

# Minimum Machine Simulation

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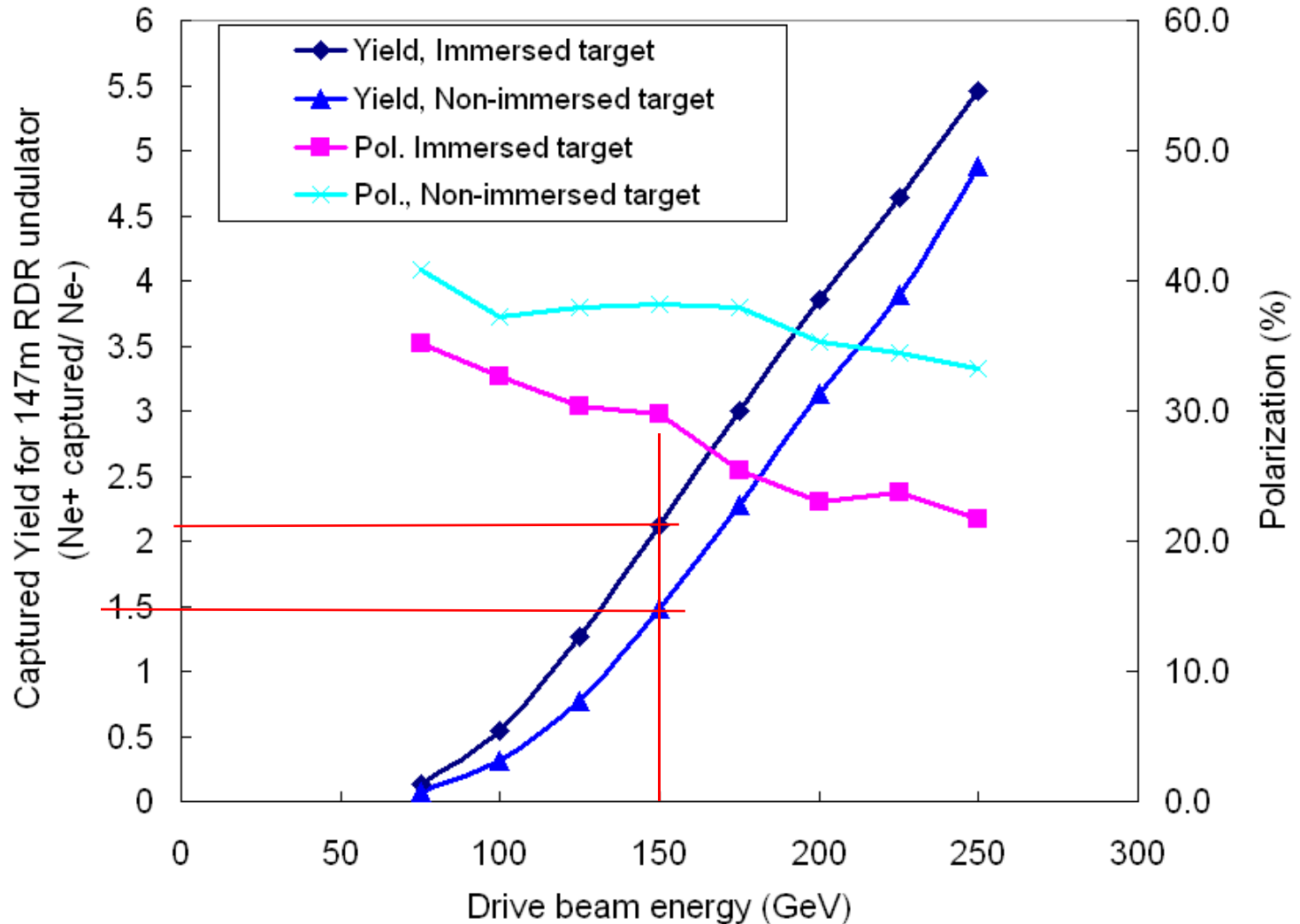
# Outlines

- Conditions and assumptions
- Yield and polarization of 147m long RDR undulator under different drive beam energy
- Yield and polarization of 210m long RDR undulator with different size of photon collimator
- Yield and polarization of 210m long RDR undulator under different drive beam energy (Ti and W target).
- 120 GeV drive beam with different undulator.

# Conditions

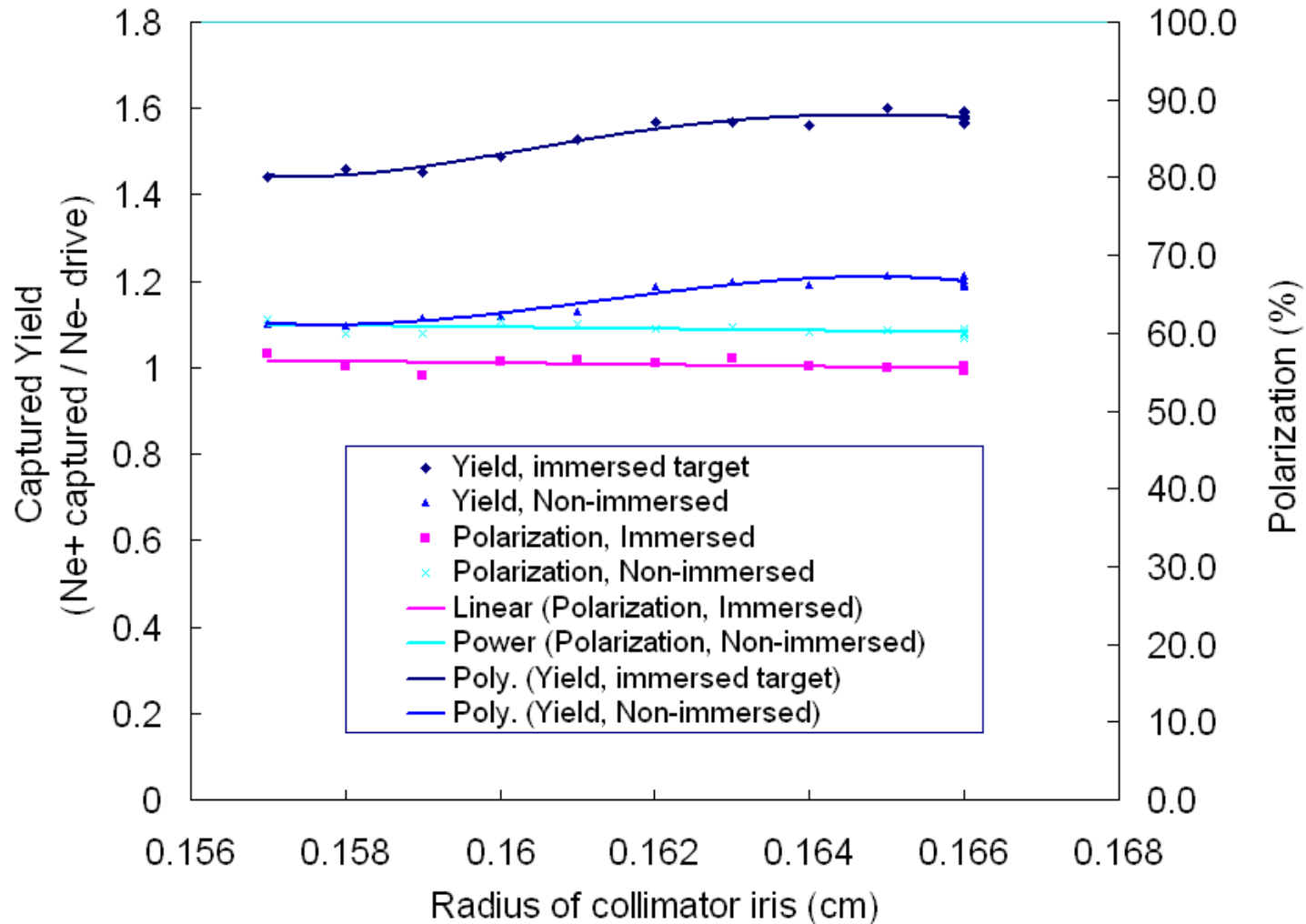
- Undulator center to target distance: 500m for 150GeV drive beam, and varies to keep the spot size on target unchanged for other drive beam energy.
- For immersed target cases: AMD 5T-0.5T in 14cm
- For Non-immersed target cases: ramp up from 1T to 6T in 2cm then fall back adiabatically to 0.5T at z=14cm
- Target: 0.4 r.l. Ti or 0.4 r.l. W23Re where noted.
- Yield and polarization evaluated after beam has been accelerated up to 125MeV using damping ring acceptance windows: +/-7.5 degree phase cut,  $\epsilon_x + \epsilon_y < 0.09$ m.rad, energy spread +/-25MeV. No energy compressing.

# 147m long RDR undulator with different drive beam energy

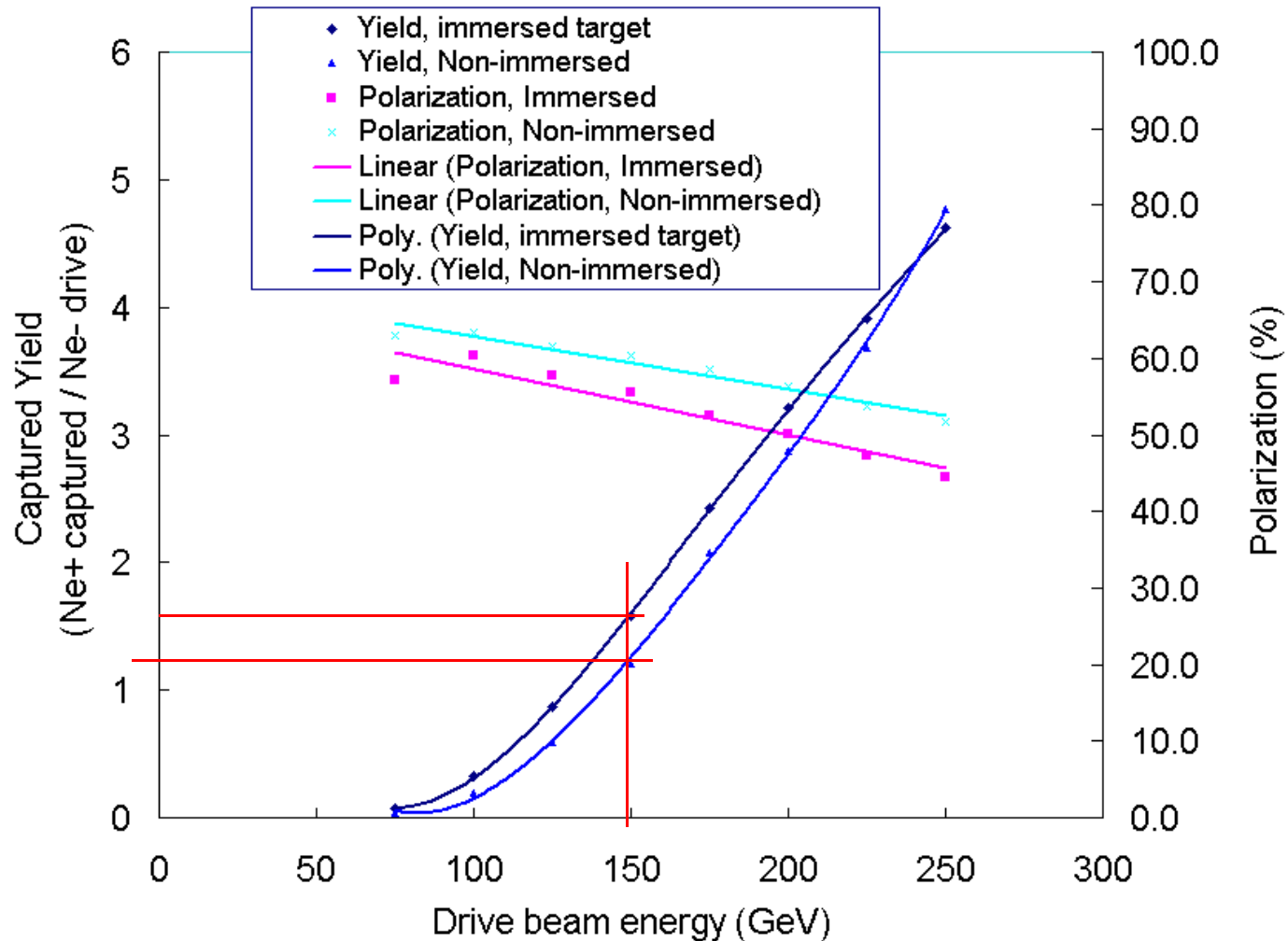


# 210m long RDR undulator

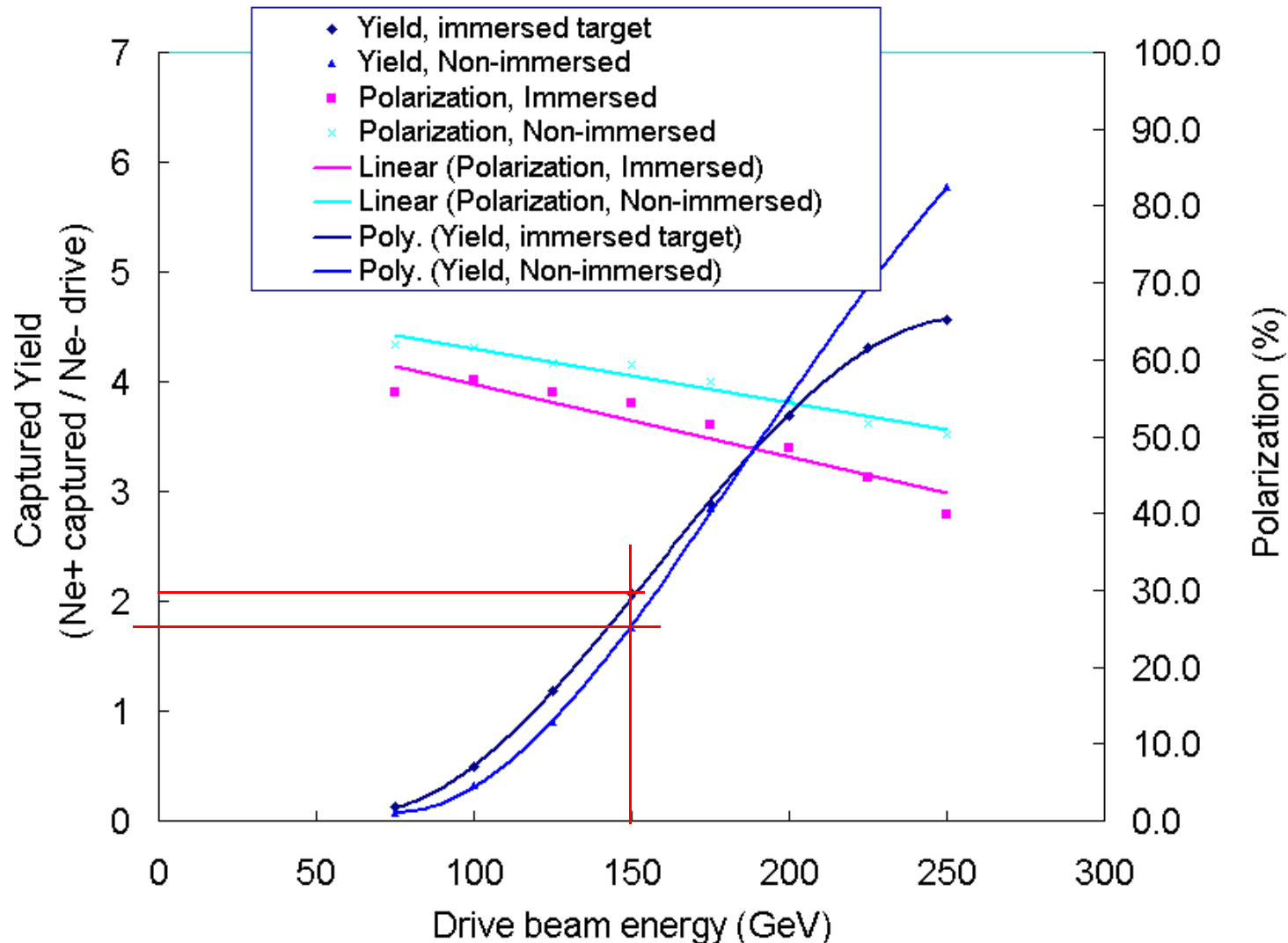
Yield and polarization as function of photon collimator iris



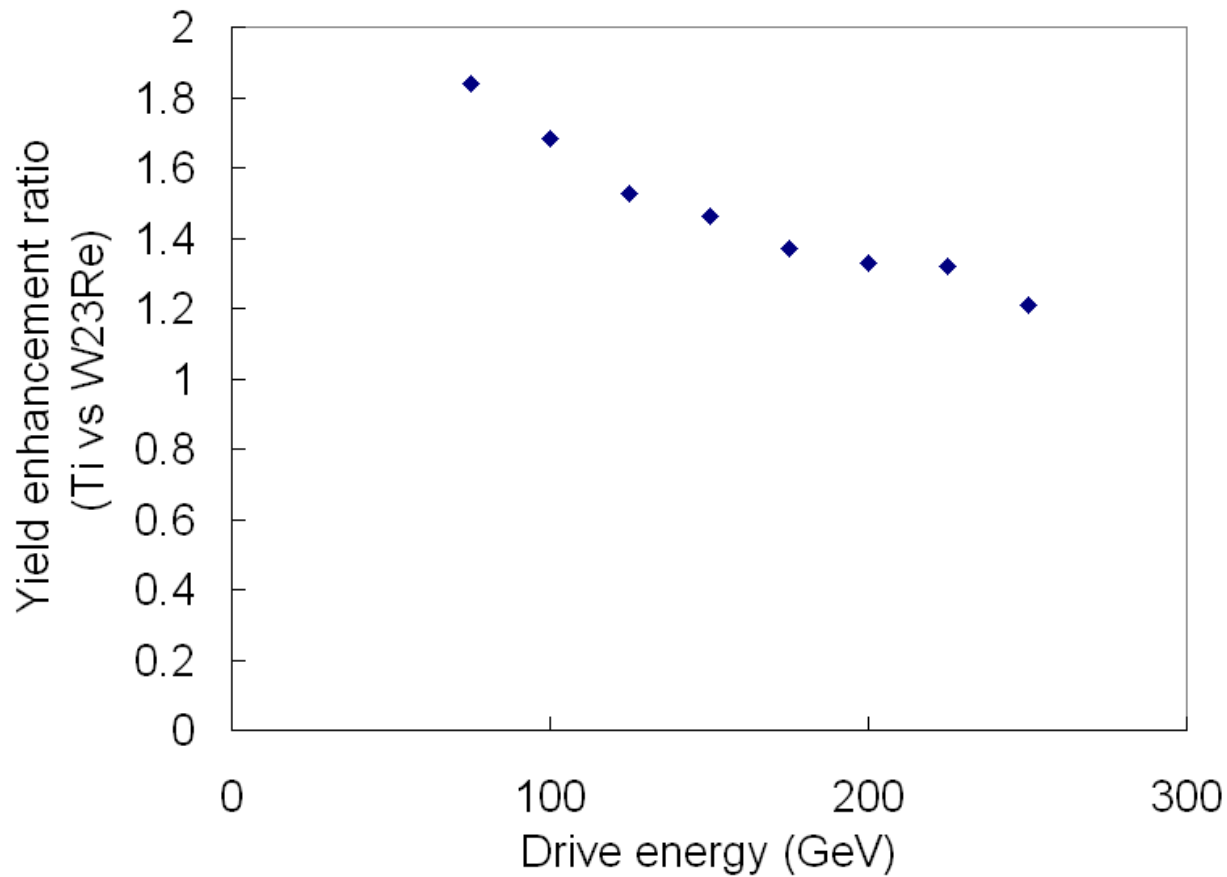
# Yield and polarization as function of drive beam energy for a 210m long RDR undulator with photon collimator (radius of iris=1.66mm),



# Yield and polarization as function of drive beam energy for a 210m long RDR undulator with collimator (radius of iris=1.66mm), W23RE target

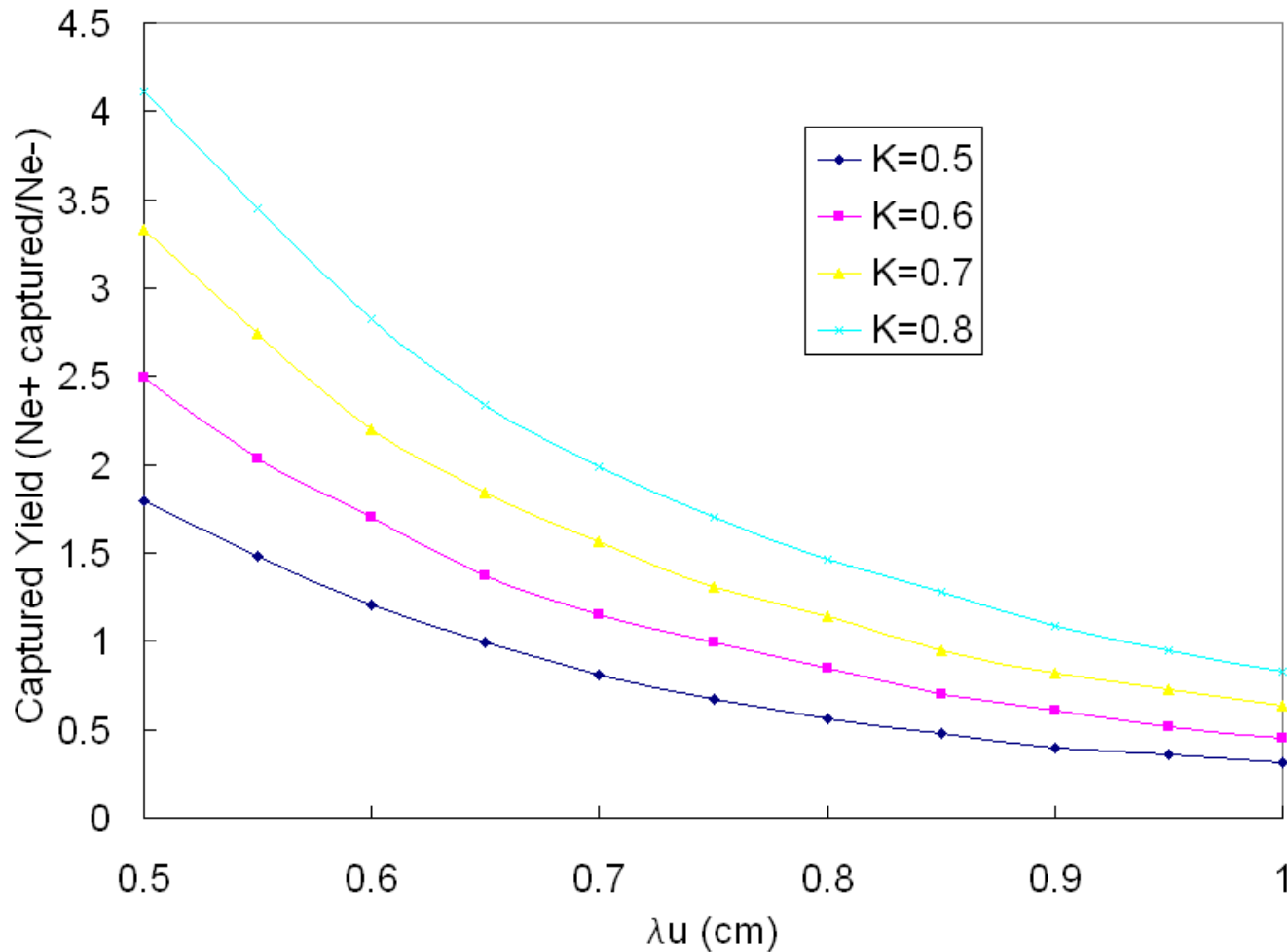


# Yield enhancement from W target 210m long RDR undulator with photon collimator





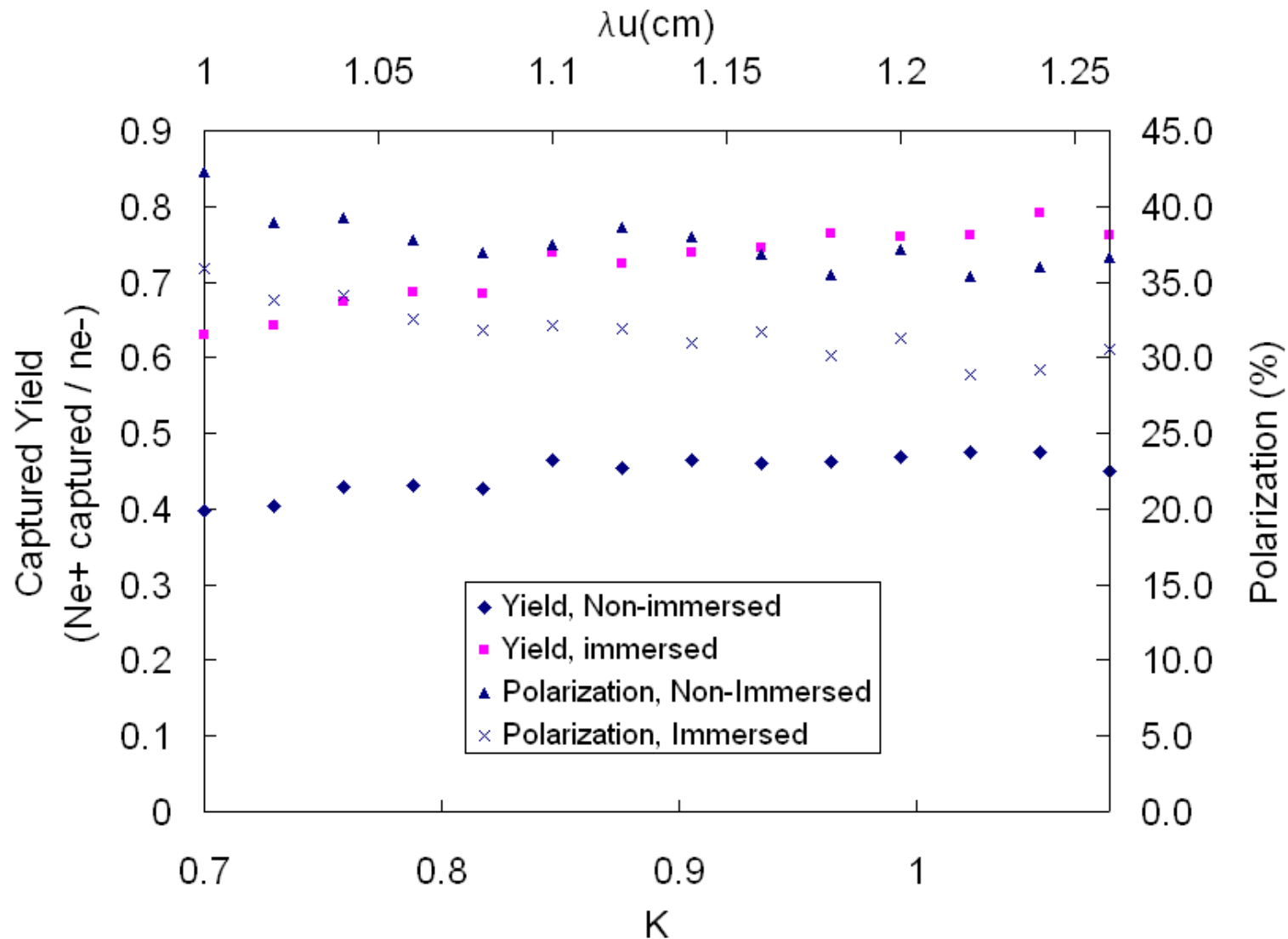
# Yield of undulators with 120GeV drive beam



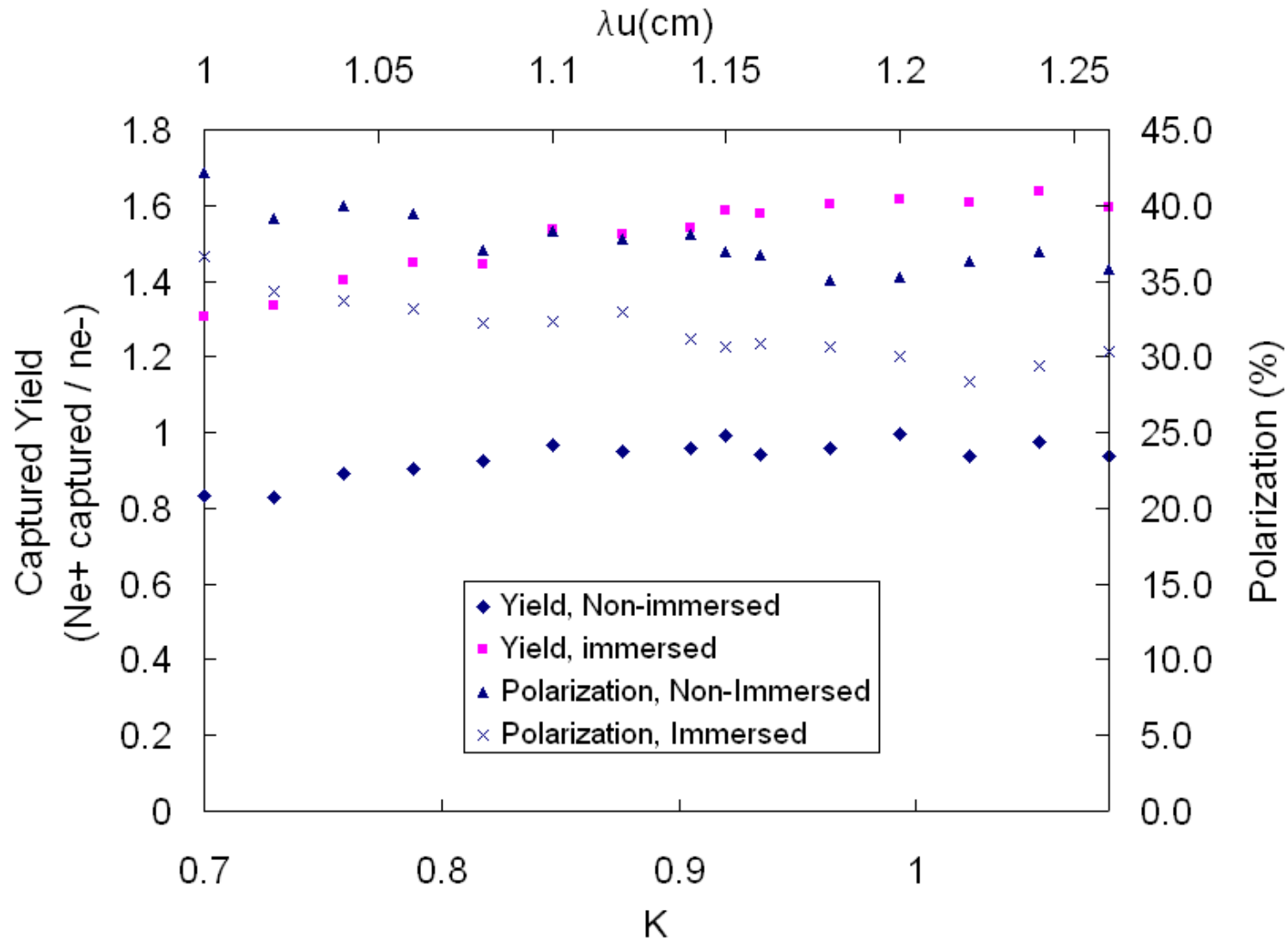
Limited by current technology,  $\lambda u$  can not be smaller than 1cm while  $K > 0.7$

- Given RDR parameters:  $K=0.92$ ,  
 $\lambda u=1.15\text{cm}$
- Given the limitation on the shortest achievable period of 1cm with  $K_{\sim}=0.7$
- We assume an achievable envelope of  $K$  as:  $K(\lambda u) < (\lambda u - 1) / (1.15 - 1) * (0.92 - 0.7) + 0.7$

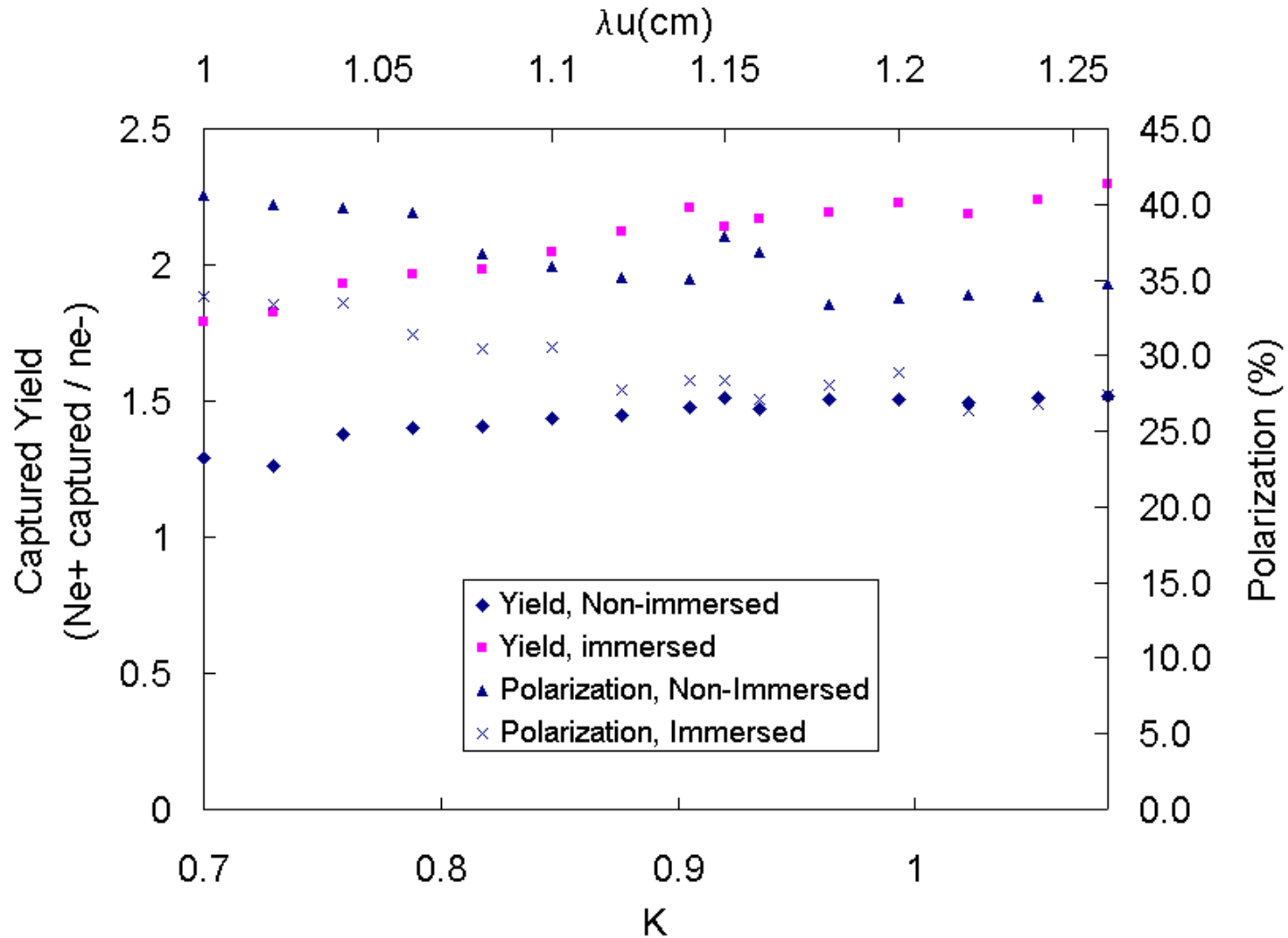
# 120GeV Drive Beam (100m Undulator, No Collimation)



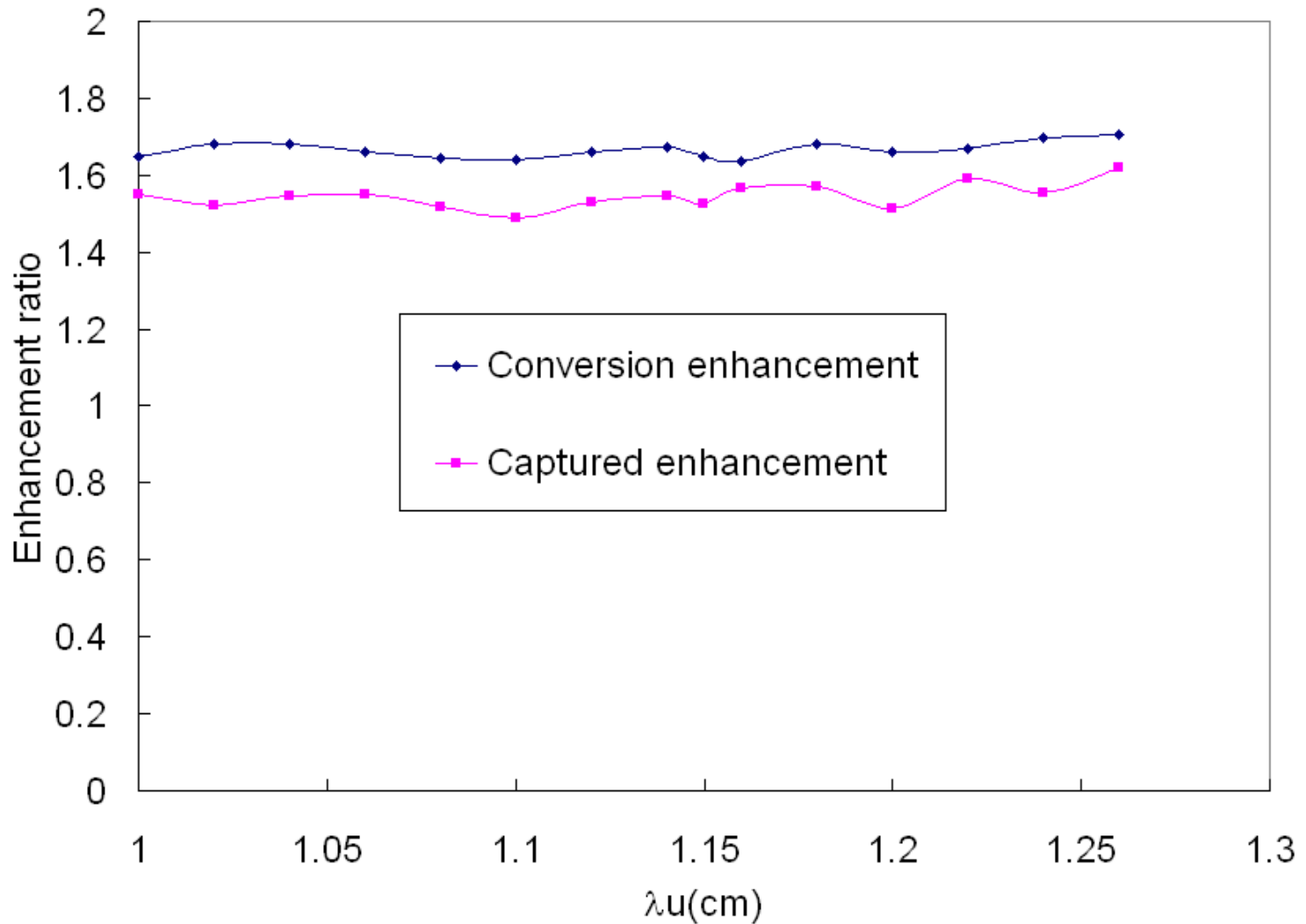
# 120GeV Drive Beam (210m Undulator, No Collimation)



# 120GeV Drive Beam (210m Undulator, No Collimation, W23Re target)



# The effect of target material



# Summary

- 147m long RDR undulator was simulated with different drive beam energy for low polarization operation.
- 210m long RDR undulator with photon collimator was simulated with different drive beam energy for polarization upgrade operation. Immersed target is needed in order to achieve yield of 1.5 for 210m long RDR undulator.
- Simulation shows for RDR undulator, using W23Re for target can give us an enhancement on yield for about from 1.2 to 1.8 when drive beam energy is changing from 250GeV to 75GeV
- Simulation shows that shorter period and higher K will be helpful for lower drive beam energy operation. Within the current limitation of technology, it requires >300m undulator with flux concentrator in order to achieve a yield of 1.5 for undulators working at 120GeV drive beam energy.
- The enhancement we can get from W23Re is simulated at ~1.5 for 120GeV drive beam.