# GSECARS Laser Drilling System

GSECARS laser drilling system allows you to drill holes in pre-indented gaskets with micron precision and ensures that the hole is well centered, which is very important for extreme pressures experiments. Below are the instructions on how to successfully drill a hole in your gasket. The system is operated by the computer named, STUDEBAKER. When the system is ready to operate, the following windows should be opened:

1) GSECARS Laser Lab main control window:
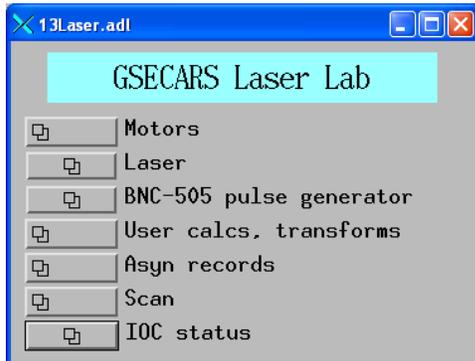
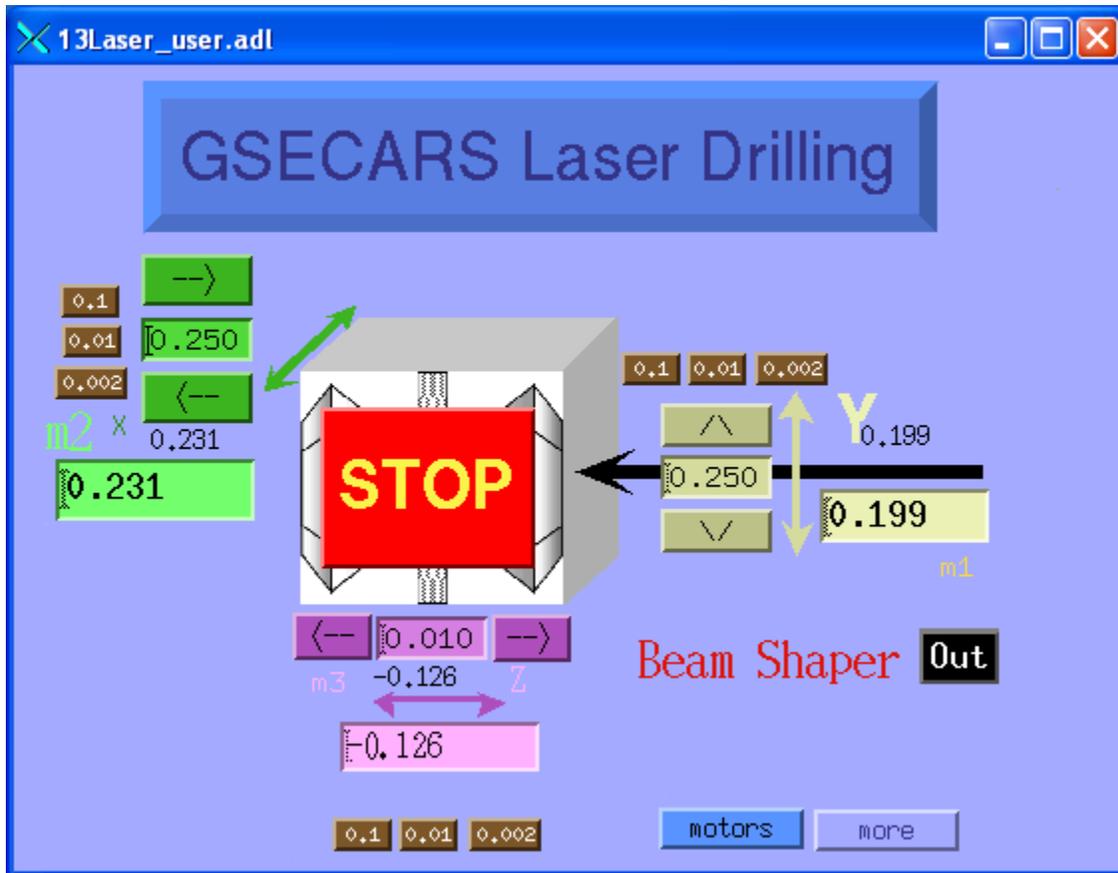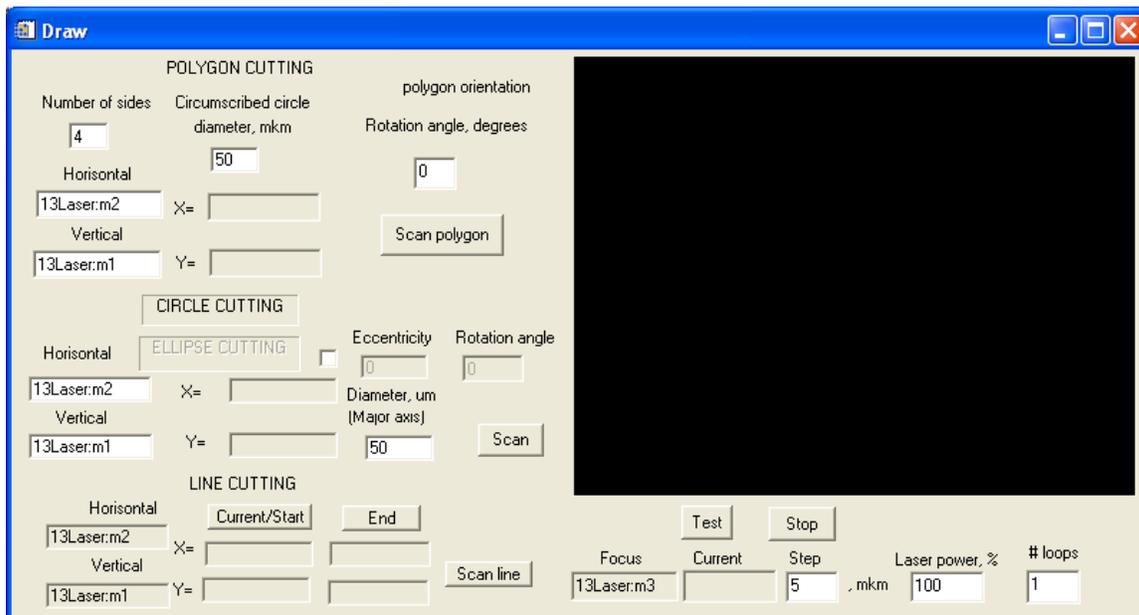2) Laser control window
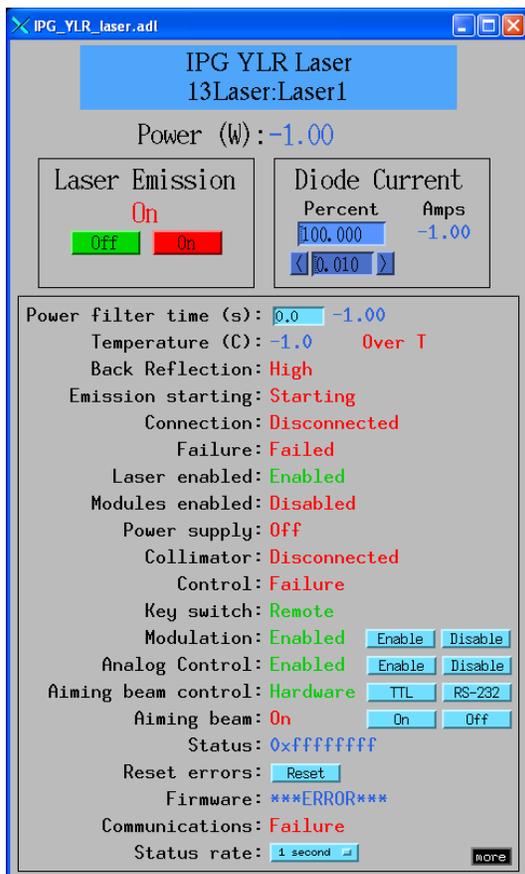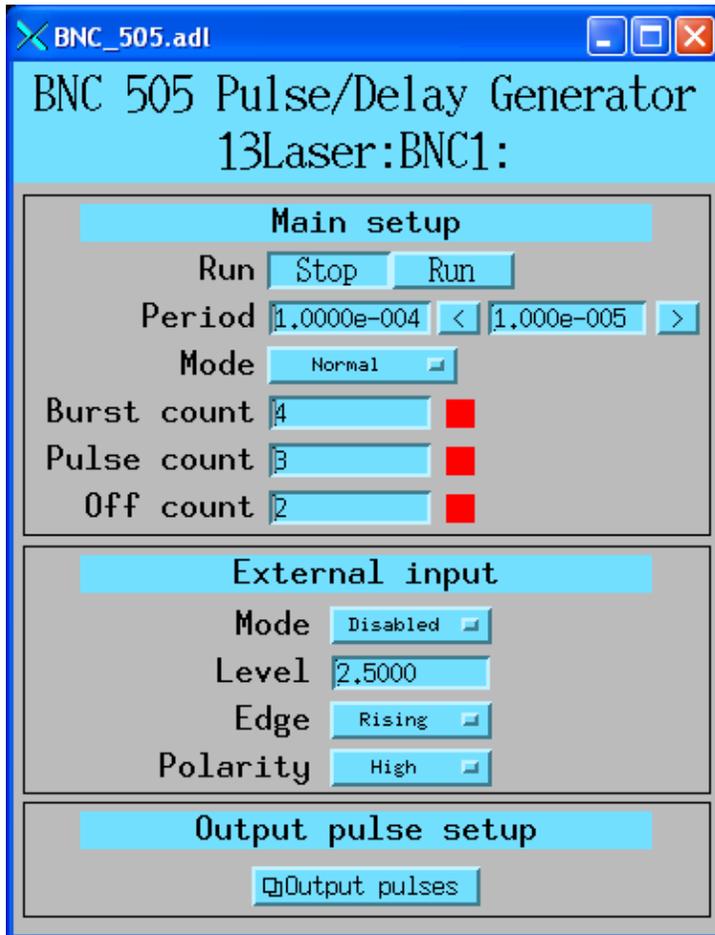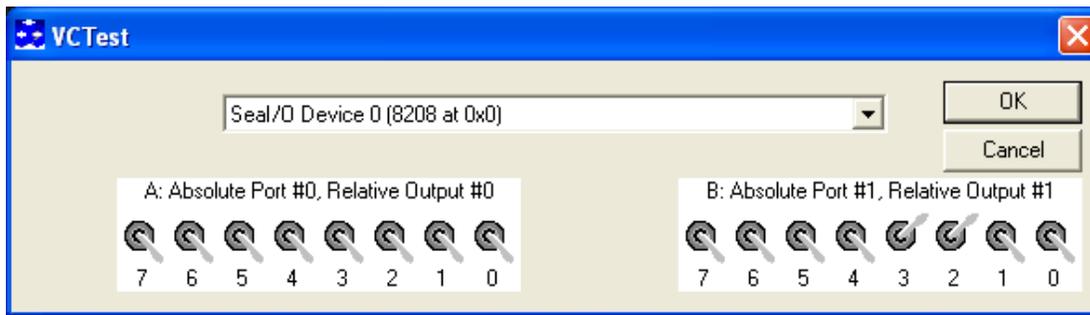
**Login: dac_user**
**Password: Daagbf**

3) Sample stage motion control window:



4) Draw IDL program window



Besides these windows, you may want to check the status of two other windows (shown below):

**VCTest**

Seal/O Device 0 (8208 at 0x0)

OK
Cancel

A: Absolute Port #0, Relative Output #0

7  6  5  4  3  2  1  0

B: Absolute Port #1, Relative Output #1

7  6  5  4  3  2  1  0

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**BNC_505.adl**

# BNC 505 Pulse/Delay Generator
## 13Laser:BNC1:

### Main setup

Run | Stop | Run
Period | 1.0000e-004 | < | 1.000e-005 | >
Mode | Normal
Burst count | 4
Pulse count | 3
Off count | 2

### External input

Mode | Disabled
Level | 2.5000
Edge | Rising
Polarity | High

### Output pulse setup

Output pulses

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Note: For drilling BN gaskets, use laser width about $2\text{-}3*10^{-6}$, drill four times.

5) What if you do not see those windows?
   a) Run Start_motors program (located on the desktop)
   b) Run VCTest program (located on the desktop)
   c) In 13Laser.adl window click on the 'Motors' tab, then 'Sample Stage'
   d) In 13Laser.adl window click on the 'Laser' tab.
   e) In the IPG YLR 13Laser:Laser1 control window 'Modulation' shall be enabled.

IPG_YLR_laser.adl

IPG YLR Laser
13Laser:Laser1

Power (W): -1.00

Laser Emission
Off
Off     On

Diode Current
Percent     Amps
100.000     0.00
< 0.200 >

Power filter time (s): 0.0     0.20
Temperature (C): 18.1     OK
Back Reflection: OK
Emission starting: Not starting
Connection: Connected
Failure: OK
Laser enabled: Disabled
Modules enabled: Enabled
Power supply: On
Collimator: Connected
Control: OK
Key switch: Remote
Modulation: Enabled     Enable   Disable
Analog Control: Disabled     Enable   Disable
Aiming beam control: RS-232     TTL   RS-232
Aiming beam: Off     On   Off
Status: 0x201000
Reset errors: Reset
Firmware: 1.0.103
Communications: OK
Status rate: 1 second     more

f)  In 13Laser.adl window click on the 'BNC-505 pulse generator' tab
g)  Start IDL program (located on the desktop)
h)  Type 'draw' in the command line and hit enter. Draw window will appear.

6) Starting laser drilling

e)  Place the gasket in the gasket holder and make sure the indented part is visible through the opening.
f)  Find the image of the indentation on camera, bring it to focus.
g)  Close all doors
h)  Push 'Laser 3 enabled' button on the laser control panel on the wall near the entrance into the lab.
i)  Center the indentation. Do it by moving it from left to right and up and down and observing the position of the cross on the screen. The image is centered when the cross is halfway between the left and right, and up and down edges of the indentation.
j)  Turn the key in the laser control box on the table. Green light under 'Interlock enabled' shall light up. Wait for a minute.
k)  Push 'remote start' button. The second green light shall light up under 'Remote start'. Wait for the laser power box to warm up.
l)  Hit 'On' button under the 'Emission' on the laser control box.

7) Using 'Draw' program. Program 'Draw' allows a user to drill any right polygon at any orientation, circle, ellipse in any orientation, and line between two pre-set points.

  a) Drilling circle.
  - Use the central section of the program window. Type in the desired diameter in the 'Diameter (Major axis)' window. Do not forget to account for the beam size (~8 micron). Press 'Enter'.
  - Press 'Test' button. The bright laser spot shall appear in the center of a future circular hole. If there is no laser, check whether it is enabled or turned on. Press 'Stop' button.
  - Press 'Scan' button. The drilling starts. Relax and wait until the circle is complete. If unsatisfied with anything, you can interrupt drilling by pressing 'Stop' button

  b) Drilling ellipse.
  - Use the central section of the program window. Check the checkbox. Label will switch from 'CIRCLE_CUTTING' to the 'ELLIPSE_CUTTING'. Type in eccentricity, tilt angle in appropriate sections. Type in the desired major axis in the 'Diameter (Major axis)' window. Do not forget to account for the beam size (~8 micron). Press 'Enter'. See below the resulting picture (example)
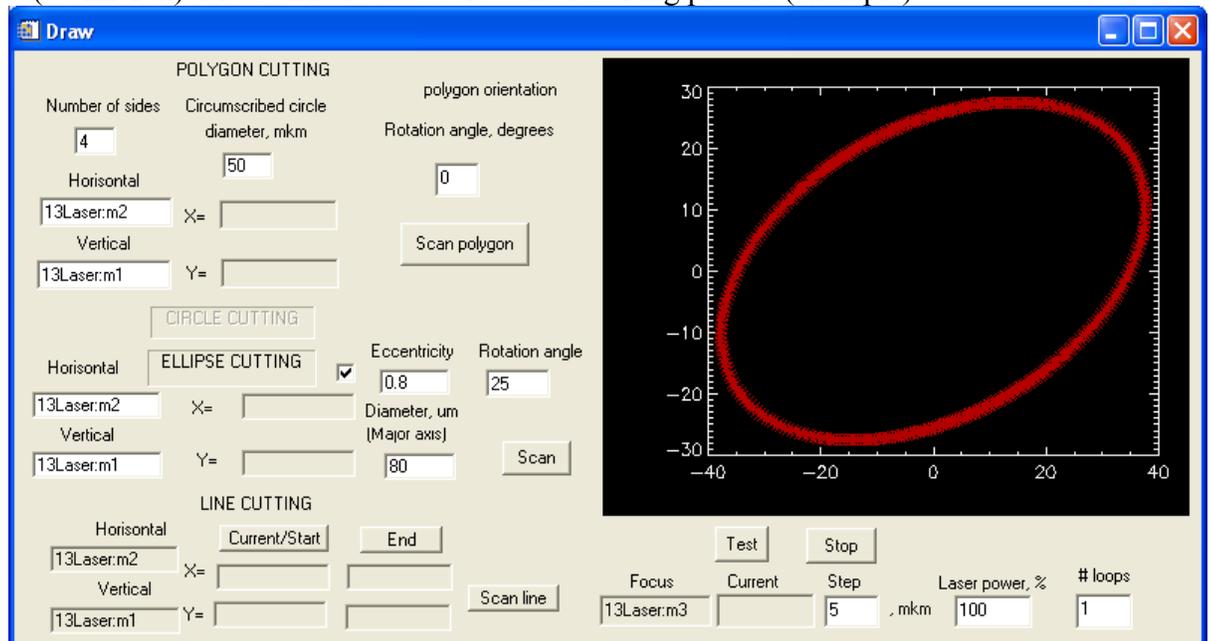


  - Press 'Test' button. The bright laser spot shall appear in the center of a future elliptical hole. If there is no laser, check whether it is enabled or turned on. Press 'Stop' button.
  - Press 'Scan' button. The drilling starts. Relax and wait until the ellipse is complete. If unsatisfied with anything, you can interrupt drilling by pressing 'Stop' button

  c) Drilling the right polygon
  - Use the top section of the program window. Type in the number of sides, rotation angle, and the diameter of the circumscribed circle the polygon shall fit into. Do not forget to account for the beam size (~8 micron). Press 'Enter'. See below the resulting picture (example).
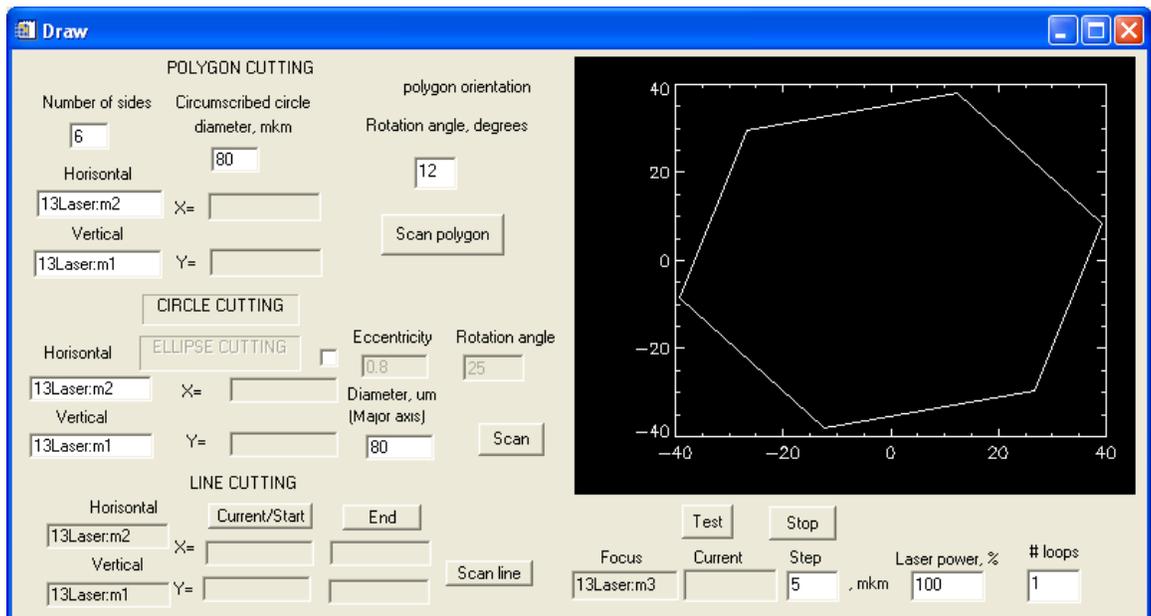
- Press 'Test' button. The bright laser spot shall appear in the center of a future polygon. If there is no laser, check whether it is enabled or turned on. Press 'Stop' button.
- Press 'Scan polygon' button. The drilling starts. Relax and wait until the polygon is complete. If unsatisfied with anything, you can interrupt drilling by pressing 'Stop' button

d) Drilling the line
- Use the lower section of the program window
- Pick up the starting point
- Press 'Current/Start' button. The coordinates of the starting point are read
- Move to the point of destination.
- Press 'End' button. The coordinates of the end-point are read.
- Type in the number of times the line shall be cut in the '# of loops' window.
- Press 'Scan line' button. Relax and wait until the line drilling is complete. If unsatisfied with something, you can always interrupt drilling by pressing the 'Stop' button.

e) Once the drilling is completed, turn off the laser by pushing 'Off' button on the laser control box, then turn the key to disable the interlock, open the door and take out your gasket. **No jerky movements, please, when taking the gasket holder out, be careful!** Congratulations, you have just drilled a shape of your choice in your gasket!

<p style="text-align:center">

**Attention:**
**if something is not working as described above,**
**stop and contact your beamline scientist.**
**DO NOT ATTEMPT TO FIX ANYTHING YOURSELF !!**
**NEVER TRY TO TOUCH ANY OPTICS INSIDE THE**
**ENCLOSURE !!!**

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NB: The instructions above are mainly for the rhenium gasket drilling. If you have soft material or something with the low melting point, you can adjust the laser power accordingly in the Draw&Scan window. Please, make sure you set it back to 100% when done!

**Please acknowledge use of GSECARS facilities in any publications resulting from work conducted using the GSE facilities.**
Please send Nancy Lazarz (lazarz@cars.uchicago.edu)
or Vitali Prakapenka (prakapenka@cars.uchicago.edu) your publication citation for inclusion into the
APS Publication Database.

The appropriate form of acknowledgement can be found at the following web-address: http://gsecars.org/acknowledge.htm

**Good Luck!!**