Inclusion of the F_0 Error

$$L_t' = L_t(1 + \alpha_L).$$

$$F_0' = F_0(1 + \alpha_F)$$

$$\rho_t' = \frac{(1 + \alpha_L)}{(1 + \alpha_F)}\rho_t \approx (1 + \alpha_L - \alpha_F)\rho_t.$$

Effects of Calibration Errors

$$\rho = \frac{\pi L}{F_0 \cos\theta_0}$$

$$\rho_t'(\lambda) = \rho_t(\lambda)[1 + \alpha(\lambda)],$$

We want to make $\alpha(\lambda)$ as small as possible.

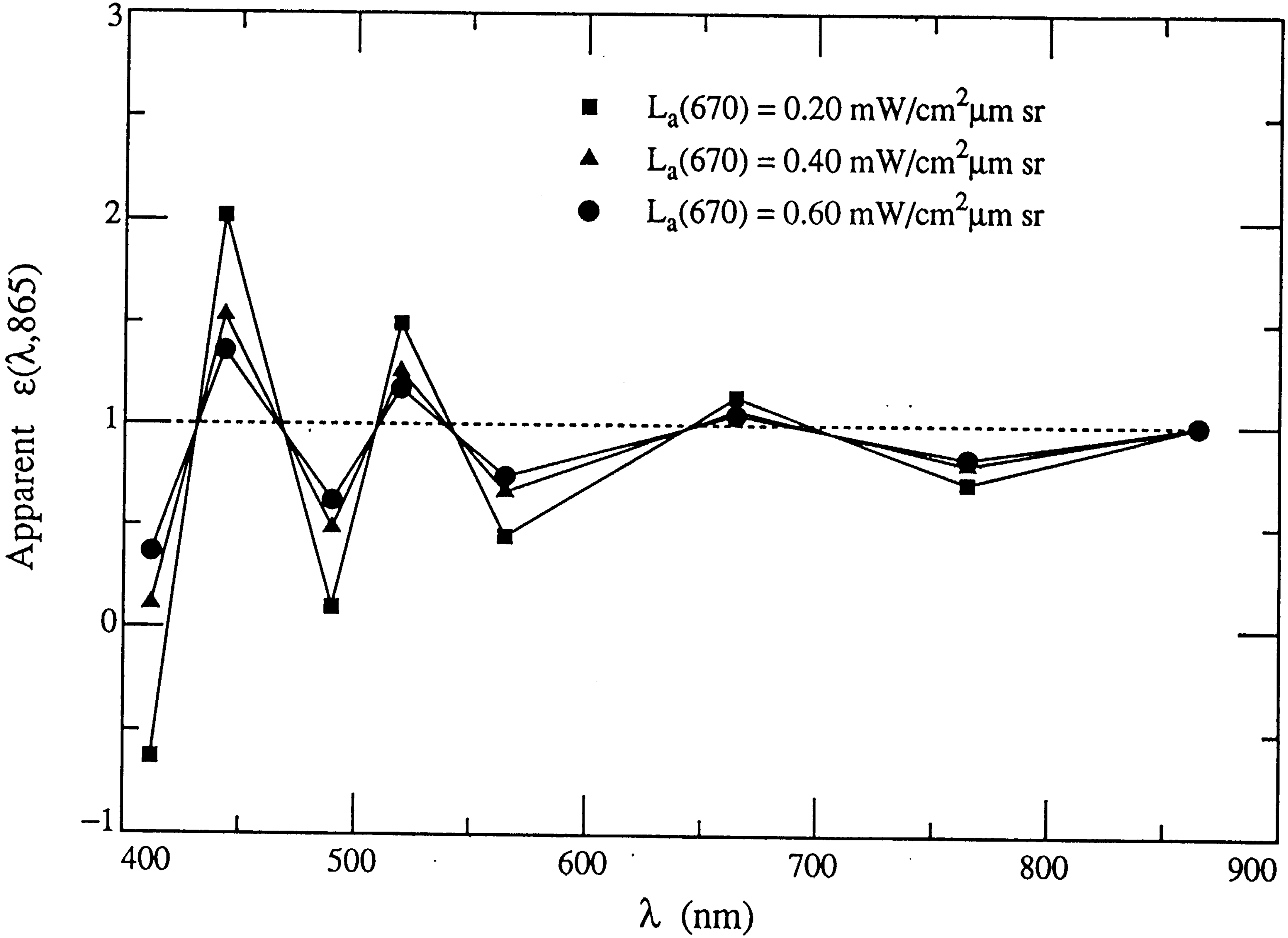
$$\rho_t = \rho_r + \rho_a + \rho_{ra} + T\rho_g + t\rho_{wc} + t\rho_w$$

Atmospheric correction yields $t\rho_w$

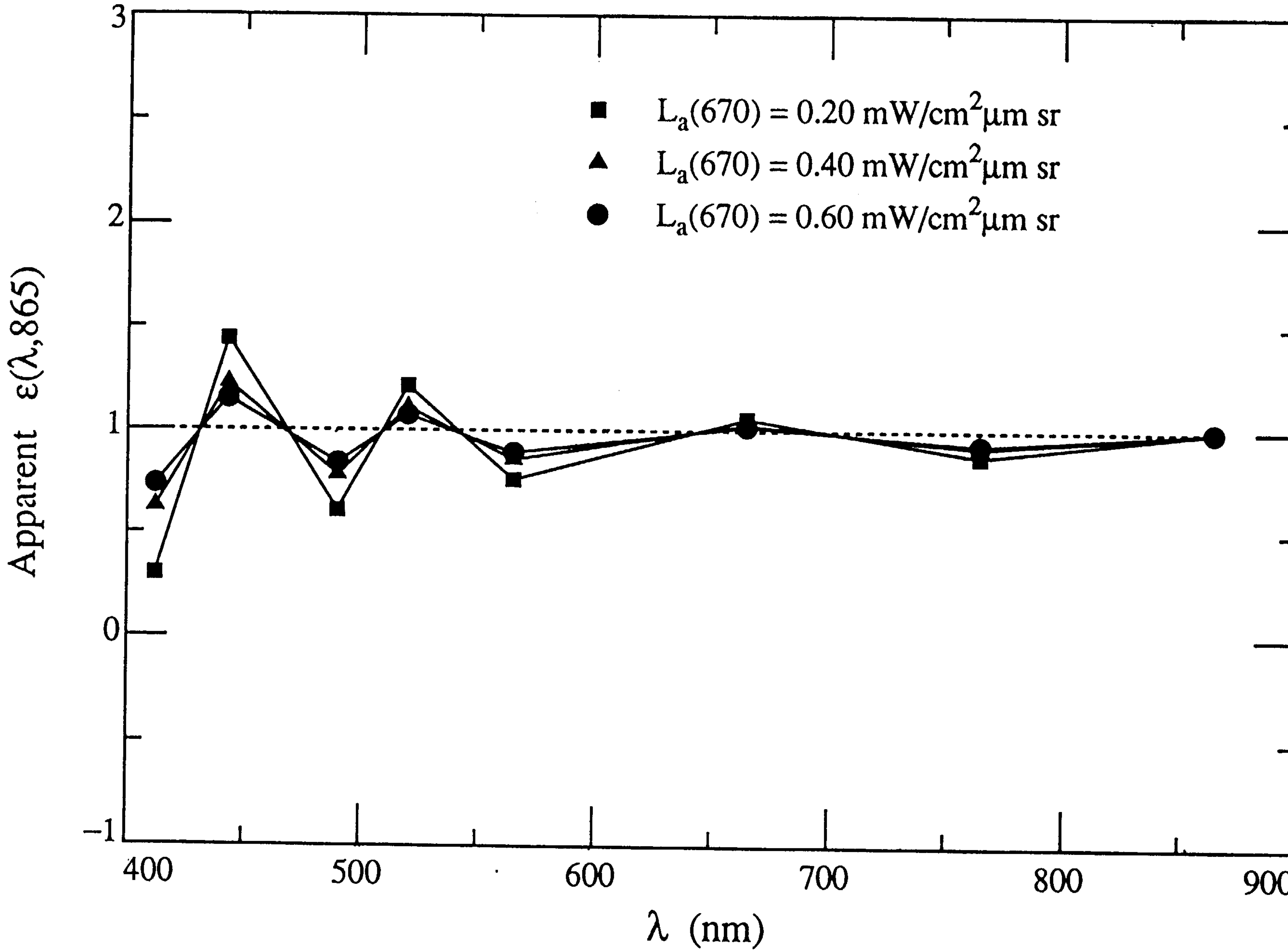
Let $\Delta\rho \equiv t\Delta\rho_w$

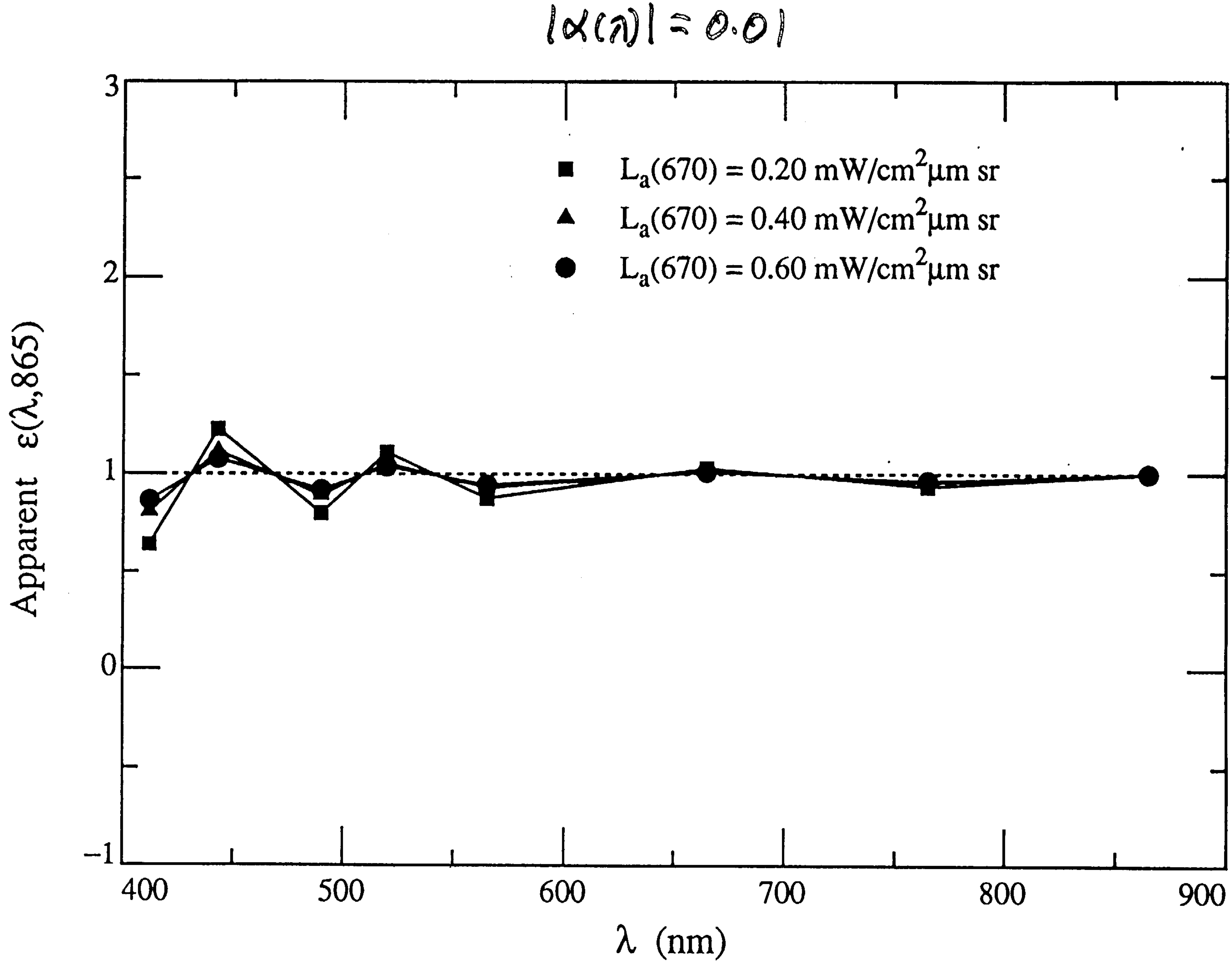
$\Delta\rho$ is the error in $t\rho_w$

$|\alpha(\lambda)| = 0.05$

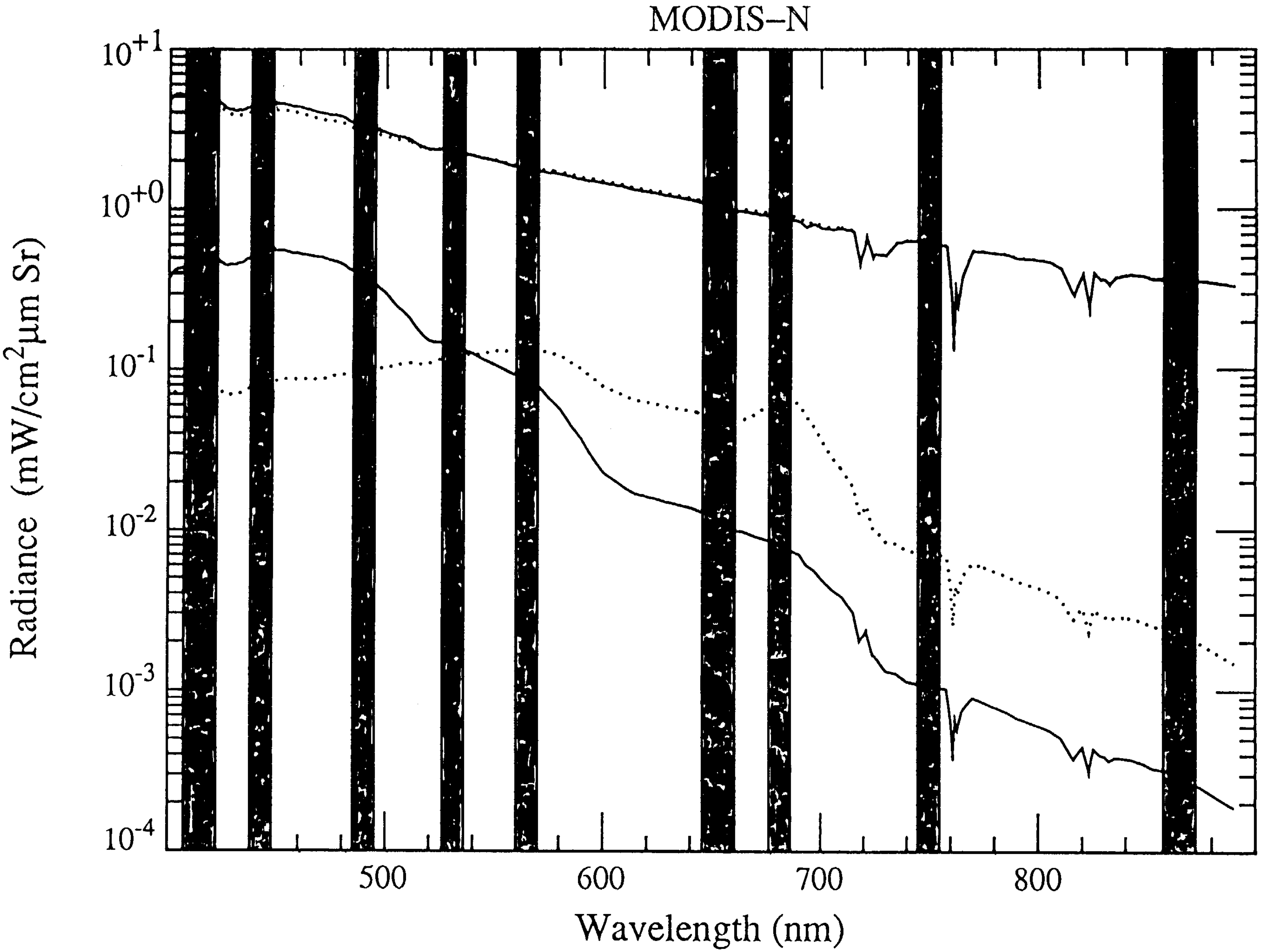


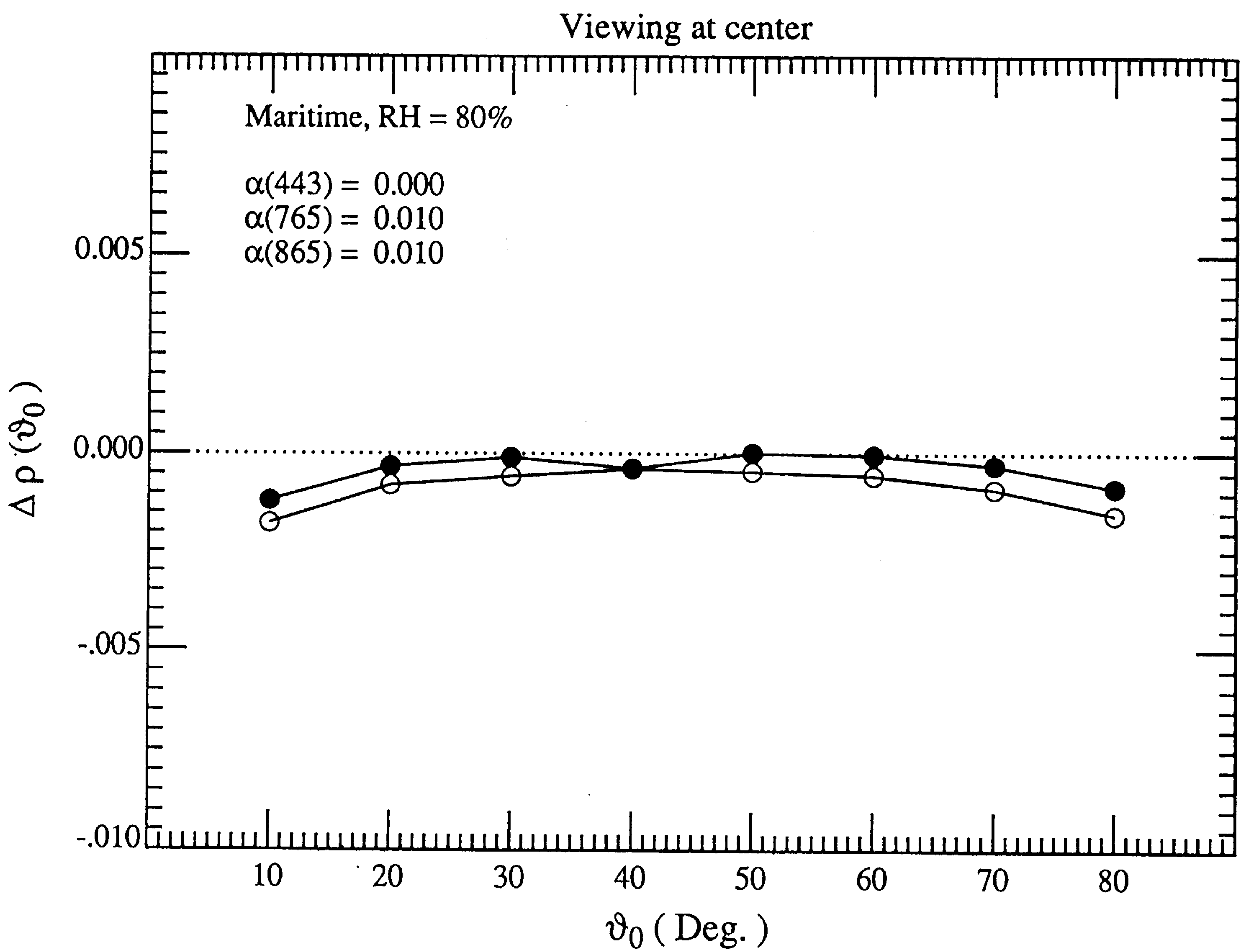
$|\alpha(\lambda)| = 0.03$

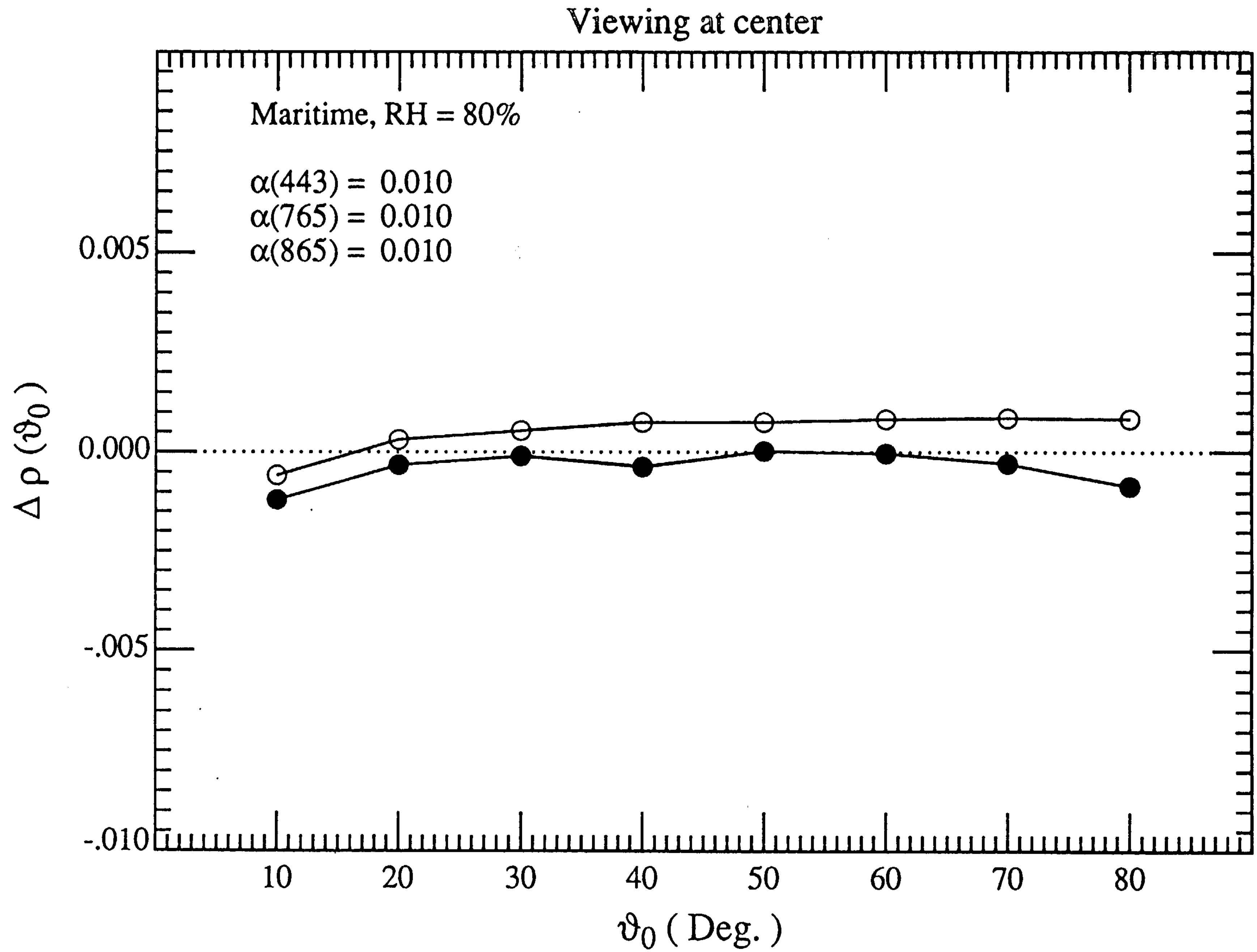




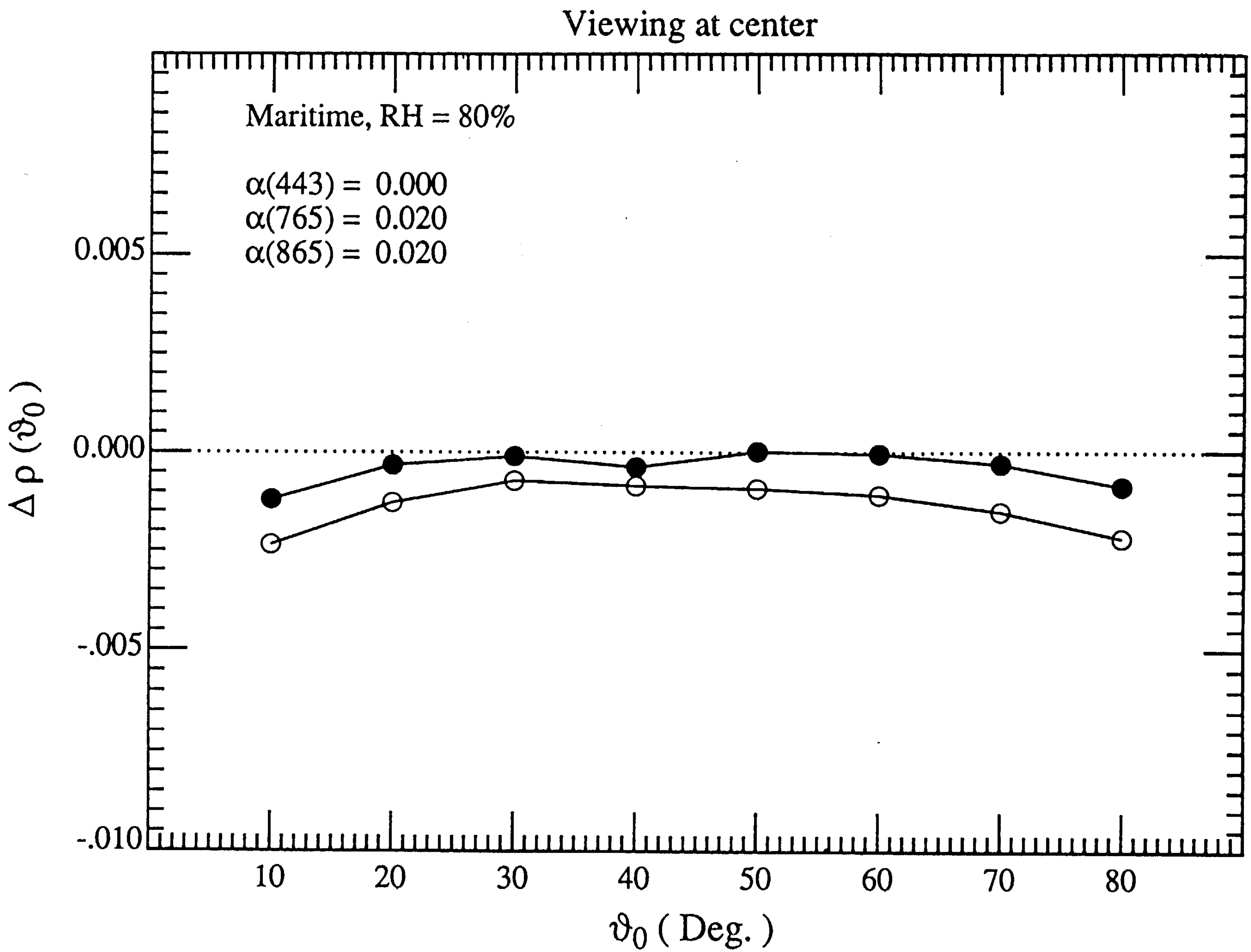
|α(λ)| = 0.01
L_a(670) = 0.20 mW/cm²μm sr
L_a(670) = 0.40 mW/cm²μm sr
L_a(670) = 0.60 mW/cm²μm sr
Apparent ε(λ,865)
λ (nm)
3
2
1
0
−1
400
500
600
700
800
900


MODIS–N
10+1
10+0
10-1
10-2
10-3
10-4
Radiance (mW/cm2μm Sr)
500
600
700
800
Wavelength (nm)

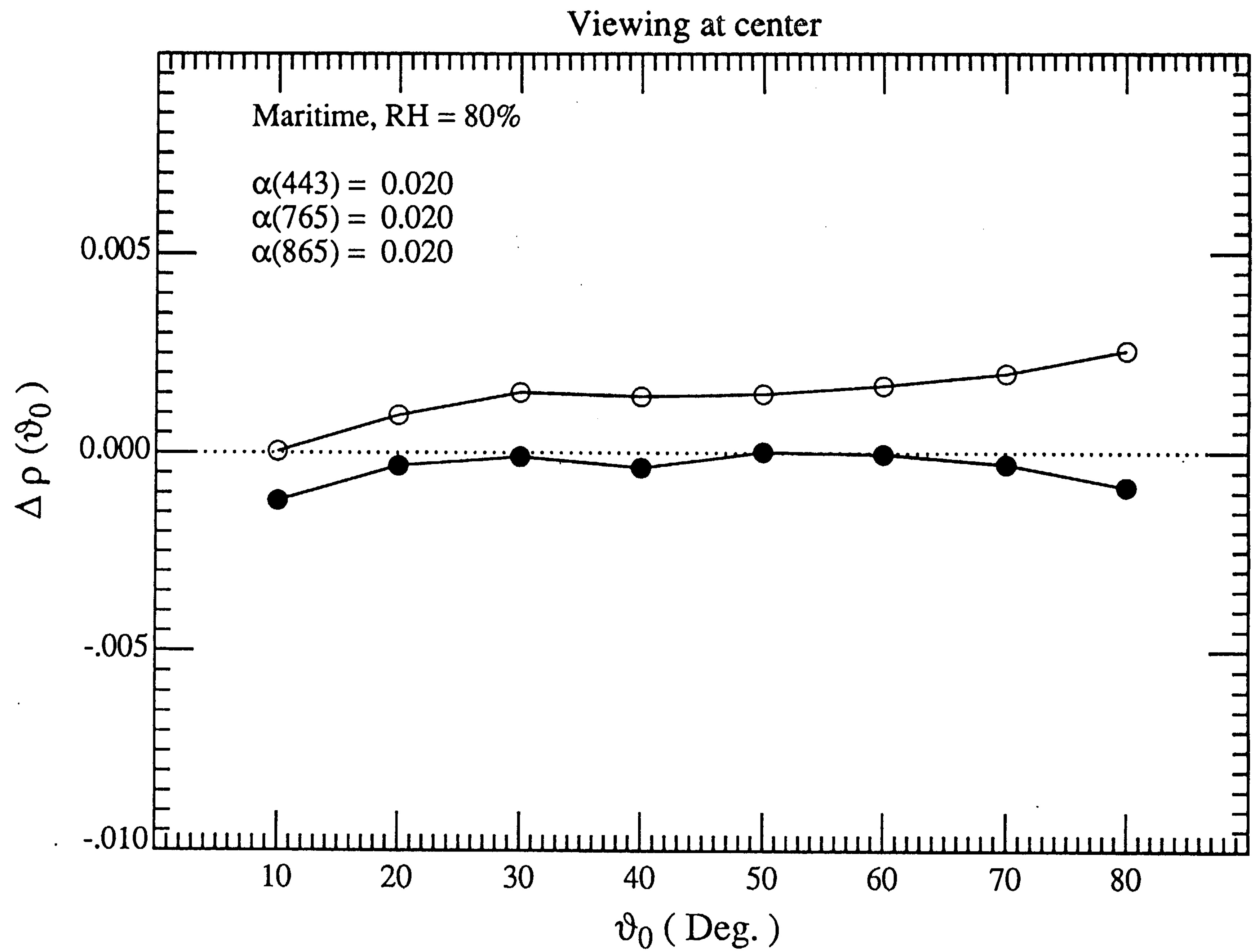

Viewing at center
Maritime, RH = 80%
α(443) = 0.000
α(765) = 0.010
α(865) = 0.010
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)



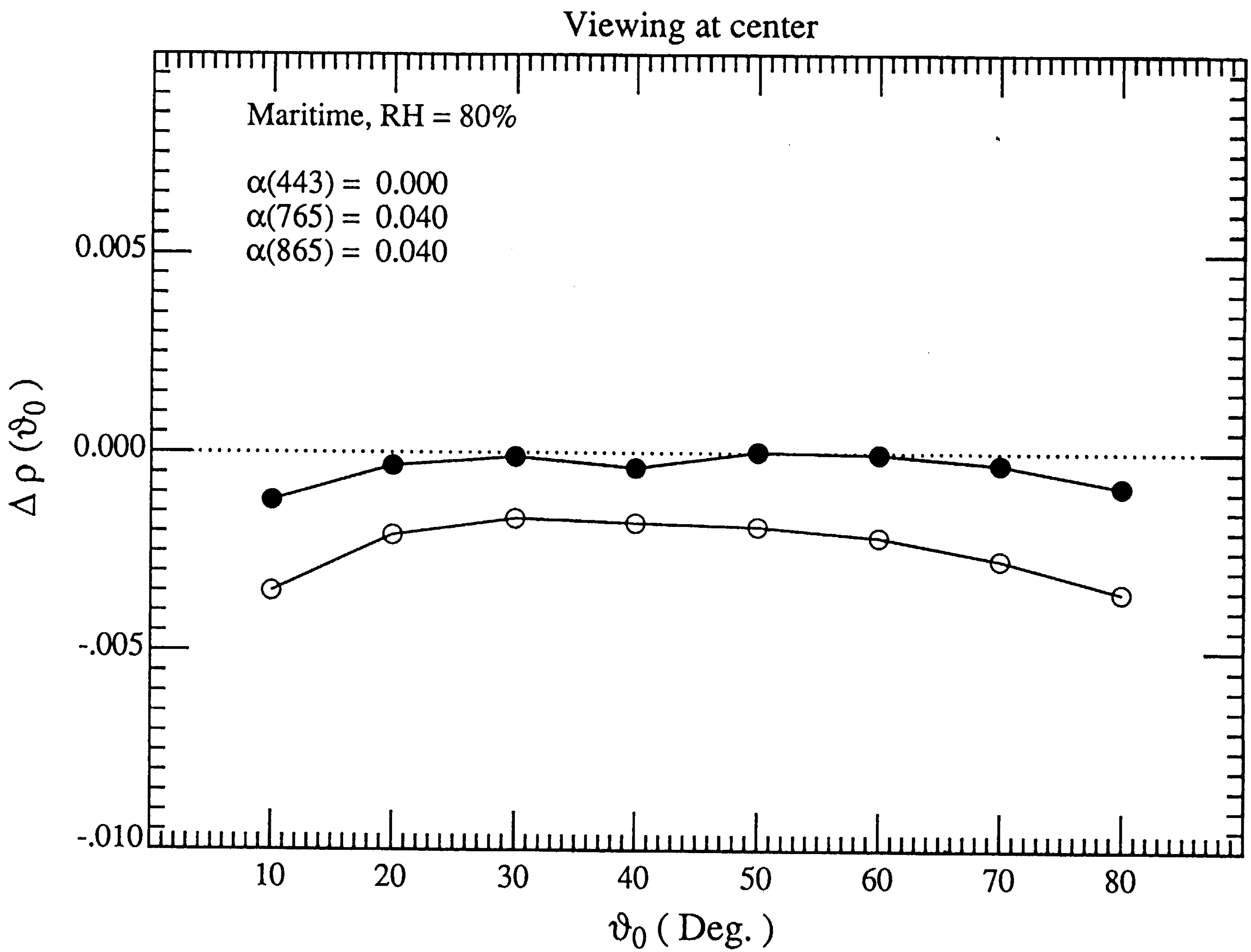
Viewing at center
Maritime, RH = 80%
α(443) = 0.010
α(765) = 0.010
α(865) = 0.010
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)

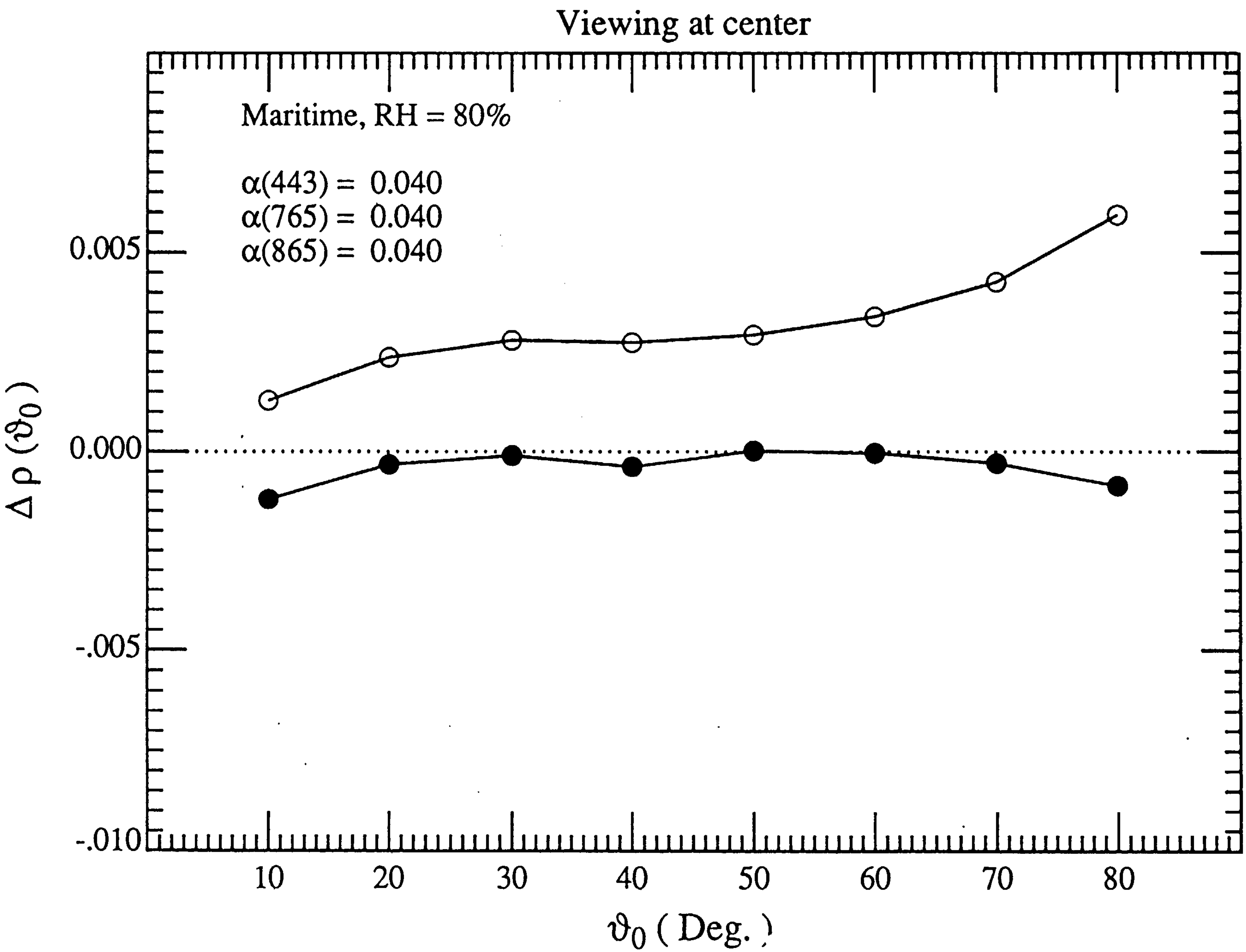


Viewing at center
Maritime, RH = 80%
α(443) = 0.000
α(765) = 0.020
α(865) = 0.020
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)

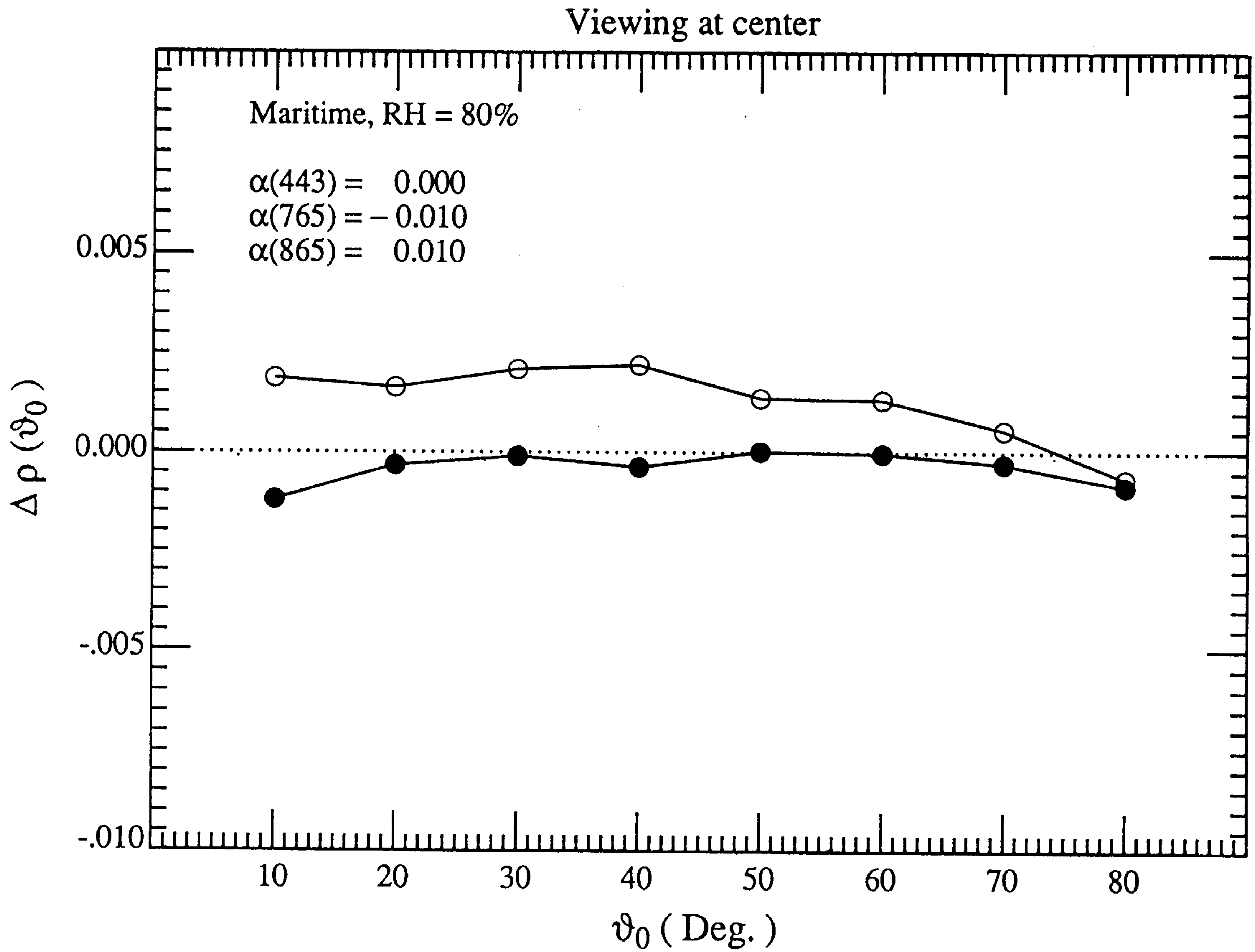


Viewing at center
Maritime, RH = 80%
α(443) = 0.020
α(765) = 0.020
α(865) = 0.020
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)

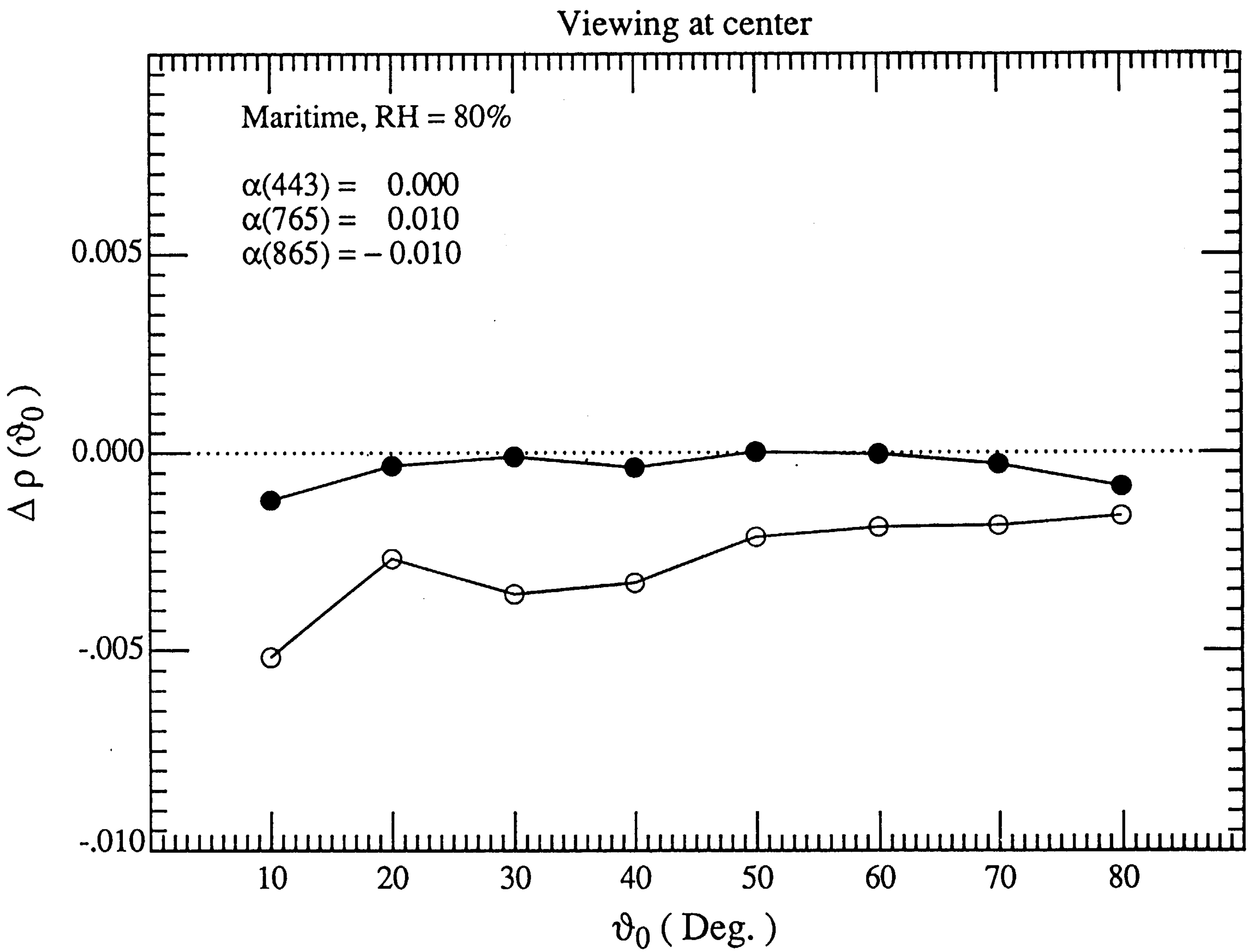

Viewing at center
Maritime, RH = 80%
α(443) = 0.000
α(765) = 0.040
α(865) = 0.040
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)



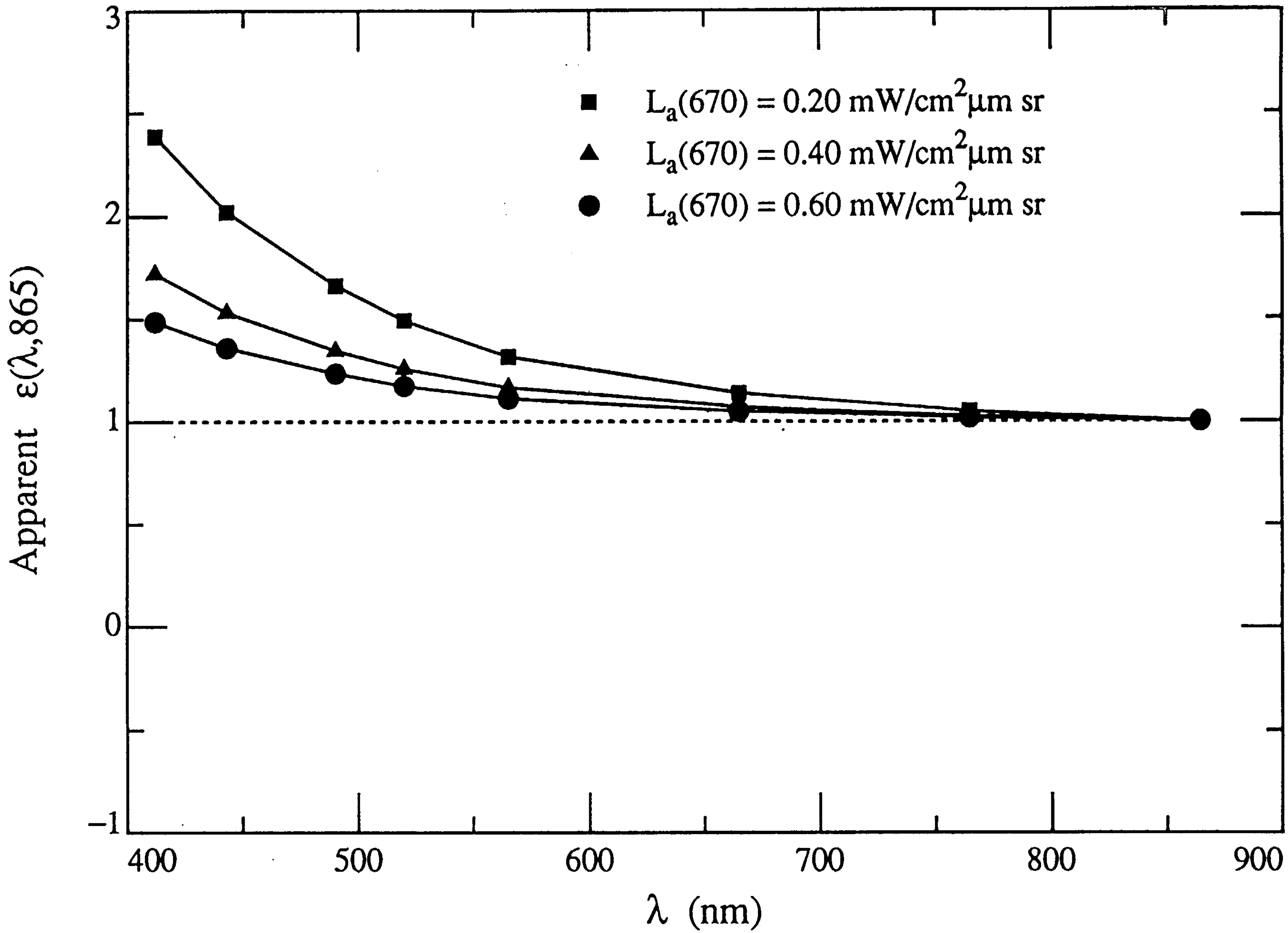
Viewing at center
Maritime, RH = 80%
α(443) = 0.040
α(765) = 0.040
α(865) = 0.040
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)

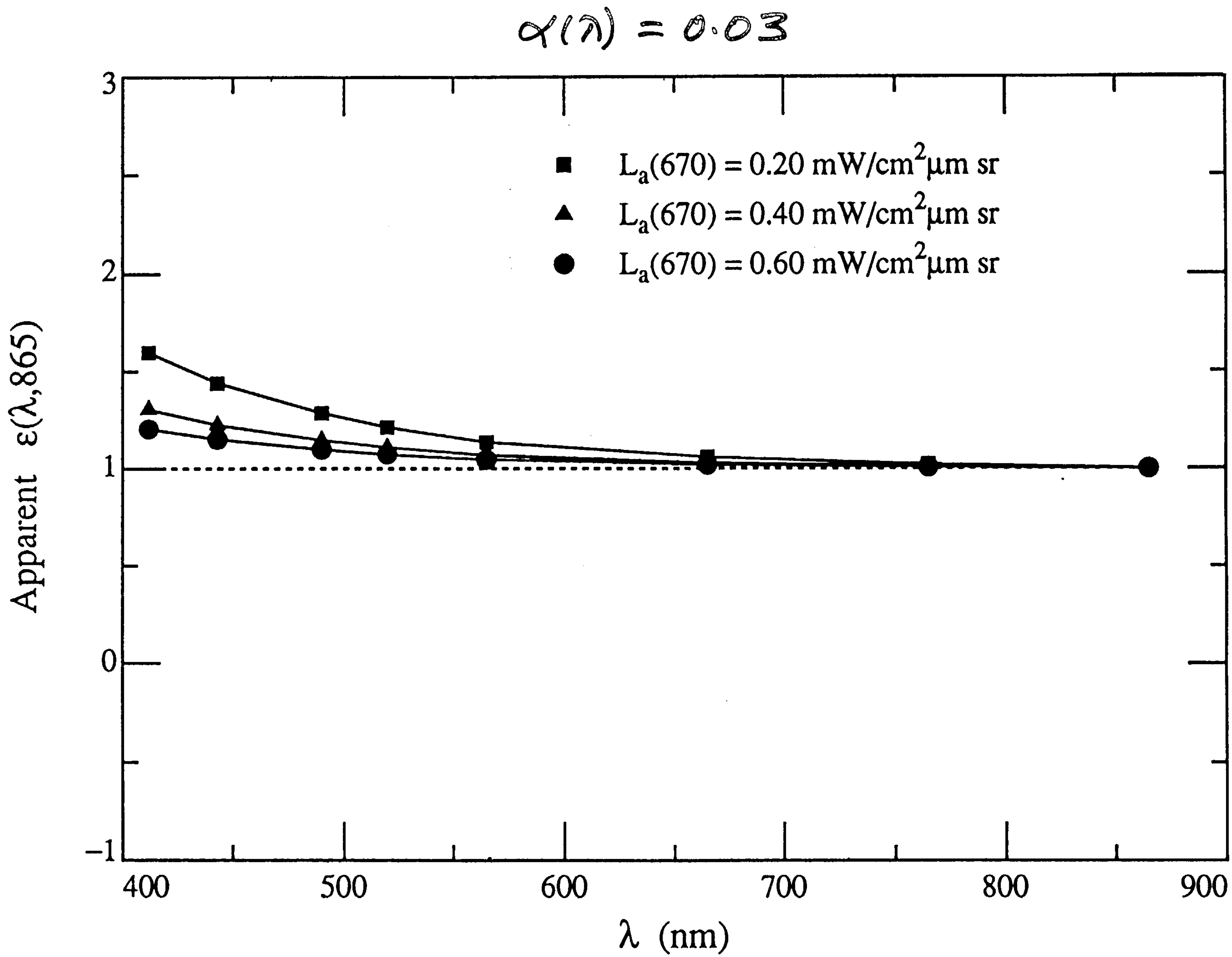


Viewing at center
Maritime, RH = 80%
α(443) = 0.000
α(765) = – 0.010
α(865) = 0.010
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)


Viewing at center
Maritime, RH = 80%
α(443) = 0.000
α(765) = 0.010
α(865) = – 0.010
0.005
0.000
-.005
-.010
Δ ρ (ϑ0)
10
20
30
40
50
60
70
80
ϑ0 (Deg.)

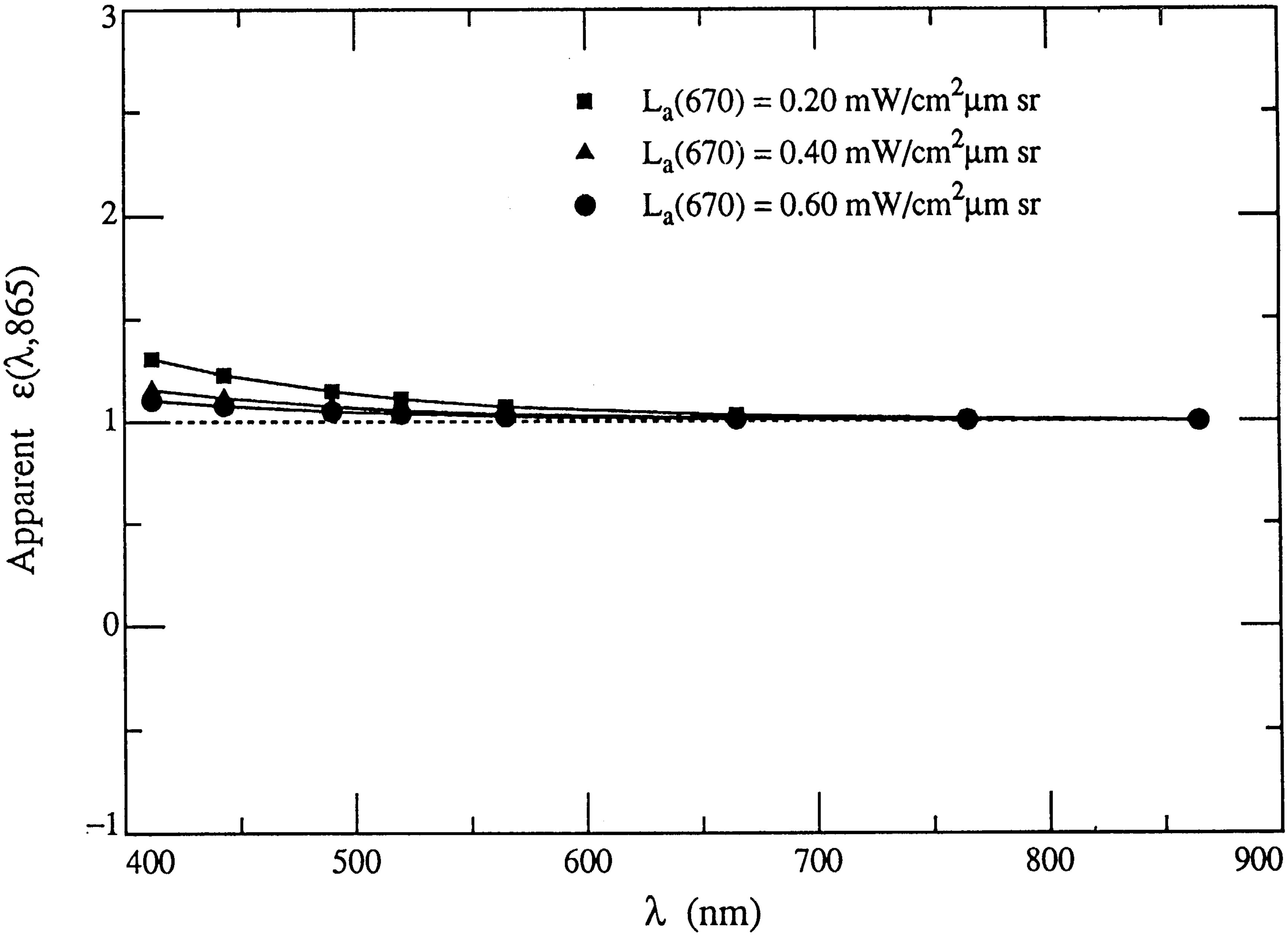
$\alpha(\lambda) = 0.05$

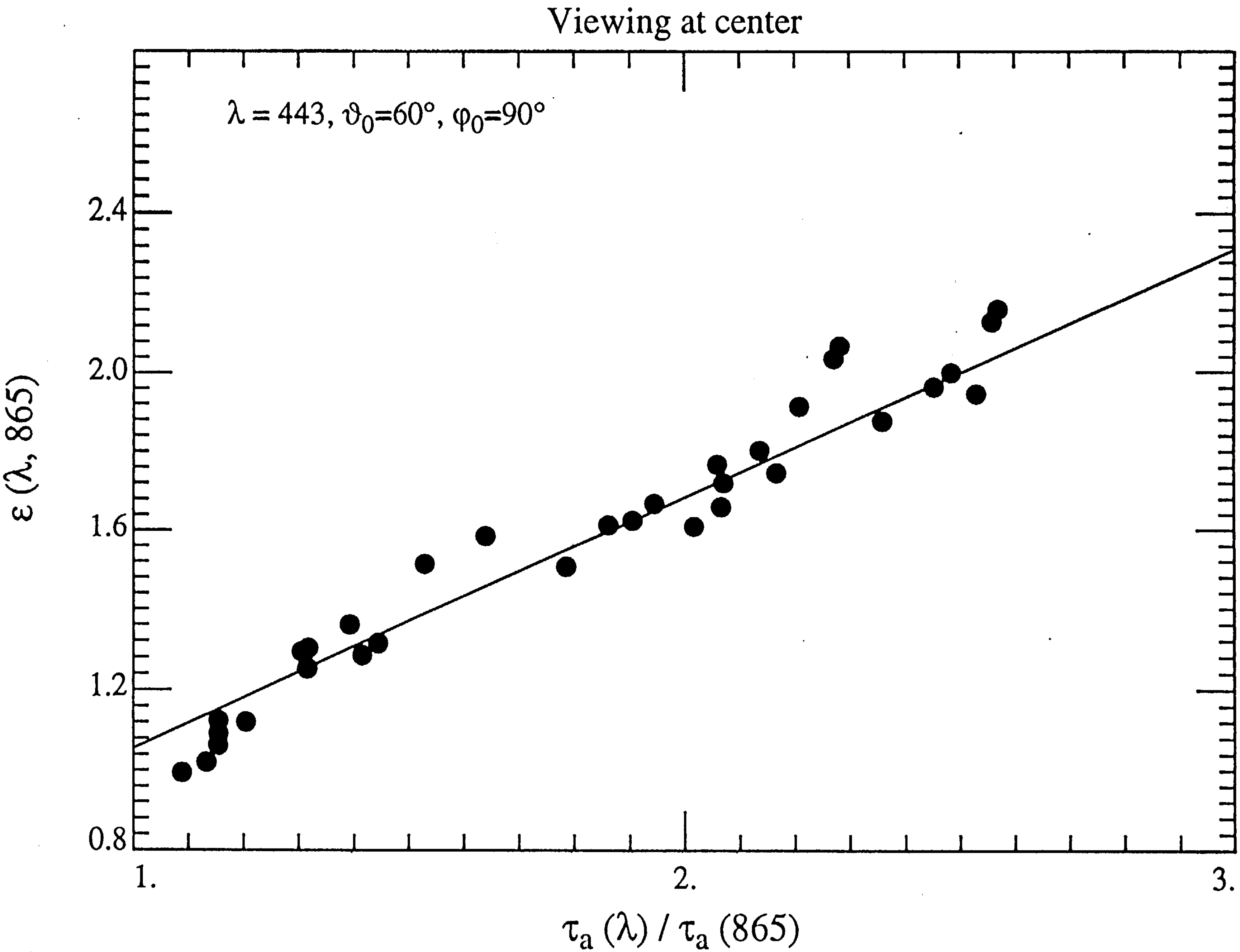


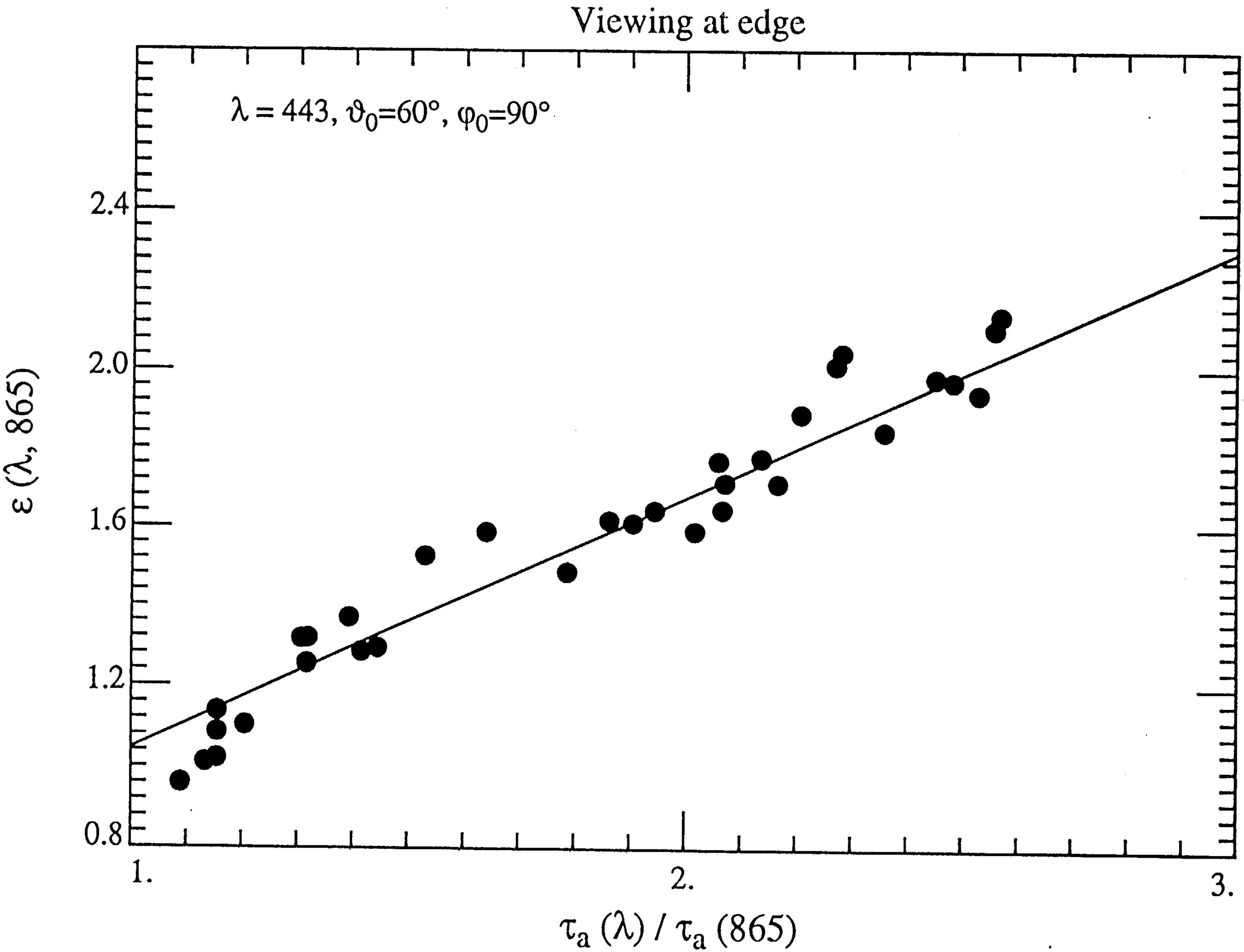


α(λ) = 0.03
L_a(670) = 0.20 mW/cm²μm sr
L_a(670) = 0.40 mW/cm²μm sr
L_a(670) = 0.60 mW/cm²μm sr
Apparent ε(λ,865)
λ (nm)
3
2
1
0
−1
400
500
600
700
800
900

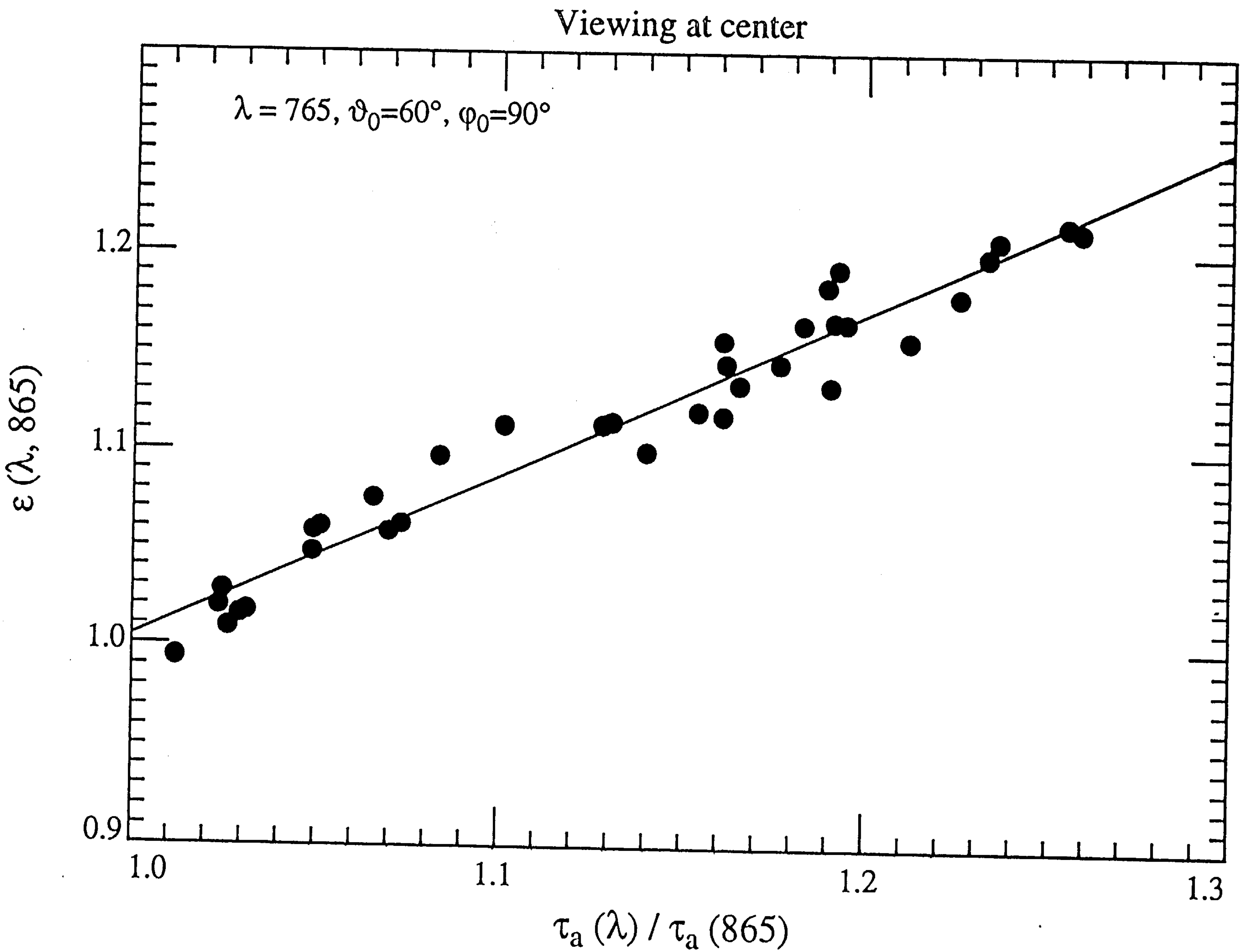
$\alpha(\lambda) = 0.01$



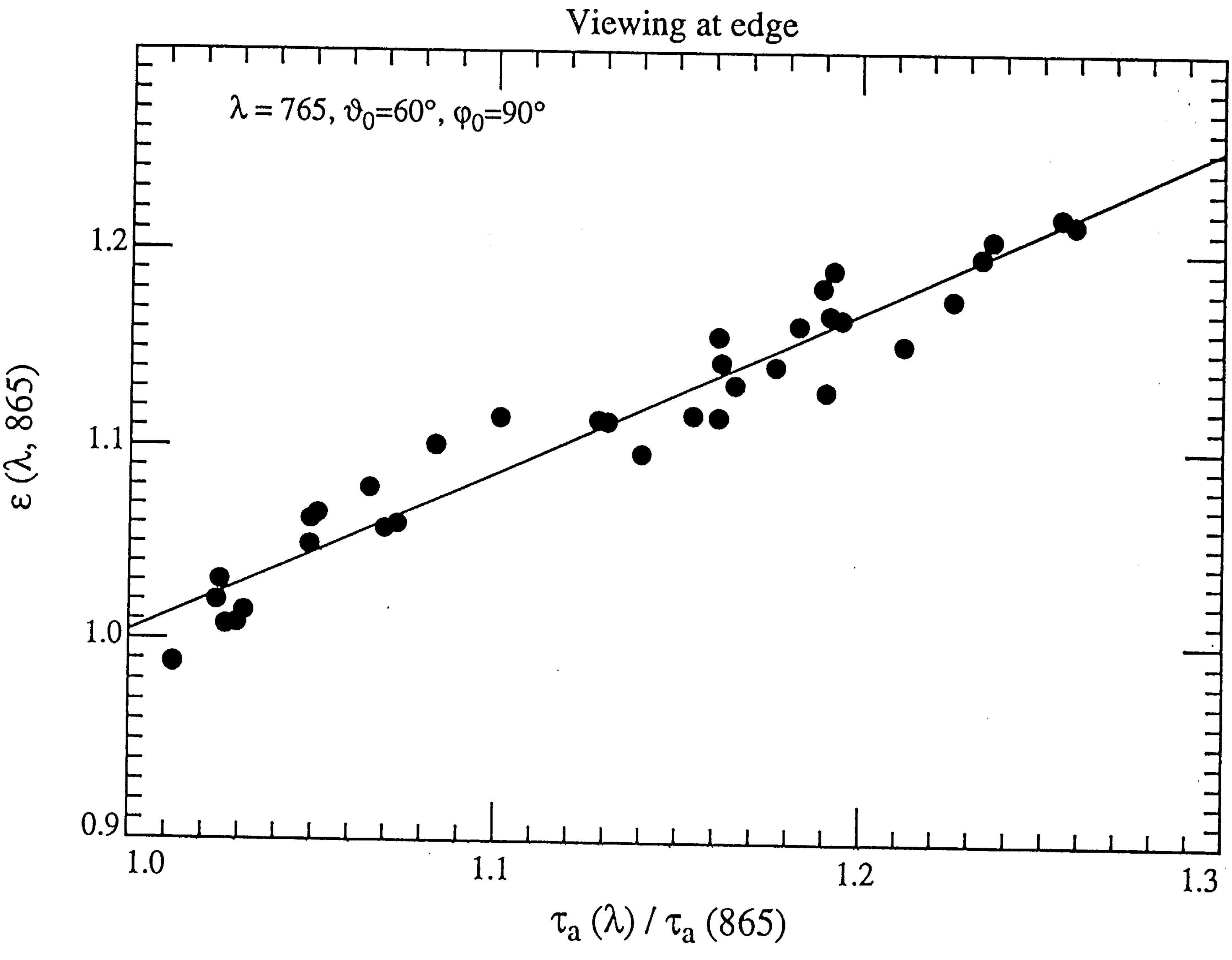

Viewing at center
λ = 443, ϑ0=60°, φ0=90°
2.4
2.0
1.6
1.2
0.8
ε (λ, 865)
1.
2.
3.
τa (λ) / τa (865)



Viewing at edge
λ = 443, ϑ0=60°, φ0=90°
2.4
2.0
1.6
1.2
0.8
ε (λ, 865)
1.
2.
3.
τa (λ) / τa (865)



Viewing at center
λ = 765, ϑ0=60°, φ0=90°
ε (λ, 865)
τa (λ) / τa (865)
0.9
1.0
1.1
1.2
1.0
1.1
1.2
1.3



Viewing at edge
λ = 765, ϑ0=60°, φ0=90°
1.2
1.1
1.0
0.9
1.0
1.1
1.2
1.3
ε (λ, 865)
τa (λ) / τa (865)

Values of $\alpha(\lambda_i)$ required to produce a nearly correct $\varepsilon(\lambda_i, \lambda_l)$ for $|\alpha(\lambda)| = 0.05$ assuming that $L_a(670) = 0.2$ mW/cm$^2\mu$m sr.

λ_i (nm)	$\alpha(\lambda_i)$
412	0.003
443	0.005
490	0.008
520	0.01
550	0.015
670	0.02
765	0.03

Use atmospheric measurements to obtain aerosol phase function to reduce $\alpha(865)$.

Calibration Initialization

$$\rho_t(\lambda) = \rho_r(\lambda) + \rho_{as}(\lambda) + t(\lambda)\rho_w(\lambda),$$

$$\varepsilon(\lambda_i, \lambda_l) = \frac{\rho_{as}(\lambda_i)}{\rho_{as}(\lambda_l)} = \frac{\rho_t(\lambda_i) - \rho_r(\lambda_i) - t(\lambda_i)\rho_w(\lambda_i)}{\rho_t(\lambda_l) - \rho_r(\lambda_l) - t(\lambda_l)\rho_w(\lambda_l)}.$$

$$\varepsilon(\lambda_i, \lambda_l) = \frac{\alpha(\lambda_i)\rho_t(\lambda_i) + \rho_{as}(\lambda_i)}{\alpha(\lambda_l)\rho_t(\lambda_l) + \rho_{as}(\lambda_l)}.$$

$$\alpha(\lambda_i) = \frac{\rho_t(\lambda_l)}{\rho_t(\lambda_i)}\varepsilon(\lambda_i, \lambda_l)\alpha(\lambda_l).$$

Adjust $\alpha(\lambda_i)$ to produce the correct $\varepsilon(\lambda_i, \lambda_l)$.