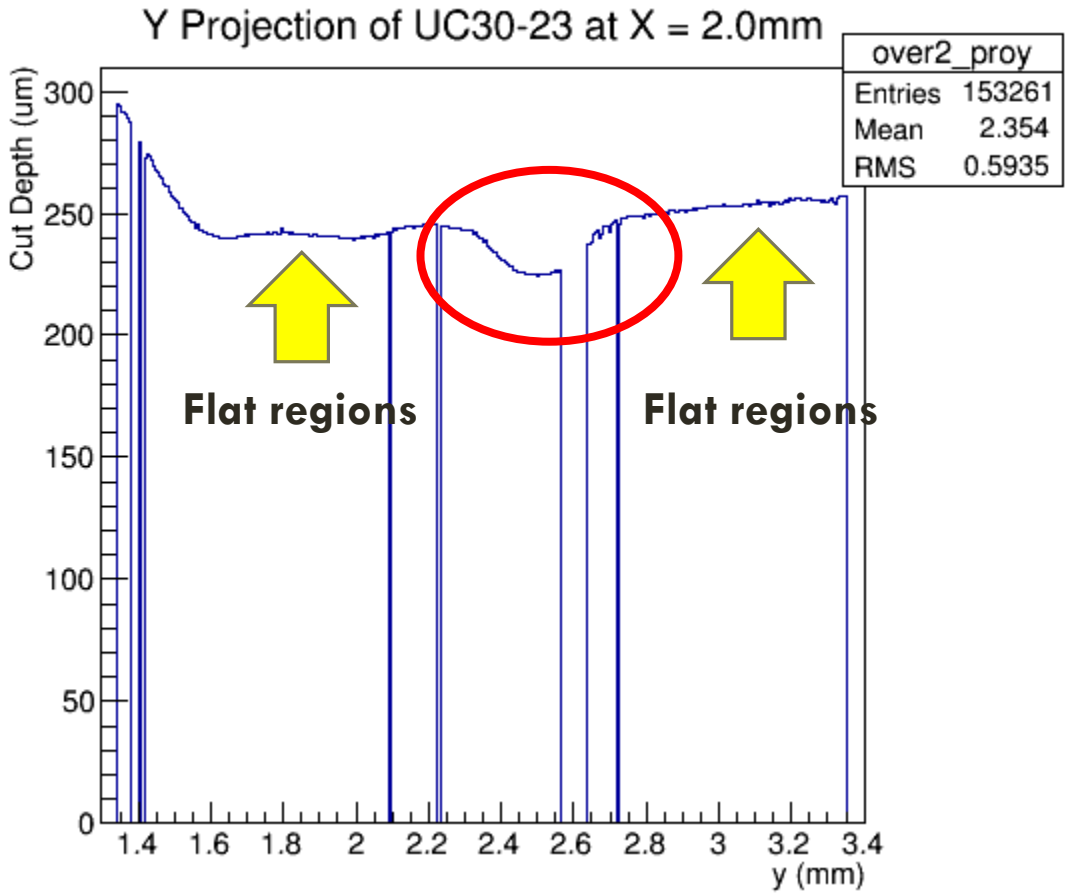
CUT DEPTH VS. LASER ENERGY:

- Cross sectional cut (x = 2.5mm)
- Ablation turns off at non-zero pulse height average.
- Use third order polynomial fit to calculate cut depth on the fly for each row of the diamond.
- Calculate next row's Y step based on the ratio of this value and a reference cut depth set at the beginning of the run.



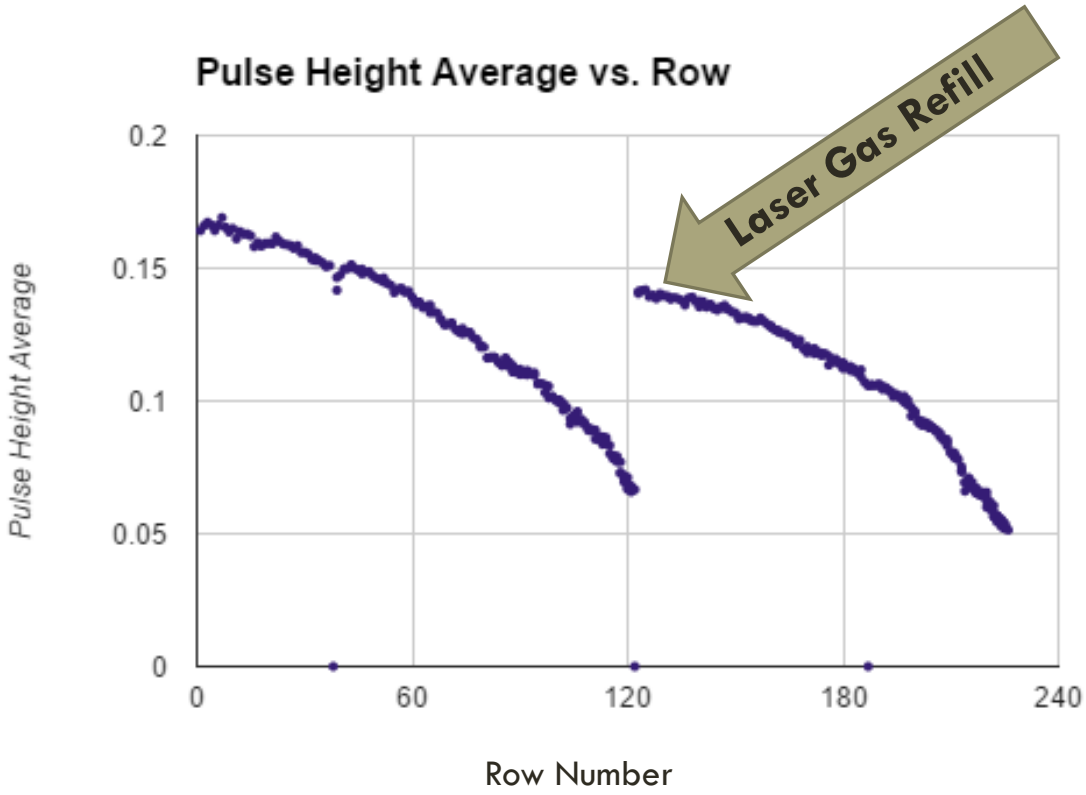
UC30-23: CUT USING Y-STEP METHOD:



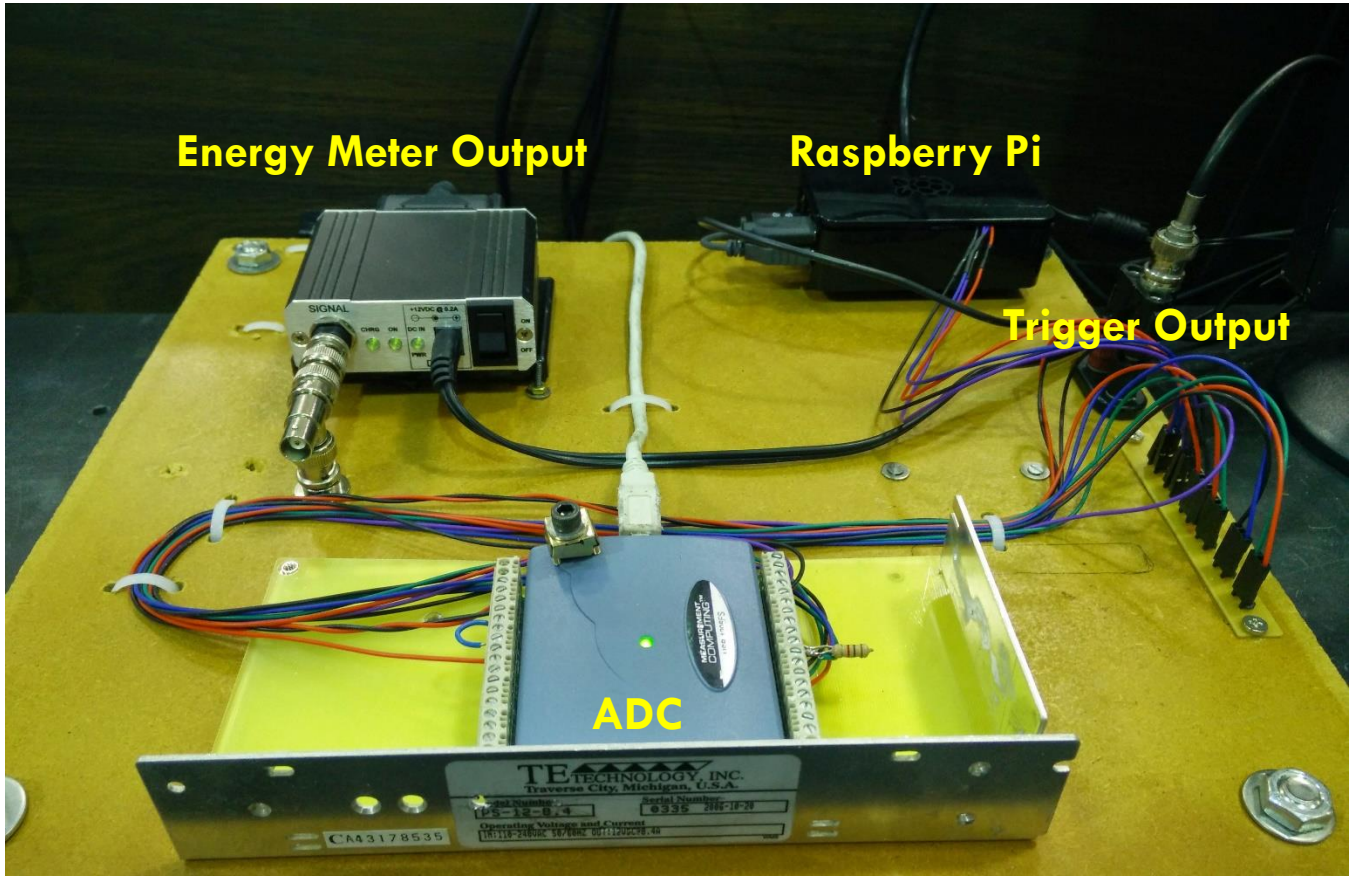


UC30-23: TRENCH CAUSED BY ROW OVERLAP:

- Laser power dies as a function of pulses.
- Laser was refilled on Row 120, exactly where the trench was cut.
- LabView software was altered to prevent an overlap.
- Effect is magnified since X motor speed was reduced to $1/5^{th}$ the normal velocity (higher cut rate per row).
- Produced very flat regions even with extremely low laser energy values.



LASER ABLATION UPGRADES: PULSE CONTROLS



- Arduino based pulse generator limited to 32K memory.
- Needed a microprocessor that can
  - read in a sequence file
  - run C code in real time
  - receive and send digital IO
- Raspberry Pi runs Linux, has multiple GPIOs, but not known for real-time control.
- Disabling the OS interrupts during pulse sequences we attain timing of 1µs precision, perfect!
- Just finished integrating into revised LabView software and will begin running after collaboration meeting.

CORRECTIVE CAPABILITY:

- Measure surface features: Zygo interferometer.
- Process image using smoothing algorithm.
- Create sequence of raster patterns.
- Run raster sequence over the diamond using new pulse controller and Y step method.
- Measure surface and repeat.

TIMELINE:

Receipt of thinned samples from Applied Diamonds: **June 30th 2015**

Completion of ablation milling of one 7x7mm^2 diamond: **July 30th 2015**

Receipt of one 7x7x0.4mm^3 diamond from Microwave Industries: **July 30th 2015**

Delivery to Jlab of **at least 3** mounted radiators: **September 15th 2015**

ACKNOWLEDGEMENTS

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