Laboratori Nazionali di Frascati

LNF-87/29

A. La Monaca, M. Iannuzzi and R. Messi:

SMALL ANGLE X-RAY SCATTERING APPARATUS WITH THREE-DIMENSIONAL IMAGING GAS DETECTOR

Estratto da:
SIF - Conf. Proc. "Synchrotron Radiation at Frascati" Vol. 5, 15 (1986)

Servizio Documentazione
dei Laboratori Nazionali di Frascati
P.O. Box, 13 - 00044 Frascati (Italy)

SMALL ANGLE X-RAY SCATTERING APPARATUS WITH THREE-DIMENSIONAL IMAGING GAS DETECTOR

A. La Monaca
INFN, Laboratori Nazionali di Frascati, Frascati, Italy

M. Iannuzzi and R. Messi
Dip. di Fisica, II Università di Roma, Roma, Italy

With the present availability of synchrotron radiation as high brilliance X-ray source, the whole information extractable from a small angle X-ray scattering (SAXS) experiment could be obtainable. However, this is actually true only when the performances of the X-ray detectors used in the experiment are suitable for an unambiguous identification of the reflection arising from the sample, and for a quantitative analysis of the shape of the scattered radiation intensity.

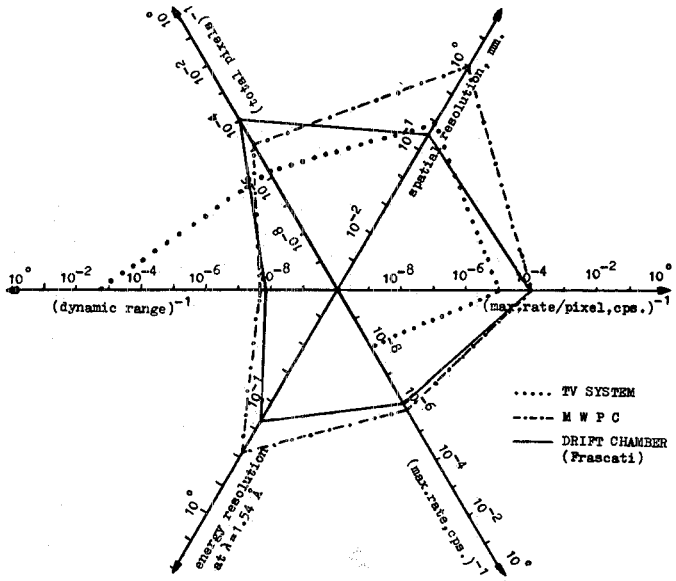

Fig. 1 - Diagram of significant parameters of the present detectors for SAXS experiments.

For an immediate comparison of the significant performances of the present detectors for SAXS experiments, we propose to use the self-explanatory diagram shown in Fig. 1.

In this diagram an ideal detector should be plotted at the origin of the coordinates. For the isotropic scattering, all the required information can be obtained by measuring the radiation scattered in one direction. In this case, the linear position sensitive detectors (PSD) are quite suitable for studying the shape of the scattered intensity. On the contrary, for an anisotropic scattering (as is the case with fibres of polymers or chain molecules of biological substances) the performances of the most used two-dimensional detectors (photographic films, TV systems, multiwire proportional chambers, etc.) are far from those of an ideal detector. Those of photographic films are limited by their small dynamic range (20-80), which very often permits to obtain only qualitative information. TV systems are useful only for high scattering intensity, because their response is noisy and not uniform on the whole detecting area. Multiwire proportional chambers are potentially fine; but at present their wire structure is responsable for non uniform response on the whole detecting area, and their spatial resolution is not optimal. Better performances are presented by our three-dimensional imaging gas detector developed since 1980[1] and recently improved.

We present the spectra of lupolen-R (Fig. 2) and dry collagen (Fig. 3), and preliminary results on dry cornea (Fig. 4), obtained by using this detector installed on a diffractometer on purpose designed for SAXS experiments with synchrotron radiation[2].

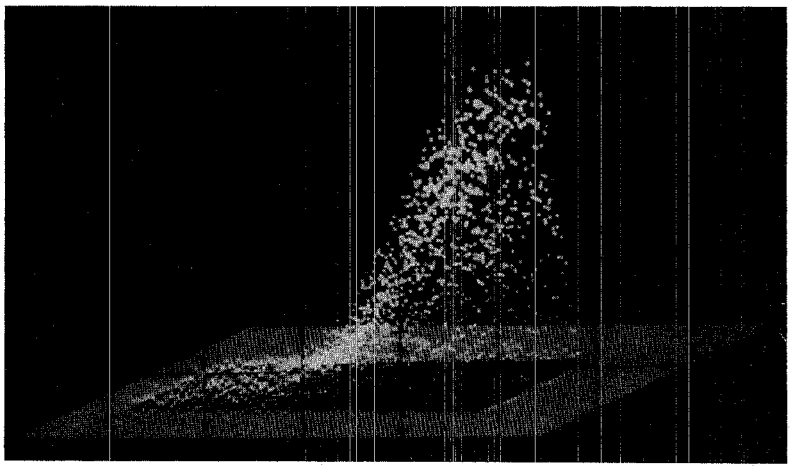

Fig. 2 - Three-dimensional gaussian spectrum of lupolen-R arising from scattering units with spherical radius R=155 Å. Recording time: 15'.

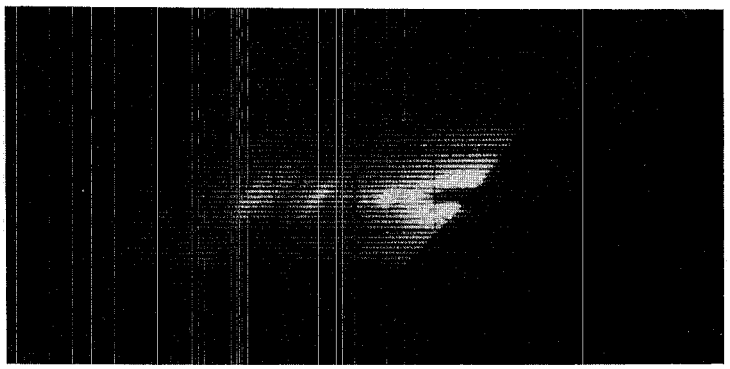

Fig. 3 - Two-dimensional image of dry collagen spectrum. The characteristic diffraction orders arranged along the fibre axis can be observed. Recording time: 60'.

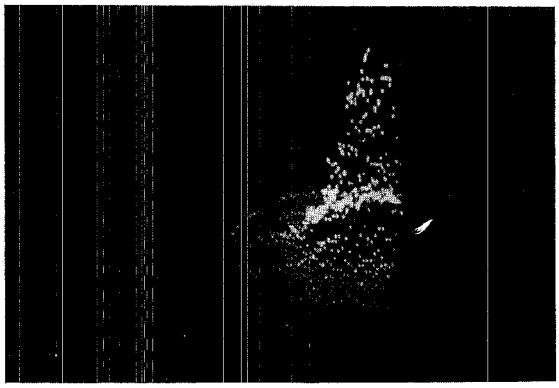

Fig. 4 - Dry cornea diffraction in the region of diffuse scattering. Two mean spacings can be measured, respectively of 648 Å and 885 Å. Recording time: 90'.

The good sensitivity and the high spatial resolution of our new apparatus allowed us to obtain new information on these samples, as the clear two-dimensional gaussian spectrum of lupolen-R, and the weak structural diffraction of dry cornea in the region of diffuse scattering close to the primary beam. Work is in progress on this last sample.

References:

(1) M.Iannuzzi and A.La Monaca, Nuclear Instr. and Meth. 201, 197 (1982).
(2) L.Allocca, M.Iannuzzi and A.La Monaca, Nuclear Instr. and Meth. 219, 227 (1984).