Quokka will be one of the best small-angle neutron scattering (SANS) instruments in the world. SANS is a highly versatile technique for investigating a wide range of materials including polymers, emulsions, colloids, superconductors, porous materials, geological samples, alloys, ceramics and biological molecules such as proteins and membranes.

What makes Quokka special?

SANS is a powerful technique for looking at structures on the nanoscale from 1 to several hundred nanometres. When a neutron beam impinges on a sample, some neutrons scatter along a path that differs from the transmitted beam by as little as several hundredths of a degree. This ‘small-angle’ scattering provides information about relatively large structural details on the nanoscale. SANS can provide particle sizes, shapes and distributions averaged over a complete macroscopic sample.

Applications:
The major strength of the SANS technique is that it can be used to investigate a host of materials, which cover a wide range of research disciplines. Materials that are routinely characterised using the SANS technique include: alloys, ceramics, biological materials, colloidal materials, complex fluids, polymers, surfaces and interfaces, flux lattices in superconductors.

Quokka will be particularly important in the Food Science project - a collaboration between ANSTO, CSIRO, Food Science Australia and the University of Queensland. Participants are investigating scientific problems of national significance for food processing and human nutrition.

Case Study 1: Fighting obesity

SANS is helping scientists understand how the human body breaks down fats, by investigating the molecules that we produce in our digestive systems to do this. 99% of fats in the Western diet are triglycerides, which require three digestive components to break down in order to be absorbed by the body. Two enzymes (pancreatic lipase and colipase) and bile salts come together to form an active complex to digest the fat. SANS is the ideal technique to investigate this large molecular structure, and scientists have been able to unravel how these digestive molecules come together to break down fat.

From this understanding, there is the potential to design drugs that can stop this active complex from forming in the digestive system and therefore reduce the amount of fat assimilated into the body.

Case Study 2: Hydrogels for Contact Lenses

One of the main obstacles to successful extended-wear contact lenses has been the inability of conventional hydrogels to prevent significant overnight corneal swelling caused by low oxygen permeability. Other important properties of the hydrogels include biocompatibility, wettability, material strength and stability. To improve materials suitability for extended wear contact lenses, novel block copolymer materials with high oxygen permeability in combination with superior hydration properties need to be developed. In order to understand this, the molecular architecture of diblock copolymers with phase separation on the nanoscale (to ensure optical clarity) is being determined by SANS.