MAKING WAY FOR LCLS II

Meriame Berboucha[1], Matthew Windeler[2], Katalin Mecseki[2], Franz Tavella[2], Joe Robinson[2], Alan Fry[2]

[1]Physics Department, Imperial College London, South Kensington Campus, London, United Kingdom.

[2]Linac Coherent Light Source, SLAC National Accelerator Laboratory, 2575 Sand Hill Road, Menlo Park, CA 94025, USA.

[+]Contact: kmecseki@slac.stanford.edu

THE NEED FOR LCLS-II

The Linac Coherent Light Source (LCLS) at SLAC is the world's first hard x-ray free electron laser.

LCLS would like to take a leap forward in capability and increase the current 120 pulses a second system to 1 million pulses a second for even more exciting scientific experiments.

Here, the high power laser system for the development of LCLS-II, known as IGNIS, will be discussed with focus on the Herriott cell system which will be used to create an optical time delay in one of the laser beam arms.

Keywords: OPCPA laser system, multi-pass cell, interns, Herriott cell

WHAT I'VE BEEN UP TO

MOVING FROM OLD LASER LAB TO NEW SHINY LASER LAB

BUILDING LASER ENCLOSURE TO MEET SAFETY REGULATIONS

Figure 1: *Top left and right:* laser enclosure for IGNIS. *Bottom left:* cleaning the inside of the laser enclosure so that optics are not damaged when the laser is on. *Bottom right:* inside of laser enclosure.

VISITING THE HUTCHES, SSRL, SLAC LINAC AND SEEING SOME SCIENCE IN ACTION

Figure 2: Picture of LINAC.

WORKING WITH THE COMMUNICATIONS GROUP AND PROMOTING SLAC INTERN LIFE

HERRIOTT CELL

IGNIS requires a pulse delay of 12.6m, in order to achieve this a Herriott cell shall be used.

HOW DOES IT WORK?

A Herriott cell consists of two spherical mirrors of the same focal length. The input beam reflects off the spherical mirrors multiple times, and forms a pattern that remains on a *rotational hyperboloid*.

The reflection points, in general, lie on an ellipse or circle.

FACTORS EFFECTING OPTICAL TIME DELAY

- Distance between mirrors
- Input beam angle
- Diameter of mirror

THE RE-ENTRANT CONDITION

The condition under which the beam will retrace its path and exit the Herriott cell:

$$N\theta = 2M\pi \quad (1)$$

where N is the total number of passes the beam makes within the cell, M is an integer, and θ is the angle between two successive reflections

SETUP

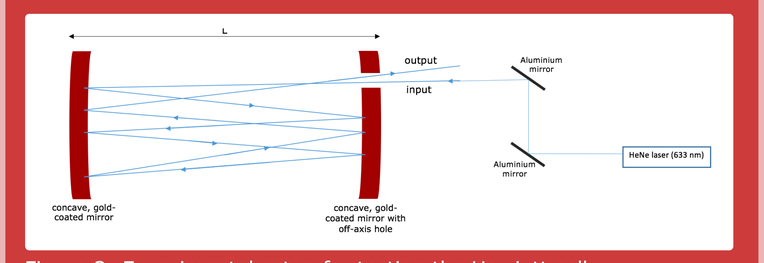


Figure 3: Experimental setup for testing the Herriott cell.

REFLECTION PATTERN

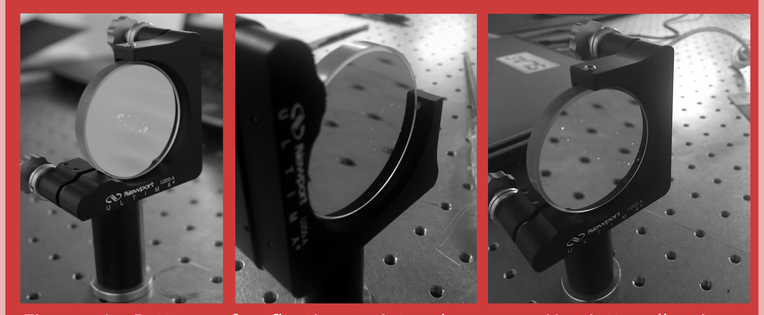
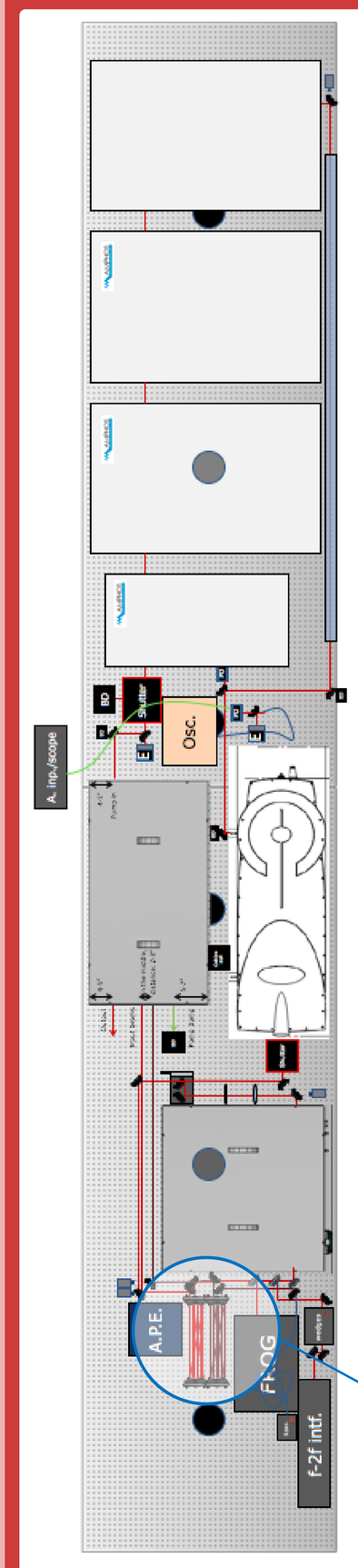


Figure 4: Pattern of reflection points shown on Herriott cell mirror where a circle and ellipse patterns are shown for various input angles and distances between the mirrors, where distances were kept to <4f (focal length).

IGNIS



THE FUTURE

High power laser system for the development of LCLS-II shall be built by late 2017.

This shall be used for research and development in preparation for LCLS-II construction.

- 800nm (and 1500nm)
- Pulse duration: 15 fs
- Pulse energy ~ 1 mJ
- 100 kHz
- Average power: 100W
- OPCPA laser system

WHY IS IGNIS SPECIAL?

- High repetition rate
- High pulse energy
- High average power

Not many of these systems exist.

Herriott cell used to produce optical time-delay so that pulses reach each other at the same time.

Figure 5: Schematic of IGNIS, the OPCPA laser system that shall be used for the research and development phase before the construction of LCLS-II.

FINAL WORDS

2'' off-axis hole Herriot cell can provide up to 35.9m of optical time delay

IGNIS shall be a high power, high repetition OPCPA laser system that shall provide important insight for the construction of LCLS-II

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