Ming Xie estimates (planar, fixed energy)

- Ming-Xie parameterization for saturation length/power (Proc. PAC’95, p.183–185)
- Photon energy given by FEL resonance condition
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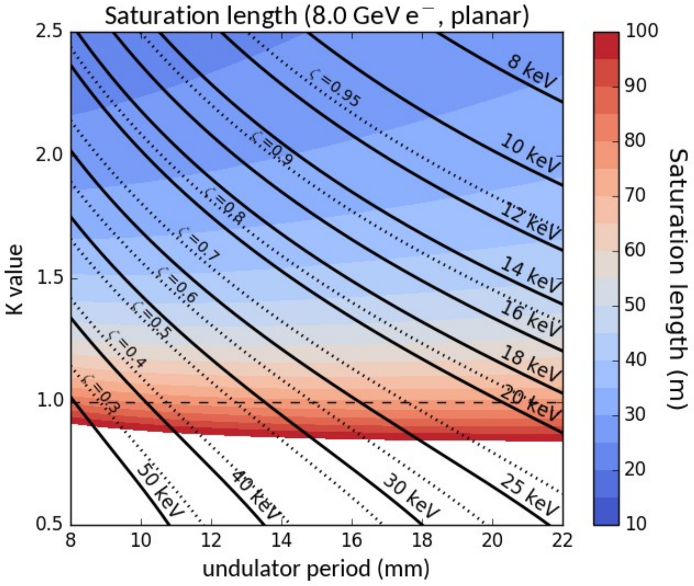
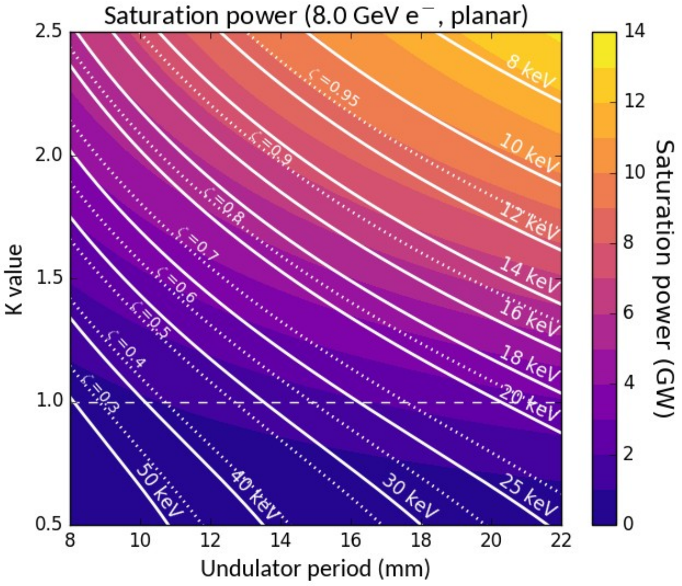
$$\frac{\epsilon_n}{\gamma} \le \frac{\lambda}{2\pi} \Rightarrow \hat{\epsilon} \equiv \frac{2\pi\epsilon_n}{\gamma\lambda} \le 1 \qquad \zeta \approx \frac{1.1\hat{\epsilon}^{1/4}}{1+0.15\hat{\epsilon}^{9/4}}$$

We want $\zeta \ge 0.7$.

Electron beam parameters:
I = 2 kA, ε = 300 nm, σ_E = 1 MeV, β = 10 m





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- Undulator K vs. gap: permanent magnet (example Aramis U15, M. Calvi et al., J. Synchrotron Rad.(2018) 25, 686-705)

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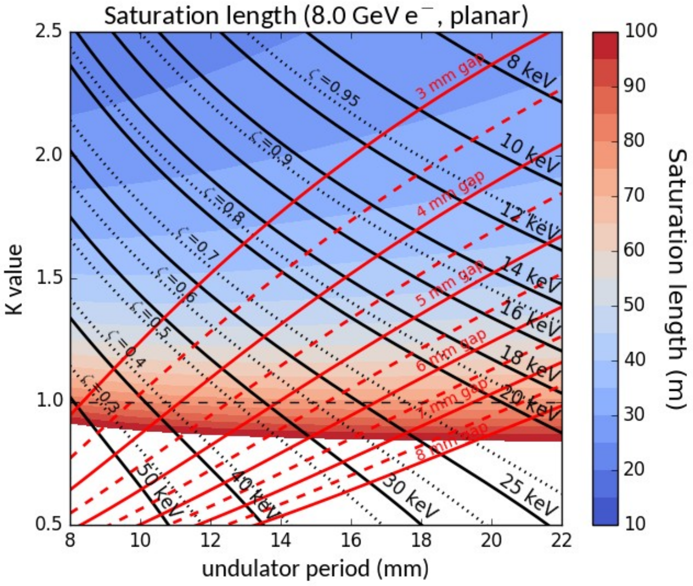

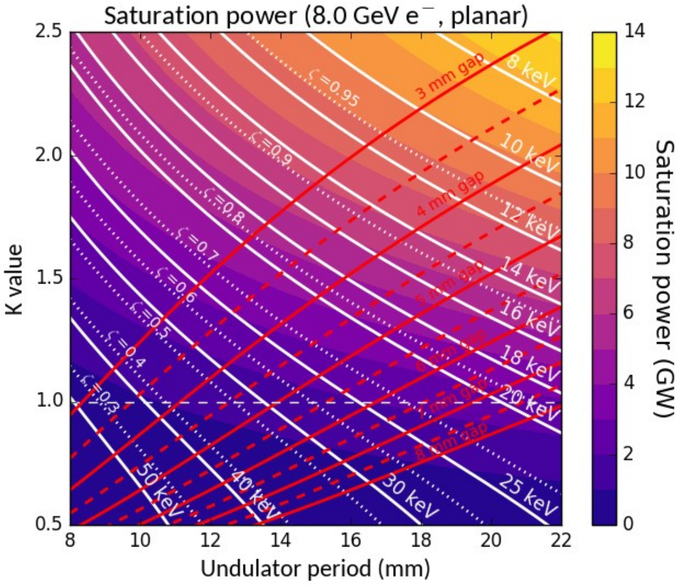

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- Undulator K vs. gap: cryogenic permanent magnet (example SLS cryo U14, M. Calvi et al., J. Phys.: Conf. Series 425 (2013) 032017)

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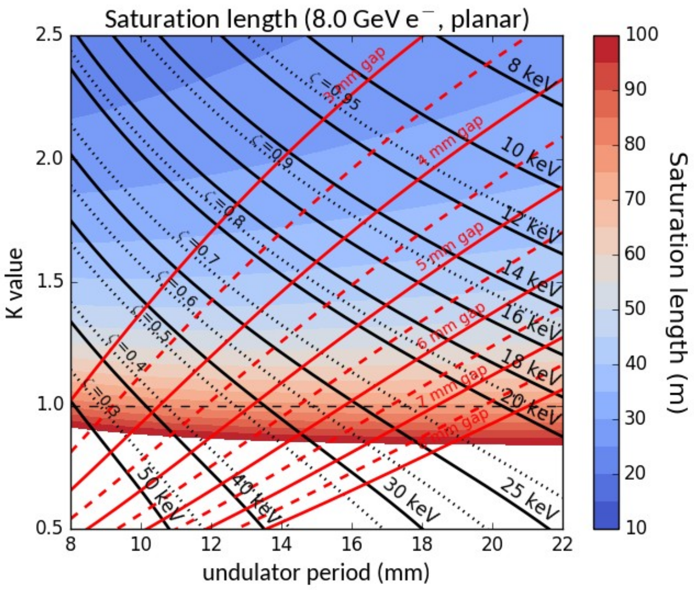

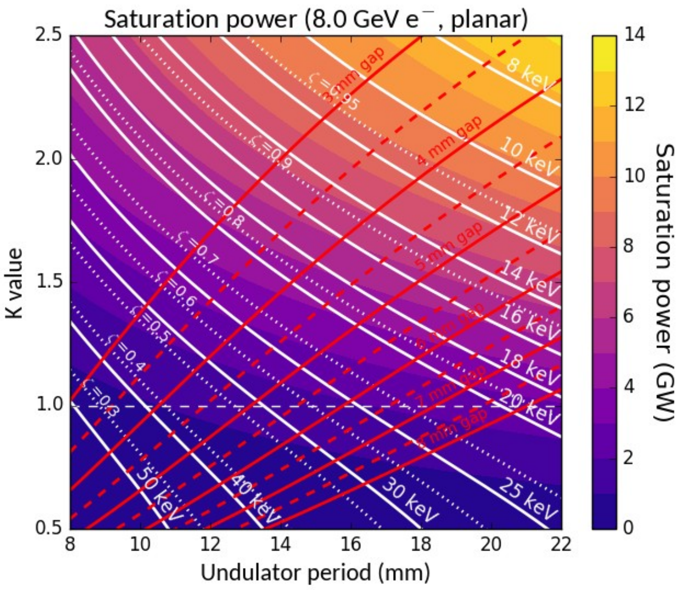

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- Undulator vs. gap: superconducting undulator (simulation data, M. Calvi, private communication)

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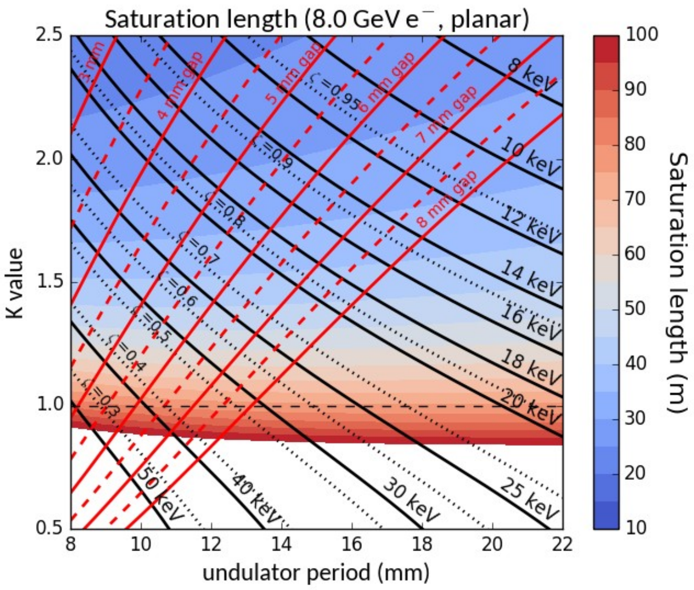
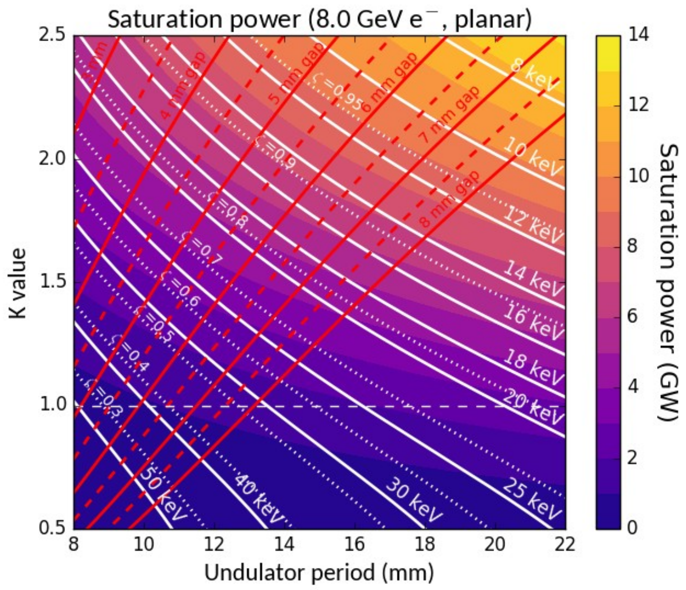
...my own fit based on data at one undulator period only! (May be wrong...)





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Electron beam parameters:
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- Undulator vs. gap: room-temperature in-vacuum APPLE-X (simulation data, M. Calvi, private communication).

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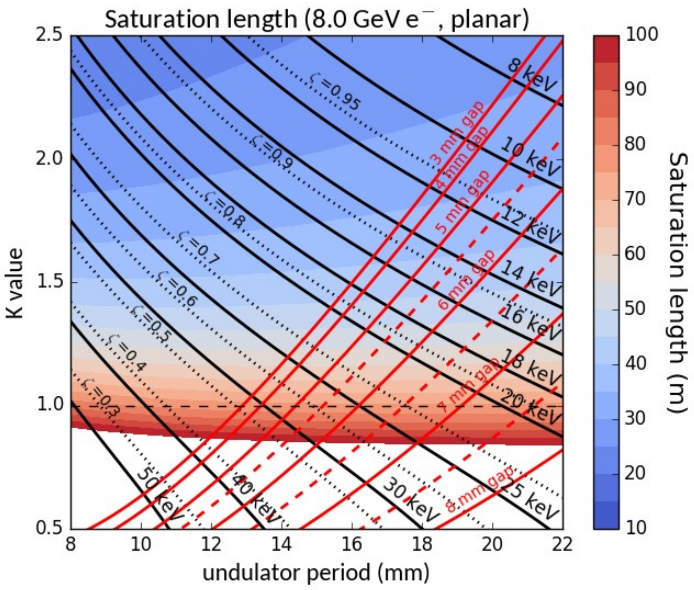
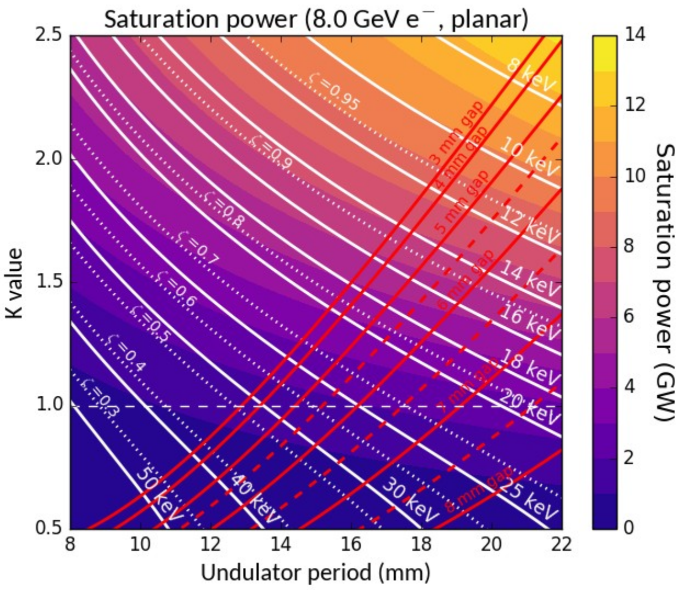
...with K_0, *a* and *b* gap dependent!





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Electron beam parameters:
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- Undulator vs. gap: cryogenic in-vacuum APPLE-X (simulation data, M. Calvi, private communication).

$$K(g) = K_0 \exp\left(-a\frac{g}{\lambda_u} + b\frac{g^2}{\lambda_u^2}\right)$$

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