# Diamond Light Source

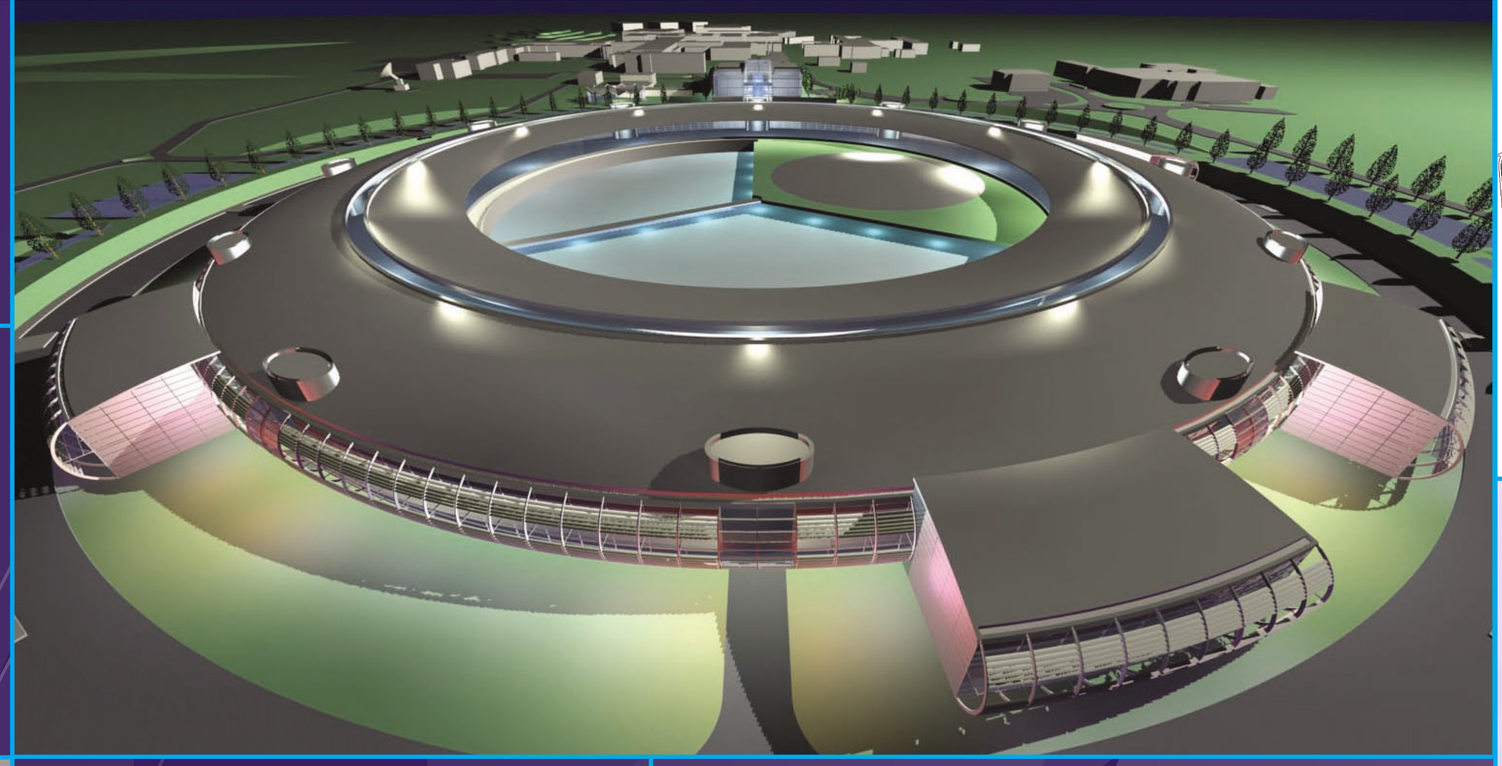
Diamond is a third generation, 3GeV synchrotron light source being constructed at the Rutherford Appleton Laboratory (RAL) in the UK to support the life and physical sciences.
The storage ring is based on a 24-cell double bend achromatic lattice of 561m circumference. The spectral output is optimised for high brightness up to 20keV from undulators and high flux up to 100keV from multipole wigglers. Initial construction includes seven beamlines.
The organisation currently consists of 100 staff and will eventually grow to 300.
Diamond is now in the design, build and procurement phase. Stage 1 of the building work, covering the enabling works, site preparation and foundations, were completed in September 2003. Stage 2, including the buildings and accelerator enclosures, is underway.
Diamond is scheduled for user operation from January 2007.

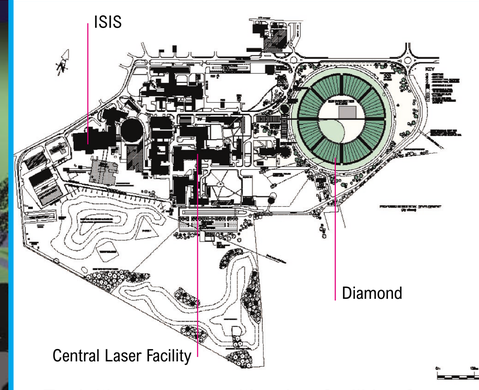
## Project Schedule

| | |
|---|---|
| Joint Venture Agreement | Mar 2001 |
| Design Review | Jun 2002 |
| Start main construction work | Oct 2003 |
| Start machine installation | Sept 2004 |
| Office block available | Dec 2004 |
| Buildings Completion | Aug 2005 |
| First beam in Storage ring | Jan 2006 |
| Start Beamline commissioning | May 2006 |
| Start of Operations | Jan 2007 |

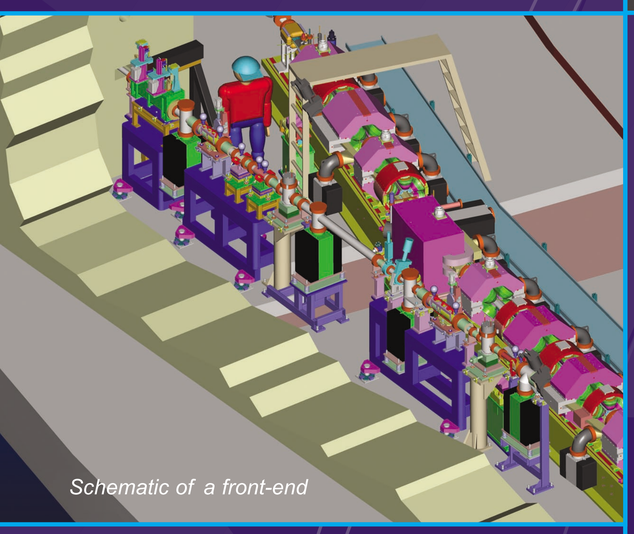
## Key Technical Parameters

| | | |
|---|---|---|
| Electron Beam Energy | 3 GeV | |
| Circumference | 561.6 m | |
| Number of cells | 24 | |
| Symmetry | 6 | |
| Straight section lengths | 6 x 8 m, 18 x 5 m | |
| No. Insertion devices | 4 x 8 m, 18 x 5 m | |
| Beam current | 300 mA | (500 mA) |
| Emittance (hor., vert.) | 2.7, 0.03 nm rad | |
| Lifetime | > 10 h | (20 h) |






*Exploiting synergy with other facilities for basic & applied research in the life, physical & environmental sciences.*

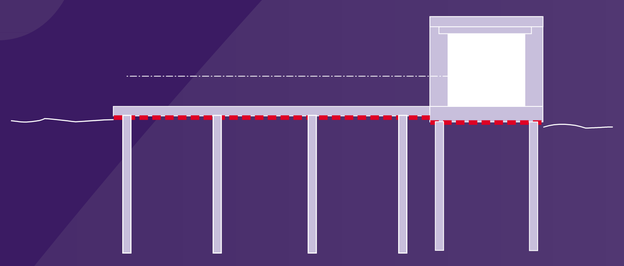


*Schematic of a front-end*

## Stability of new building

Key challenge: Stability to < 1 micron

Solution:
- 600 mm / 900 mm thick experimental hall / storage ring tunnel slab
- no gap between experimental floor and storage ring
- Foundations based on 1500 un-sleeved piles anchored into the Chilton chalk, 12-15 m deep, 600 mm diameter, 4-5 cm separation for void between slab and ground



## Diamond Science Programme

| | |
|---|---|
| Phase I: | 7 beamlines on IDs; Jan 2007 |
| Phase II: | 15 beamlines on IDs and BMs at 4 per annum from Jan 2008 |
| Operations: | From Jan 2007 |

## Provisional Order of Construction

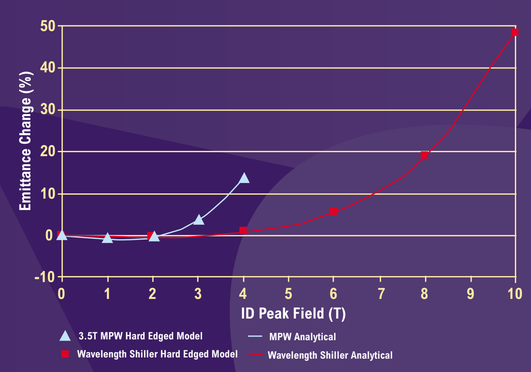
| Completion Date | Beamline | Characteristics | |
|---|---|---|---|
| Year 1 | Extreme Conditions – I15 | 5-100 keV | 1-2m 3.5T MPW |
| | Materials and Magnetism – I16 | 3-25 keV | 5m U33 |
| | Macromolecular Crystallography – I02 | 3-25 keV | 2m U21-IV |
| | Macromolecular Crystallography – I03 | 3-25 keV | 2m U23-IV |
| | Macromolecular Crystallography – I04 | 3-25 keV | 2m U23 –IV |
| | Microfocus Spectroscopy – I18 | 2-13 keV | 2m U27 –IV |
| | Nanoscience – I06 | 80-1500 keV | 5m HU64 |
| Year 2 | Non-Crystalline Diffraction – I22 | 4-20 keV | 2m U27 |
| | Test Beamline – B16 | Bending Magnet | |
| | Small Molecule Single Crystal Diffraction – I19 | 5 – 25 keV | U23-IV |
| | High Resolution Powder Diffraction – I23 | 5 – 25 keV | U |
| | Microfocus Macromolecular Crystallography – I24 | 6 – 18 keV | U |
| Year 3 | Circular Dichroism Spectroscopy – B24 | 2 – 10eV | BM |
| | JEEP – I12 | 30 – 180 keV | 3.5T MPW |
| | Monochromatic MX Side Station – I04.2 | 12 keV | U29 or U26 |
| | Versatile X-ray Spectrometer (XAS-3) – I20 | 4 – 35 keV | 1.6T MPW |
| Year 4 | Infrared Microspectroscopy – B21 | 1 – 10 mm | BM |
| | Surface and Interface Diffraction – I07 | 8 – 30 keV | U23-IV |
| | Surface and Interface Structural Analysis – I08 | 0.2 – 10 keV | U50, U38 |
| | Core EXAFS – B17 | 2 – 35 keV | BM |

## Insertion devices (Phase I)

| Name | Period (mm) | Length (m) | Type |
|---|---|---|---|
| MPW60 | 60 | 1.0 | 3.5T s/c wiggler |
| U33 | 33 | 4.9 | standard |
| U23 Iva | 23 | 2.0 | in-vacuum |
| U23 IVb | 23 | 2.0 | in-vacuum |
| U21 IV | 21 | 2.0 | in-vacuum |
| U27 IV | 27 | 2.0 | in-vacuum |
| HU64 | 64 | 2 x 2.2 | APPLE-2 |

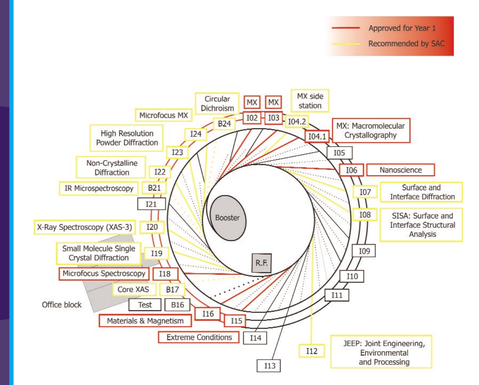
All undulators will be designed and constructed in-house.

## Emittance Change (Brightness Scaling)




## New Proposals

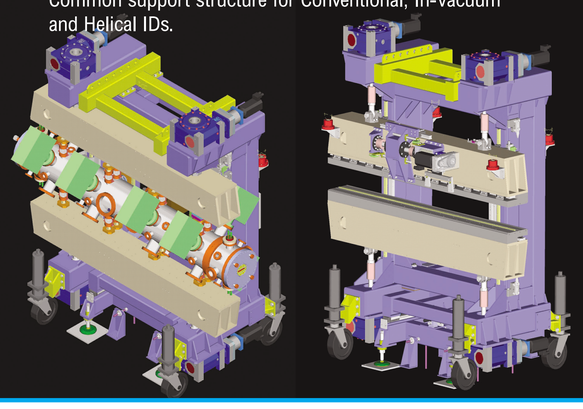
| | | | |
|---|---|---|---|
| P039 | Time Resolved X-ray Diffraction | 5 – 30 keV | U |
| P040 | Polarised Soft X-ray Beamline | 0.4 – 2 keV | HU |
| P041 | Small Angle Scattering | 8 – 20 keV | U –IV |
| P042 | HERALDS | 4 – 25 keV | 2.5T MPW |
| P043 | Low Energy X-ray Microscopy | 90 eV – 2.5 keV | HU |
| P044 | Macromolecular Crystallography | 4 – 12 keV | U or W |
| P045 | Inelastic X-ray Scattering | 5 – 10 keV | U |
| P046 | Coherent X-ray Diffraction | 6 -8 keV | U |
| P047 | Surfaces, Interfaces, Gas phase and Nanostructures | 30 eV – 1.2 keV | HU200, HU64 |

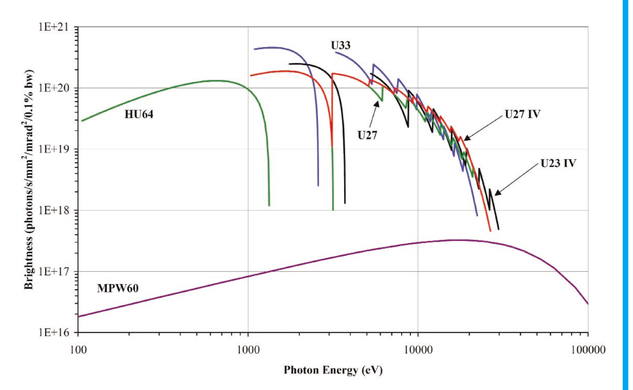


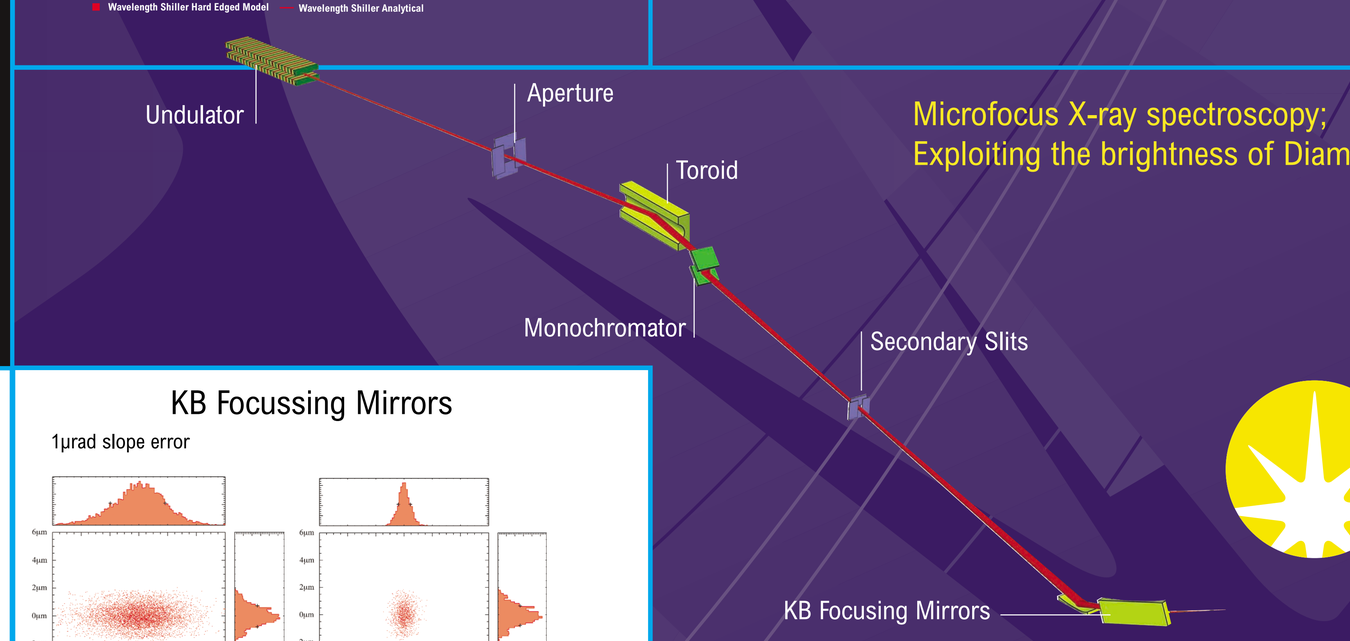

*Straw Plan*

## Insertion Devices (IDs)

Common support structure for Conventional, In-Vacuum and Helical IDs.






## Microfocus X-ray spectroscopy; Exploiting the brightness of Diamond

## KB Focussing Mirrors

1µrad slope error



Secondary slits fully open 6 x 1µm

secondary slits closed to 30µm to obtain a final spot size of about 1x1µm.

diamond