e^+ Polarization and Thermal Stress in Target for source at 500 GeV

Misalignment of Undulator Modules

A. Ushakov

e+ Source WebEx Meeting

03 April 2012

Outline

IPAC'12: Wanming Liu et al. "*On the Polarization Upgrade of ILC Undulator-based Positron Source*"

- e^+ polarization of source at 500 GeV
- Thermal stress at 150 GeV and 500 GeV

IPAC'12: Ushakov et al. "*Simulations of Positron Polarization in Undulator-Based Source*"

- Misalignment of undulator modules

e^+ source at 500 GeV

Some source parameters from EDMS table:

- K-value = 1 $\Leftrightarrow$ B-field on axis = 0.25 T
- Undulator period = 4.3 cm
- Undulator length = 132 m (12 $\times$ 11 m)

- Ti6Al4V target with thickness of 0.4 X_0
- Pulsed flux concentrator: max. field on axis is 3.2 T

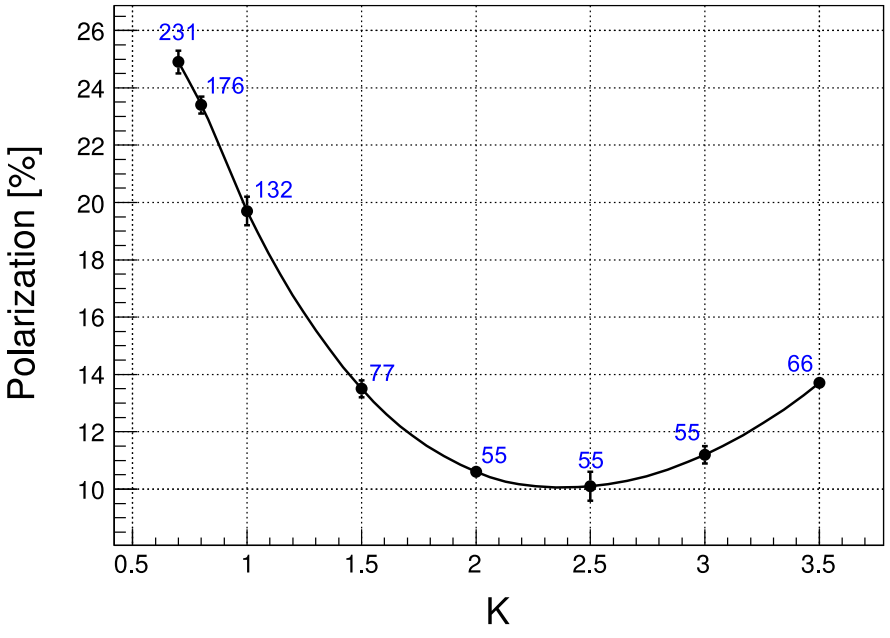
e^+ polarization $\approx$ 20 %

currently no polarization value in EDMS table (29Feb2012 version)

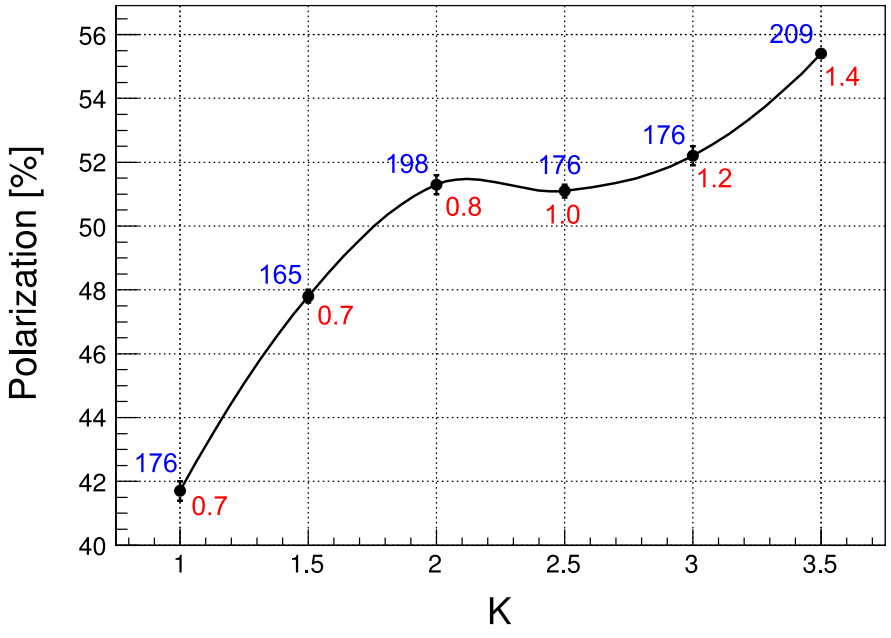
Polarization vs K

Yield $\gtrsim$ 1.5

without Photon Collimator



with Photon Collimator

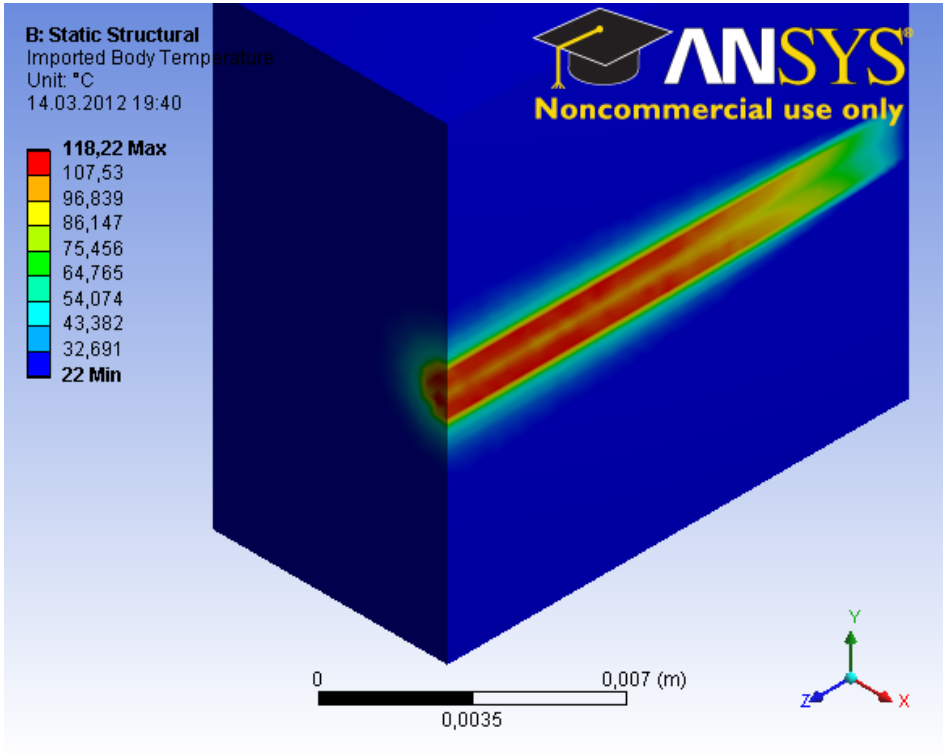


blue numbers – required active undulator length [m]
red numbers – collimator radius [mm]

- Highest polarization of source without collimator is 25%
- What is highest *K* or *B*-field of undulator with 4.3 cm period?

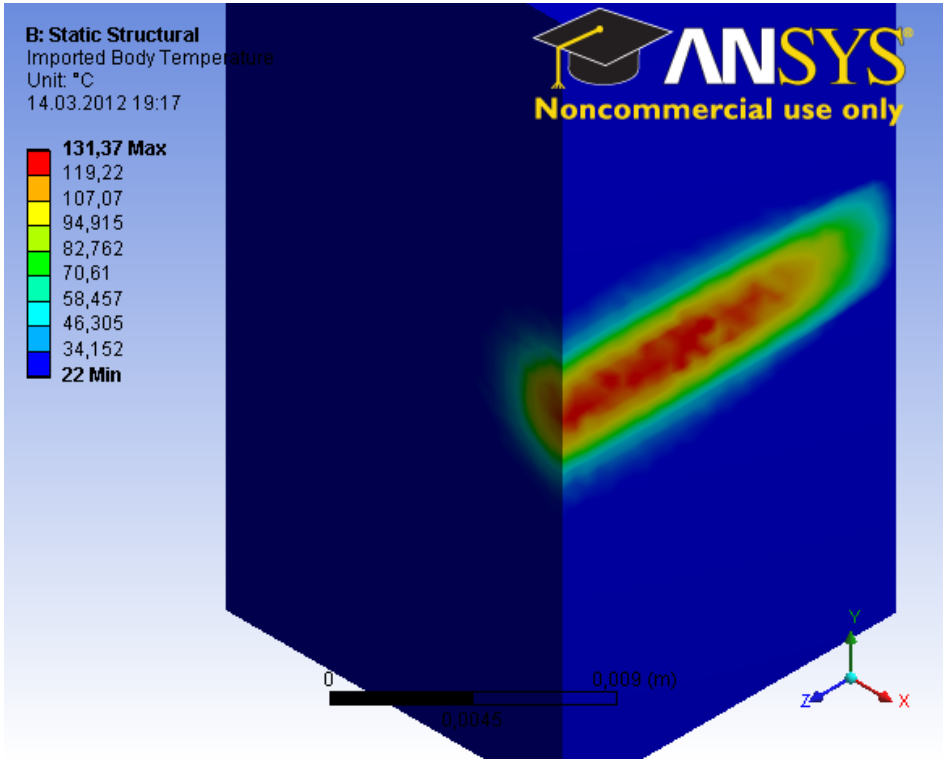
Temperature Map

500 GeV e^-, $K = 2.0$, $\lambda = 4.3$ cm,
$L_u = 198$ m, $R_{col} = 0.8$ mm,
39.4 bunches



$\delta T_{max} = 96\,^{\circ}$C/pulse

150 GeV e^-, $K = 0.92$, $\lambda = 1.15$ cm,
$L_u = 231$ m, $R_{col} = 2$ mm,
80.8 bunches

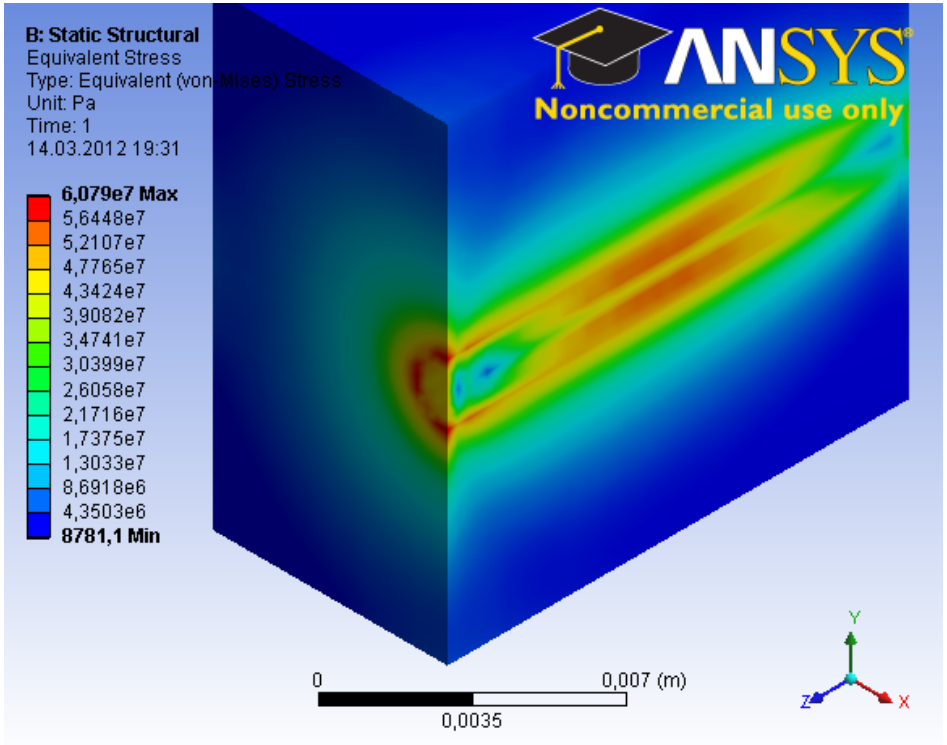


$\delta T_{max} = 109\,^{\circ}$C/pulse

Static Stress

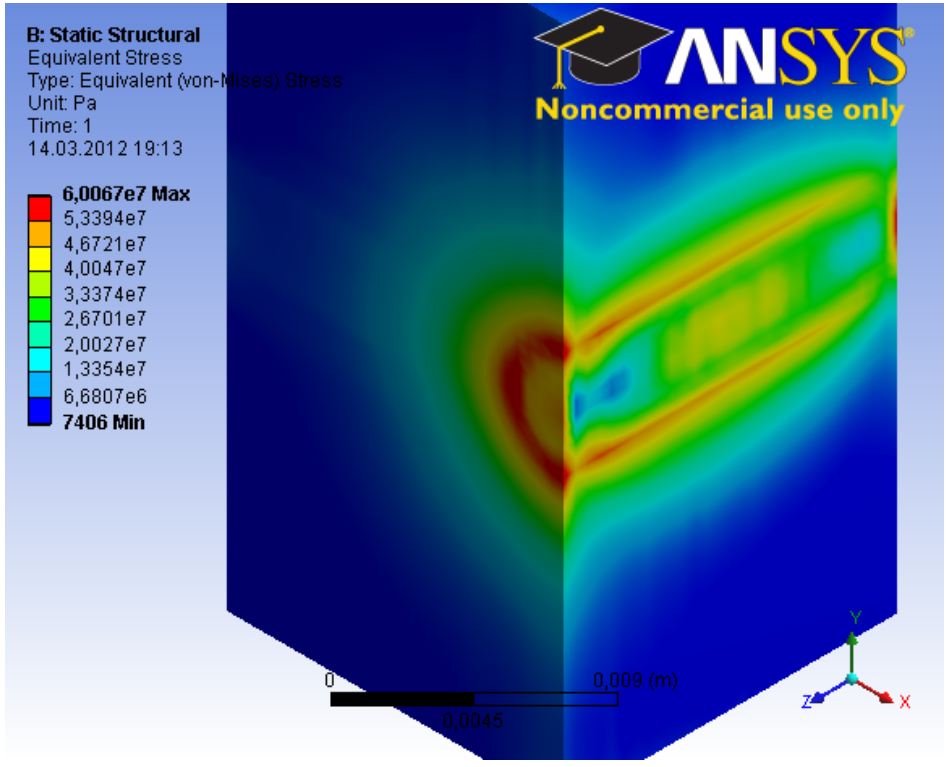
at the end of pulse (t = 0)

500 GeV e^-



$\sigma_{max} = 61$ MPa

150 GeV e^-

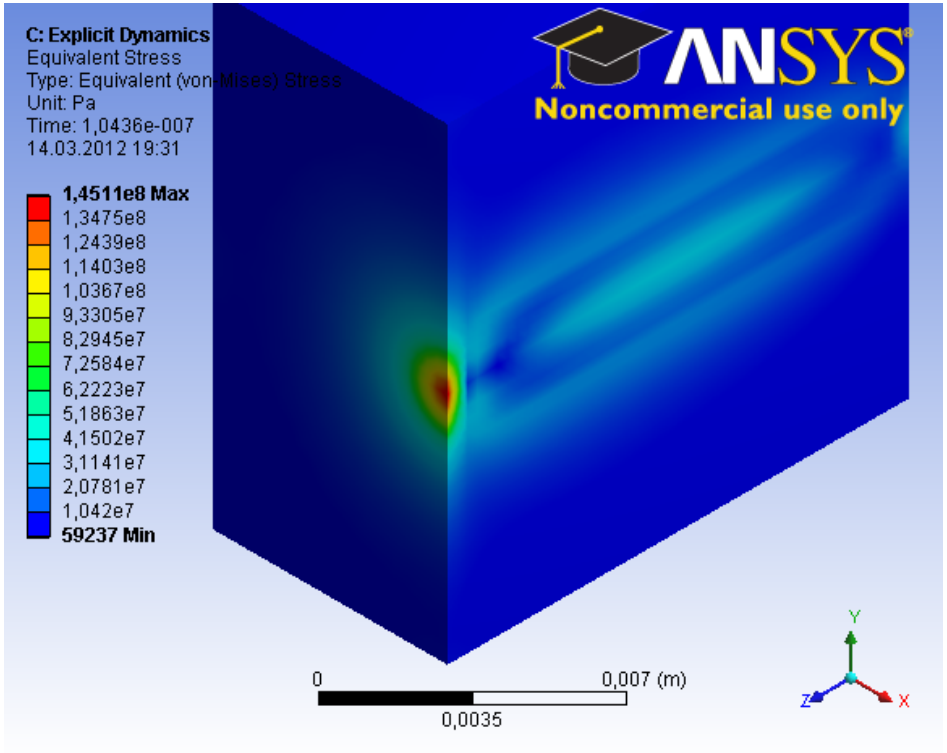


$\sigma_{max} = 60$ MPa

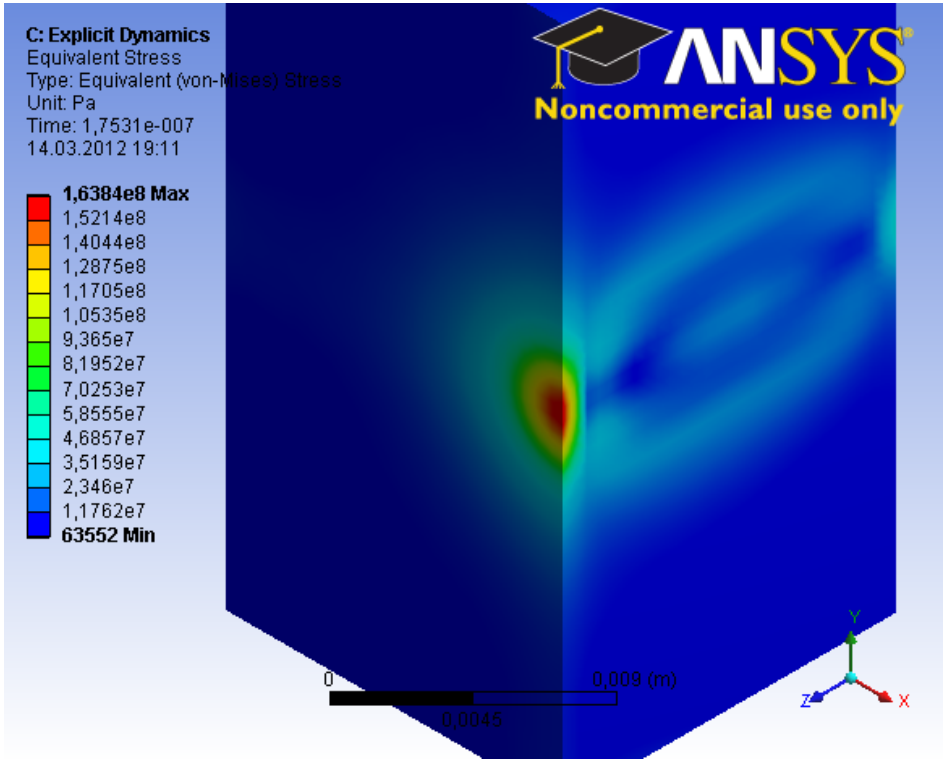
Maximal Stress

at $\sim$ 100 ns after pulse end

500 GeV e^-



150 GeV e^-



$\sigma_{max} = 145$ MPa

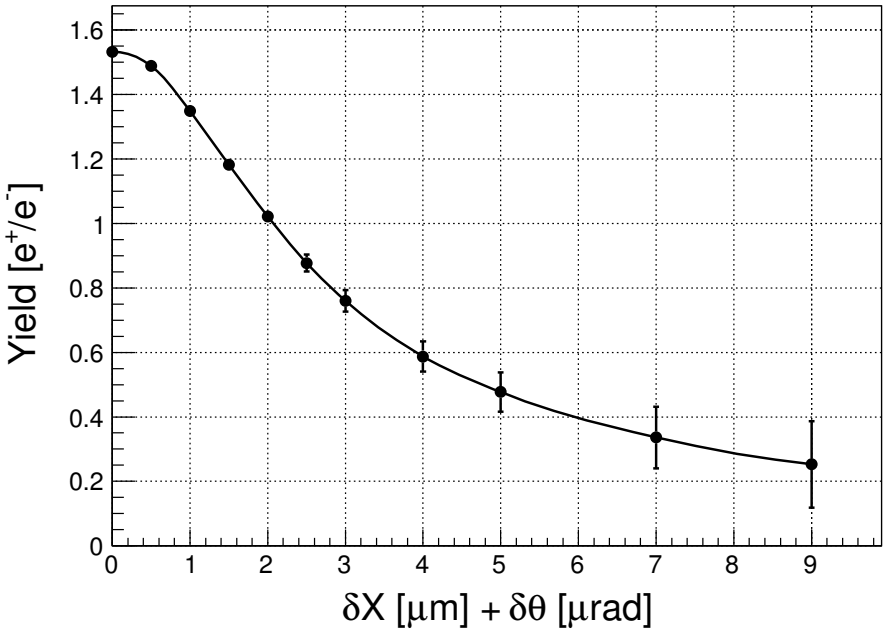
$\sigma_{max} = 164$ MPa

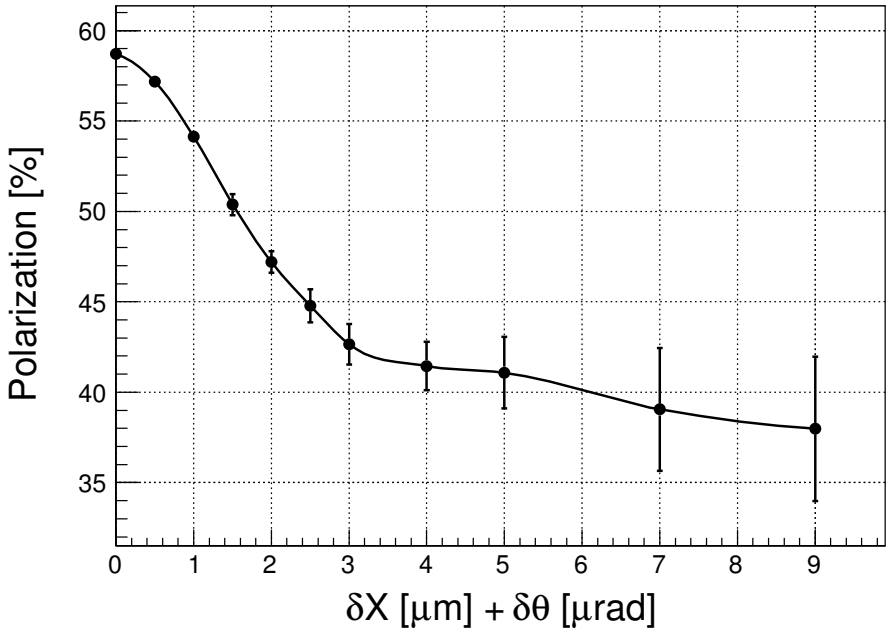
- Stress in target for 5 Hz operation mode is at acceptable level
- Stress for 10 Hz mode (both “luminosity” and “production” beams passing through undulator?!) *should be evaluated carefully*

Misalignment of Undulator Modules: Impact on Yield and Polarization

Baseline undulator at 250 GeV with collimator (aperture radius = 0.7 mm)

- undulator modules have been randomly shifted
- every module has additionly to the position offset also random angle (positions and angles are “not correlated”/independent)





- Misalignment of undulator effects *Y* and *P* significantly!
- How big realistic undulator misalignments could be?
- Should misalignments be included in EDMS source parameters table?