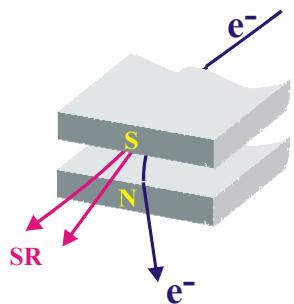


# Features of coherent edge radiation angular distribution

G. Naumenko, A. Potylitsyn, M. Shevelev, V Soboleva

Tomsk Polytechnic University, Tomsk, Russia

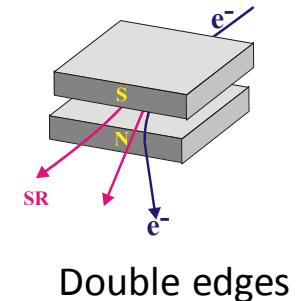
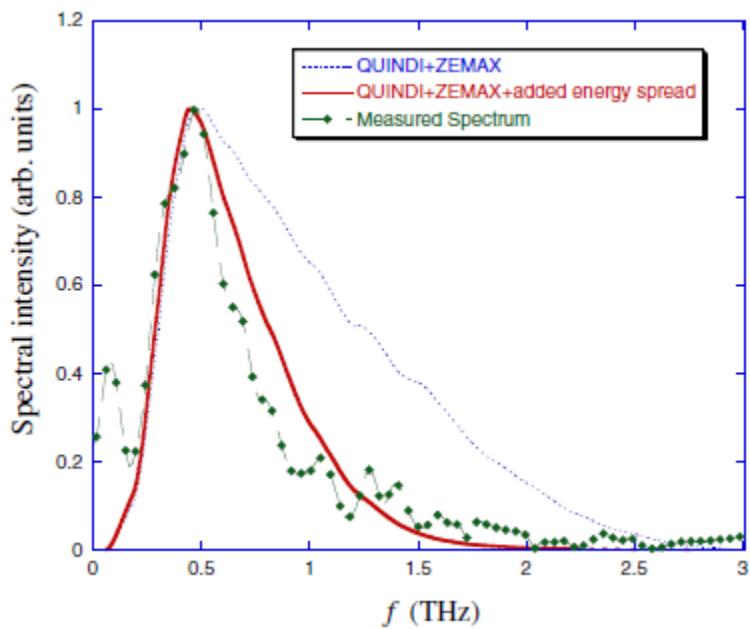
# Edge radiation



Single edge

G. Andonian, A. Cook, M. Dunning, ... *University of California*  
M. Babzien, K. Kusche, and V. Yakimenko. *Brookhaven National Laboratory*

*THz radiation*



Double edges

A.-S. Müller, I. Birkel, M. Fitterer, .... *Anka Storage Ring*  
*THz radiation*

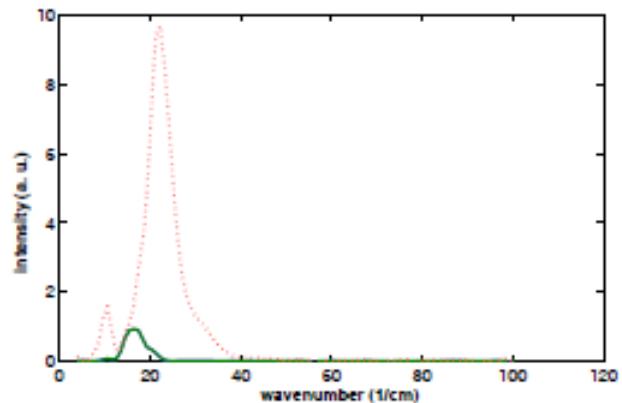


Figure 6: FTIR spectrum of emitted coherent synchrotron edge radiation at the ANKA-IR1 beamline without (dashed curve) and with a custom made bandpass filter [7] (solid curve).

Only spectral and polarization properties were investigated

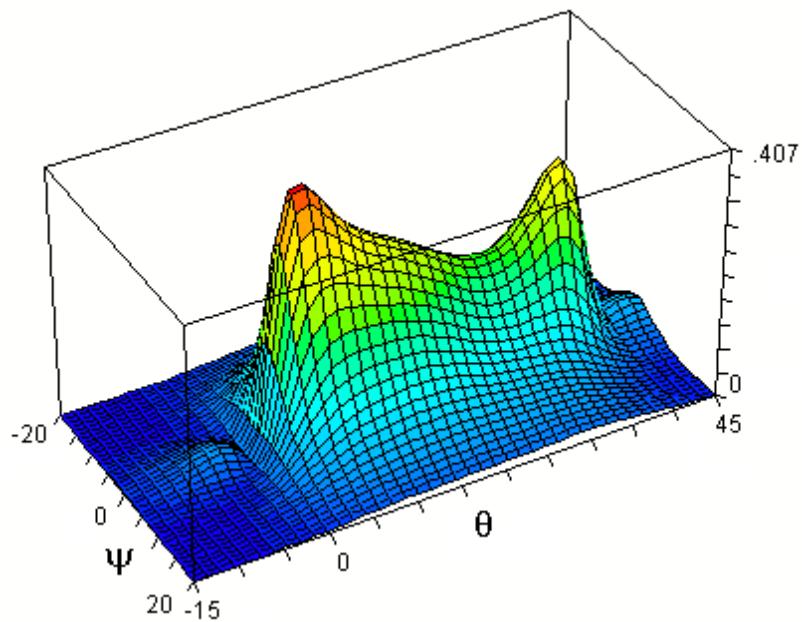
# Theory

## Incoherent radiation

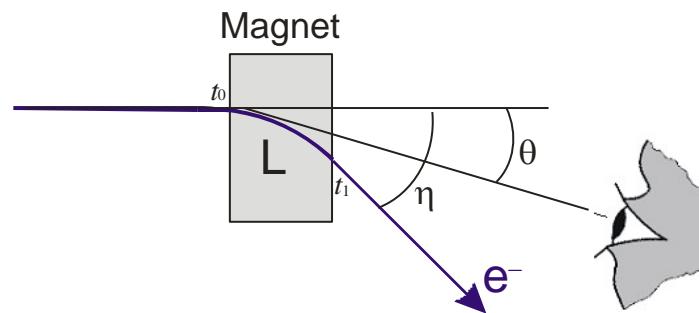
Lenar-Wikherd potentials

$$\vec{E}_\omega = \frac{e^{-i\omega R_0}}{4\pi R_0} \frac{e^-}{\sqrt{2\pi}} \int_{t_0}^{t_1} e^{-i\omega' t} \cdot \frac{\left[ \vec{n} \times \left[ (\vec{n} - \beta \vec{v}(t)) \times \vec{a}(t) \right] \right]}{\left( 1 - \beta(\vec{n} \cdot \vec{v}(t)) \right)^2} dt,$$

$$\omega' = \omega \cdot (1 - \beta(\vec{n} \cdot \vec{v}(t))), \quad \omega = \frac{2\pi}{\lambda}, \quad \hbar = c = 1$$



$$L = 130\text{mm}, \quad \eta = 39^\circ, \quad \lambda = 15\text{mm}, \quad \gamma = 12$$

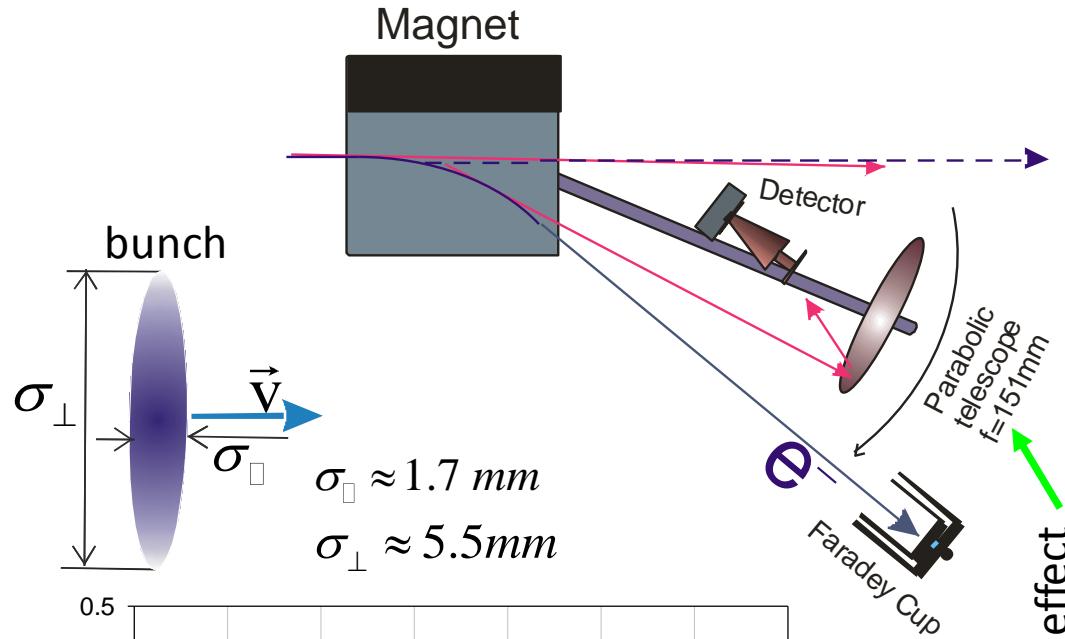


$$\frac{dW}{d\omega d\Omega} = 4\pi R^2 |\vec{E}_\omega|^2$$

# Experiment

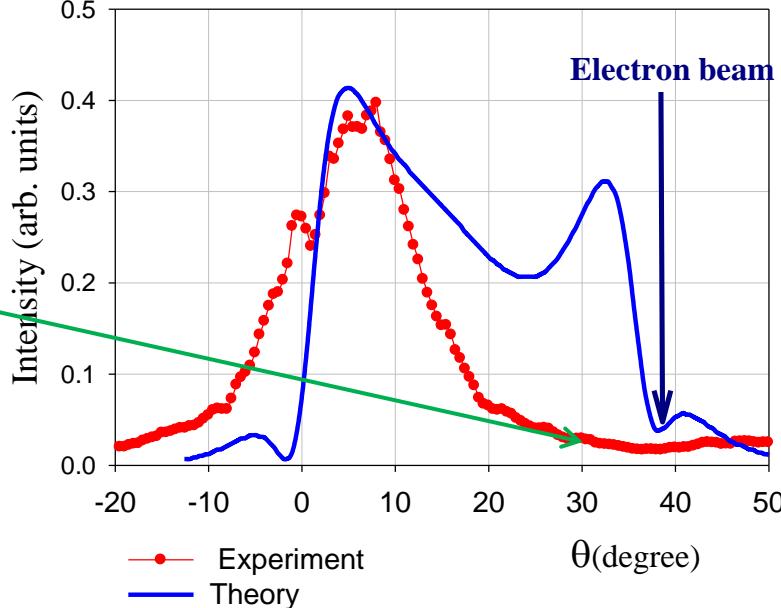
## Beam parameters

Electron energy	6.1 MeV
Macro-pulse duration	2~6 ms
Pulse repetition rate	1~8 Hz
Micro-pulse length	$\approx 6$ mm
Electrons number per micro-pulse	$\approx 10^8$
Micro-pulses number per macro-pulse	$\approx 10^4$
Beam size at the output	$4 \times 2$ mm <sup>2</sup>
Emittance: horizontal	$3 \cdot 10^{-2}$ mm × rad
vertical	$1.5 \cdot 10^{-2}$ mm × rad



The radiation in the finite beam direction is suppressed.

Why?



To exclude the prewave zone effect

# Coherency

$$\frac{dW_{coh}}{d\omega d\Omega} = \frac{dW}{d\omega d\Omega} N^2 f^2$$

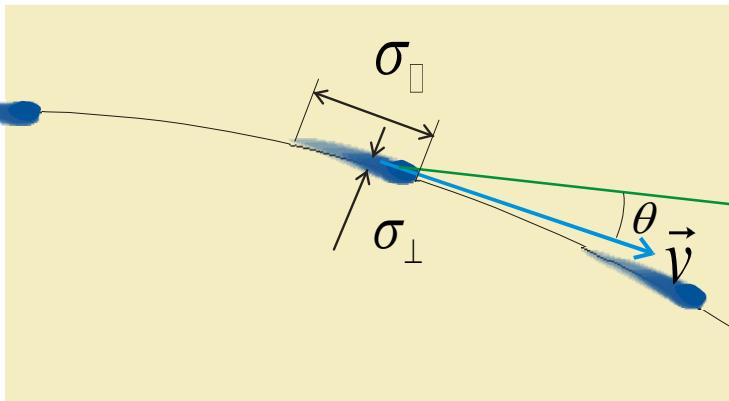
$$f = f_{\parallel} \cdot f_{\perp}$$

$$f_{\parallel} = e^{-\omega^2 \frac{(\cos \theta)^2 \sigma_{\parallel}^2}{2}}$$

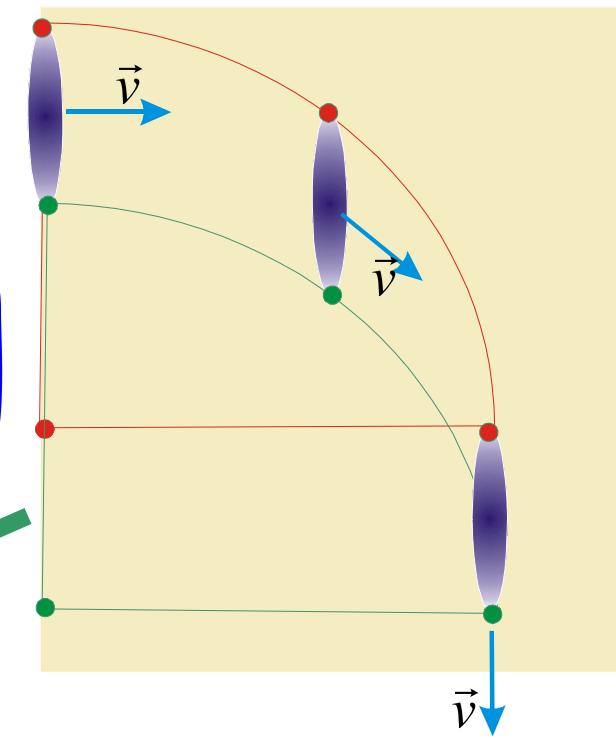
$$f_{\perp} = e^{-\omega^2 \frac{(\sin \theta)^2 \cdot \sigma_{\perp}^2}{2}}$$

For Gaussian bunch distribution approach

$$\sigma_{\parallel} > \sigma_{\perp}$$



$$\sigma_{\parallel} < \sigma_{\perp}$$



*Now  $f$  may not be divided on  $f_{\parallel}$  and  $f_{\perp}$*

*Factorization is impossible*

## Factorization

~~$$f = f_{\square} \cdot f_{\perp},$$~~

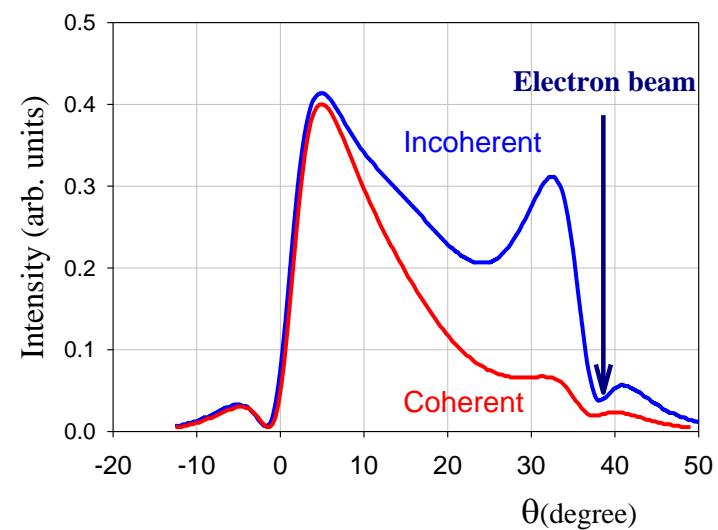
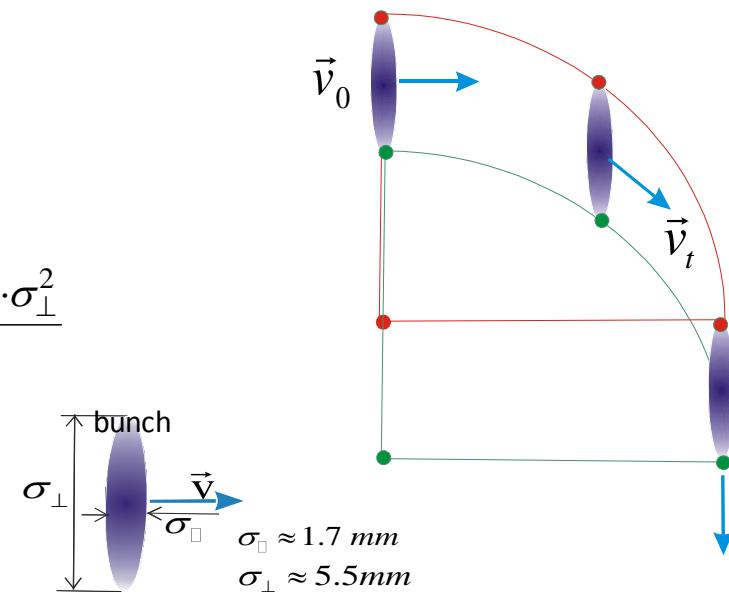
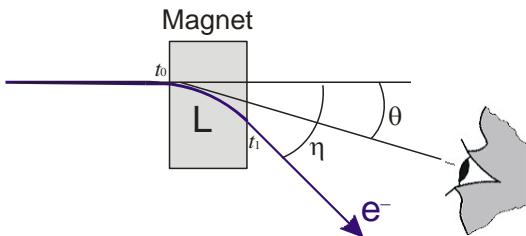
$$f_{\square} = e^{-\omega^2 \frac{(\cos \theta)^2 \sigma_{\square}^2}{2}}, \quad f_{\perp} = e^{-\omega^2 \frac{(\sin \theta)^2 \cdot \sigma_{\perp}^2}{2}}$$

After rotation transformation we can again factorize the form-factor:

$$f(t) = f_1 \cdot f_2 \quad f_1 = e^{-\omega^2 \frac{(\cos(\theta + \phi(t)))^2 \sigma_{\square}^2}{2}}$$

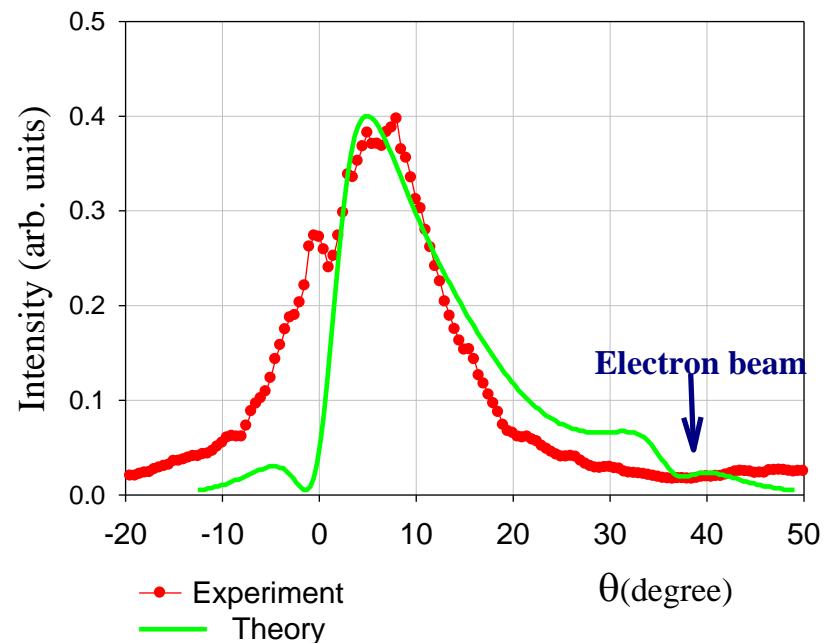
$$f_2 = e^{-\omega^2 \frac{(\sin(\theta + \phi(t)))^2 \cdot \sigma_{\perp}^2}{2}} \quad \phi(t) = \vec{v}_0 \cdot \vec{v}_t$$

$$\vec{E}_{\omega} = \frac{e^{-i\omega R_0}}{4\pi R_0} \frac{e^{-}}{\sqrt{2\pi}} \int_{t_0}^{t_1} f(t) \cdot e^{-i\omega' t} \cdot \frac{\left[ \vec{n} \times \left[ (\vec{n} - \beta \vec{v}(t)) \times \vec{a}(t) \right] \right]}{(1 - \beta(\vec{n} \cdot \vec{v}(t)))^2} dt$$



## Now with experiment

$$\frac{dW}{d\omega d\Omega} = 4\pi R^2 \left| \vec{E}_\omega \right|^2$$



**Thank you for attention**

