The nongaussian behaviour of the spread function of the x-ray policapillary lens: characteristical cases and new nonstandard approximation models

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At the first view the spread function (SF) of a x-ray polycappillary lens is the symmetrical gaussian function [1]. However it is not right for the cases of the nonideal adjustment of lens' angles and positions that is almost always resulted from the complexity of synchronous setting many coordinative axises and from the limitations of its' accuracy for widely applied motorized stages. Especially it may be critical for cases of the micro-XRF experiments with «controlled retuning of lens' confocal value» [2, 3]. In these cases it often need to measure the spread function thoroughly (around wide spacial fields of the space after the lens) before the experiments, especially if required a sufficiently high presicion. Alternatively, it is may reduce a number of needed procedures by using the approximation models (i.e., by the description of behaviour of lens' spread function at the great number of intermediate positions).

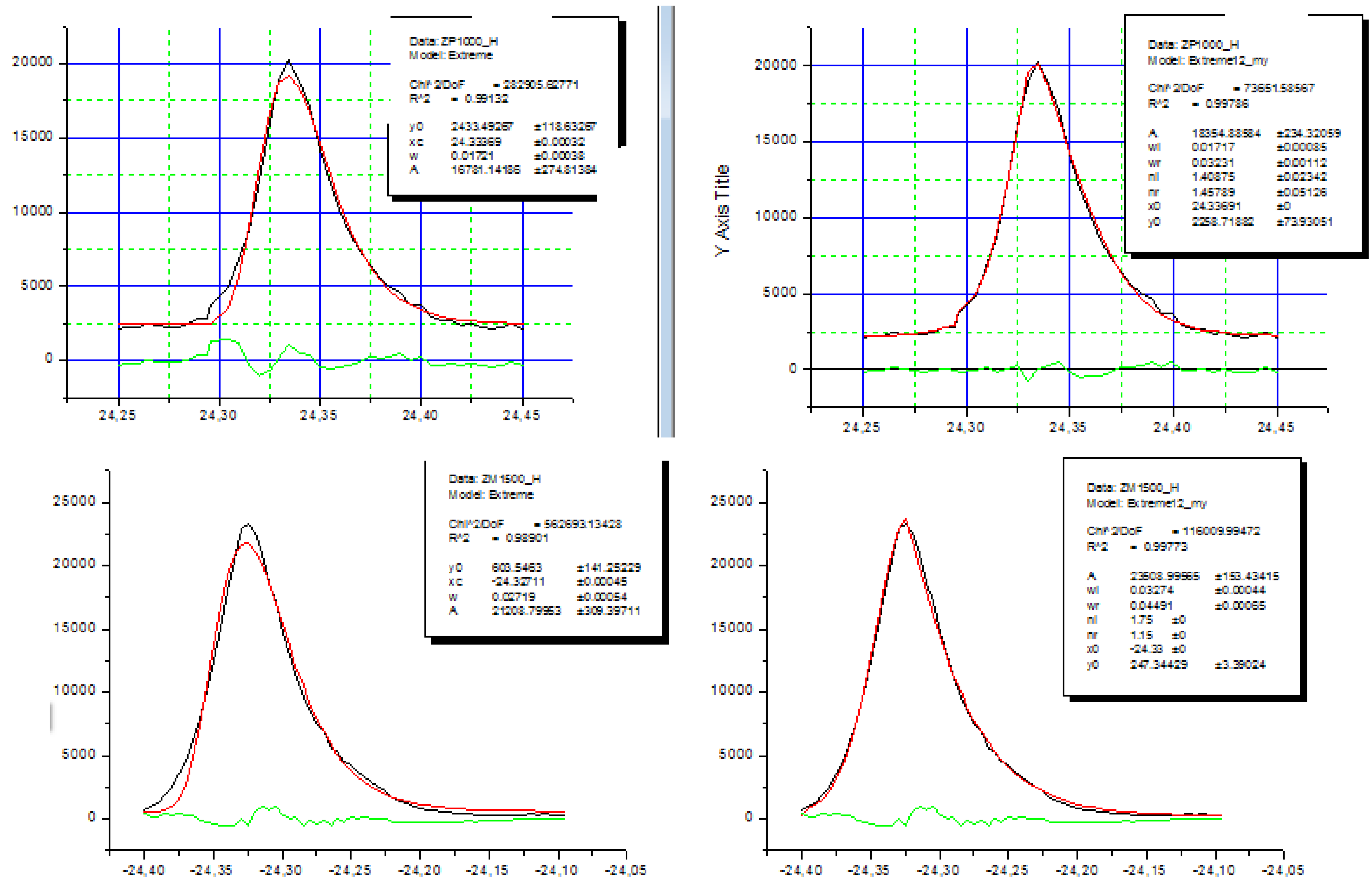

Fig. 1. The results of the fittings of the spread function of the x-ray policapillary lens by most perspective approximation models for one concrete case of lens' adjustment and two positions along axial directional (in relation to lens' focus position): -1500 mkm and 1000 mkm. The abscissa axes means the position of scanning (one step is 2 mkm), the ordinate axis is the fluorescence signals from tungsten. Black line is SF, red one is the fitting, green one is the fitting residuals.

We have analysed in detail the behaviour of lens' spread function at the example of a series of about ten cases of the final adjustment of the x-ray polycappillary lens. The SF around sifficiently wide spacial fields was defined by using the procedure [2] including lateral scanning tungsten wire sample near several specific positions along lens' axial direction. After that a range of approximation model were tested by us. The results with relatively good quality are resulted by using the «extreme peak» model [4]. This approximation model specifically modified by us results in the fitting results with best quality. All other model including fitting by an asymmetric gaussian showed very poor results. However it should say that the results of strong statistical tests [e.x., 5] of normality for fitting resuduals are fail for many cases. Consequently we may consider that hypotetical ideal approximation model is probably more complex.
As a result the «extreme peak» approximation model and this model specifically modified by us are very perspective ones to use for the quantitative description of the spread function of x-ray polycapillary lens after its adjustment under the increased requirements to it's quality.

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[3] F. Darin, D. Sorokoletov, Ya. Rakshun et el. On the search and localization of platinum group microelements in samples of the chromote horizon in the Bushveld complex. // Journal of surface investigation: x-ray, synchrotron and neutron techniques, 12 (1), 2018, 123-127
[4] http://www.originlab.com/pdfs/16_CurveFitting.pdf; [5] http://www.mathworks.com/help/stats/lillietest.html

This work is supported by RFBR Grant № no. 19-05-50046.
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