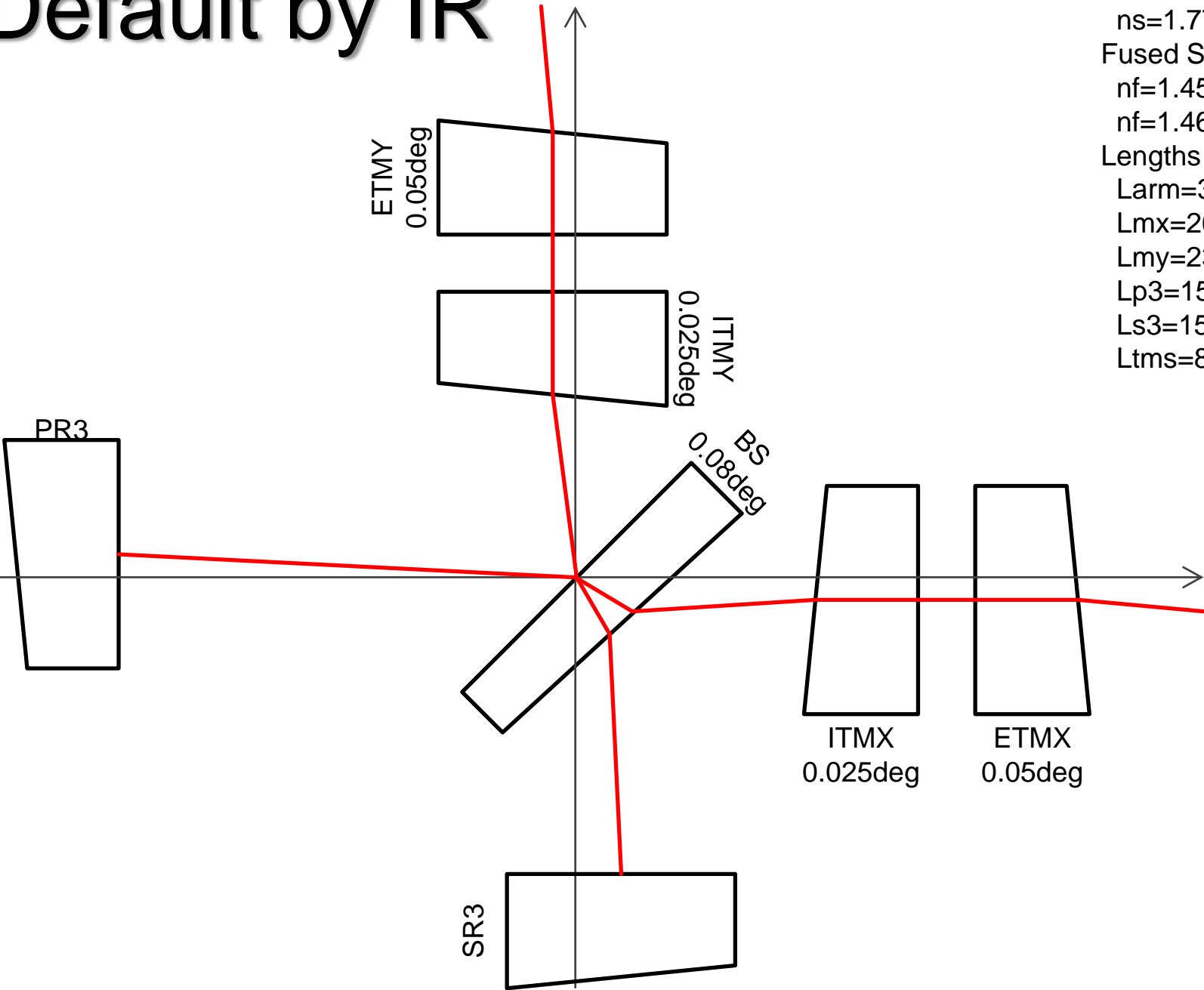


# Interferometer Layout for Both IR and Green Beams, With and Without ITMs

Yuta Michimura

Department of Physics, University of Tokyo

# Default by IR



Sapphire  
ns=1.754 for 1064 nm  
ns=1.772 for 532 nm  
Fused Silica  
nf=1.450 for 1064 nm  
nf=1.461 for 532 nm  
Lengths  
Larm=3000 m  
Lmx=26.6649 m  
Lmy=23.3351 m  
Lp3=15.7386 m  
Ls3=15.7386 m  
Ltms=8.3 m

# IR

## Full

Calculation consistent with default layout at  $10^{-4}$  m level

$$y_p = L_{p3} \cdot \sin(\theta_{in}) = 0.0122 \text{ m}$$

$$x = -L_{my} \cdot \sin(\theta_y) = -0.00768 \text{ m}$$

$$\theta_y = \arcsin(ns \cdot \sin w_{ITM}) - w_{ITM} = 329 \text{ urad}$$

$$\theta_{in} = \theta_y + 2 \cdot \theta_{bs} = 775 \text{ urad}$$

$$\theta_{oy} = \pi/4 - \theta_{bs} - \theta_r = 15.818 \text{ deg}$$

$$\theta_r = \arcsin(\sin(\pi/4 - \theta_{bs} - \theta_y) / nf) = 29.169 \text{ deg}$$

$$x_{bs} = d_{BS} / \cos(\theta_r) \cdot \sin(\theta_{oy}) = 0.0250 \text{ m}$$

$$\theta_s = \pi/4 - \theta_{bs} - w_{BS} - \arcsin(nf \cdot \sin(\theta_r - w_{BS})) = 1429 \text{ urad}$$

$$x_s = x_{bs} + L_{s3} \cdot \sin(\theta_s) = -0.0475 \text{ m}$$

$$x_t = x - L_{tms} \cdot \sin \theta_{yt} = -0.0131 \text{ m}$$

$$\theta_{yt} = \arcsin(ns \cdot \sin w_{ETM}) - w_{ETM} = 658 \text{ urad}$$

This can be derived from  $w_{BS}$  and  $w_{ITM}$ . Assuming BS incident angle to be  $\sim \pi/4$ ,  $\theta_{bs} = \arcsin(nf \cdot \sin(\arcsin(\sin(\pi/4)/nf) + w_{BS})) - w_{BS} - \pi/4$  / 2 -  $\theta_y = (a-1) \cdot w_{BS} / 2 - \theta_y$ , where  $a = \sqrt{(nf^2 - \sin^2(\pi/4)) / \cos(\pi/4)}$

$$\theta_{bs}' = 134.987226891 \text{ deg} = 135 \text{ deg} - \theta_{bs}$$

$$y_{bs} = -d_{BS} / \cos(\theta_r) \cdot \sin(\theta_{ox}) = -0.0250 \text{ m}$$

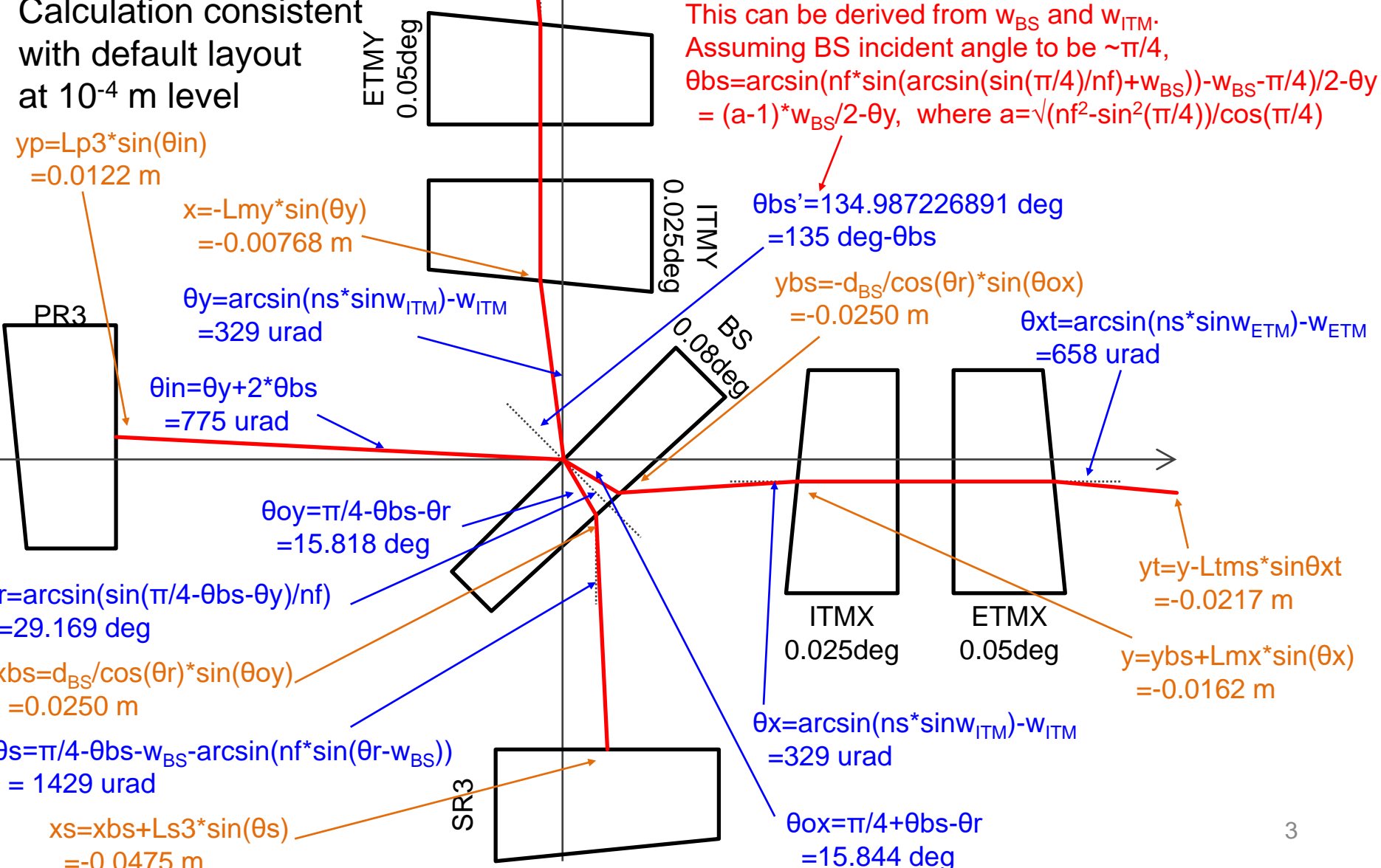
$$\theta_{xt} = \arcsin(ns \cdot \sin w_{ETM}) - w_{ETM} = 658 \text{ urad}$$

$$y_t = y - L_{tms} \cdot \sin \theta_{xt} = -0.0217 \text{ m}$$

$$y = y_{bs} + L_{mx} \cdot \sin(\theta_x) = -0.0162 \text{ m}$$

$$\theta_x = \arcsin(ns \cdot \sin w_{ITM}) - w_{ITM} = 329 \text{ urad}$$

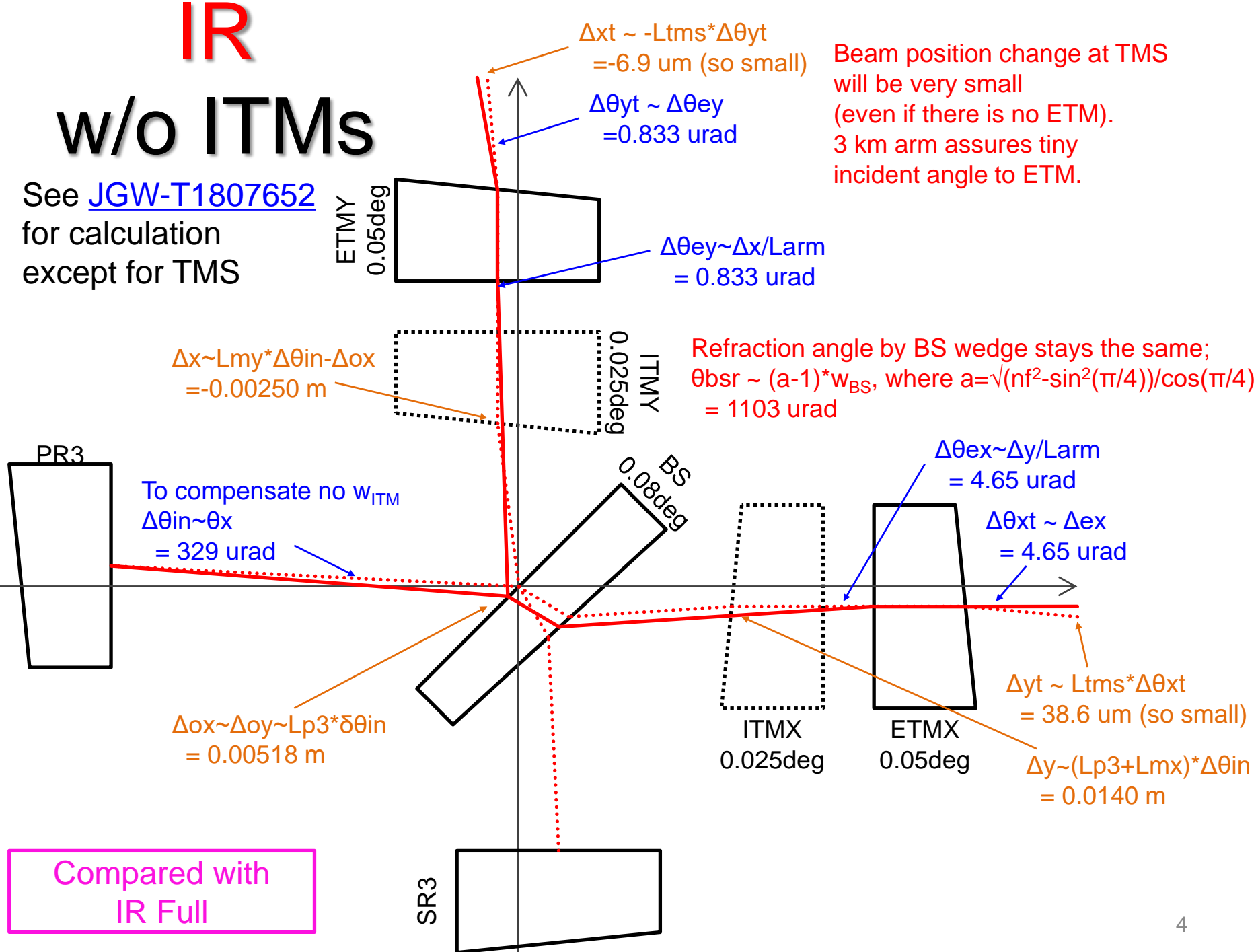
$$\theta_{ox} = \pi/4 + \theta_{bs} - \theta_r = 15.844 \text{ deg}$$



# IR

## w/o ITMs

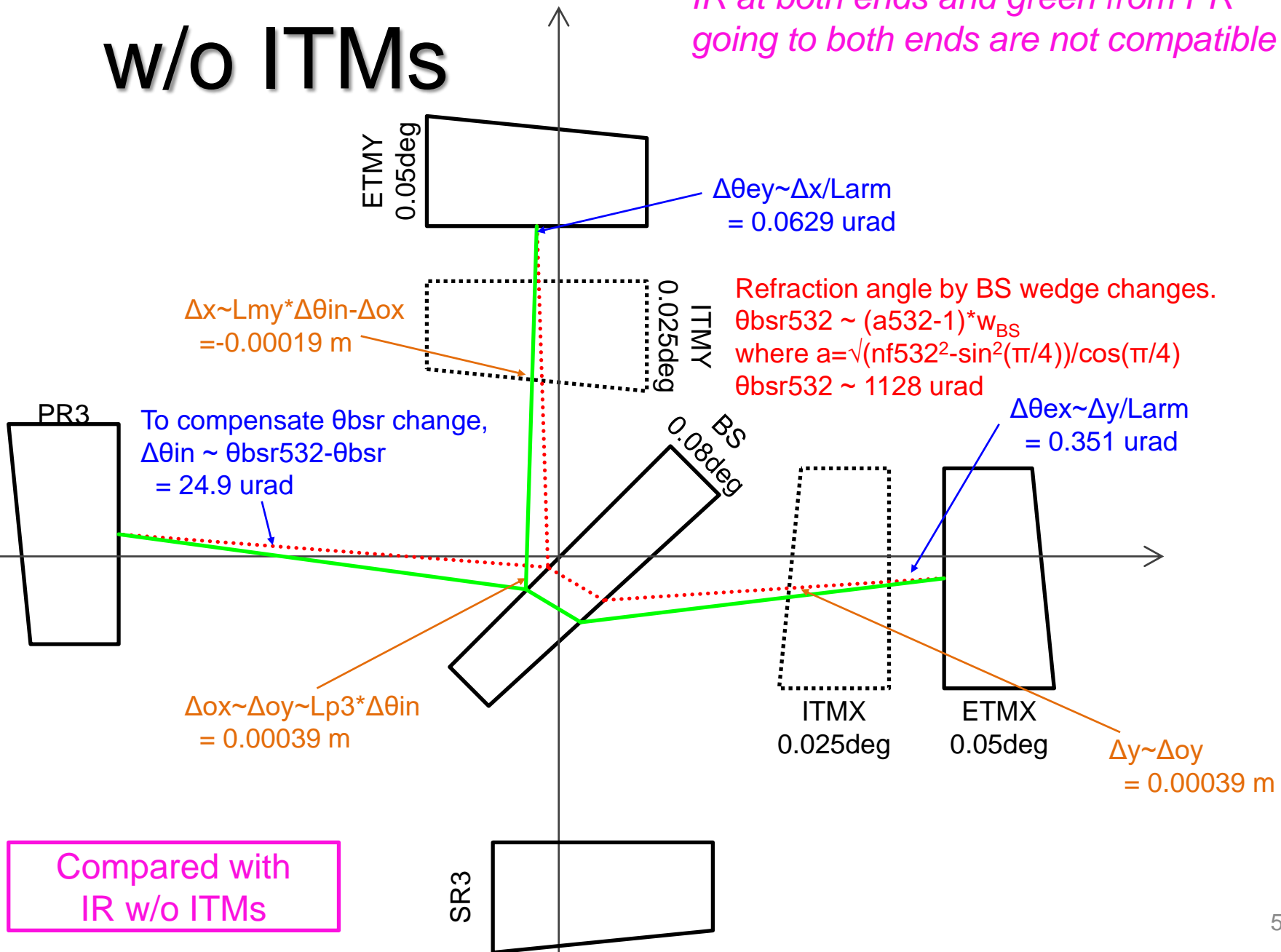
See [JGW-T1807652](#)  
for calculation  
except for TMS



# Green from PR

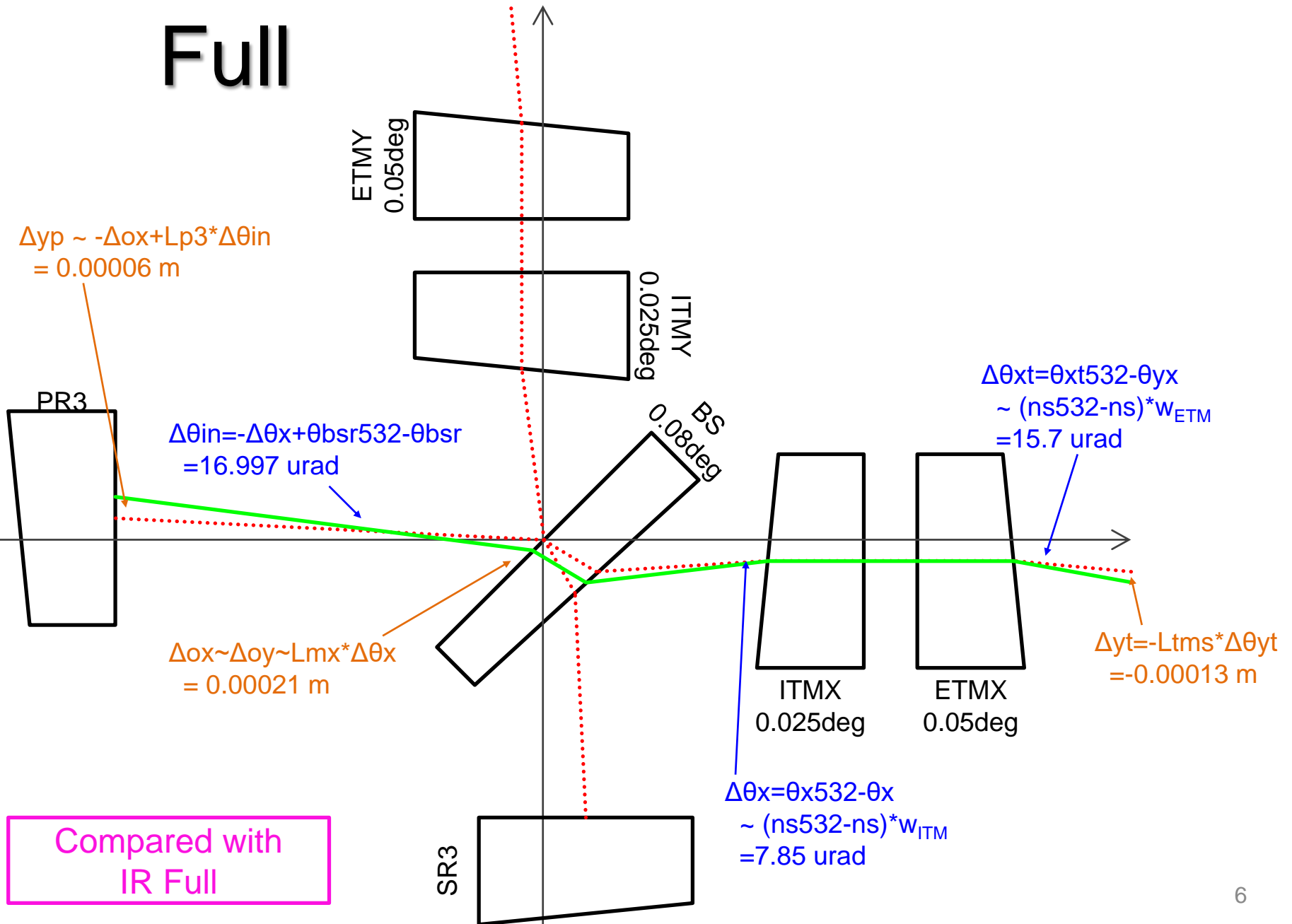
## w/o ITMs

*IR at both ends and green from PR going to both ends are not compatible*



# Green X

## Full



# Green Y

## Full

