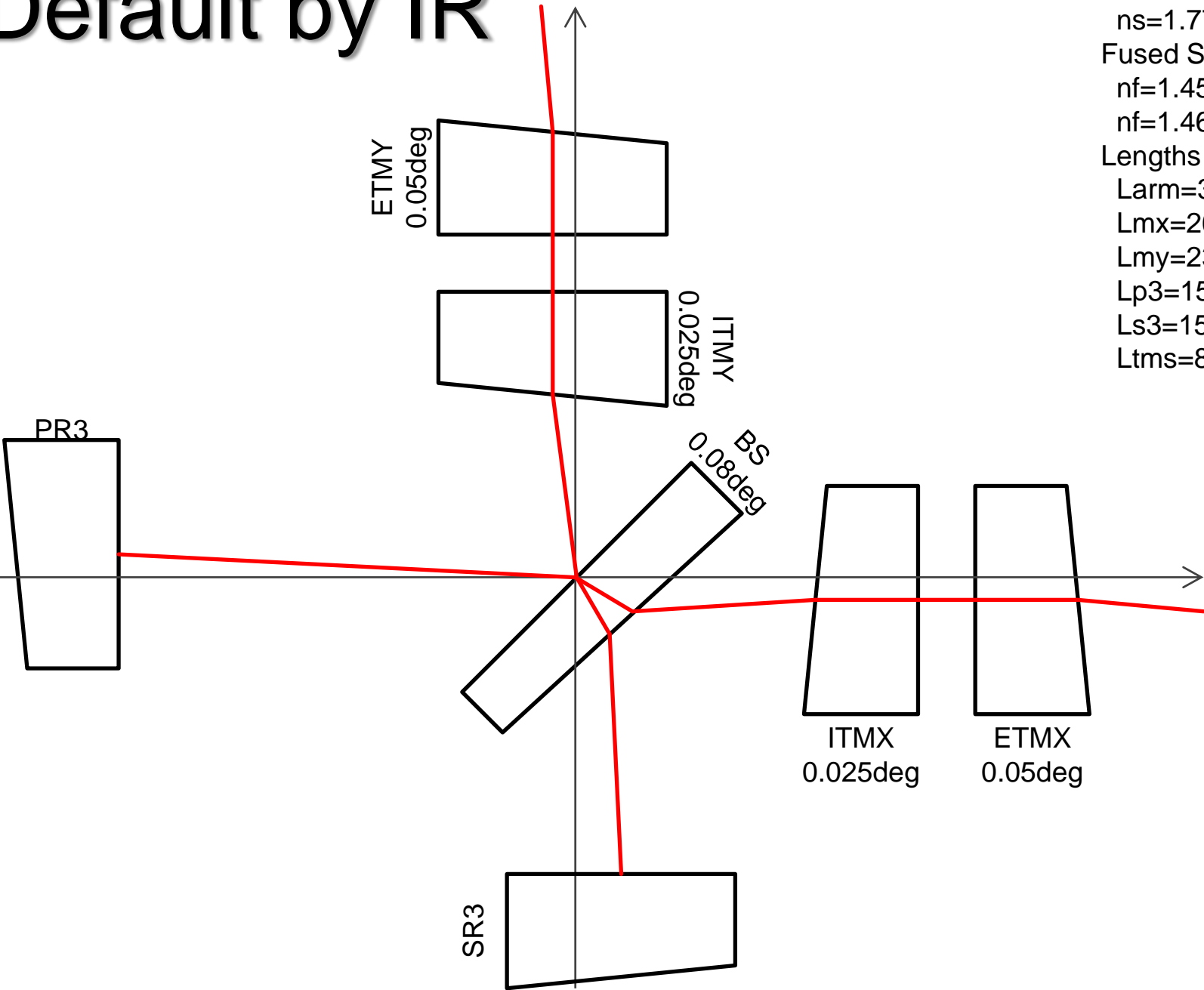


Interferometer Layout for Both IR and Green Beams, With and Without ITMs

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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

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



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

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

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

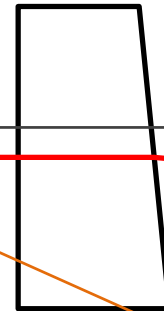
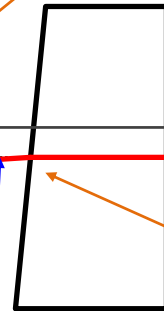
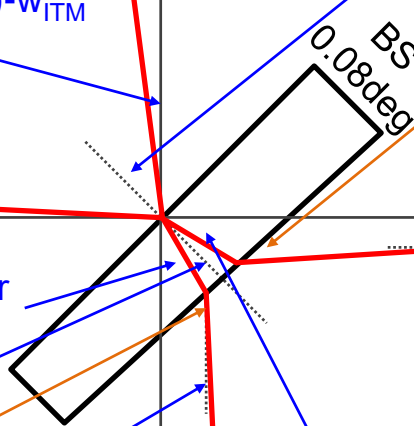
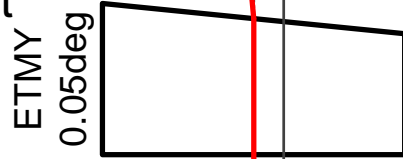
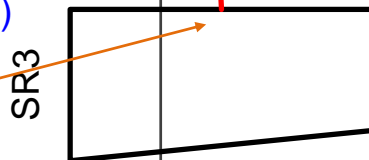
$$\theta_{oy} = \pi/4 - \theta_{bs} - \theta_r = 15.818 \text{ deg}$$

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

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

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

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



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

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

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

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

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

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

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

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

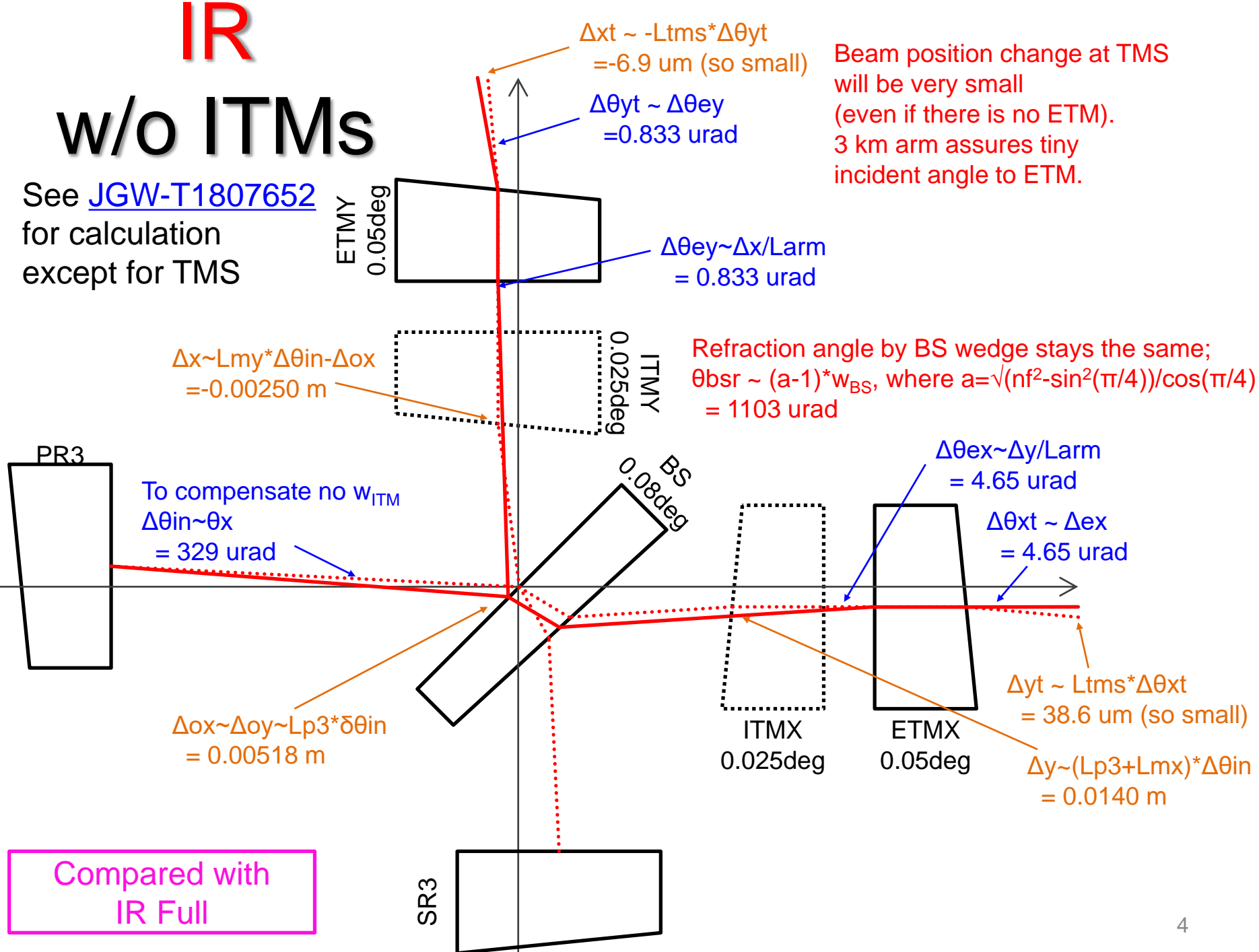
$$\theta_x = \arcsin(n_s \cdot \sin w_{ITM}) - w_{ITM} = 329 \text{ urad}$$

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

IR

w/o ITMs

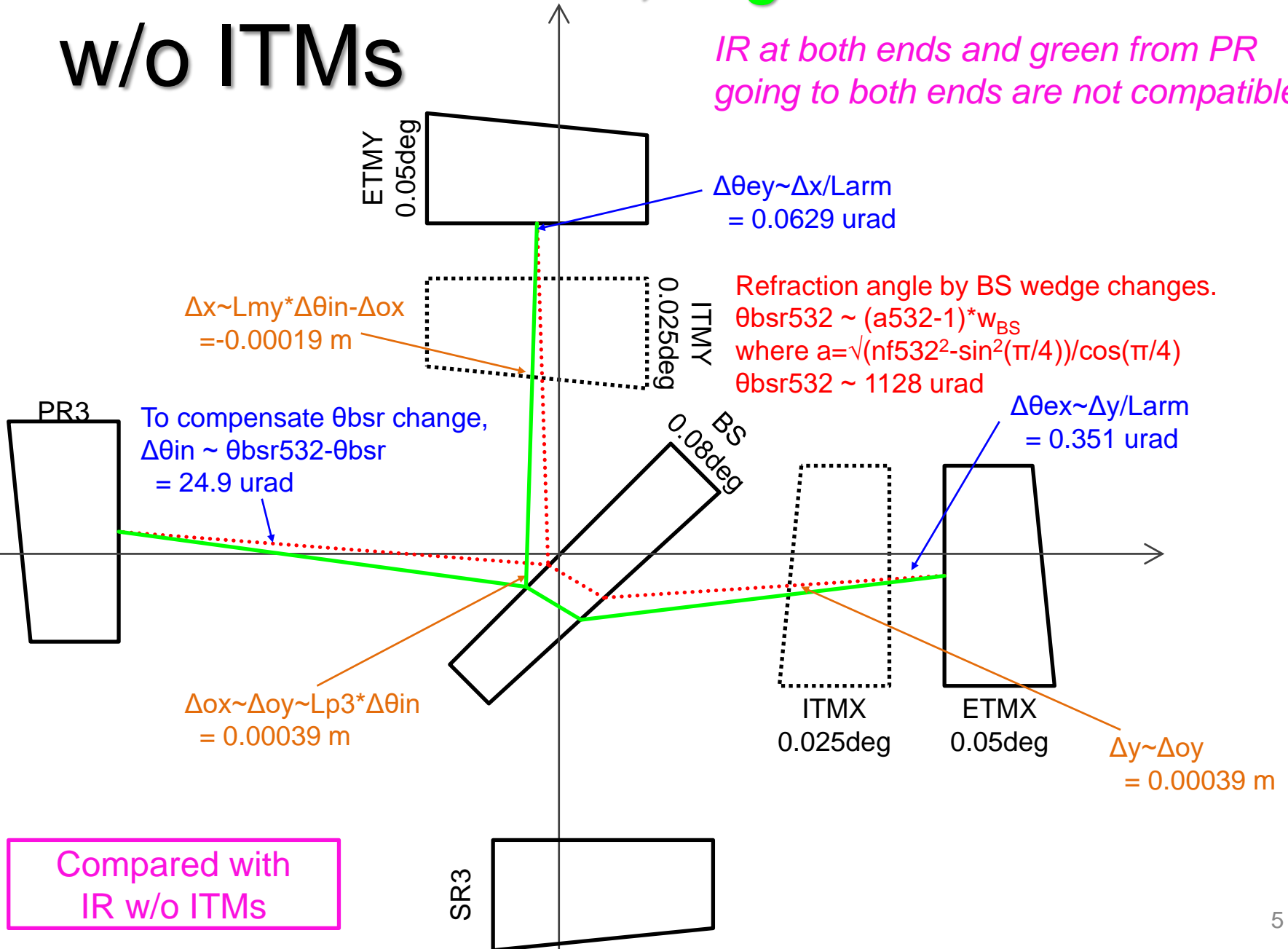
See [JGW-T1807652](#)
for calculation
except for TMS



Green from PR, aligned to both ends

w/o ITMs

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

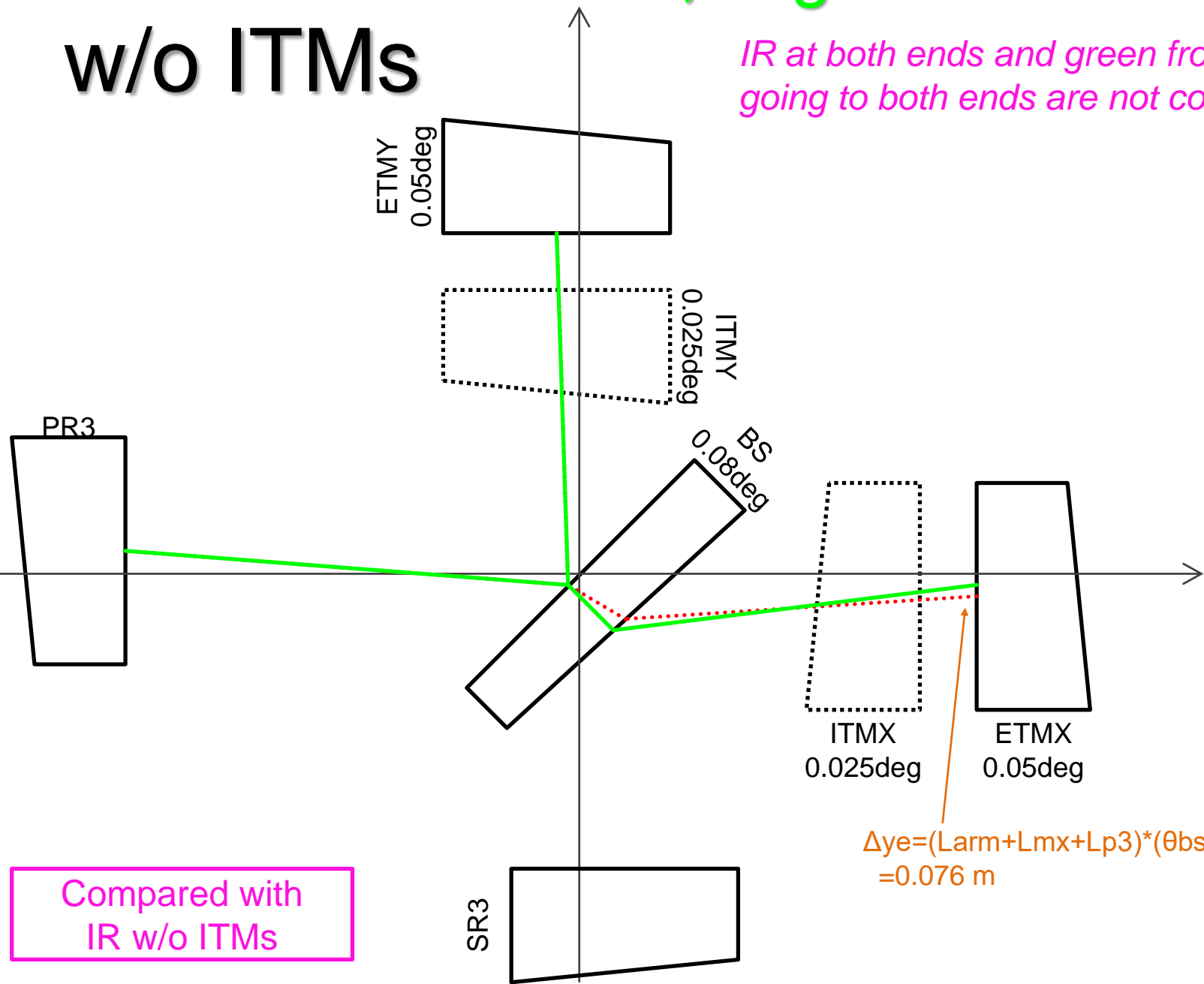


Compared with IR w/o ITMs

Green from PR, aligned to IR beam

w/o ITMs

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

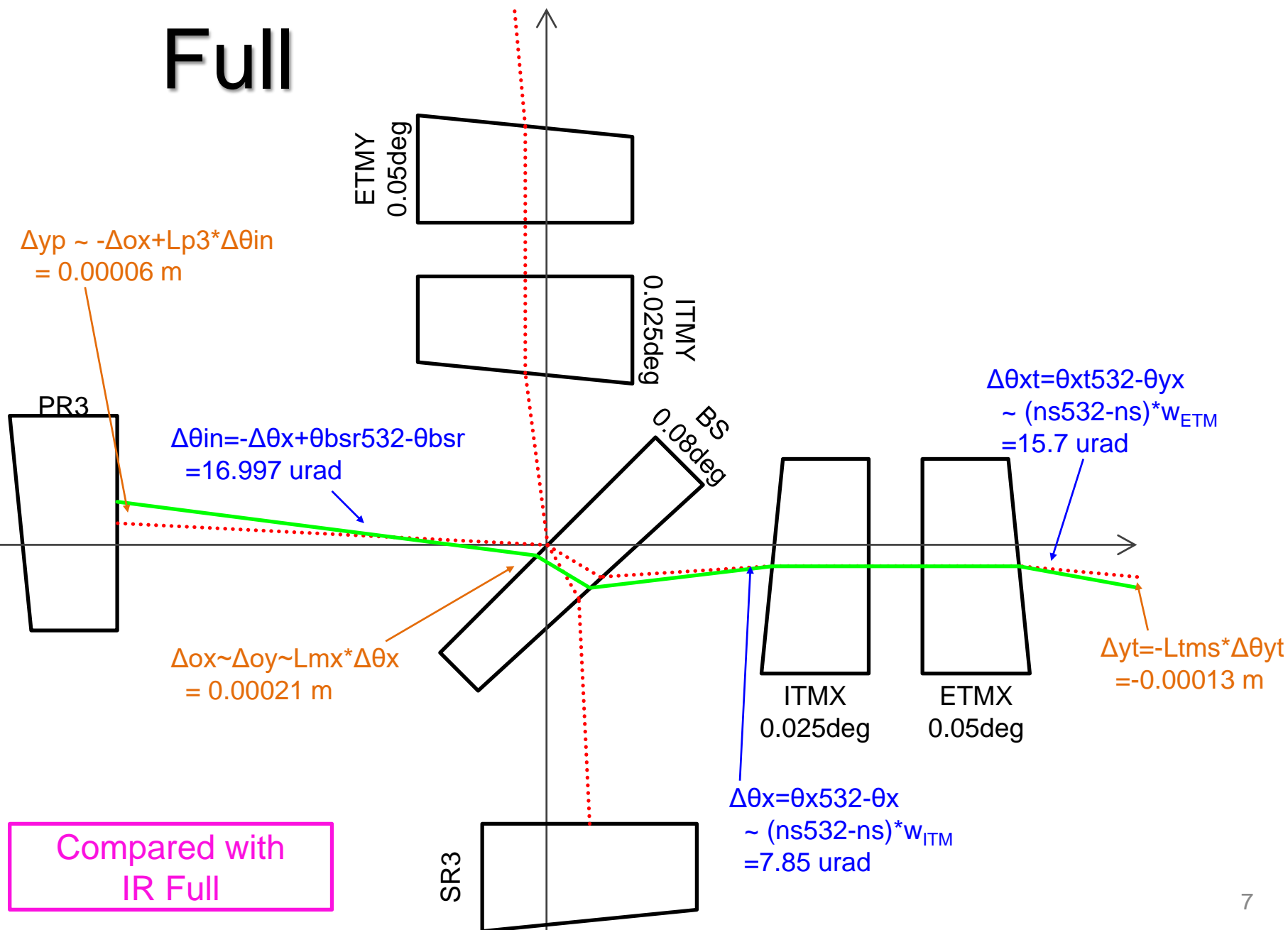


Compared with IR w/o ITMs

$$\Delta y_e = (L_{arm} + L_{mx} + L_{p3}) * (\theta_{bsr532} - \theta_{bsr}) = 0.076 \text{ m}$$

Green X

Full



Green Y

Full

