Physics 371 Quiz #5 May 9, 2016

What happens when two qubits prepared in an entangled "singlet" quantum state

$|\Psi\rangle = \frac{|0\rangle|1\rangle - |1\rangle|0\rangle}{\sqrt{2}}$ are both rotated with the same angle θ and phase ϕ:

$$R(\theta,\phi)\,|0\rangle = \cos\left(\frac{\theta}{2}\right)|0\rangle + \mathrm{e}^{i\phi}\sin\left(\frac{\theta}{2}\right)|1\rangle$$
$$R(\theta,\phi)\,|1\rangle = \cos\left(\frac{\theta}{2}\right)|1\rangle - \mathrm{e}^{-i\phi}\sin\left(\frac{\theta}{2}\right)|0\rangle$$

$R_1(\theta,\phi)\,R_2(\theta,\phi)\,|\Psi\rangle$

$$= \frac{1}{\sqrt{2}}\left(\cos\left(\frac{\theta}{2}\right)|0\rangle + \mathrm{e}^{i\phi}\sin\left(\frac{\theta}{2}\right)|1\rangle\right)\left(\cos\left(\frac{\theta}{2}\right)|1\rangle - \mathrm{e}^{-i\phi}\sin\left(\frac{\theta}{2}\right)|0\rangle\right)$$
$$-\frac{1}{\sqrt{2}}\left(\cos\left(\frac{\theta}{2}\right)\left|1\right\rangle - \mathrm{e}^{-i\phi}\sin\left(\frac{\theta}{2}\right)\left|0\right\rangle\right)\left(\cos\left(\frac{\theta}{2}\right)\left|0\right\rangle + \mathrm{e}^{i\phi}\sin\left(\frac{\theta}{2}\right)\left|1\right\rangle\right)$$
$$= \frac{|0\rangle|1\rangle - |1\rangle|0\rangle}{\sqrt{2}}$$

doesn't change!!!