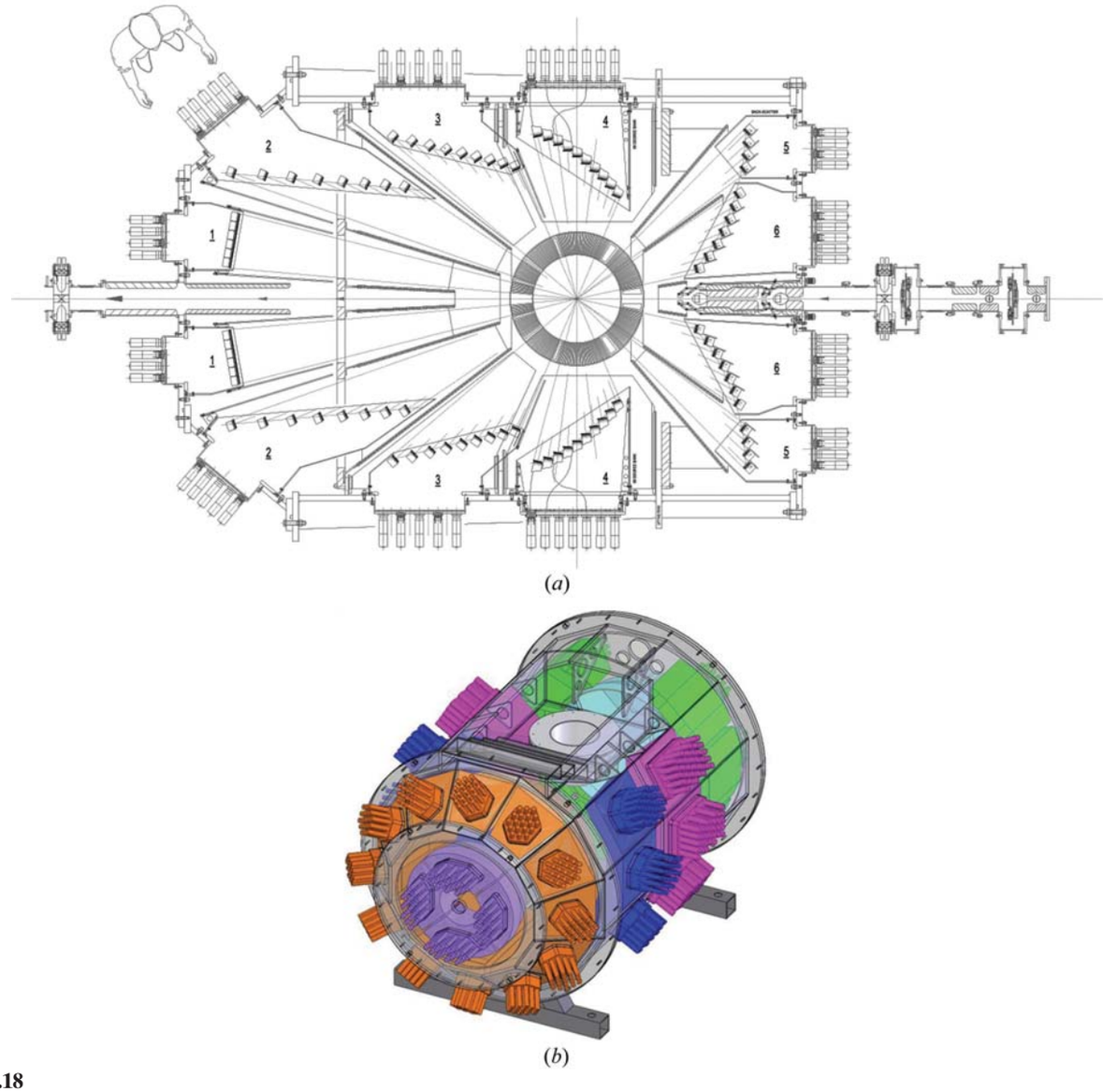

Figure 2.3.18
(*a*) Schematic cross section of the POLARIS diffractometer at the ISIS facility, UK, and (*b*) a three-dimensional solid model of the detector chamber. (Credit: STFC.)

2.3.4.2. *Time-of-flight (TOF) diffractometers*

Time-of-flight (TOF) diffractometers differ substantially from CW diffractometers. Neutrons delivered to the instrument are already partially collimated and TOF instruments have no monochromator and consequently no moving parts. The full incident neutron spectrum is utilized and needs to be well characterized in order to extract meaningful intensities; in addition the wavelength dependence of detector efficiencies needs to be taken into account. In principle, measurements from an incoherently (therefore isotropic and wavelength-independent) scattering sample such as V or H_2O provide the required characterization.[16] In practice, however, incident spectra are usually recorded using a low-efficiency detector (beam monitor) in the incident beam. Data from V are still required to correct for the relative efficiency of individual detectors or detector elements and their wavelength dependence (Soper *et al.*, 2000).

The basic components of a TOF powder diffractometer are the flight tube from the neutron source or a neutron guide, a precisely located sample position, banks of detectors at various positions around the sample position and a neutron-absorbing beam stop. In early TOF diffractometers, detector banks were relatively localized typically in forward scattering, close to $2\theta = 90^\circ$ and backscattering locations. More modern diffractometers have very extensive detector arrays such as the newly upgraded POLARIS instrument at the ISIS facility, which is illustrated in Fig. 2.3.18. Neutrons enter the diffractometer at the right of Fig. 2.3.18(*a*) through a number of adjustable neutron-absorbing jaws which trim the beam size to match the sample size. The beam is then incident on the sample, which is located within the chamber where the detectors, arranged in numbered banks, are housed. The entire sample/detector chamber (and flight tube) is evacuated during data collection in order to reduce absorption and scattering of the incident neutron beam by air, effects which both decrease the intensity of the neutrons incident on the sample and increase the background scattering. A human figure in Fig. 2.3.18(*a*) indicates the large scale of the device and it should be

[16] The much larger incoherent scattering cross section of H allows normalization data to be recorded much more quickly using H_2O; however, the small amount of additional moderation of the beam that occurs is usually considered undesirable.