Handbook of Time-Resolved Scanning Kerr Microscopy in G31a

F.B. Mushenok, C.S. Davies, V.V. Kruglyak

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1 Introduction

The purpose of this manual is to collect and organize the best practices of measurement with Time-Resolved Scanning Kerr Microscopy setup in G31. Some parts of the manual were copied from manual of Carl Davies. Please, fill free to amend and improve the manual (if you are confident in what are you doing).

F. Mushenok (mushenokf@gmail.com)

2 Laser safety

Before any experimental work in the lab, you should be familiar with laser safety rules. Please adhere to the best practise rules:

3 Cold start

4 Preliminary work

The laser system is maintained at a constant temperature, of 18 degrees celsius, by a coolant. This should always be kept on. First of all, inspect floor, area around the

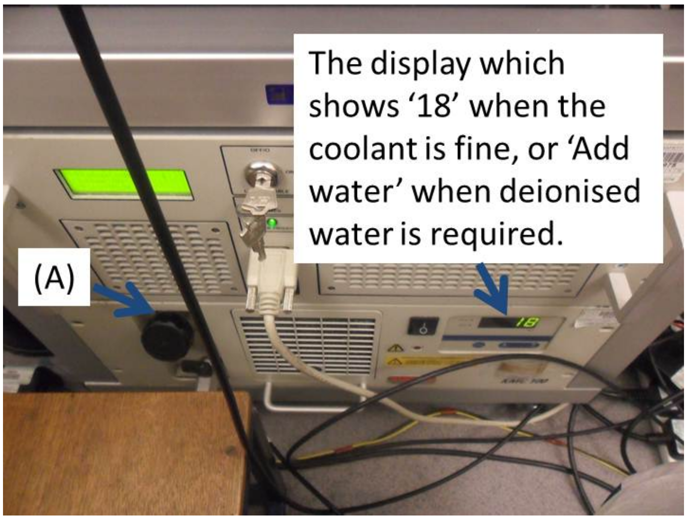

Figure 1: The front panel of the laser coolant

laser and bench surface for water leaks. If there are any water droplets or spillages, find the reason and amend it. Keep in mind potential danger of water spillage.

If the chiller is off, then press the buttion and switch it on, wait a couple of minutes and make sure make sure the chiller's display indicates 18 degree. If the display inducates "ADD", then fill a canister with distilled water, open the large black cap (labelled (A) in Figure 1.1), and refill the coolant until the display reverts back to '18'.

IMPORTANT!!! Every six months the water filter (on the rear side of the chiller) should be replaced on the new one.

4.1 Mounting the sample

The structure we wish to study lies on a substrate. Typical examples include a permalloy structure mounted on a silicon substrate, or a GaAs structure mounted on a glass substrate. The structure must first be attached to the printed circuit board (*PCB*), and to do this, we simply apply sticky-tape. Wearing latex gloves, and preferably with the help of a magnifying glass/angled lamp, the structure should be laid on top of the signal line of the PCB (the PCB consists of ground(yellow)-signal-ground(yellow) lines. The substrate should also be lying fully on the PCB. Care should be taken to ensure this is done correctly - in my personal experience, it has sometimes taken up to an hour to do this.

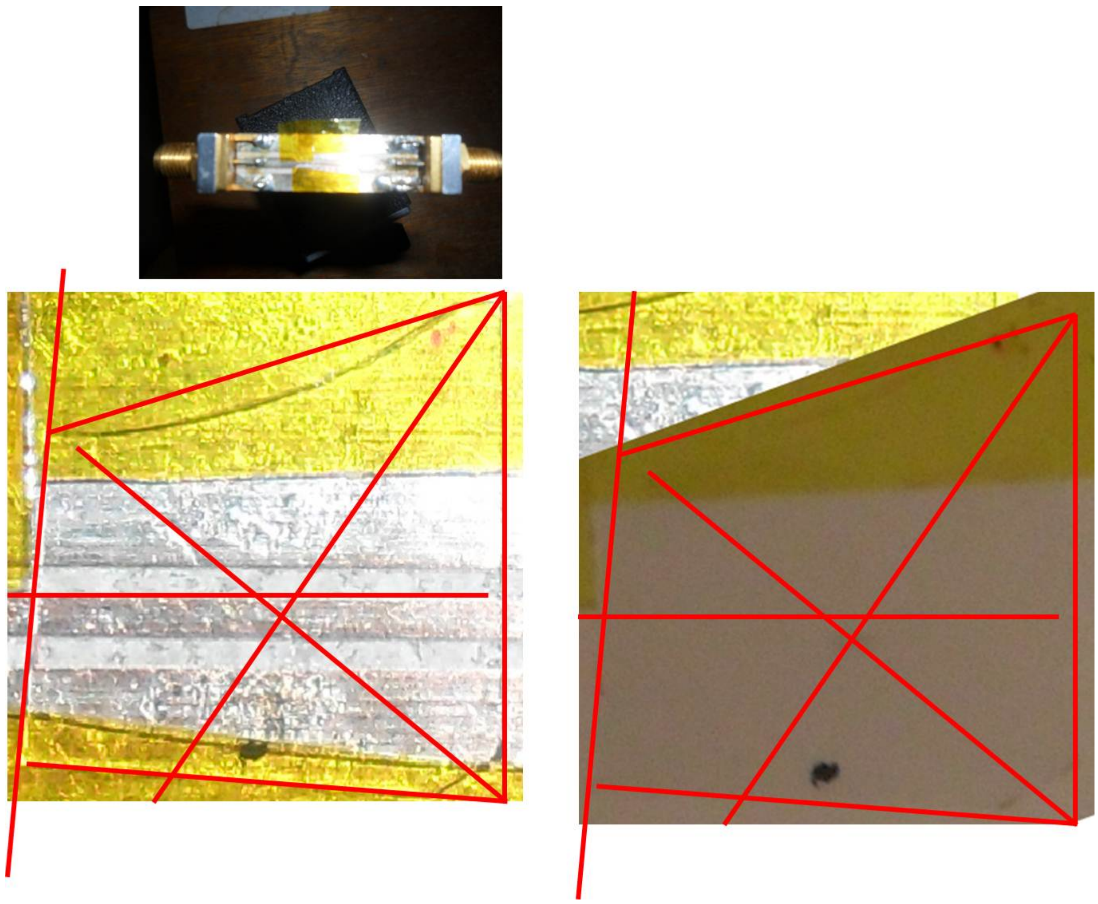

Figure 2: Using Microsfot Powerpoint, we can verify the sample lies on the signal line. We can see the sample in the left photo, but the scratches on the PCB make the sample invisible to the naked eye in the photo on the right. By making a series of reference points (here, we have used lines surrounding the glass), we can copy and paste this overlaying 'net', therefore showing the position of the sample relative to the PCB

A good way to double-check this step has been done correctly is to take a photo of the sample (where you can see it), and then a second photo of the sample lying on the PCB (scratches on the PCB invariably make the structure on the substrate impossible to discern). Using an application as simple as Microsoft Powerpoint gives us a way to verify that the structure is lying on the signal line (see Figure 2)

With the sample now mounted on the PCB, the PCB can now be dropped on to the piezo-electric stage. After ensuring the magnetic ring is switched off, magnet (1) can be pulled out, breaking the circle. The piezo-electric stage can then be gently pulled towards the space left by magnet (1), and the sample merely dropped in to the slot at the centre of the stage. The two green cables, held in place either side of the stage by two clamps, can then be screwed on to the PCB. These two cables provide the electrical field with which we pump the structure.

5 Setup alignment

6 Laser optimization

7 Optical alignment

Optical alignment is the most important part of the experimental work and main condition of robust and repeatable measurements.

General advice:

- Follow the safety rules ALWAYS!!! You have two eyes only.
- Use holders, screws and fasten optical components to the table. Firstly, it will prevent occasional movement of the component and disruption of alignment. Secodnly, all components are extremely expensive and one accidental falling of a mirror can cost hundreds of pounds.
- Block and properly dump back reflections of filters and mirrors.
- Check operating wavelength of mirrors. Make sure it fits your setup.
- something else???

7.1 Delay line

Delay line allows one to change length of optical path and introduce time delay between excitation of the investigated sample and moment of measurement.

Ideally the laser beam goes parallel to the rail of DL, incidents to the corner reflectors and reflects to the rotating mirror. Incident and reflected beams should be exactly parallel to each other. Otherwise, reflected beam walks up-down or left-right with DL movement and alignment of subsequent optical elements is impossible.

How to:

1. Set DL to -300 mm position.

2. Install a screen before the corner reflector.

3. Using the directing mirror send the beam to the screen. The incident point should be over against left half of the reflector.

4. Remove the screen, install it somewhere near the directing mirror and catch spot of the reflected beam.

5. Using screws of the directing mirror, adjust position of the spot thus to make incident and reflected beams are roughly parallel.

6. Put a screen before the reflector and check where the beam goes to. If the incident beam is very close to the reflector's edge, move the directing mirror perpendicular to DL axis and fix it.

7. Repeat steps 4-5.

8. Install, connect and focus the CCD camera thus to see image of reflected spot on the TV screen.

9. Notice the spot position.

10. Open control panel of the DL

11. Make a small step of DL in positive direction (for instance, 10 mm).

12. Most likely, position of the spot will be changed. Rotate the direction mirror screws and set the spot in initial position.

13. Repeat steps 11 and 12 till position of the spot depends on DL shift. If you achieve opposite end of the DL (+300 mm), move it to the origin (-300 mm) and continue

alignment. If the incident beam is very close to the reflector's edge, move the directing mirror perpendicular to DL axis and fix it.

14. Install the rotating mirror to send the beam to the microscope.

15. Put the screen after the rotating mirror and repeat steps 8 - 13.

7.2 Microscope

8 Sample installation

9 Pulse measurement

10 CW measurement

10.1 Configuring the laser