

The Astra Gemini project – an overview

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Introduction

The Astra Gemini project formally started in July 2004 to upgrade the existing Astra laser system into a dual beam Petawatt (PW) level facility. This has been made possible through the award of a £3 Million facility development grant by the CCLRC. When complete in the summer of 2007 it will deliver into a new target area two independent synchronised 0.5 PW beam lines capable of being focused to a maximum intensity of $\sim 10^{22}$ Wcm⁻² each. Moreover, each will have a pulse peak to ASE / pre-pulse contrast of some 10 orders of magnitude and will operate at 1 shot per minute. The first year of the project has seen significant progress, principally in design (Figure 1) and modelling that are summarised below.

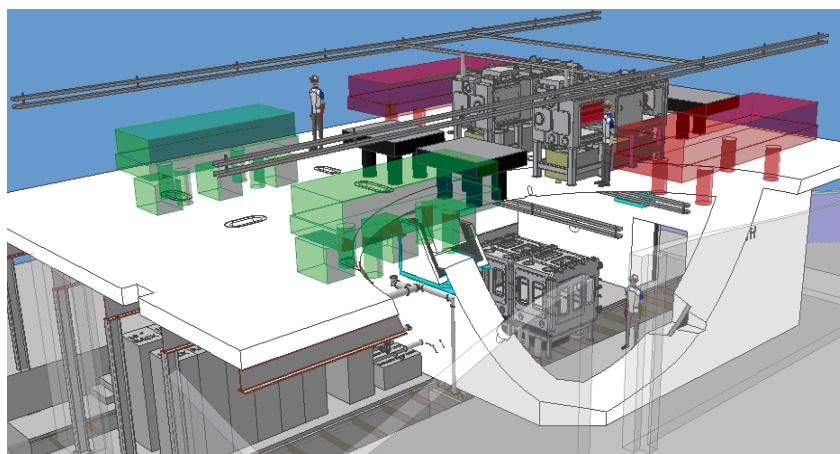


Figure 1. 3-D CAD impression of the Astra Gemini Facility showing the new laser, target and services areas.

Building Engineering

The building work has been complicated by the need to engineer the Astra Gemini system into an existing building structure whilst maintaining the operational integrity of the functions housed within that structure. These included the existing Astra system and a number of important CLF engineering functions. The need for due process with regard to radiological has also been a key factor. A phased approach has therefore been necessary. The first three of the four phases are now complete as is the design aspect of Phase 4 (the main bunker & laser area construction)¹.

Laser Design

Work on the laser design has progressed on multiple fronts. The requirement for extremely high contrast has prompted a short R&D campaign to develop and evaluate contrast enhancement techniques². Complementing this, there has also been work on the re-design and re-configuration of the front end of Astra³ for Gemini. Modelling and design work has been undertaken on the two main large aperture Titanium Sapphire amplifiers⁴ and the two large aperture optical compressor systems⁵. The pump lasers for these two amplifiers, originally to have been developed as part of the project, have instead been purchased from Quantel, France.

Target Area

Work on the target area has concentrated on the assessment and mitigation of the radiological hazards⁶ presented by the

Astra Gemini system and on the design and specification of the interaction system⁷. A user consultation exercise has been conducted to ensure that the eventual target area is as flexible as possible given the funding constraints.

Management and Reviews

An important aspect of the project in its first years has been its management and review process. A project management team has been established that has developed a detailed project plan. This in turn reports to a Project Board, chaired by Dr. Mike Johnson (Director, CCLRC Engineering and Instrumentation Department). User interests on this board are represented by Prof. Ken Ledingham (University of Strathclyde) and Prof. Karl Krushelnick (Imperial College).

CCLRC and CLF interests are represented by Prof. Henry Hutchinson (CCLRC Chief Scientist, Director CLF) and Mr. Colin Danson (CLF Projects Representative). Membership also includes Dr. John Collier (Project Manager and Principal Investigator) and Dr. Andrew Langley (Secretary).

An external design review⁸ was held at about the 6 month point to expose the design basis to the scrutiny of an expert international panel comprised of Dr. Jean-Paul Chambaret (Laboratoire d'Optique Applique, France), Dr. Mikhail Kalashnikov (Max Born Institute Germany) and Dr. Ian Ross (consultant to the CLF). The radiological hazard and mitigation assessment⁶ was also subjected to international expert scrutiny by a panel composed of Dr. Victor Malka (Laboratoire d'Optique Applique, France), Dr. Mike Singh (Lawrence Livermore National Laboratory, USA) and Dr. Paul Berkvens (ESRF, France)

References

1. B Wyborn *et al.*, CLF Annual Report 2004/2005, p 211
2. E Divall *et al.*, CLF Annual Report 2004/2005, p 222
3. A Langley *et al.*, CLF Annual Report 2004/2005, p 214
4. K Ertel *et al.*, CLF Annual Report 2004/2005, p 217
5. O Chekhlov *et al.*, CLF Annual Report 2004/2005, p219
6. To be published as a CCLRC Report in due course
7. P Foster *et al.*, CLF Annual Report 2004/2005, p 221
8. See www.clf.rl.ac.uk