# Comparison of the Smith-Purcell radiation yield for different models

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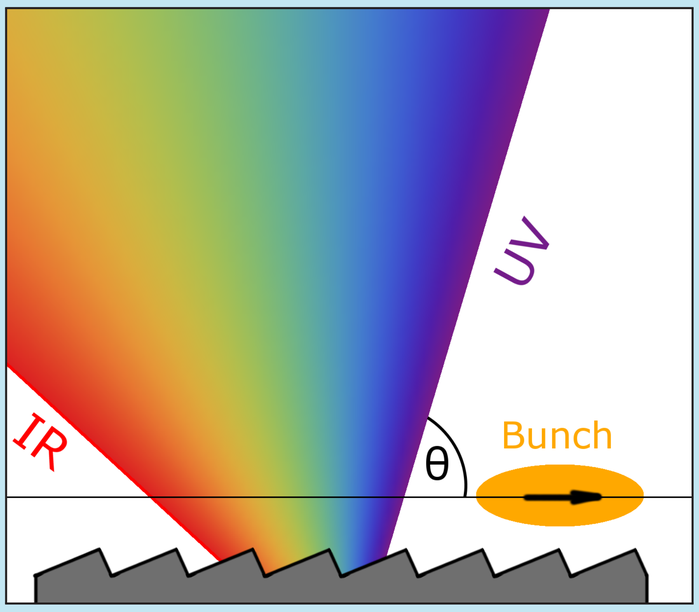
## Smith-Purcell radiation

Smith-Purcell radiation is a phenomenon observed, when a charged particle moves near a periodical grating

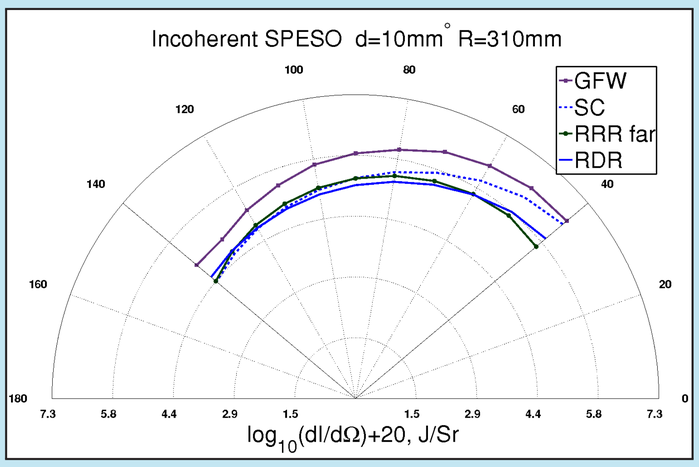



It has a specific wavelength dependency:

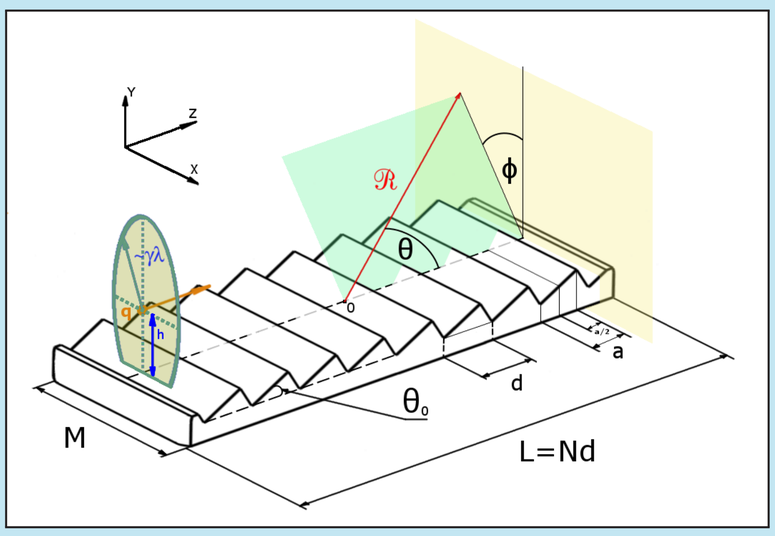
$$\lambda = \frac{d}{n}\left(\frac{1}{\beta} - \cos\theta\right)$$

## Smith-Purcell SEY

Prediction of the Smith-Purcell Radiation single electron yield for the SPESO parameters



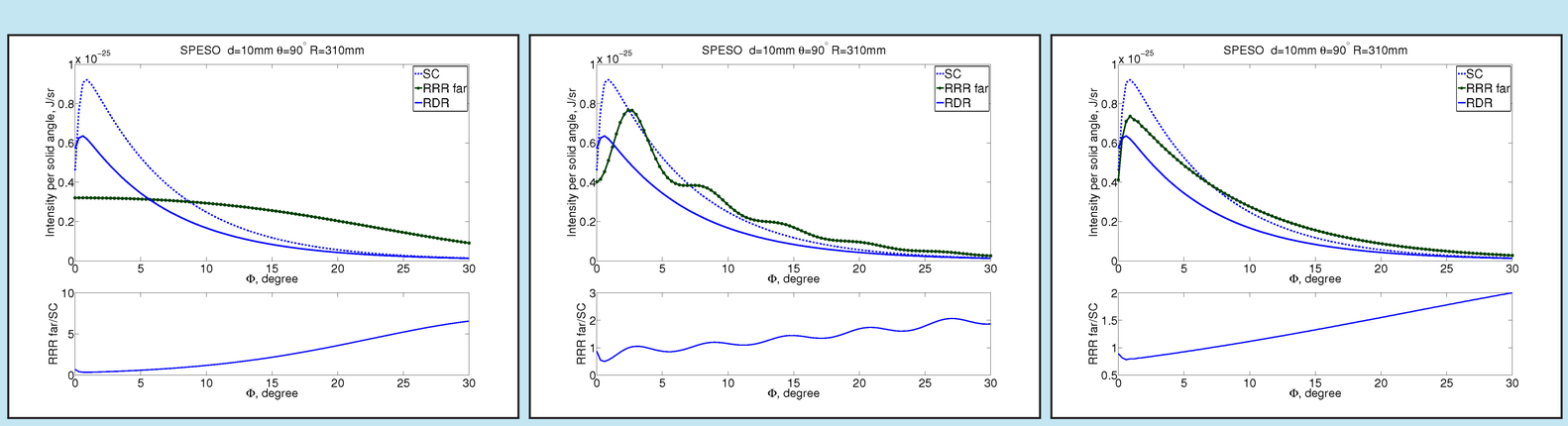

## Parameters




| Symb. | SPESO | E203 | Units | Description |
|---|---|---|---|---|
| $\gamma$ | 200 | $4\times10^4$ | 1 | The Lorentz factor (E=100 MeV) |
| $d$ | 10 | 0.25 | mm | The grating period |
| $a$ | 7.5 | 0.187 | mm | The width of one strip |
| $R_0$ | 310 | 220 | mm | The distance between detector and grating |
| $L$ | 90 | 40 | mm | The length of the grating |
| $M$ | 20 | 20 | mm | The width of the grating |
| $h$ | 5 | 1 | mm | The beam-grating separation |
| $\theta_0$ | 30 | 30 | deg | The blaze angle |
| $C_1'$ | 400 | 6395 | $mm^{-3}$ | The normalization constant for the RRR model |

## Grating width influence on the SPR phi distribution

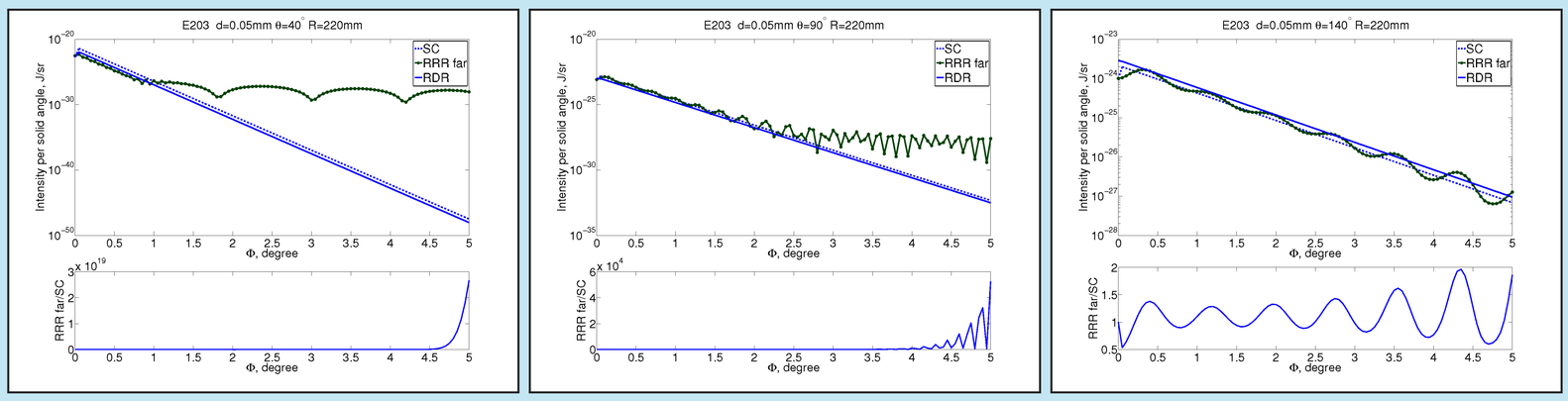
With the increase of the grating width, the RRR model tends to have same distribution as the SC and RDR models. The parameters are from the SPESO experiment.




M=20mm | M=200mm | M=2000mm

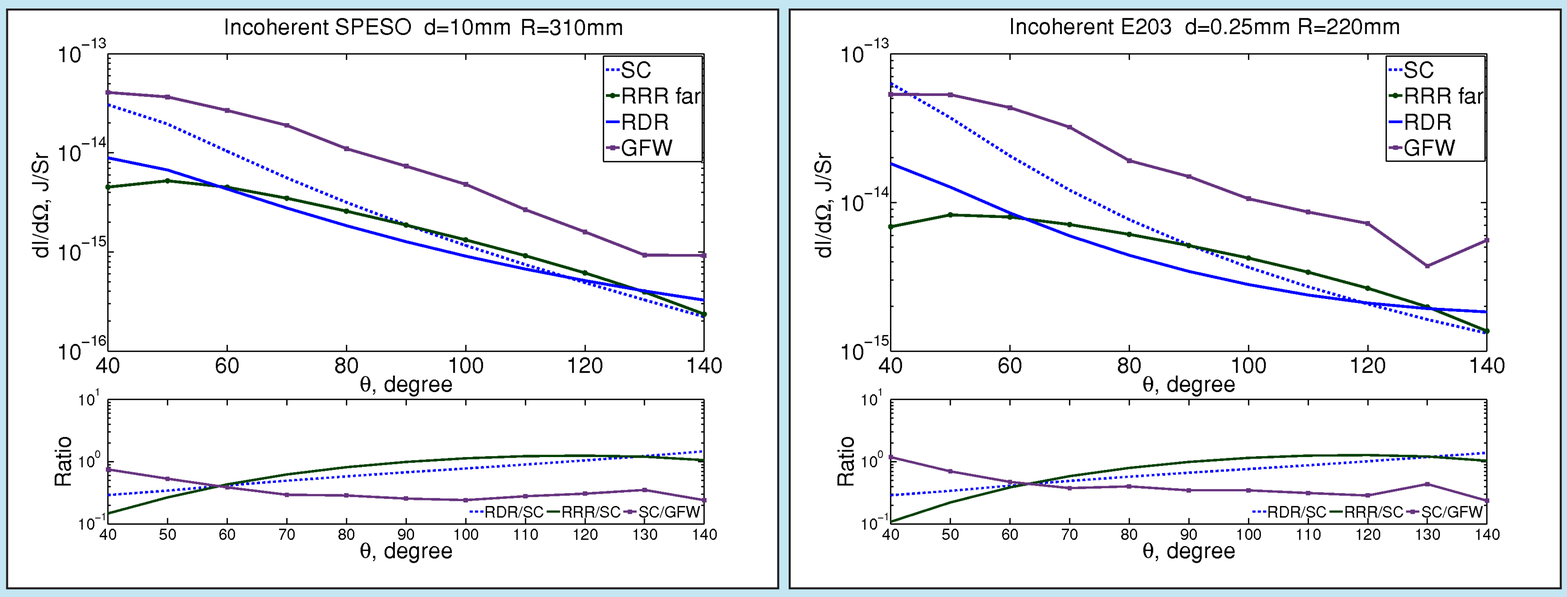
## SPR phi distributions at different $\theta$ angles

Increasing the observation angle means the decrease of the wavelength, as result the influence of the grating width will be more intense at larger phi. The parameters are from the E203 experiment, the pitch is d=50$\mu m$.




$\theta = 40°$ | $\theta = 90°$ | $\theta = 140°$

## Comparison of the SPR SEY for different models




SPESO experiment parameters, d=10mm | E203 experiment parameters, d=0.25 mm

**Conclusions:** The simulation shows that the SC and RDR models are in agreement within experimental errors. The RRR model is also close to the RDR and SC. GFW does a more detailed treatment of the grating profile and the simulations predict an intensity about 10 times bigger. The ratios between the models are not changing much with the parameters (except the observation angle), which means that it is possible to introduce a parameter-independent model correction factor.

## References

[1] D. V. Karlovets and A. P. Potylitsyn., *Phys. Rev. ST Accel. Beams*, vol. 9, p. 080701, 2006.
[2] J. H. Brownell, J. Walsh, G. Doucas, *Phys. Rev. E* vol. 57, pp. 1075–1080, 1998.
[3] D. V. Karlovets and A. P. Potylitsyn., *JETP Letters*, vol. 84, no. 9, pp. 489-–493, 2006.

## Models

The models, that were used: **R**esonance **D**iffraction **R**adiation (**RDR**) [1] **S**urface **C**urrent (**SC [1], GFW [2]**), **R**esonance **R**eflection **R**adiation (**RRR**) [3].

For the Surface current models, the SC model makes the assumption that the width of the grating is infinite, whether the GFW model uses a finite width.