



Science and
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Fringe field considerations for spiral FFA simulations

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Model fringe field

Enge fringe field: $\mathcal{F}(d) = \frac{1}{1 + \exp(P(d))}$

Simplest Enge: $P(d) = C_1 \frac{d}{\lambda}$ (equivalent to tanh)

Scaling condition:
$$\begin{cases} d = r \left(\theta_{EFBen} - \left(\theta - \tan \zeta \ln \frac{r}{r_0} \right) \right) \\ \lambda = \frac{r}{r_0} \lambda_0 \quad (\text{Full gap height } \lambda_0) \end{cases}$$

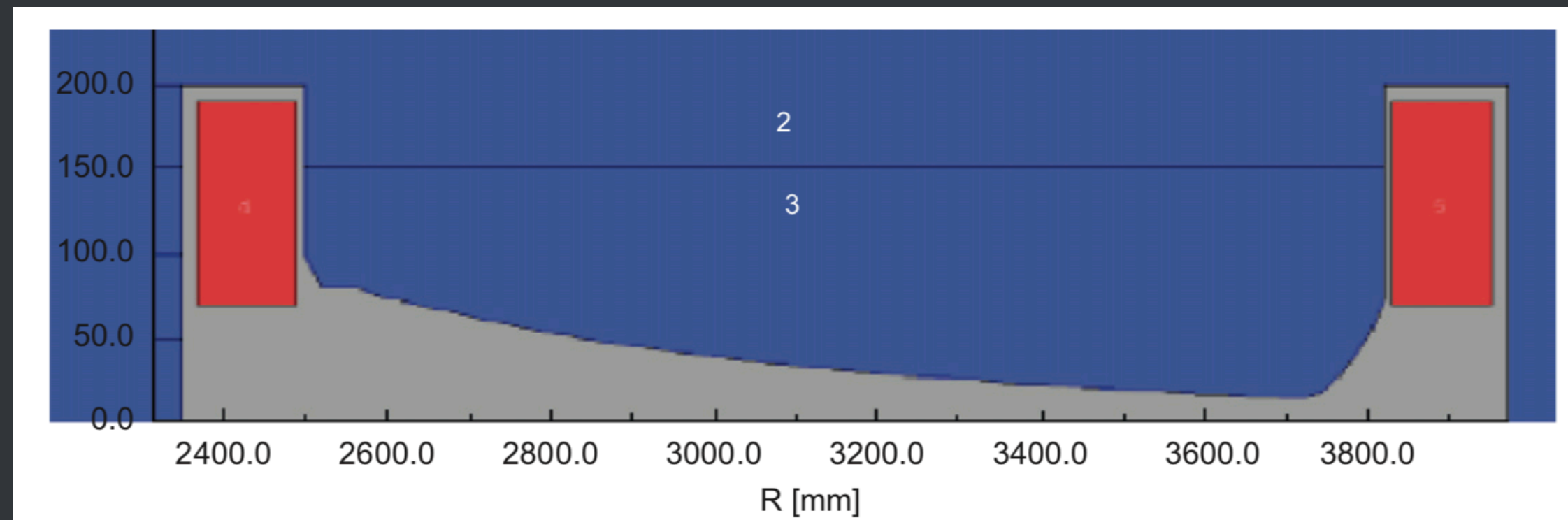
$\Rightarrow P(\theta) = C_1 \frac{r_0}{\lambda_0} \left(\theta_{EFBen} - \left(\theta - \tan \zeta \ln \frac{r}{r_0} \right) \right)$

C_1 coefficient

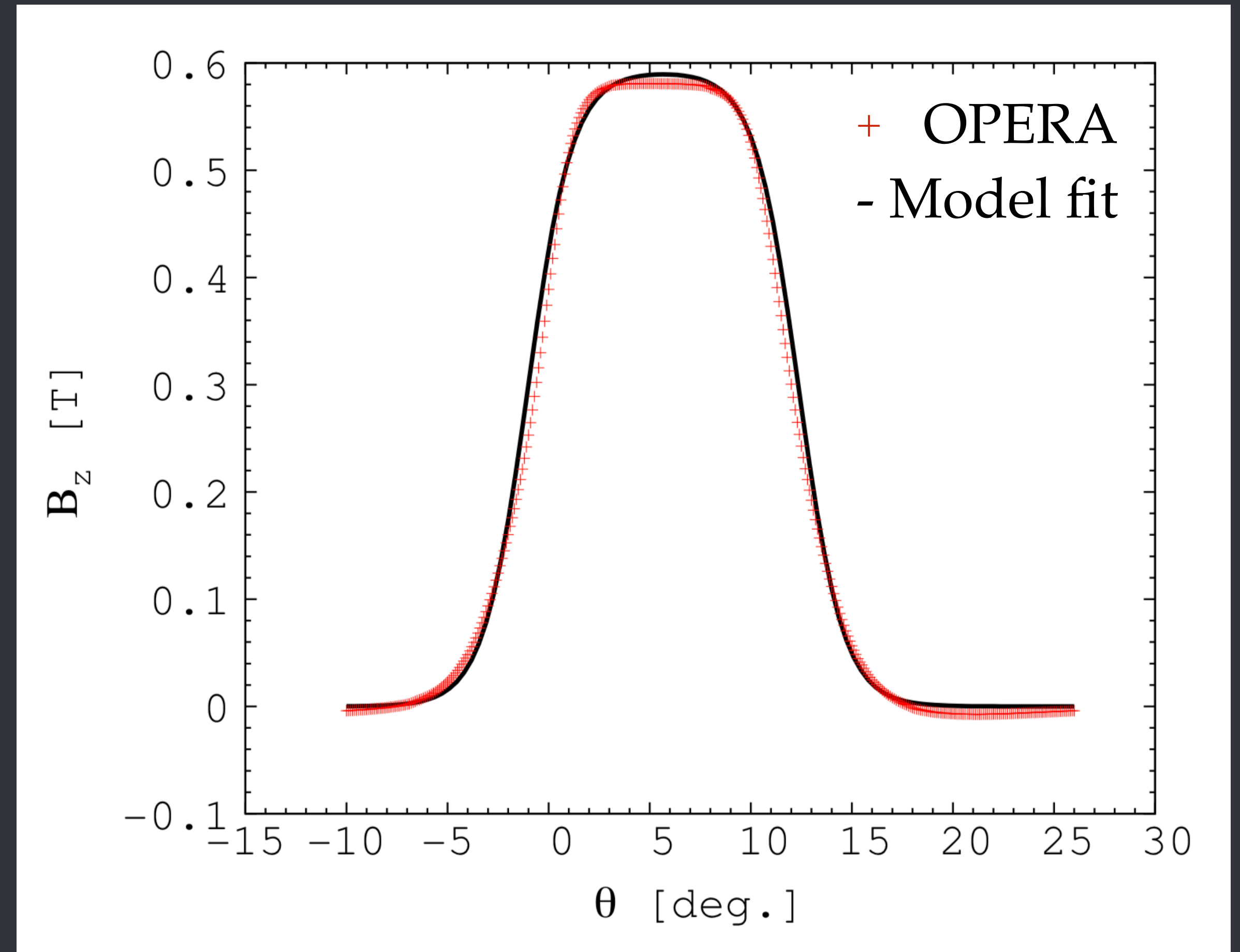
RACCAM prototype 3D OPERA model

- Without clamp
- At injection radius (2.8 m)
- $\lambda_0 = 0.12$ m (full gap at injection)

➔ $C_1 = 2.24$



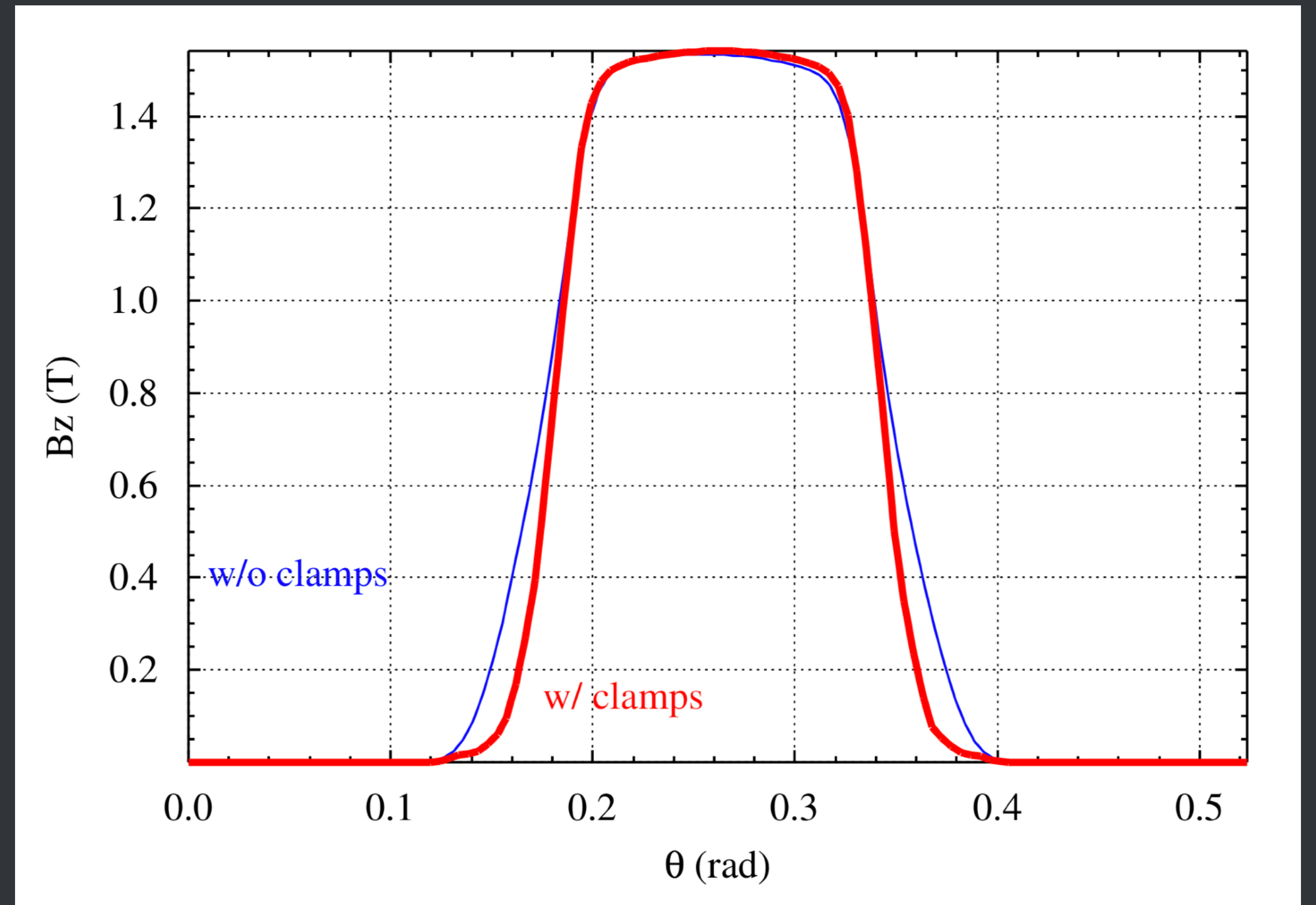
T. Planche, NIM A, 604 (3), (2009) 435-442



T. Planche, PhD thesis (2010)

Effect of field clamps

No fit done with clamps to my knowledge.
Need of field map with clamps to have new C_1 fit.

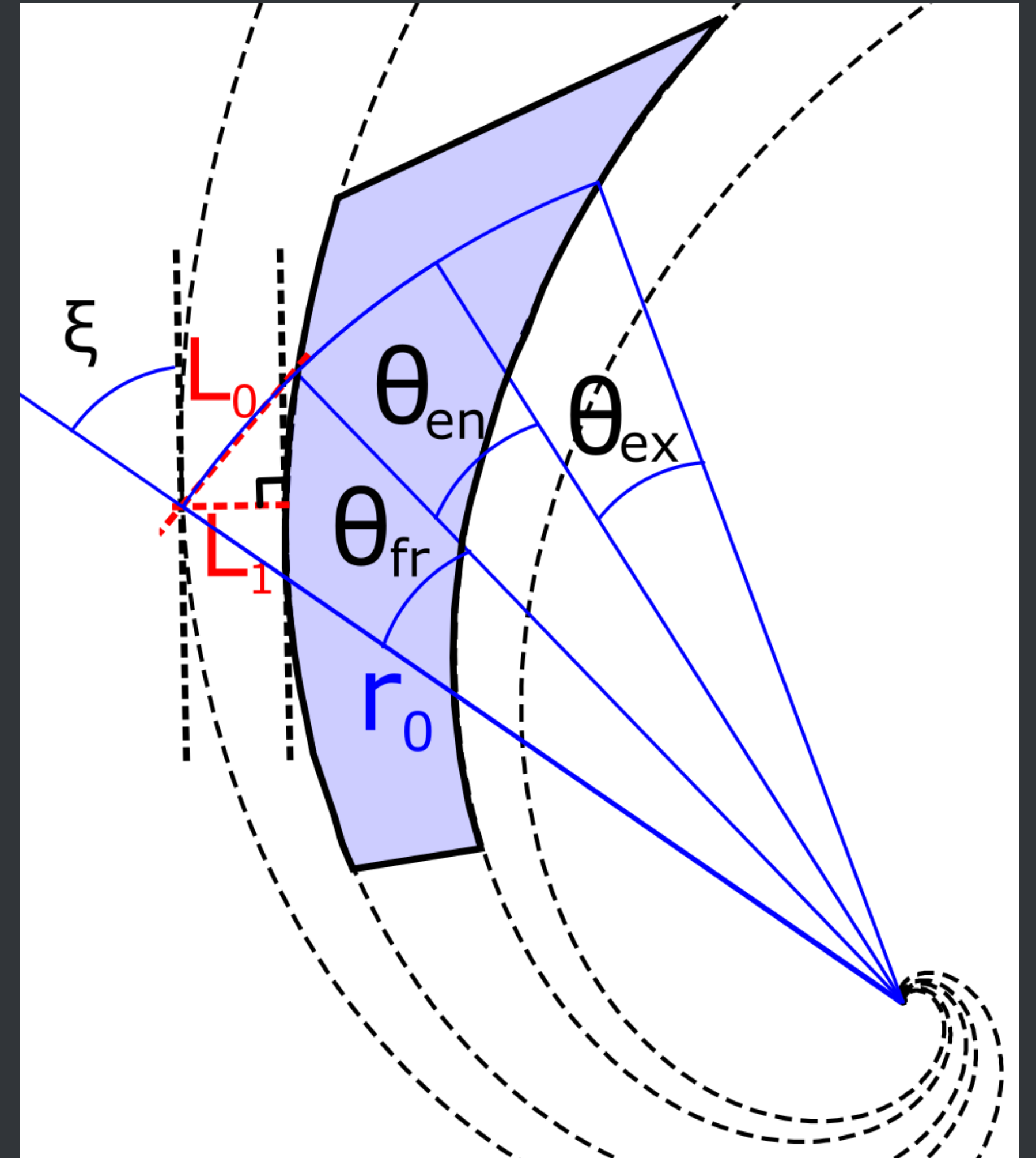


J. Fourier, NIM A, 589, (2008) 133–142

Geometrical fringe field extent

$$L_0 = \frac{L_1}{\cos \zeta}$$

$$\theta_{\text{fr}} = \frac{L_0}{r_0}$$



Entrance/Exit fringe fields

Added fringe fields:

$$\mathcal{F}(\theta) = \frac{1}{2} \left(\tanh \left(\frac{\theta_{ex} - \theta}{\lambda_{\tanh}} \right) + \tanh \left(\frac{\theta - \theta_{en}}{\lambda_{\tanh}} \right) \right)$$

$$\mathcal{F}(\theta) = \frac{1}{1 + e^{\left(\frac{\theta_{en} - \theta}{\lambda_{\text{enge}}} \right)}} + \frac{1}{1 + e^{\left(\frac{\theta - \theta_{ex}}{\lambda_{\text{enge}}} \right)}} - 1$$

$$\lambda_{\text{enge}} = \frac{\lambda_{\tanh}}{2}$$

tanh and Enge with only $C_1 \neq 0$ are equivalent.

Multiplied fringe fields:

$$\mathcal{F}(\theta) = \frac{1 - e^{\left(\frac{\theta_{en} - \theta_{ex}}{\lambda_{\text{enge}}} \right)}}{\left(1 + e^{\left(\frac{\theta_{en} - \theta}{\lambda_{\text{enge}}} \right)} \right) \times \left(1 + e^{\left(\frac{\theta - \theta_{ex}}{\lambda_{\text{enge}}} \right)} \right)}$$

Added and multiplied simulations are equivalent if entrance and exit fringe functions have same λ , but not the case if they are different.