$\boxed{4.3}$ Since $|\psi\rangle$ is an eigenstate of both $\hat{A}$ and $\hat{B}$, let

$\hat{A}|\psi\rangle = \alpha|\psi\rangle$

$\hat{B}|\psi\rangle = \beta|\psi\rangle$

Given: $\hat{A}\hat{B} + \hat{B}\hat{A} = 0 \Rightarrow \hat{A}\hat{B} = -\hat{B}\hat{A}$

$|\psi\rangle = |\psi\rangle$

hit it with $\hat{A}\hat{B} = -\hat{B}\hat{A} \rightarrow \hat{A}\hat{B}|\psi\rangle = -\hat{B}\hat{A}|\psi\rangle \Rightarrow \alpha\beta|\psi\rangle = -\beta\alpha|\psi\rangle$

Thus, since $\alpha\beta = \beta\alpha$, This gives us $|\psi\rangle = -|\psi\rangle$

which isn't true unless $\boxed{\alpha = 0 \text{ or } \beta = 0}$

Now let $\hat{A} \rightarrow \hat{\pi}$, $\hat{B} \rightarrow \hat{p}$

Then, let's define some eigenvalues: $\hat{\pi}|\psi\rangle = \varepsilon_\pi|\psi\rangle$

$\hat{p}|\psi\rangle = \varepsilon_p|\psi\rangle$

OK, so $\{\hat{\pi}, \hat{p}\} = 0 \Rightarrow \hat{\pi}\hat{p} + \hat{p}\hat{\pi} = 0$

$\Rightarrow \hat{\pi}\hat{p}|\psi\rangle = -\hat{p}\hat{\pi}|\psi\rangle$

$\Rightarrow \hat{\pi}\varepsilon_p|\psi\rangle = -\hat{p}\varepsilon_\pi|\psi\rangle \Rightarrow \varepsilon_p\varepsilon_\pi|\psi\rangle = -\varepsilon_p\varepsilon_\pi|\psi\rangle$

$\Rightarrow \varepsilon_p\varepsilon_\pi = -\varepsilon_p\varepsilon_\pi$ Thus either $\varepsilon_\pi = 0$ or $\varepsilon_p = 0$.

Actually, we know in this case that $\varepsilon_\pi = \pm 1$, so $\boxed{\varepsilon_p = 0}$

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So, we know That, except for when mometun is zero, mometun eigenstates aren't parity eigenstates.