LASER under magnetic field

From October 2008

- 16 Oct, first field effect:
  - Room laser2 : air unit control out of order. Spare unit available in this room
  - Screen of scope disturbed
  - laser power meter unusable
  - Infrared viewer gun unusable

  } NOT possible to repair laser under field

- 12 Nov., shielding test:
  - MU metal all around power meter : No effect
  - Moving MU metal close to device measurement: No effect
  - Try with 5mm steel plate No effect

But shielding with MU metal seems useless : steel are used inside UXC and shielding OK.

- LASER :

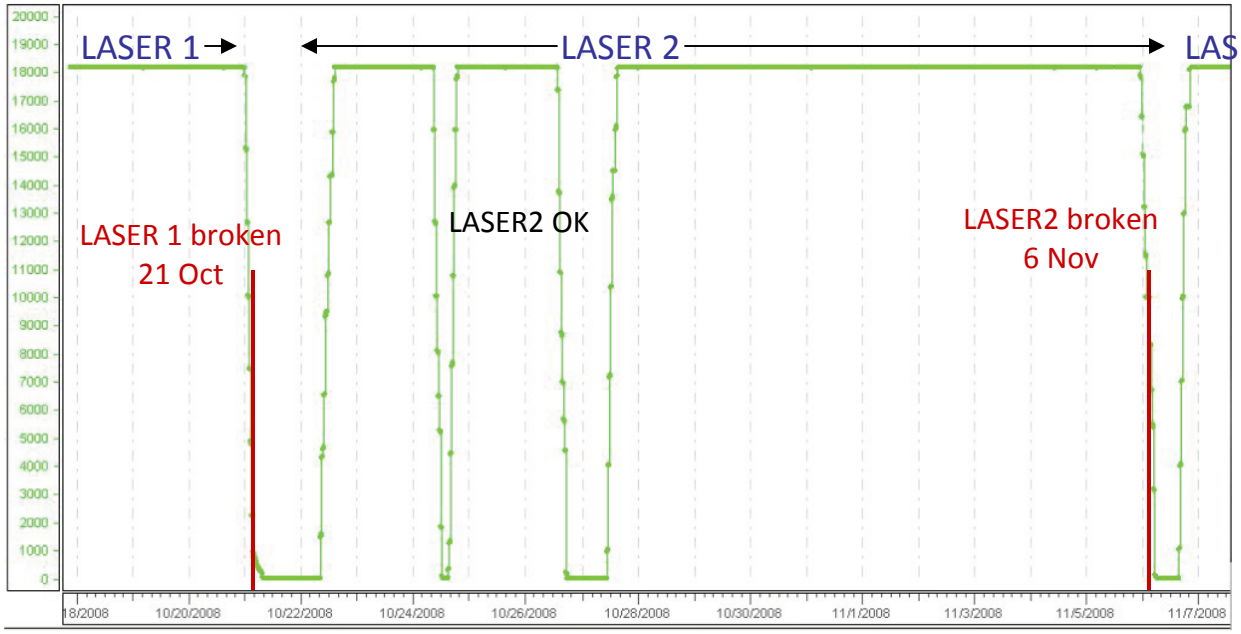
laser is working fine under stable field; No effect on power
Effect on long time ?

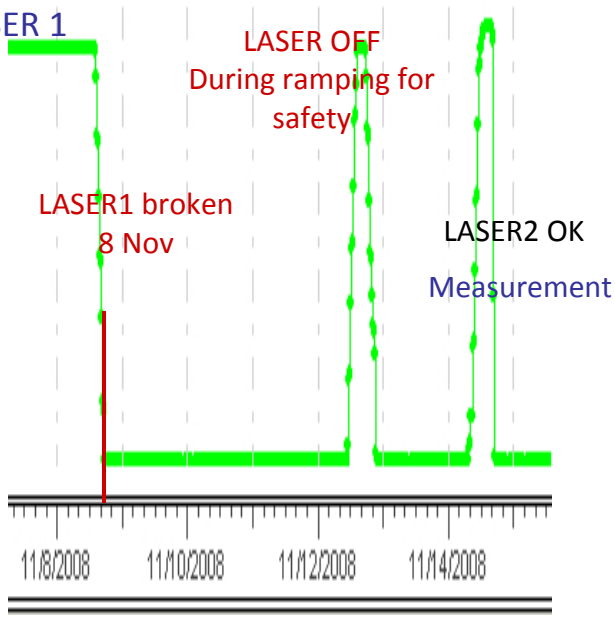
3 times the lamp has been brake on laser 1 and 2;
Reparation → need magnet OFF else can't ensure laser specifications.

Laser and magnet ramping history

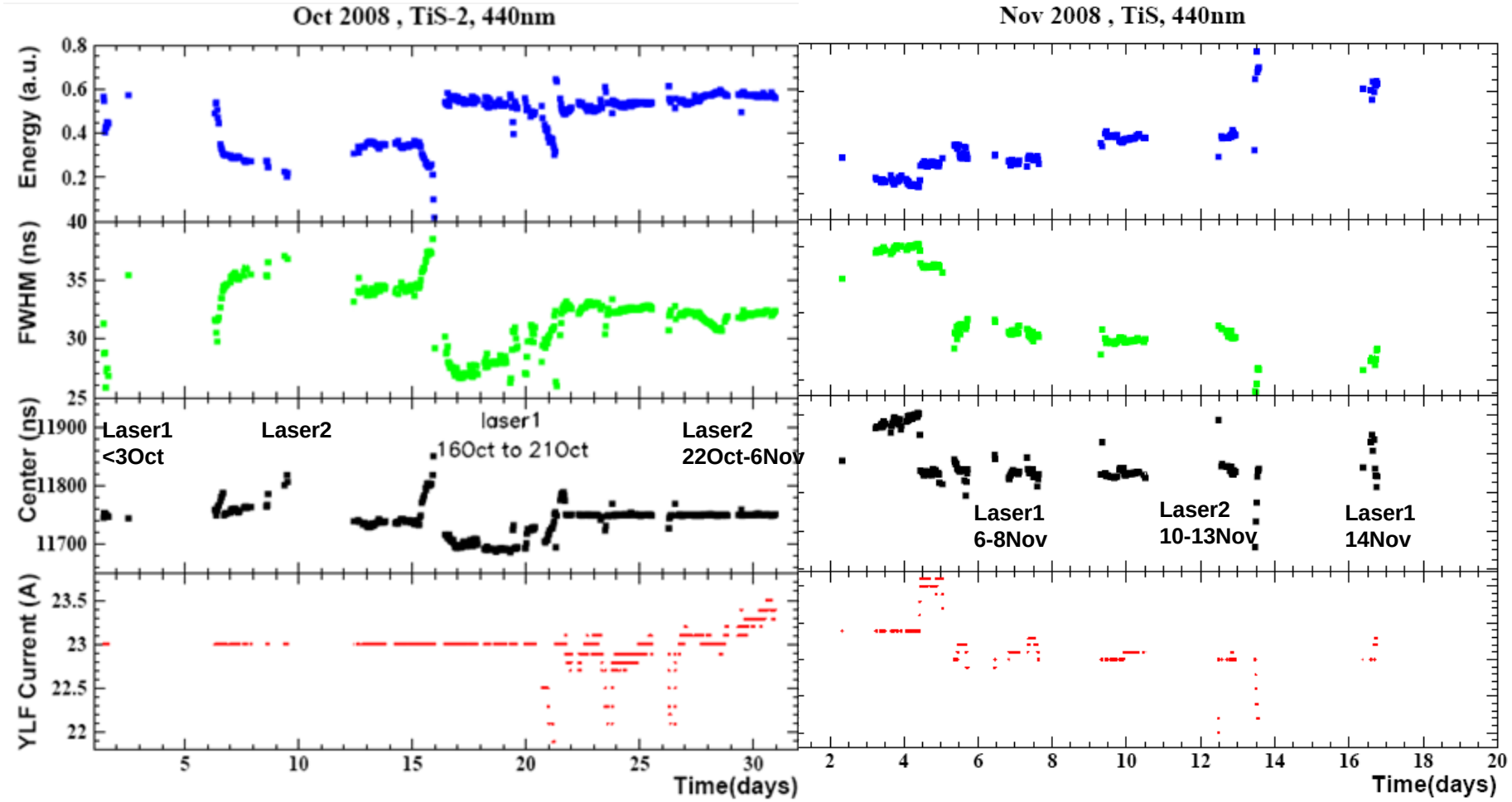
- 21 Oct : Lamp LASER 1 broken. Discovered on the 22Oct.
- 6 Nov: Lamp LASER 2 broken (380 hrs). Plateau 10kA at 1:50 hrs then fast dump. Laser went off at 1:52 *(run 69536)*
- 8 Nov: Lamp LASER 1 broken (<48hrs). Magnet shut down at 14:00, slow then fast dump. Laser went off since ~ 16:20.
- 10Nov: LASER 2 online.
- 14Nov: LASER 2 Lamp ON during ramping up and fast discharge → LAMP OK.

6 ramping down → 3 failures





Plot Lasers 1 and 2 - Oct and Nov -



Measurement done on the 14Nov

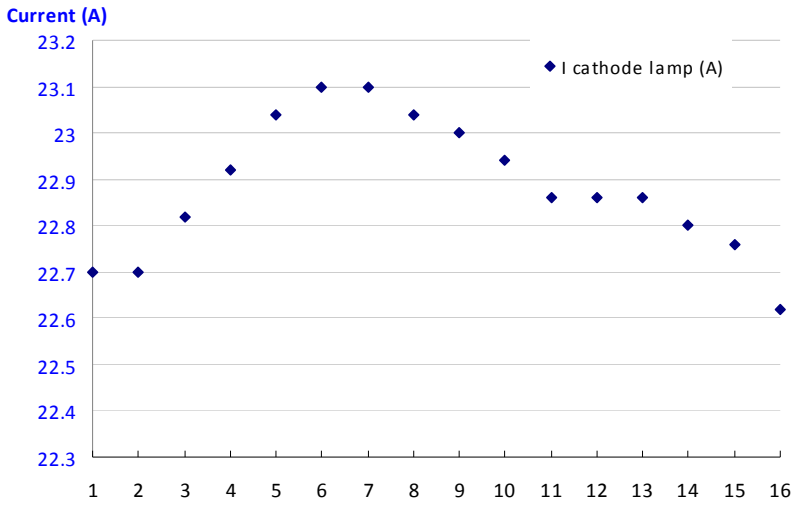
(S.Lusin and P.P.Trapani)

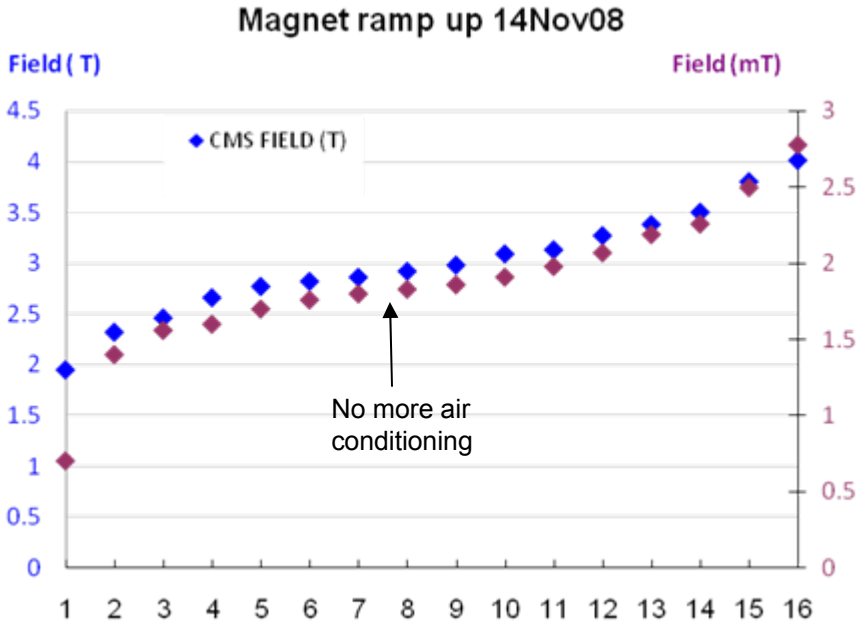
LASER 2 ON during ramping up and down the 14 Nov
→ NO FAILURE

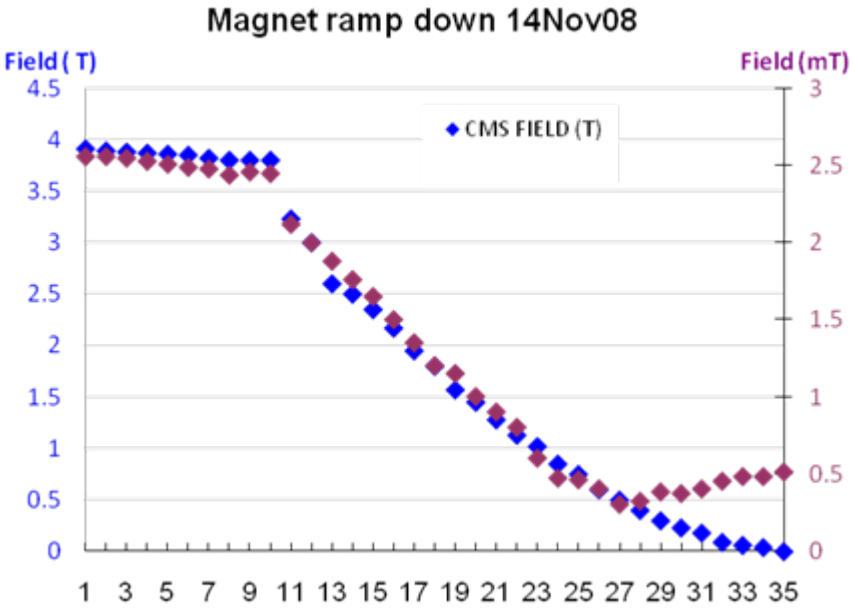
On the main 3 phases transformer:
1A variation during ramping

On the lamp cathode:
no significant variation (22.6 to 23.1 A) for working point at 23A.

At 3.8T : LASER1 = 3.40 mT
LASER2 = 2.74 mT
LASER3 = 1.86 mT







Krypton arc lamp *(EG&G optoelectronic)*

- At start up: 20-25 kV is momentarily applied. This ionizes the gas within the lamp which now becomes a conducting plasma.
- Boost supply: bridge between high and low impedance for constant current generator.
- Constant current supply able to control the lamp

Also note that the cathode isn't just made out of metallic tungsten - it is specially processed and coated to promote the formation of an sufficiently dense electron cloud so that AMPS of current can be passed through the tube with minimal additional heating at the cathode itself. The AC of the filament supply keeps arc moving in the vicinity of the cathode Even so, ***if conditions aren't perfect***, you can end up with localized heating leading to cathode sag and ***eventual failure***. ***Plasma oscillations can result in erosion of the cathode***. One that loses its filament supply during operation will go out - and there may be damage to the cathode in the process.

Even where the average tube current is way below its maximum specs, ***the unstable and constantly moving arc, particularly at the cathode, can result in continuing damage to the tube.***

Ar/Kr ion tubes use a gas discharge in a narrow capillary bore to excite the laser medium to upper energy states, they both need a starting pulse to overcome the initially non-conducting gas, and a current controlled power supply to regulate the discharge.
Tube current can theoretically be controlled by varying the voltage of the supply. However, this control would be ***extremely sensitive to EVERYTHING since a small change in input voltage would result in a large change in current***. For example, assuming the effective discharge resistance is 1 ohm for a tube dropping 100 V at 10 A, a ***5 percent variation in input voltage would result in more than a 50 percent change in tube current***!

Summary

→50% of chance to have laser failure in case of fast dump. Need more statistic ?
→ Can't ensure good LASER performance after services with B field *(no calibration)*

Go to full barrack shielding solution ?
Wait next year CMS magnet ?

If not → - need solution for laser devices: new attempt of shielding ?
- need solution for lamp: interlock by software with magnet ? Shielding?

Other tasks to be done:

- move to ecal-laser-room-04. Rebooting remotely ? Better to move PC to S2 rack ?
-Installed CANBus and ELMB for 1 rack then connection to DCS for room & cooling temperature alarm + VME crate
- final cooling system (switch on closed loop circuit)