Diagnostic for 10Hz diode pumped laser system

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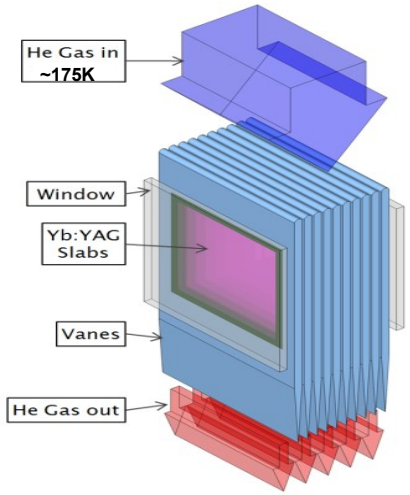
Overview

- Brief overview of the laser system
- The proposed diagnostics
- EPICS

Laser System

The laser produces light at 1030nm. YAG ceramic is doped with Yb pumped using solid state diodes at 940nm. The system will be run at 10Hz and can be thought of in three stages-

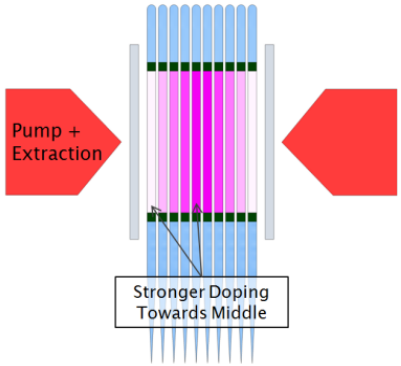


Schematic of 1 kJ head design

Front end

10J amplifier

100J amplifier



Diagnostics

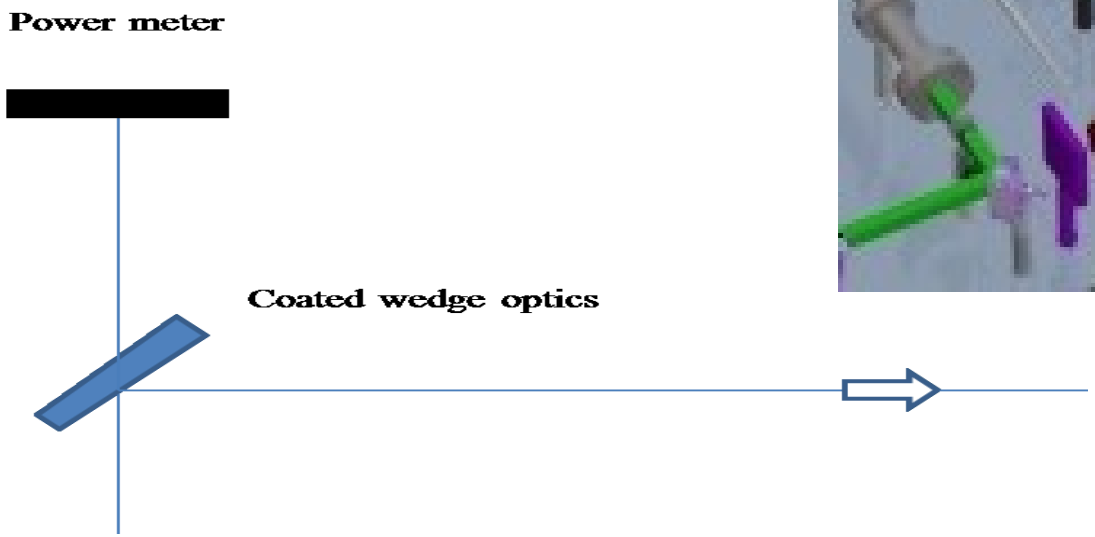
The diagnostics system intended for 100J Project

- **Commercial –**
  - **Spectrometers**
  - **RGA**
  - **Wave-front sensor**
  - **Energy**
  - **Temporal**
- **Near and Far Field**
  - **Beam alignment**
- **Dark-field**

The commercial diagnostics

- **Spectrometers**
  - 2 with the output displayed in control room
- **Residual Gas Analysis**
  - Placed on the amplifier head
- **Wave-front Sensor**
  - Monitor the wave-front

Energy Diagnostics



Temporal Diagnostic

Simple set-up using

- Photodiode with a response time ~80ps
- Oscilloscope with a 5 GHz response time

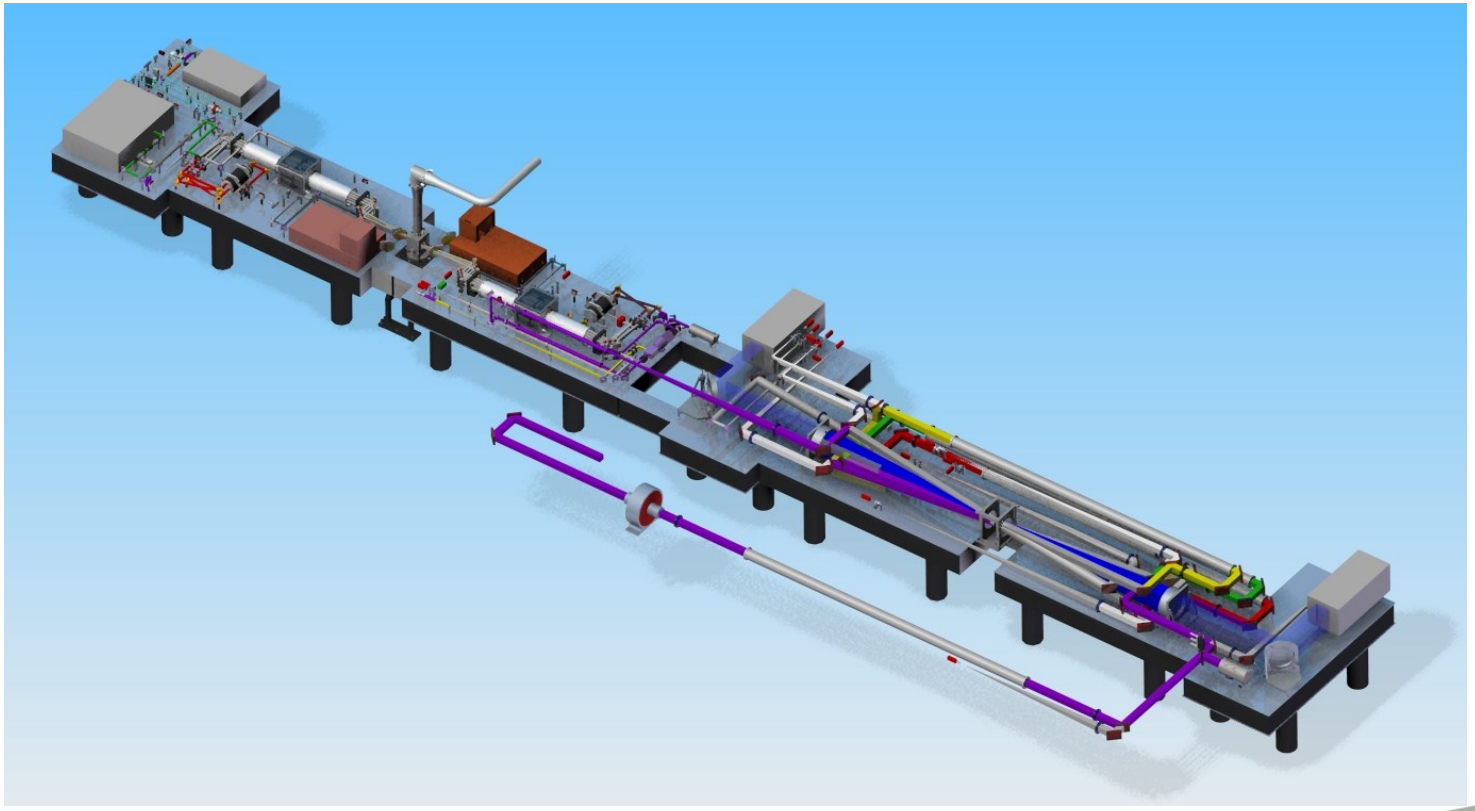
- Several positions identified for temporal diagnostics:-

  - Output of each laser section

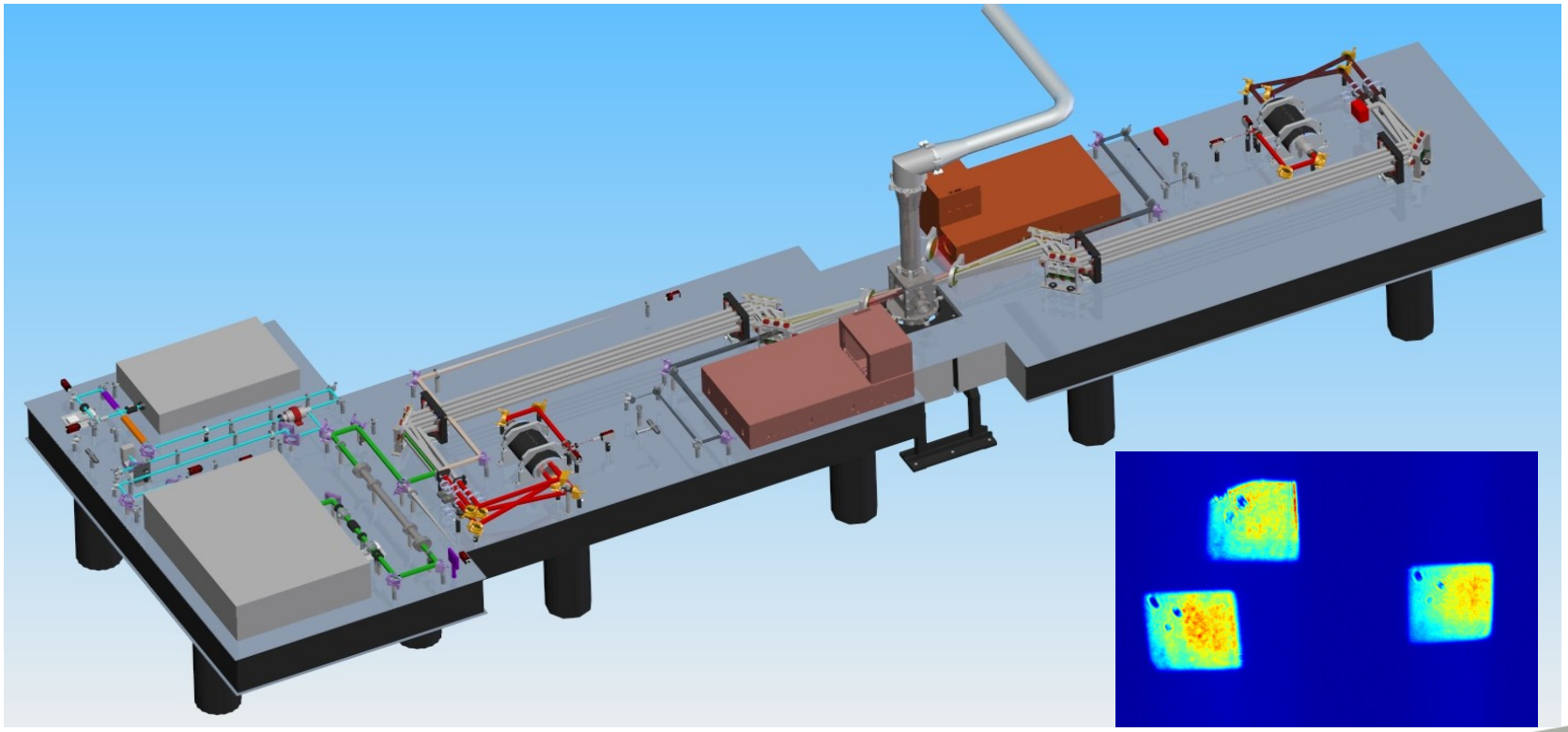
Camera Positions

- The simplest application of the cameras will be to monitor the pinholes in the VSF's. These can be monitored in the control room.
- Capture of the near and far-field images with additional functionality arising from the software
- Cameras used to capture dark-field images - integration with control software to provide a safe laser shut down.

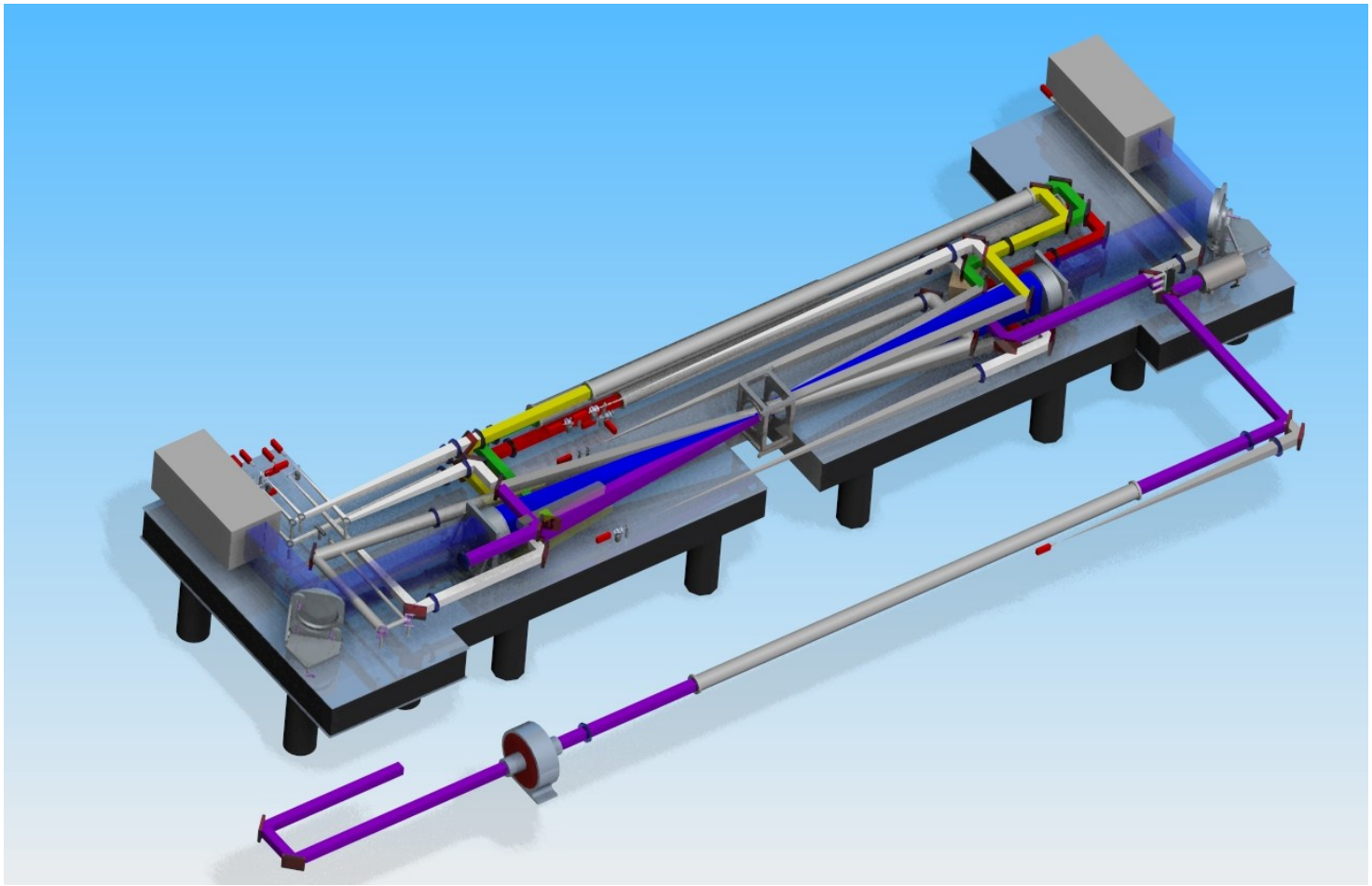
Laser Layout



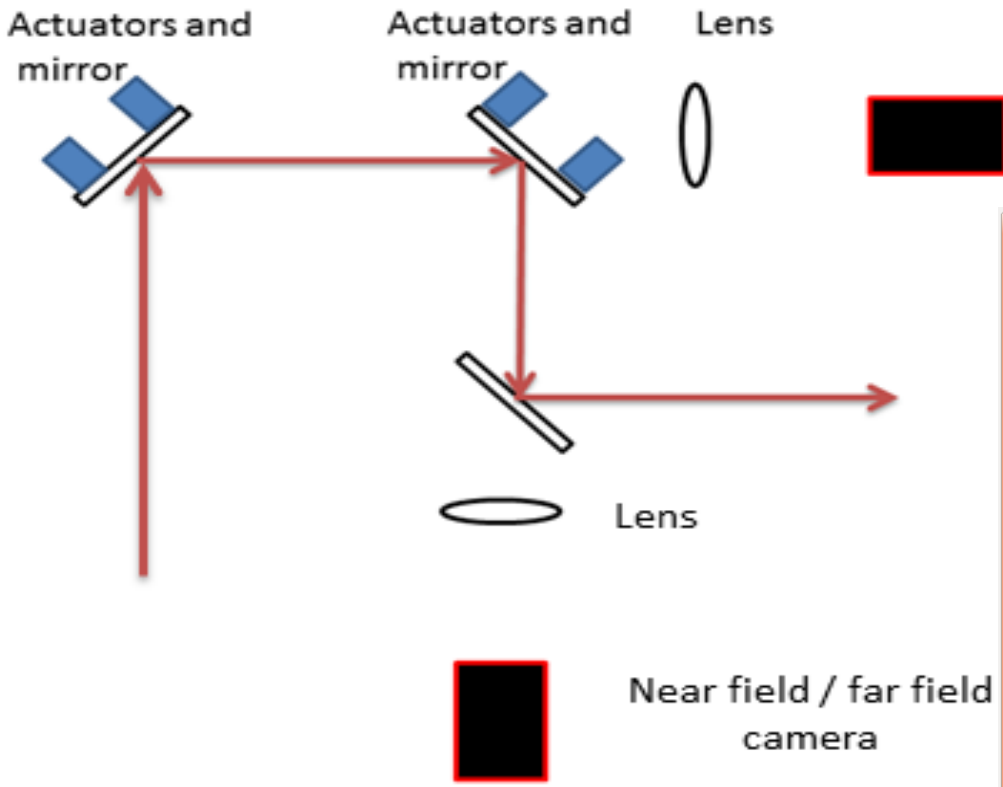
10J Near and Far Field Diagnostics Positions

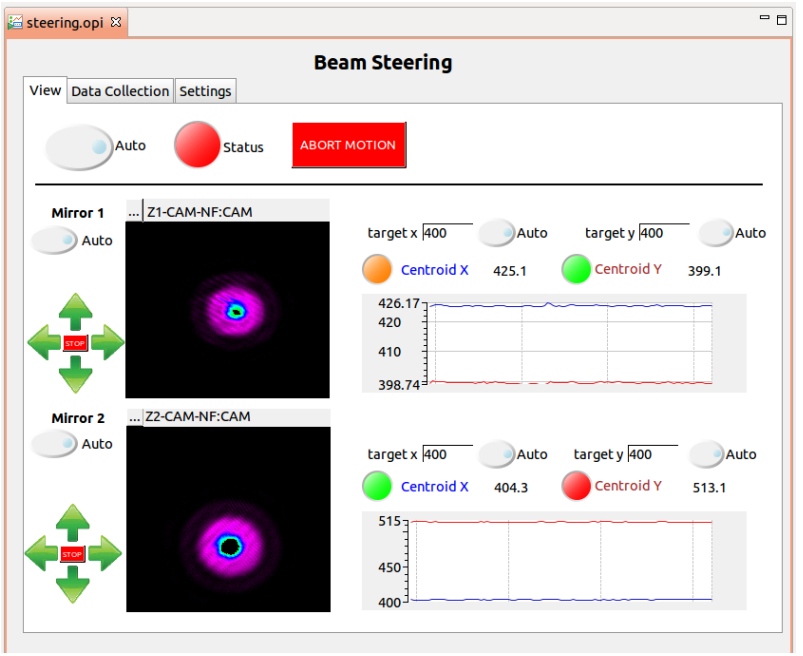


100J Diagnostics Positions

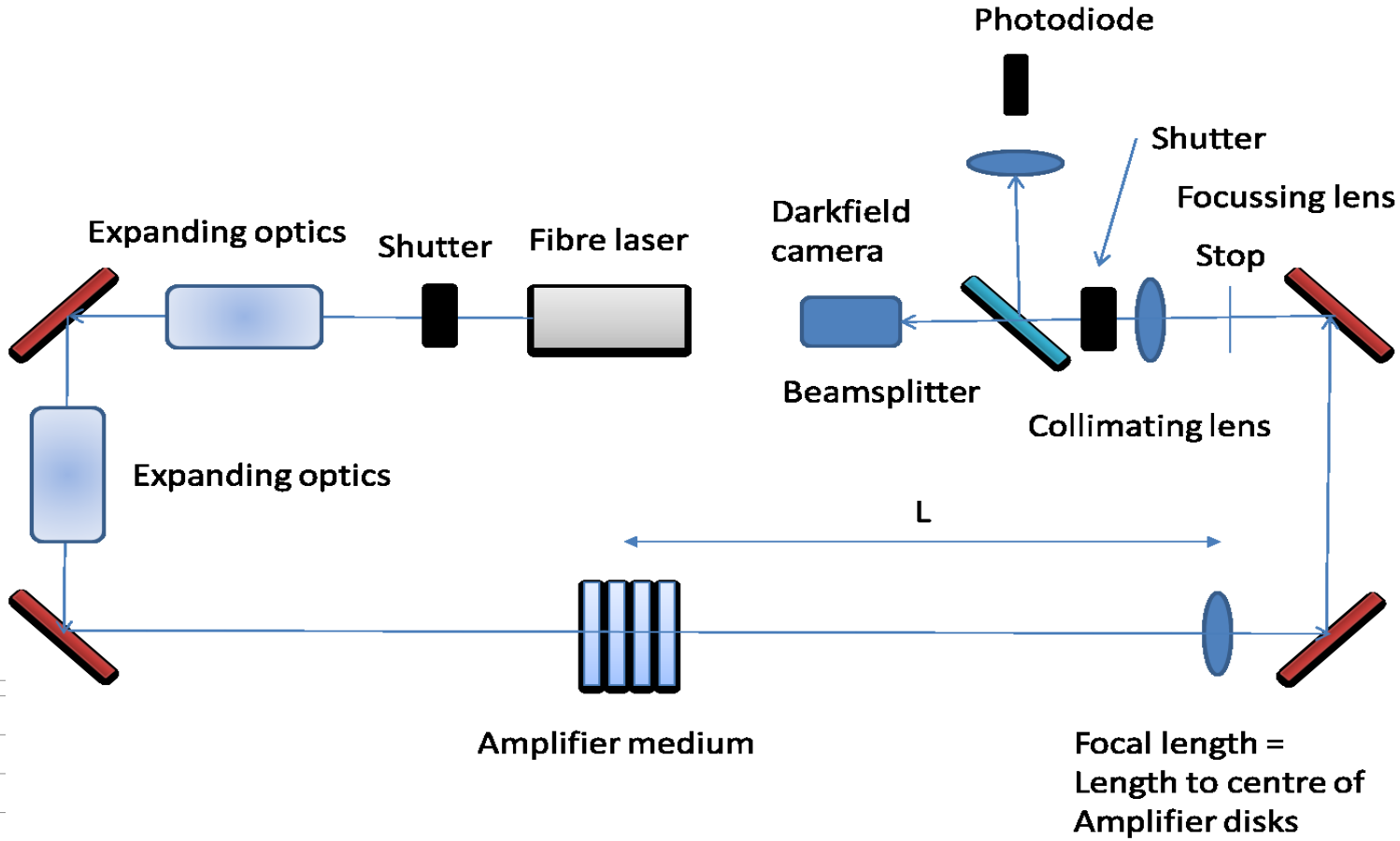


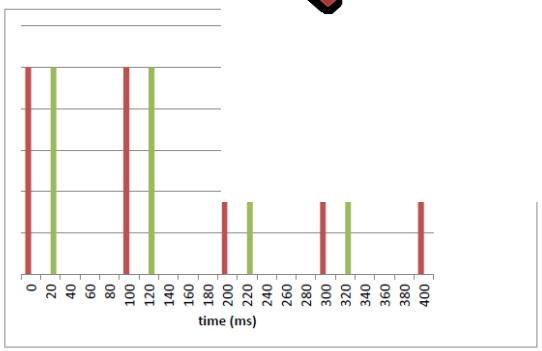
Beam alignment System





Dark-field Diagnostic





Dark-field Operation

Proposed operation of the dark-field diagnostic:-

- Interleaved with pump diodes
- Open shutter for camera (and photodiode)
- Capture image on camera (and signal on photodiode)
- Process data
- Any action to switch amplifiers off
- Close shutter for dark-field laser and on camera /photodiode

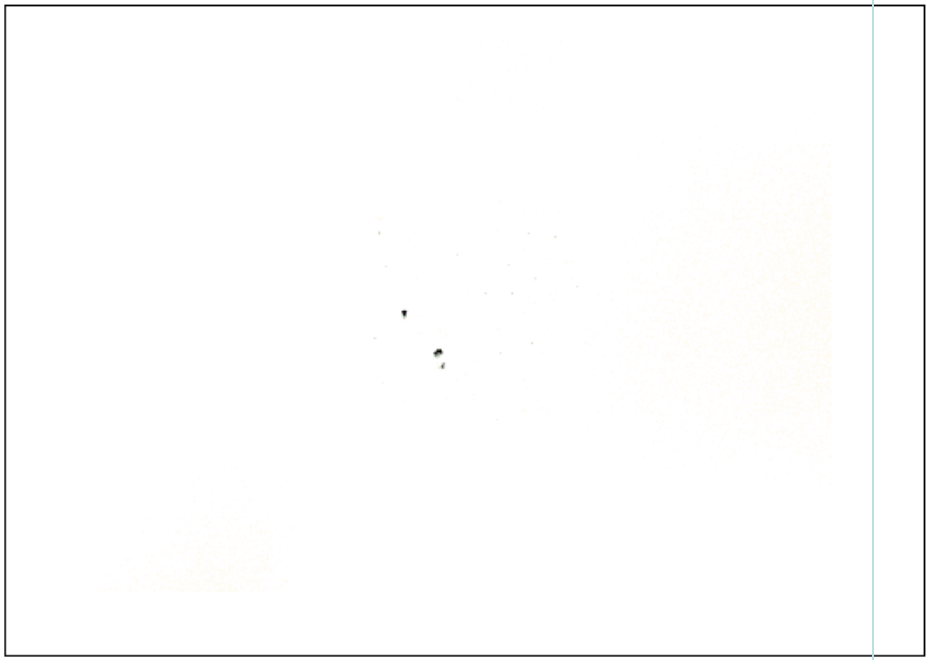
Research and design required in the coming months

Dark-field Data

Dark-field with no damage

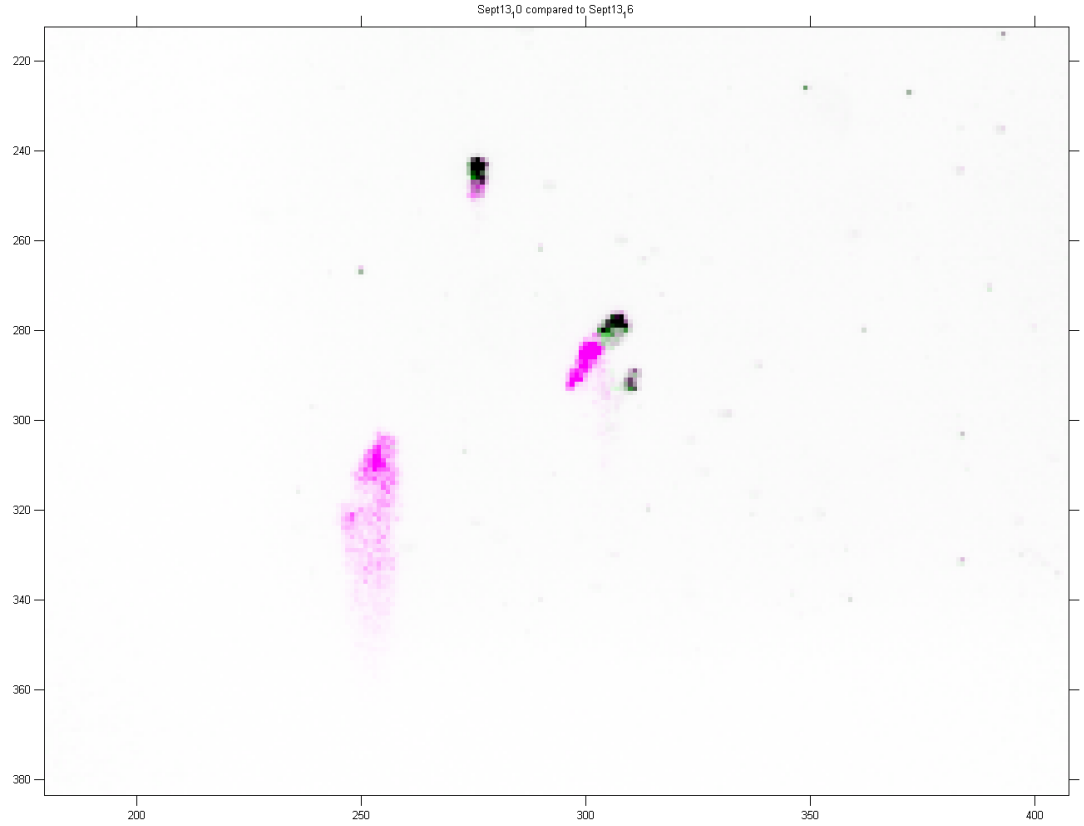
Dark-field Data

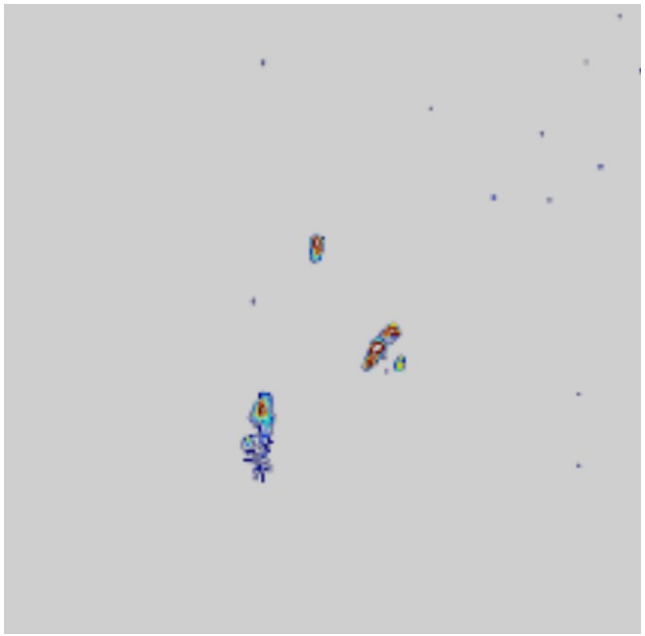
- Dark-field after damage of disks



Dark-field Data

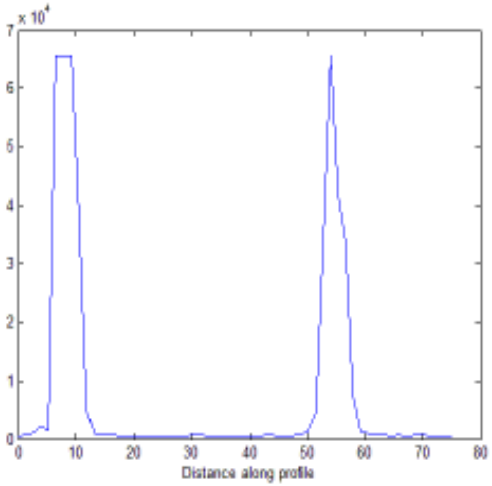
- Dark-field - damage growth





Dark-field Data

Intensity profile taken along the blue line covering two damage spots, this will be used to set boundary conditions for the shutting off the amplifiers.



Storing the diagnostic data

EPICS (Experimental Physics and Industrial Control System)

- **used to capture and store large amounts of data**
- **it allows the data to be archived**
- **is a modular system allowing quick adaption for new applications**
- **Likely that only 1:500 shots will be stored as the days run and can then be archived or deleted**
- **Images and data will be shown in control room for real time monitoring**

Overview

- Brief overview of the laser system
- The proposed diagnostics
    - Near and far field
        - Automated beam steering system
    - Dark-field
- EPICS