# Increasing the productivity of the DiPOLE prototype laser

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**Introduction**

The DiPOLE laser system was constructed as a proof of concept system, to establish a new architecture of scalable laser systems. DiPOLE has since become a test bed, enabling technologies to be developed and optics to be tested. The DiPOLE system was, however, operated on an ad hoc basis, with no defined schedule of experimental activities and no regular maintenance period. Despite this approach, work has continued to deliver scientific output from the DiPOLE system. Recently a new system has been trialled which schedules experimental campaigns. The need for scheduling became more apparent while making changes to the DiPOLE system to accommodate the laser shock peening experiments.

**Campaign System**

Every three months a call goes out to CALTA staff for proposals for activities utilising DiPOLE. These are reviewed and proposals are prioritised in line with the strategic goals of CALTA and the CLF. Many of the activities proposed are to support other CALTA and CLF projects, such as D-100X and the HiLASE Centre of Excellence Widespread Teaming projects. The activities vary in length but have a fixed start and end date, allowing more effective resource management and providing the necessary preparation time for a successful experiment. In the event that a proposal is not selected for the next campaign period, it can be resubmitted during the next call for proposals.

Regular maintenance weeks are included in each campaign period to ensure that the DiPOLE system is kept in good working order and further development can continue.

Time on DIPOLE has been oversubscribed every quarter since the commencement of this campaign-style system, which is a testament to the versatility and ongoing benefit of the prototype system.

**Recent campaigns**

In the year 2016-17, the primary focus of CALTA was the installation and commissioning of the DiPOLE100 system at the HiLASE facility in Prague, Czech Republic. This drew the majority of CALTA's resource away from operating DiPOLE and the system was occasionally left dormant. The main activity on DiPOLE during this period was an investigation into different coating types and suppliers for DiPOLE gain media, a critical system component.

In 2017-18, the campaign system was trialled, during which nine experimental themes were investigated with several of these themes awarded multiple experimental sessions. A total of 27 experimental sessions of varying duration were scheduled and all successfully completed, including planned developments to DiPOLE itself.

Improvements made to DiPOLE included replacing the DiPOLE amplifier head with a new design to allow efficient switch over of gain media, reducing the risk of damage and increasing the speed of change over. Additionally a significant amount of EPICS software deployment and development was carried out on the DiPOLE system, allowing the stability and user experience to feedback into the development of control systems for both HiLASE and the wider CLF.

A proof of concept study into laser shock peening began. Originally, time was scheduled in weekly experimental blocks, but eventually evolved into two-day sessions on a more regular basis. This time allowed for the creation and later modification to the peening set up; finally resulting in the installation of a new optical table to allow greater experimental flexibility.

Other campaigns included:

- Second harmonic generation experiments investigated different crystals, the effect of thermal stabilization for efficiency and long term stability
- Investigation into temporal diagnostics – in particular methods which are robust to drift in pointing
- Closed loop temporal pulse shaping using software
- Characterization of thermal birefringence on the DiPOLE system.
- Investigation into reflectivity changes within the DiPOLE amplifier head
- Characterization of phase modulation on the front end of DiPOLE

Details of several of these experiments are published both here in the annual report and in peer reviewed papers.

The closed loop pulse shaping is continuing to be developed and will appear as an article in a future annual report.

**References**

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