An inexpensive CCD neutron alignment camera

Simple techniques are often the most effective. The neutron Polaroid camera is an excellent example of the use of an existing commercial device in an essential new role – to ensure that the sample is actually within the neutron beam! This has saved countless hours of lost beamtime since the first Polaroid cameras were constructed for most ILL instruments 30 years ago.

However new interlock systems, while improving safety, have made it more difficult to use a manual device such as the Polaroid camera. And commercial film cameras have been largely replaced by CCD cameras, with millions spent on development.

Two years ago, Bachir Ouladdiaf replaced the old wet-film crystal alignment camera with a new cooled image-intensified neutron CCD system, which is ten times more sensitive and much easier to operate. The resulting OrientExpress Laue diffractometer has been a huge success, and is now being marketed commercially by Photonic Science UK. An even more powerful machine (Cyclops) is under construction.

Cooled, image-intensified CCD cameras were developed by several laboratories long ago and at ILL by Toni Heidemann, Roland Gähler and others. They are important for neutron tomography, where the highest resolution and sensitivity are essential, but are still too large and expensive for our purposes. A search for the modern equivalent of the Polaroid camera turned up CCD cameras used for video surveillance and amateur astronomy, where high sensitivity is obtained by frame integration rather than image intensification. Such cameras are relatively cheap and do not need to be cooled for integration over a few seconds.

Figure 1: The compact version of the CCD neutron alignment camera with a nominal sensitive area of 80x60 mm, together with its optional 7" (18cm) TFT monitor, alternative USB-2 PC adapter, and electronic exposure controller.

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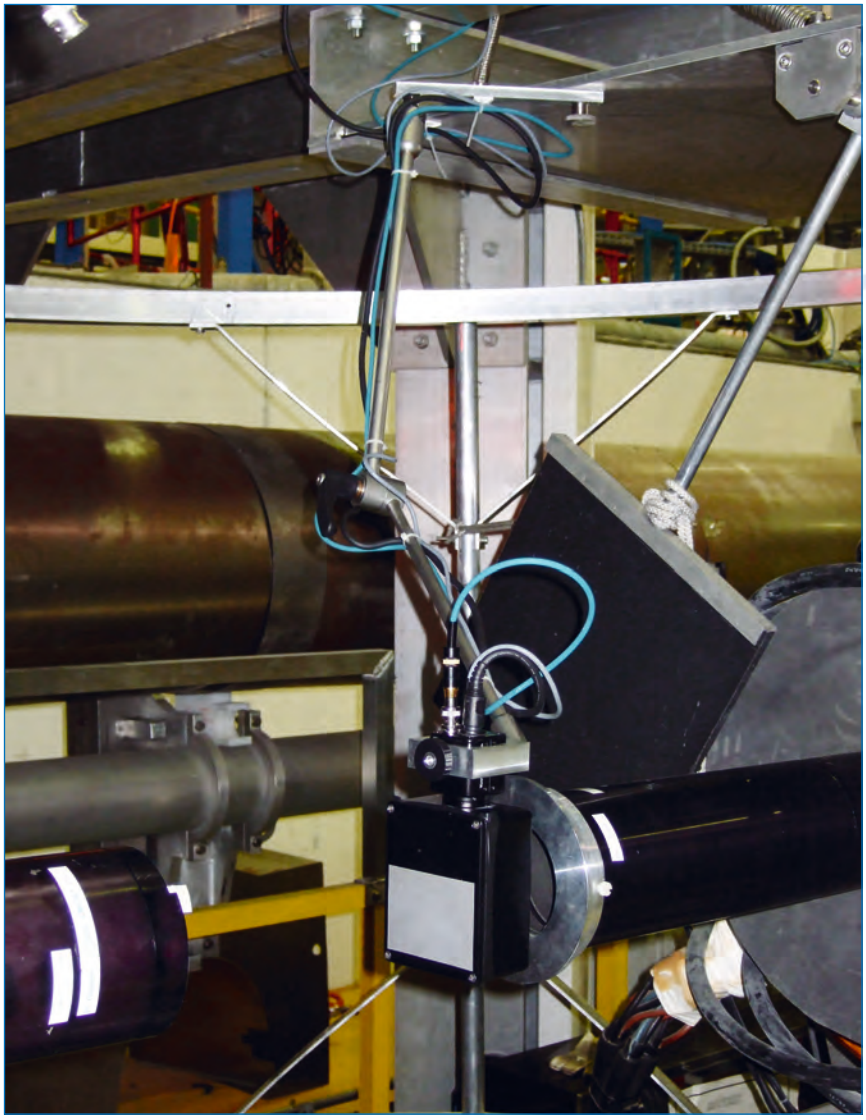

Figure 2: A compact CCD camera on an articulated arm on IN15.
The articulating arm is made of stainless steel and the 3 movable joints are simultaneously lockable by turning the black lever.

The CCD alignment camera (figure 1) is almost as compact as the old Polaroid camera, and has the great advantage that it can be operated remotely to give an almost real-time image of the neutron beam. Monitoring of the sample in the beam becomes a routine part of the experiment, not a manual procedure to be skipped by impatient users.

Figure 2 shows the new camera mounted on an articulated arm built by IN15 technician, Claude Gomez. To accommodate the various instrument configurations the camera was mounted on a triple jointed arm, based on a commercial product designed for holding micrometer dials. Using this arm the camera could be put in position with one hand and then locked in place with the other hand. The signal from the camera is sent through a video splitter to feed an LCD screen at the sample position for manual cryostat alignment, and it also feeds a frame grabber on the control computer to aid computerized positioning. It takes literally 5 seconds to position the camera or to stow it away, and there is always a screen to look at nearby. There is no excuse not to use this camera!

The low cost of this simple CCD camera has meant that over 30 examples have already been made for most instruments at ILL, with Jean-Claude Tribbia machining all of the aluminium camera boxes. A small company (NeutronOptics) has been set up to satisfy the demand from other laboratories. In collaboration with PSI Switzerland, new scintillators will be used on future cameras, and with the help of the Japanese maker of the CCD unit, an unlimited exposure model is being tested for weaker neutron beams.

Further details are available on *http://www.neutronoptics.com.*