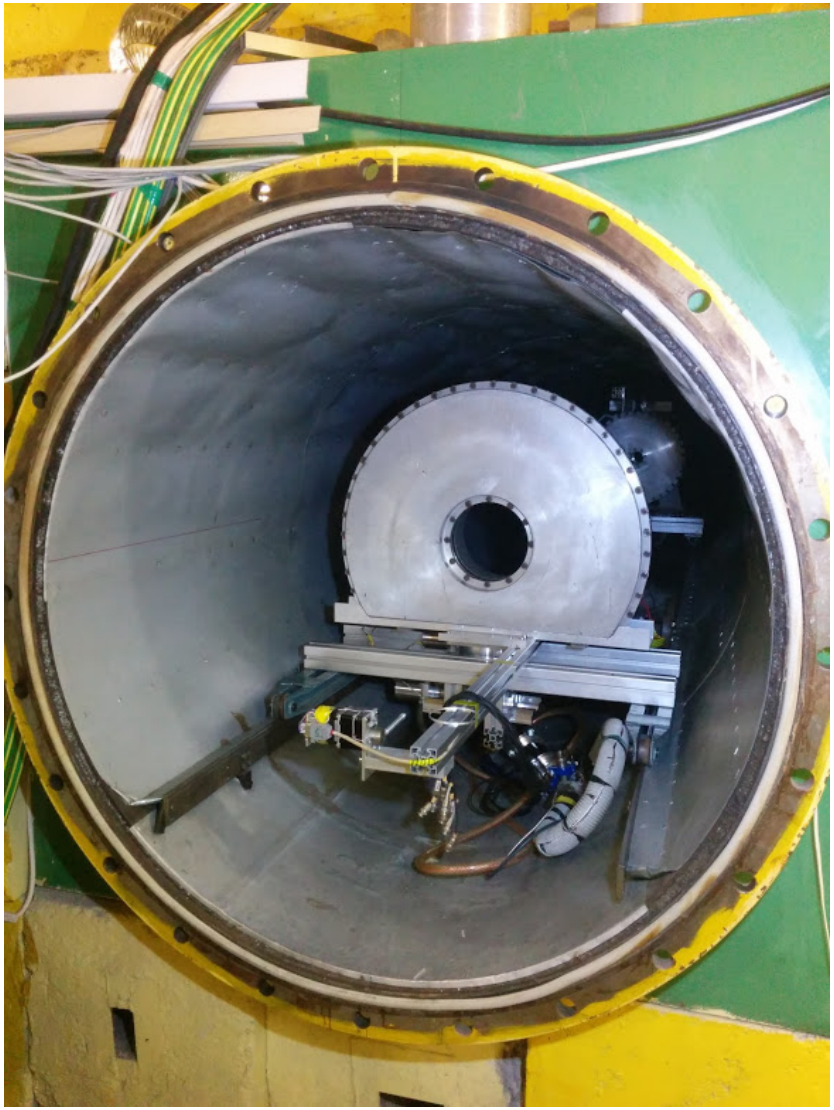
Primary data treatment software for position-sensitive detector of small-angle neutron scattering spectrometer in isotropic pattern scattering case

A.G.SOLOVIEV, S.A.KUTUZOV, O.I.IVANKOV, A.I.KUKLIN

YuMO SANS TOF spectrometer

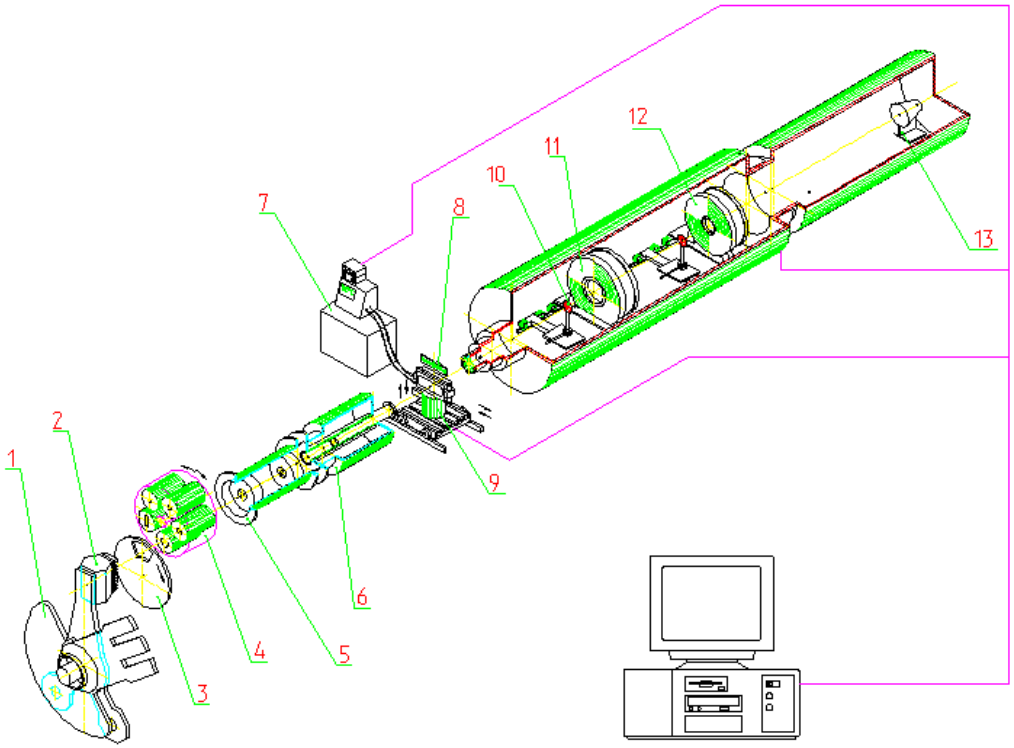
The key element of the modernized YuMO spectrometer is two detector system

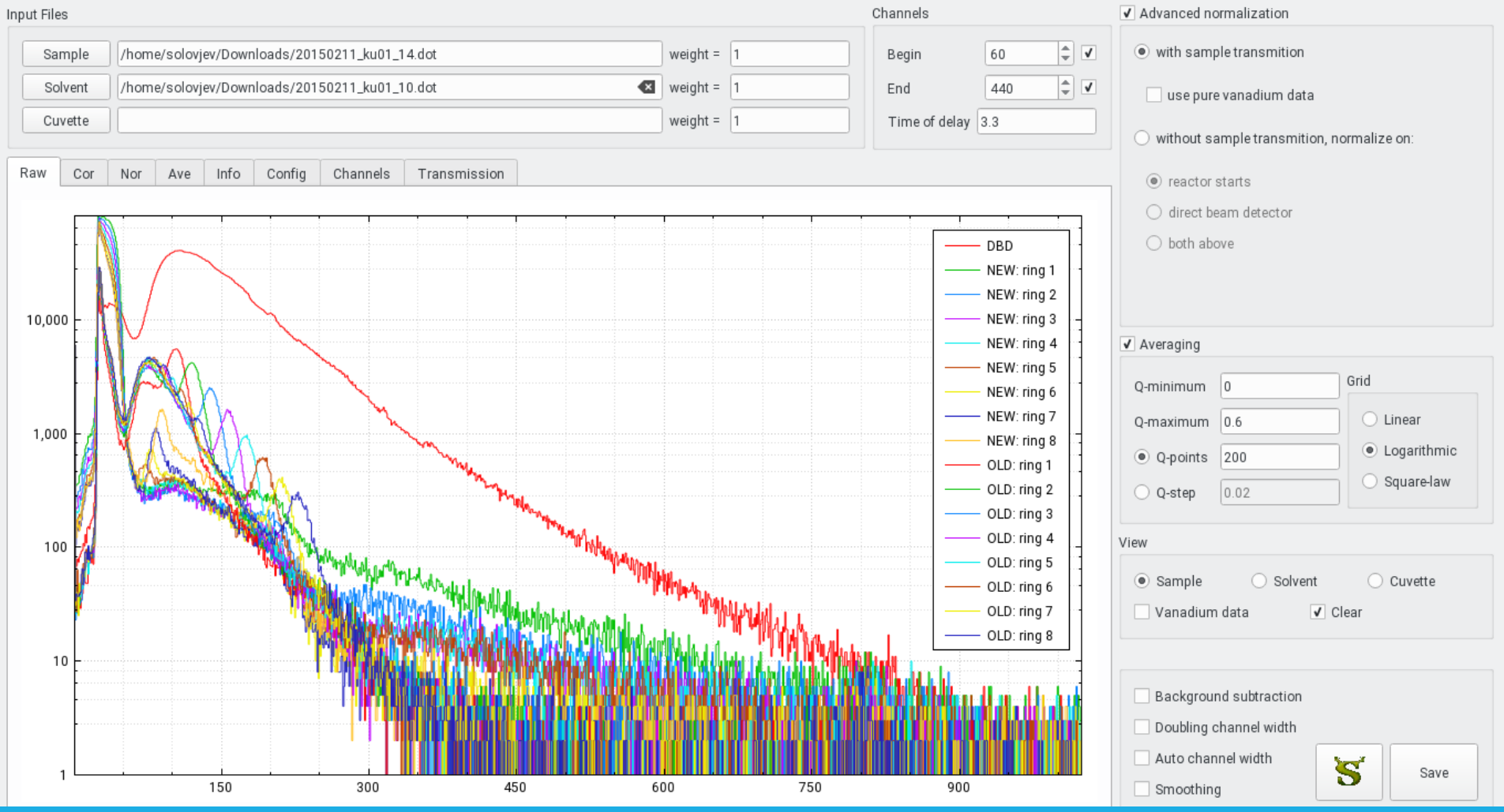
- dynamic range (Qmax/Qmin) has been considerably increased up to about 90
- data acquisition time has been reduced twice times



YuMO SANS TOF spectrometer

1 - reflectors, 2 - a zone of a reactor with moderator, 3 - the chopper, 4 - changeable collimator, 5 - a vacuum tube with additional background collimators, 6 – justified collimator, 7 - thermostat, 8 – holder with samples on the table with thermos boxes, 9 - a table of samples, 10 - the vanadium standard, 11, 12 - detectors ("OLD" and "NEW" accordingly), 13 - the detector of a direct beam.



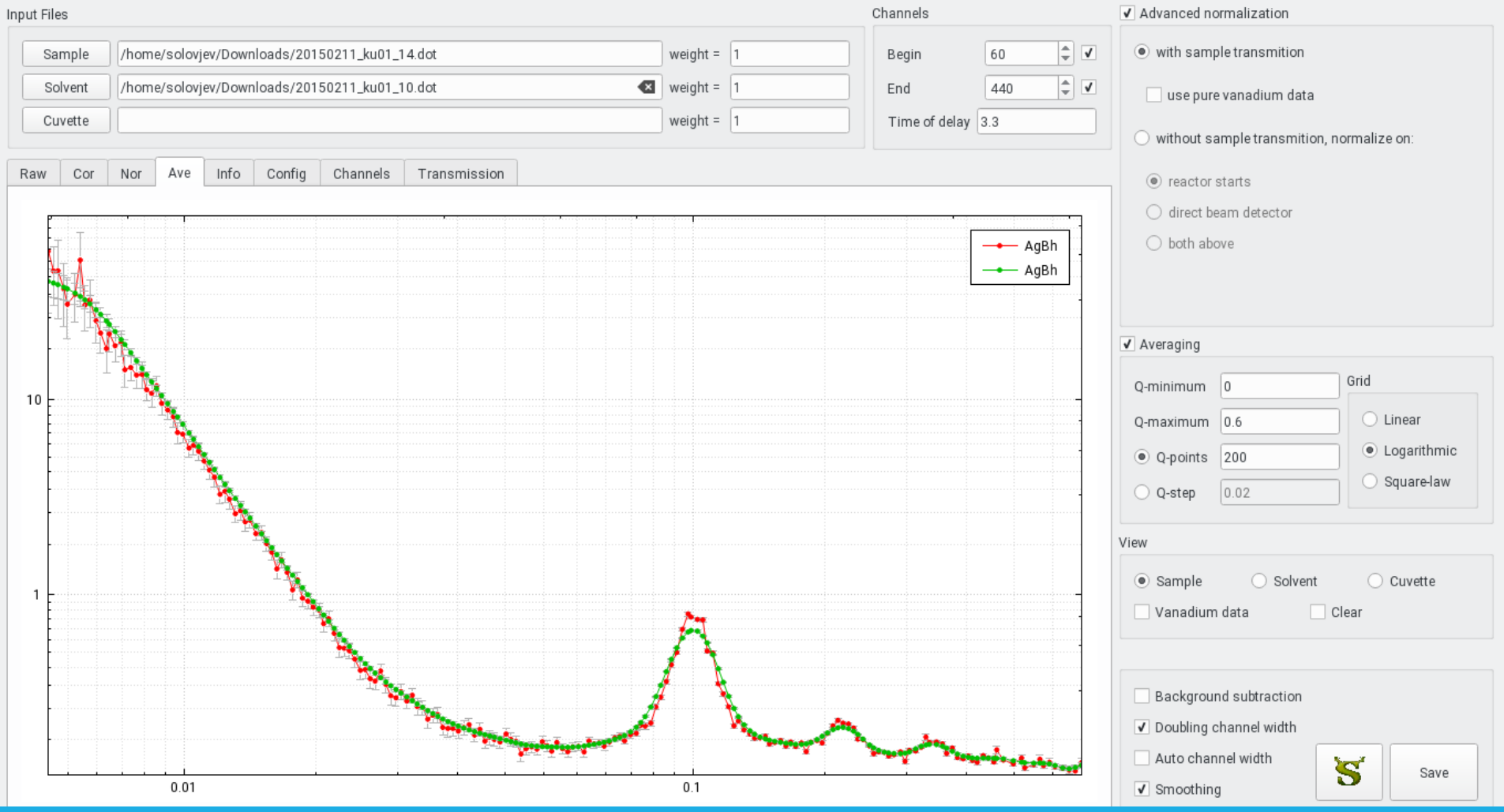


SAS

Package for small-angle neutron scattering data treatment

Processing with SAS includes:

- normalization of the time spectra over the scattering from the vanadium standard;
- conversion time spectra into the space of neutron momentum transfer.



SAS

Package for small-angle neutron scattering data treatment

Conversion into Q-space and averaging spectra.

- SAS does NOT operate with “OLD” and “NEW” detectors separately, and does NOT sew spectra.
- Instead, it operates with a set of their rings and produces the final spectrum in a natural way.

Position-sensitive detector

The modern trends in use of the small-angle scattering method consist in varying a sample environment, e.g. temperature, pressure, magnetic or electric fields. The objects under investigation can be oriented in the field or by the flow of a liquid. In this case the need for the position-sensitive detector (PSD) arises.

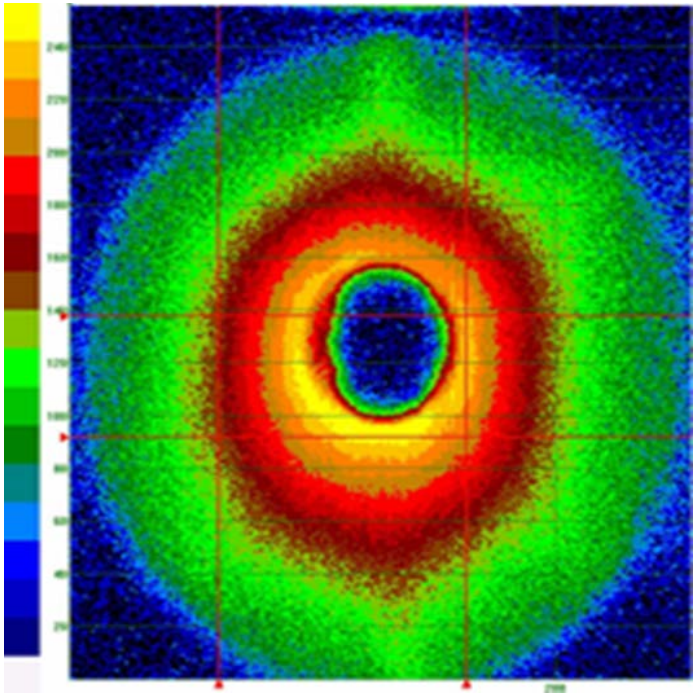
- PSD for YuMO spectrometer has been created and tested.
- PSD is planed to be mount either in the place of one of YuMO detectors, or in addition to them.

Position-sensitive detector “Volga”

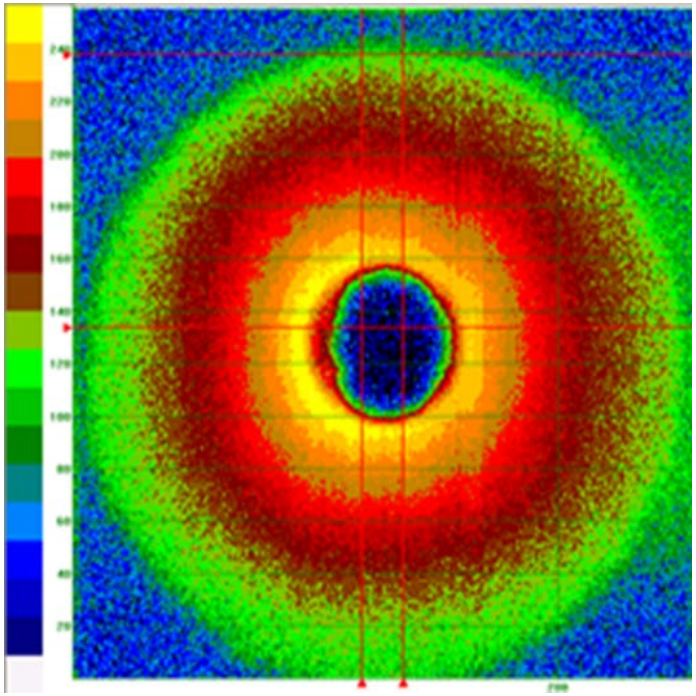
- External diameter: 1070 mm
- Central hole diameter: 70 mm
- Body material:Aluminum alloy
- Window thickness: 8 mm
- Detection depth: 40 mm
- Sensitive part: 600x600 mm
- Weight: 181 kg

Typical patterns of scattering

ANISOTROPIC



ISOTROPIC



PSD data processing

Note:

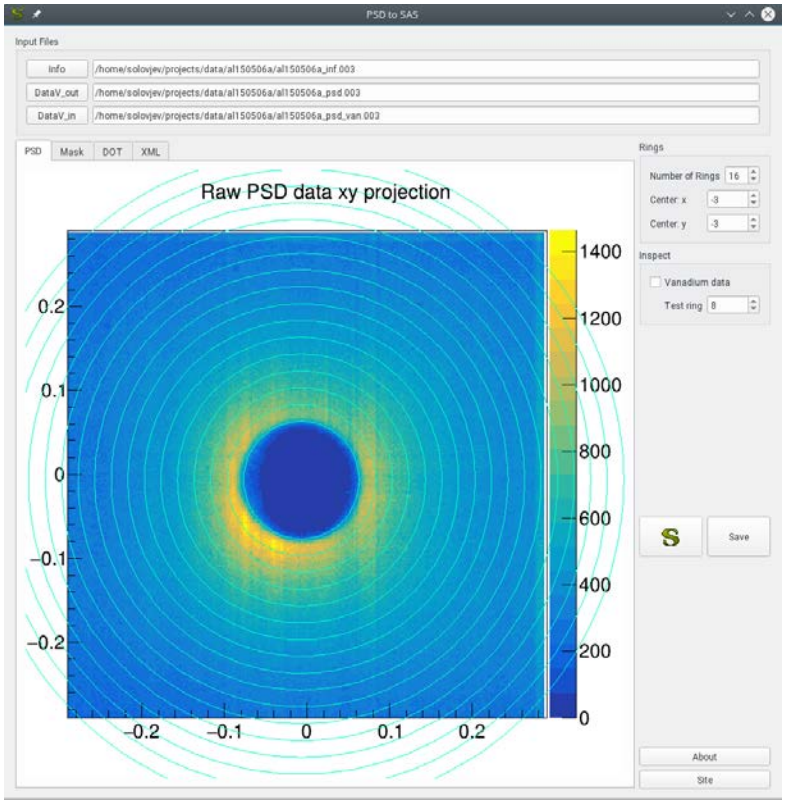
- In most of the experiments one needs isotropic pattern of scattering only.
- Due to small size of PSD cells statistics in them is often poor. That fact negatively impacts on data treatment.

In most cases is possible to combine PSD cells into concentric rings what

- improves statistics
- makes applicable the algorithms already used for data processing in SAS.

PSD2SAS

Data converter for position-sensitive detector of small-angle neutron scattering spectrometer in isotropic pattern scattering case



ROOT-based Qt Application.

Entire area of detector is used.

The crossection area of a cell and the resulting ring is taken into account.

OpenMP parallelism:

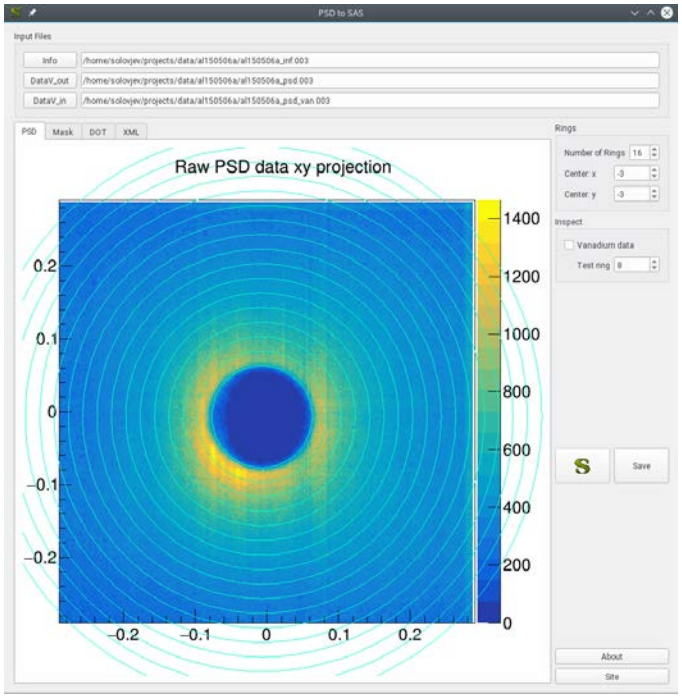
- reading data
- rings construction

https://wwwinfo.jinr.ru/programs/jinrlib/psd2sas/indexe.html

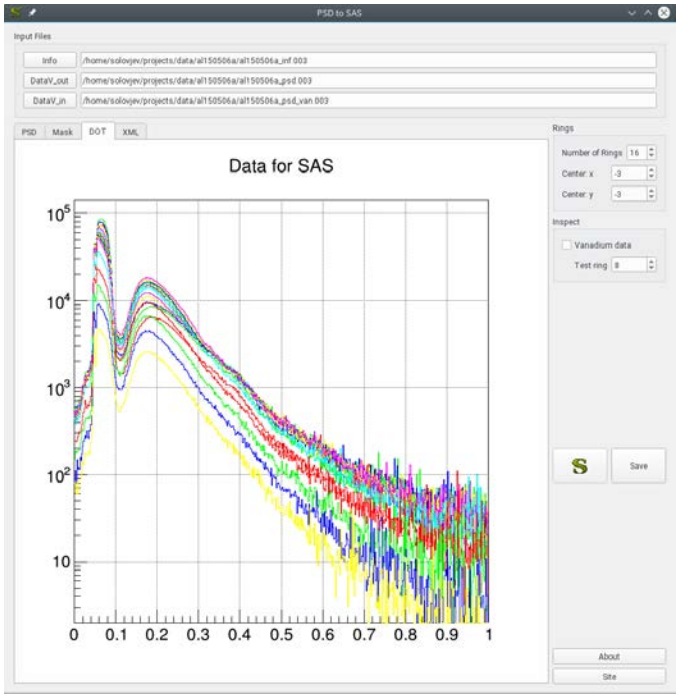
PSD2SAS

Data converter for position-sensitive detector of small-angle neutron scattering spectrometer in isotropic pattern scattering case

PSD RINGS PATTERN



TIME SPECTRA FOR RINGS SHOWN, READY FOR PROCESSING IN SAS



Conclusion

- The data converter for position-sensitive detector has been created.
- The Q-resolution provided by the detector is practically fully available.
- The Q-range provided for the detector is not truncated due to the use of detector edges.
- The program is fast, the time is comparable to the processing time in SAS.