# Influence of real photons diffraction contribution on parametric X-ray observed characteristics

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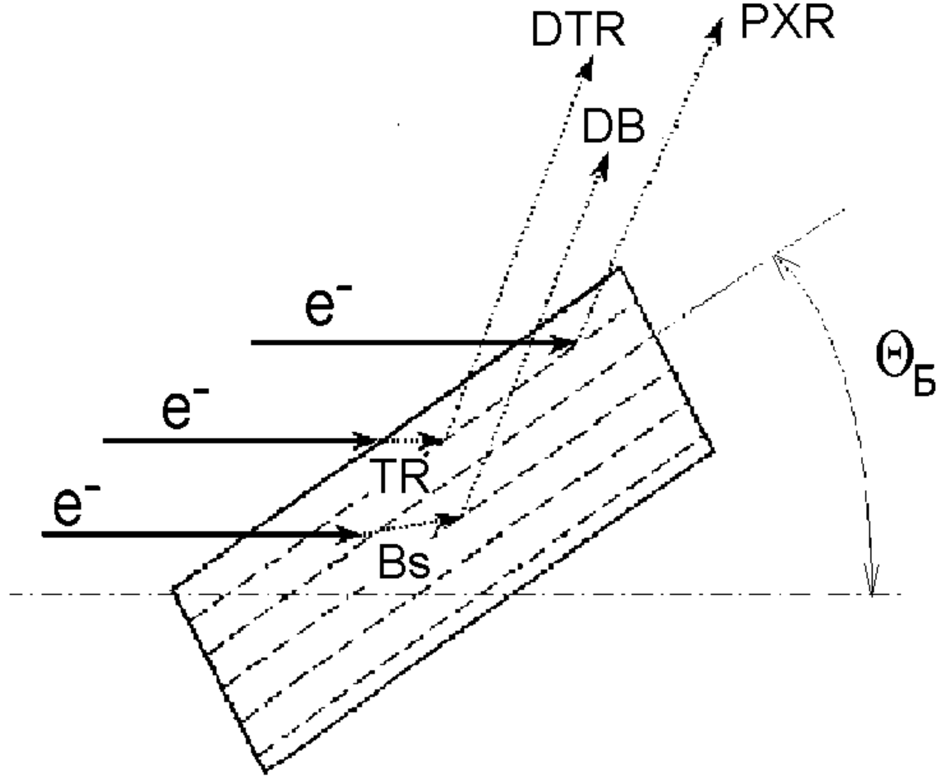
Aim –careful comparison of the experimental data taking into account all experimental condition and different types of photons emissions

# Contribution of different radiation types into photon yield measured




PXR – polarized; Bs – polarized ( for thin target); TR –polarized
Diffraction changes polarization because of the different reflectivity for emission with the different direction of polarization vector.

# Calculation technique

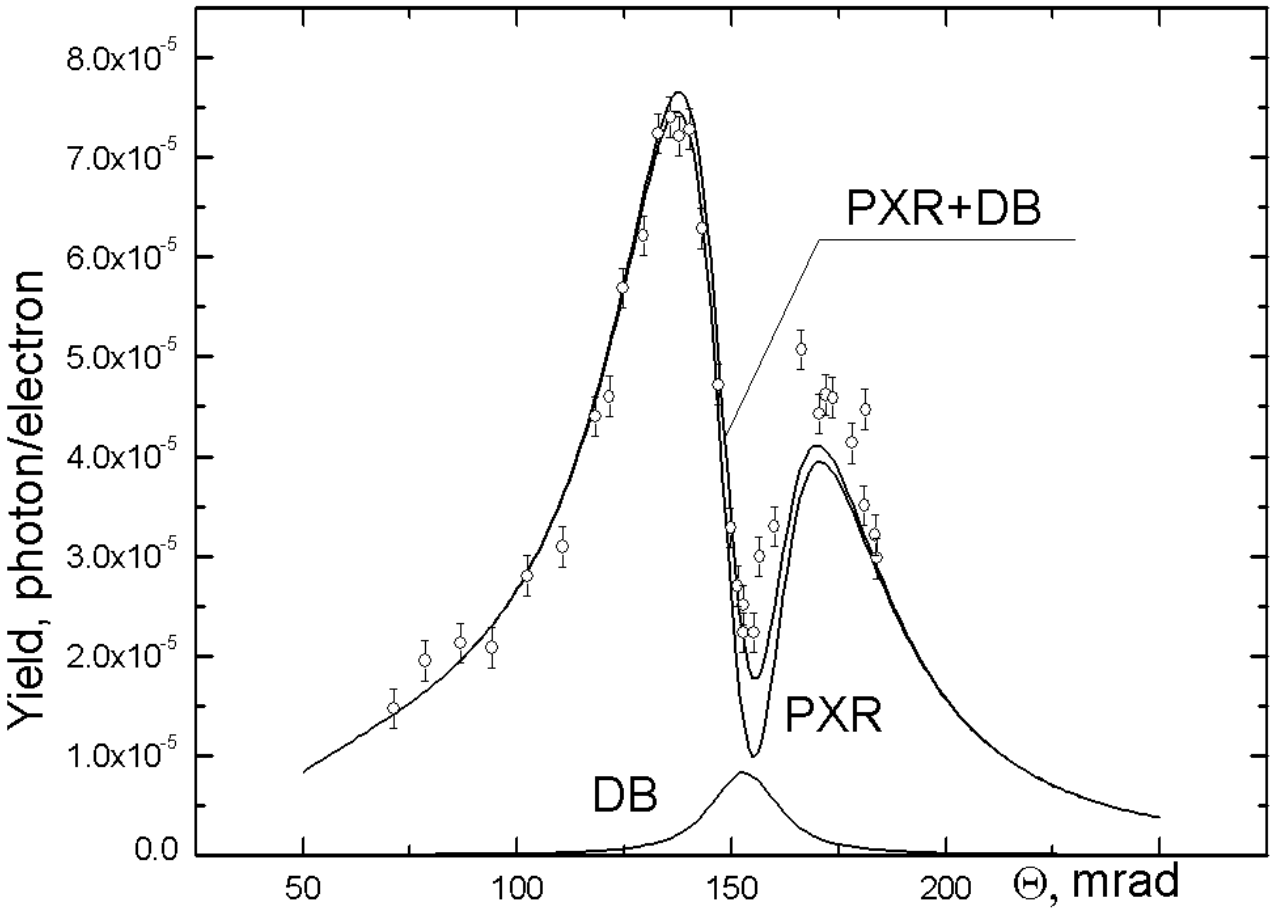
$$\frac{d^2N}{dZd\Omega}=\frac{\sum_{\nu}\alpha\omega^3\left|\chi_{\vec{g}}\right|^2}{2\pi\varepsilon^{3/2}(1-\sqrt{\varepsilon_0}\vec{\beta}\vec{n})}\left[\frac{(\omega\vec{\beta}-\vec{g})\vec{e}_{\vec{k}\nu}}{(\vec{k}_{\perp}+\vec{g}_{\perp})^2+\frac{\omega_p^2}{\beta^2}\{\gamma^{-2}+\beta^2(1-\varepsilon_0)\}}\right]^2$$

$$N_{\mathrm{DB}}(\Theta)=\int_0^T dt\int d\omega\int\frac{d^2I^*_{TИ}}{d\omega d\Omega}R(\omega,\vec{n},\vec{g},\vec{n}',t)S(\omega,\vec{n},\vec{n}',t)d\Omega$$

Darvin "table" $\Delta\omega=\omega\cos(\Theta)\Delta\Theta/\sin(\Theta)$

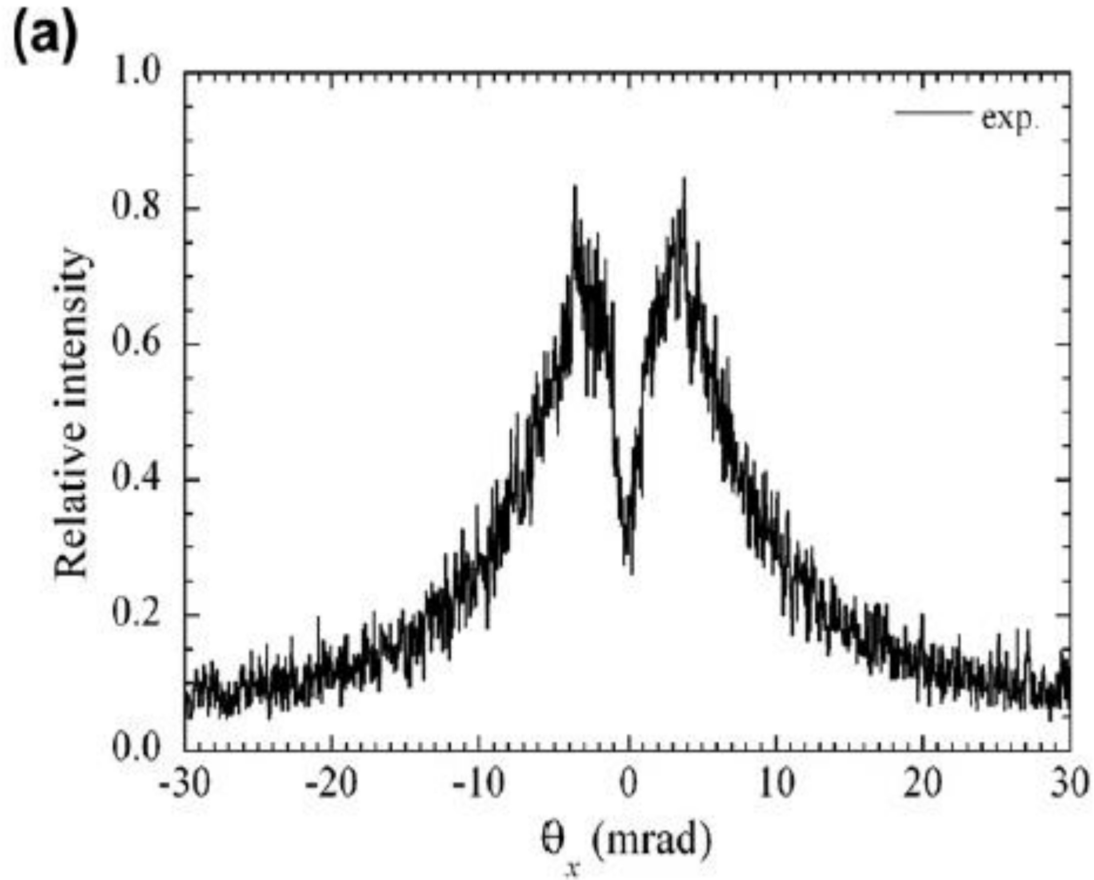
$\Delta\Theta=2\gamma\Delta\theta_0$ $\theta_0=\frac{2\delta}{\sin(2\Theta)}$ $\delta=(\omega_p/\omega)^2/2$ $\gamma=\frac{f(g)}{f(0)}(1+\cos(2\Theta))/2$

Theta-scan, silicon (111), E=15.7 MeV, T= 17 mm
Shchagin A. V.,Pristupa V. I., Khizhnyak N. A.
//Phys. Lett. A. 1990. V.148. P.485.



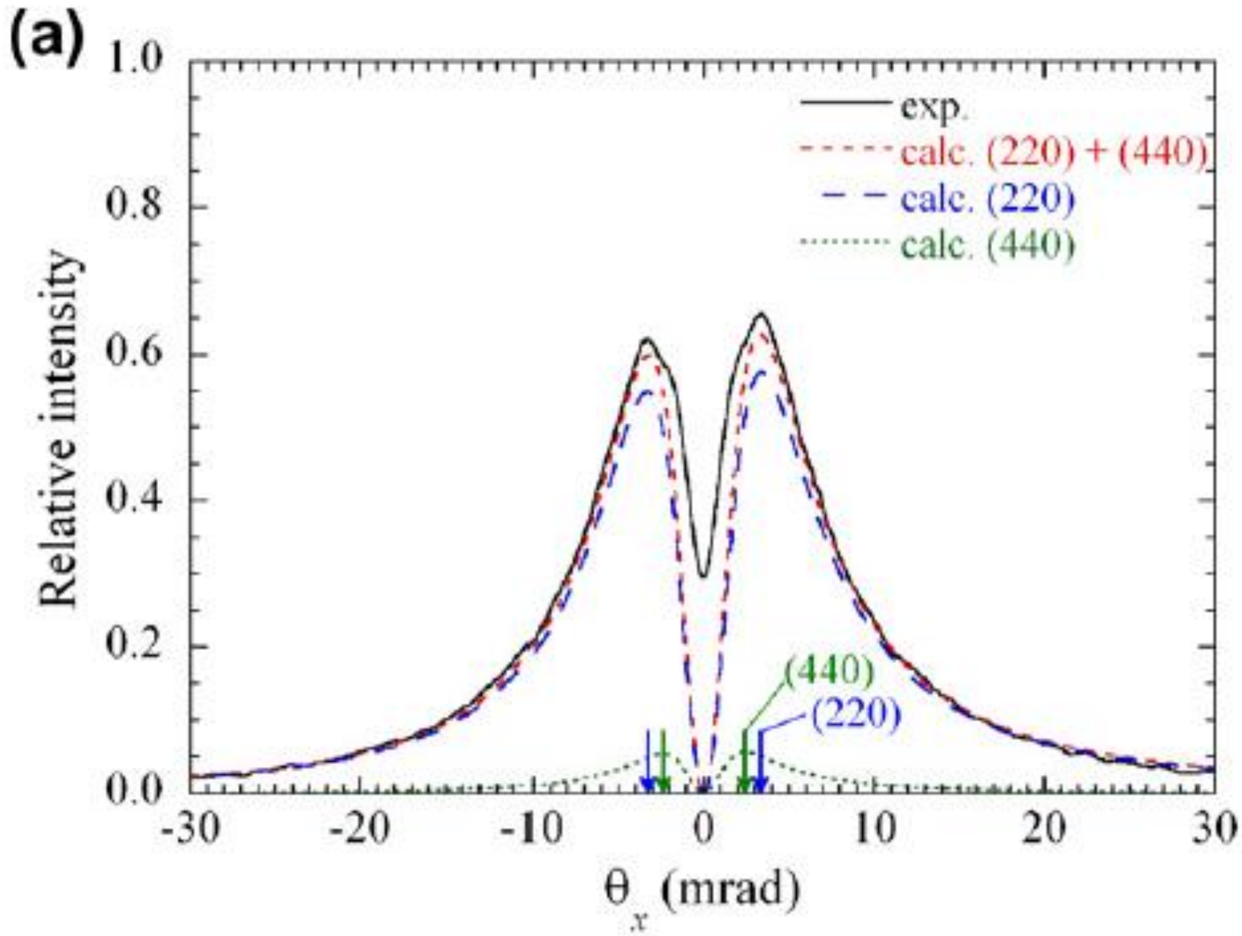
# Angular distribution

Takabayashi Y., Shchagin A.V. NIM B V. 278 (2012) P.78

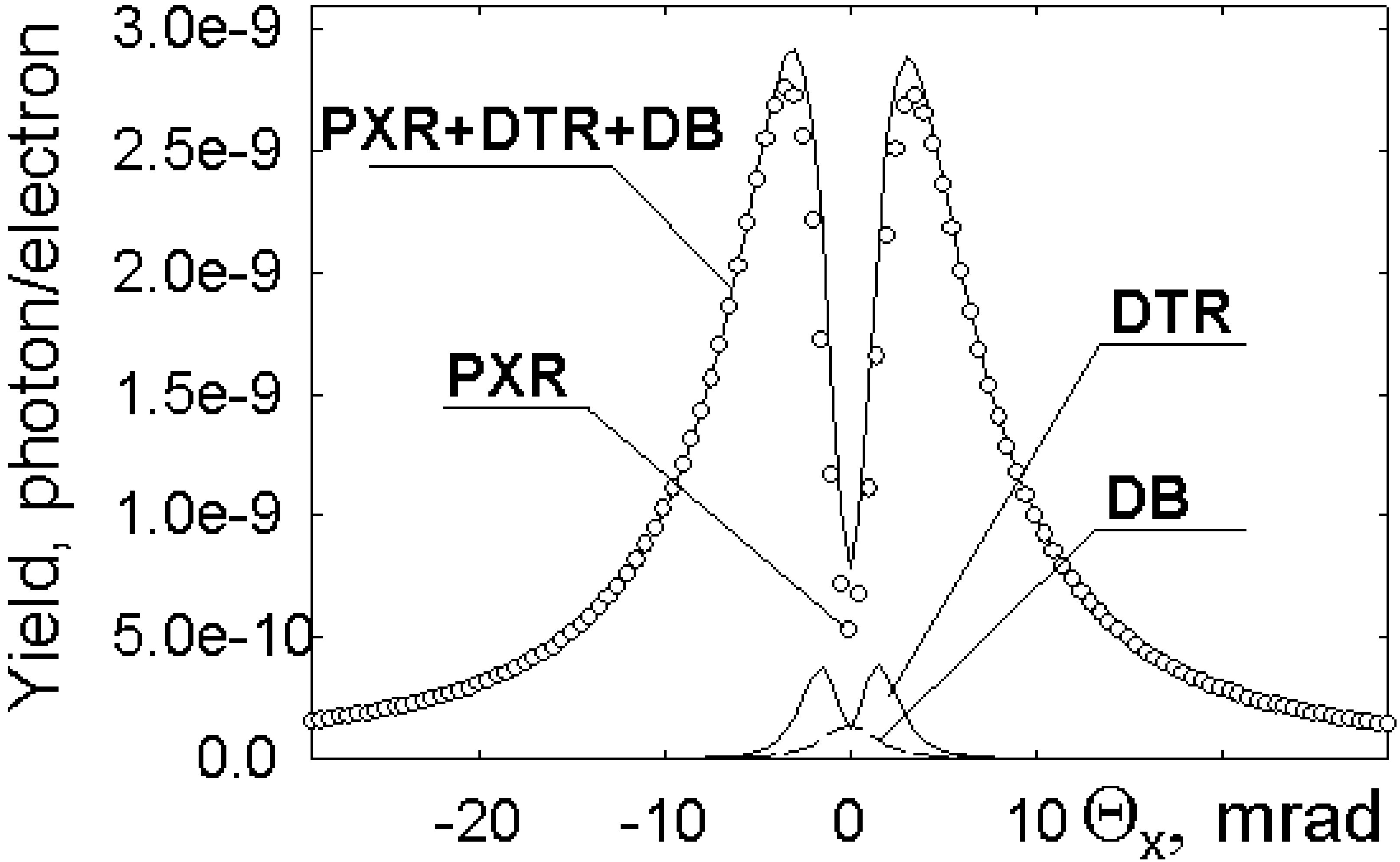



E=255 MeV, Silicon, (110), T=20 microns

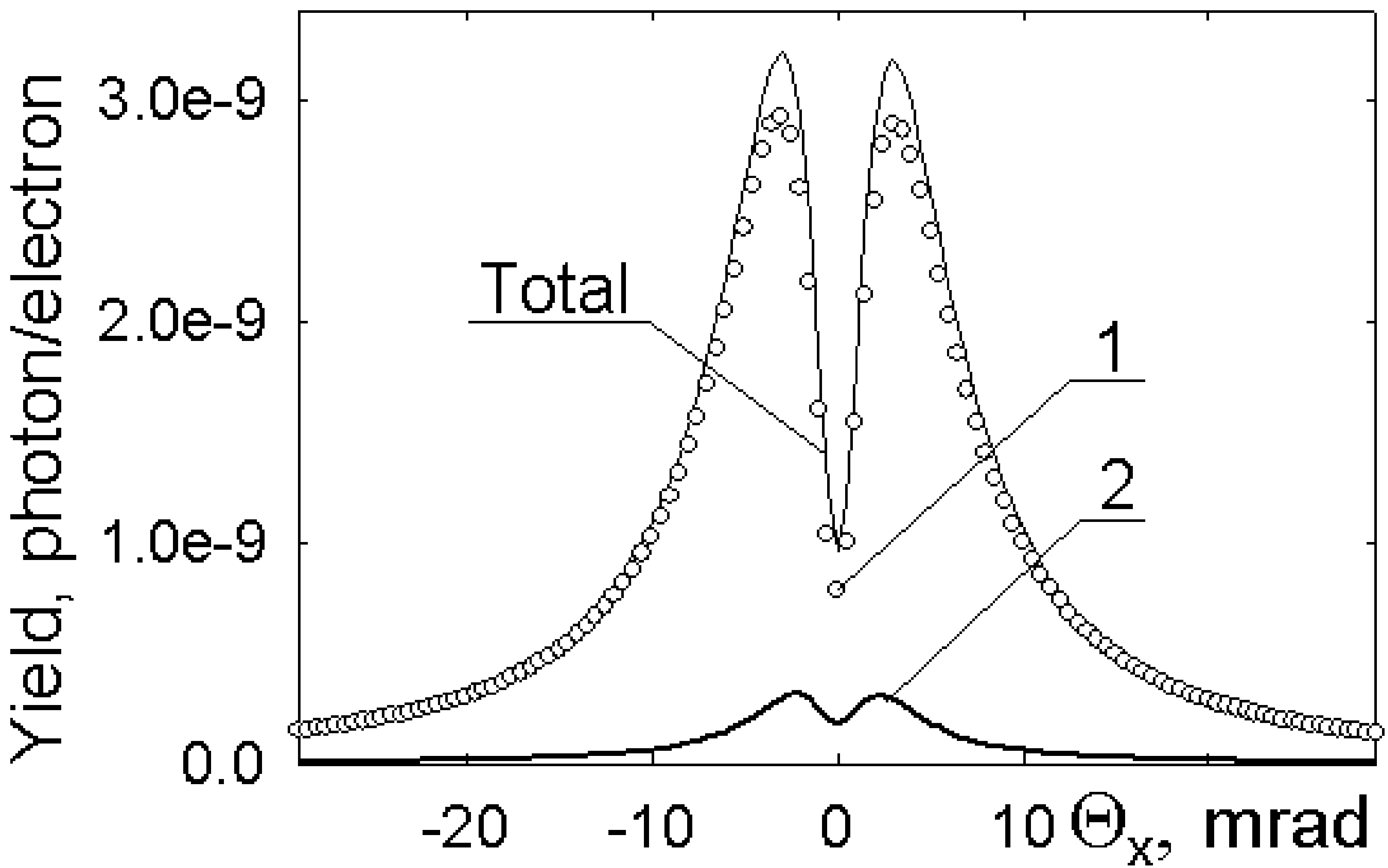
# Angular distribution (Author's calculation )



# Angular distribution for the first order (our calculation)

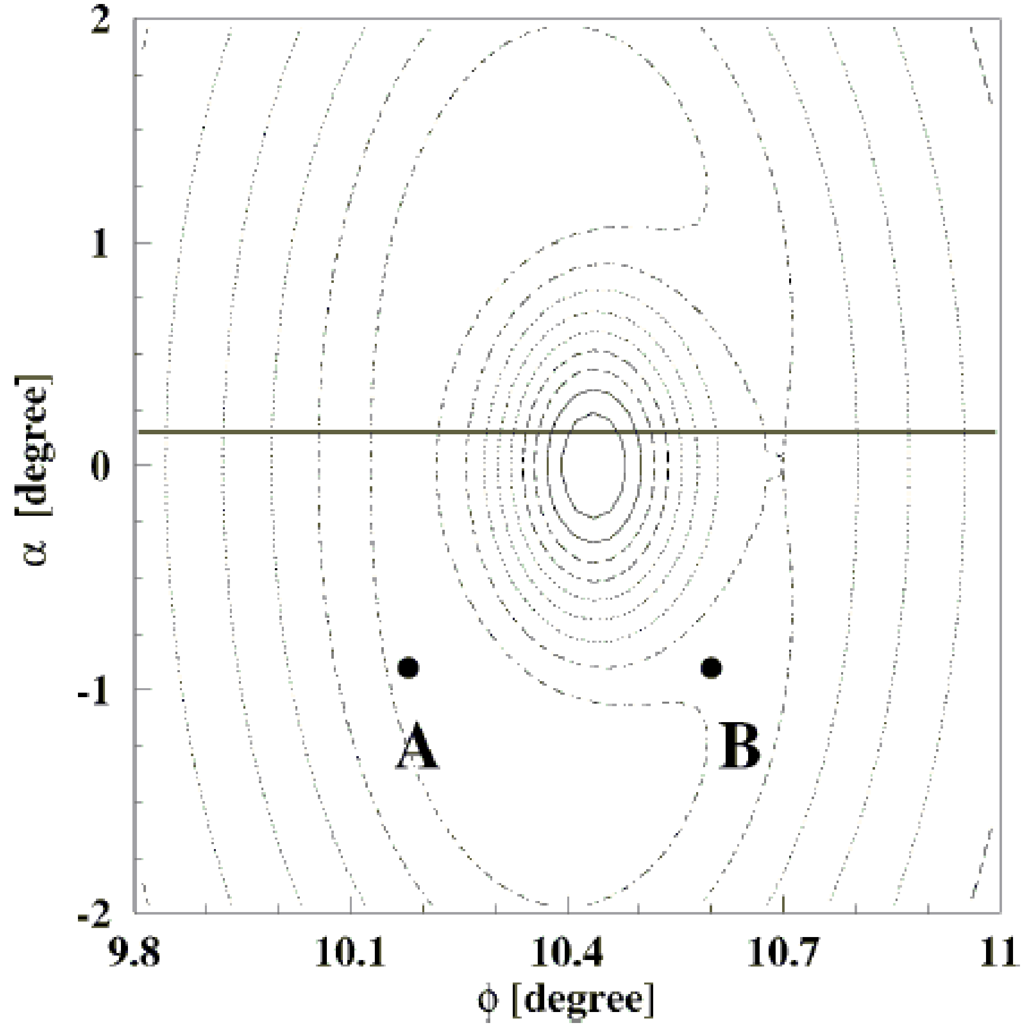


# Angular distribution for two diffraction orders



Pugachov D. et al. Physics Let, A286 (2001) P.70 and NIMB V201 (2003) P. 55

E= 72 MeV, Silicon , (111), T= 20 microns



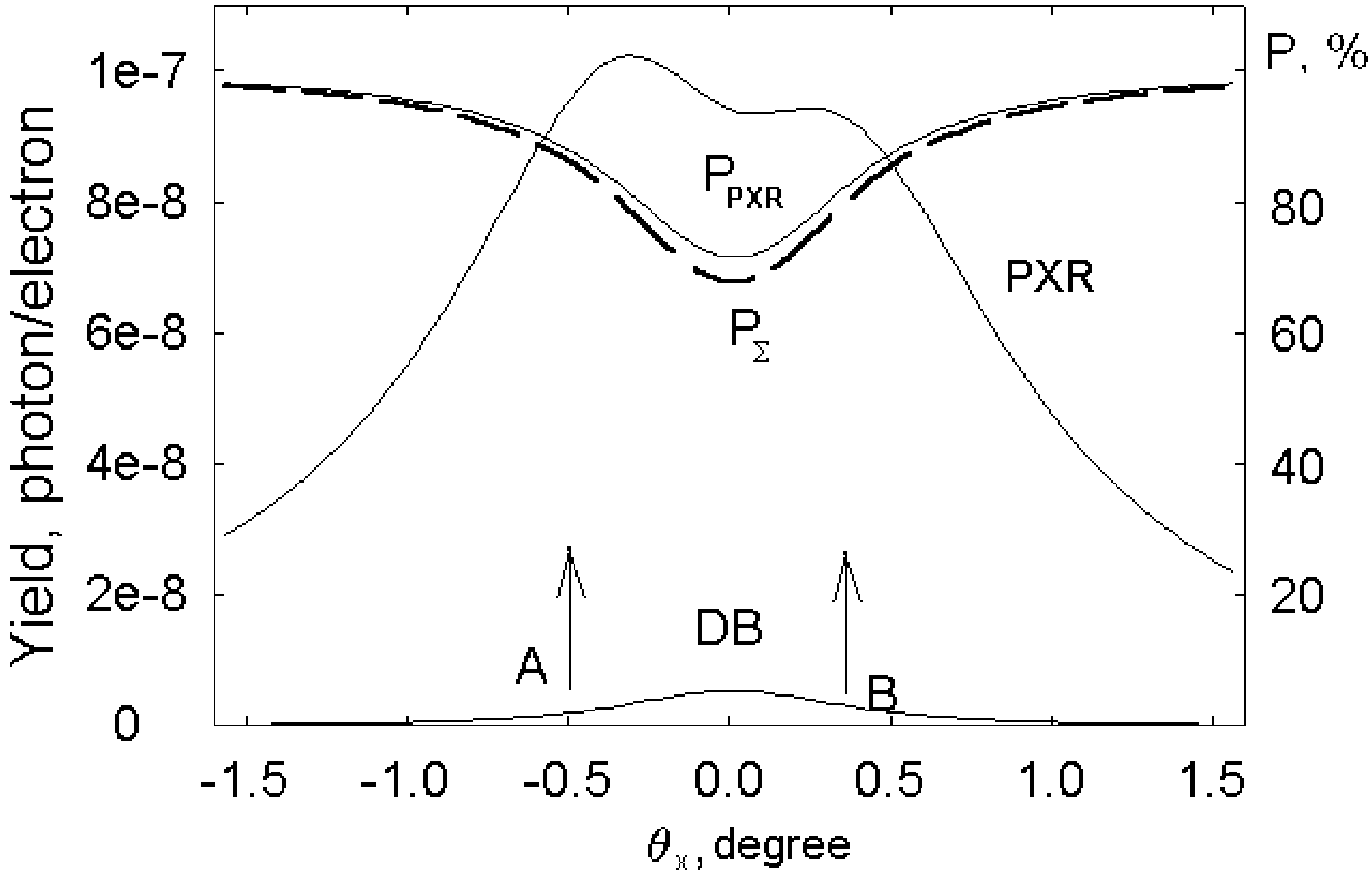
# Experimental condition

| Points | $\theta_x$,° | $\theta_y$,° | $\vartheta$,° | x, mm | y, mm |
|---|---|---|---|---|---|
| A | 0.5 | 0.328 | 0.6 | 3.2 | 2.1 |
| B | -0.34 | 0.328 | 0.47 | 2.2 | 2.1 |
| C | 0.14 | 0.385 | 0.41 | 0.9 | 2.46 |
| D | 0.3 | 0.355 | 0.46 | 1.92 | 2.27 |
| E | 0.42 | 0.27 | 0.5 | 2.68 | 1.72 |
| F | 0.52 | 0.136 | 0.54 | 3.322 | 0.869 |
| G | 0.54 | 0.018 | 0.54 | 3.45 | 0.015 |
| H | 0.14 | 0.385 | 0.41 | 0.9 | 2.46 |

# Calculation results

| Points | $P_{exp}$ | $\Psi_{exp}, ^\circ$ | $\Psi_{calc}^{they}, ^\circ$ | $P_{calc}$ | $\Psi_{calc}, ^\circ$ |
|---|---|---|---|---|---|
| A(0.6) | 0.86 | 45.8 | 34.3 | 0.88 | 34.69 |
| B(0.47) | 0.66 | 52.4 | 46.4 | 0.82 | 44.95 |
| C(0.41) | 0.87 | 73.5 | 70 | 0.77 | 68.3 |
| D(0.46) | 0.79 | 58.6 | 50.5 | 0.84 | 53 |
| E(0.5) | 0.75 | 43.7 | 33.2 | 0.835 | 33.9 |
| F(0.54) | 0.85 | 12.3 | 15.1 | 0.84 | 15.5 |
| G(0.54) | 0.84 | 5.7 | 1.9 | 0.845 | 1.95 |
| H(0.41) | 0.79 | 68 | 70 | 0.77 | 68.3 |

# Calculation results, Angular distribution



# Conclusion

1) Contribution of real photon diffraction into PXR spectrum measured for thin crystals is not negligible, especially for small emission angle relatively center of the PXR spot.
2) For this crystals we should use more complicated technique then for thick ones. Approximation 50:50 is to rough.
3) Real photon diffraction contribution should be taken into account for the calculation of total emission polarization especially for small angles relatively center of the PXR reflex.