Melanjutkan penurunan rumus P function dan Q function, sampai dengan persamaan (3.115)

$$\hat{B} = \int B_p(\alpha.\alpha^*)\,|\alpha\rangle\,\langle\alpha|\,d^2\alpha \tag{3.110}$$

$$\begin{aligned}
\langle\hat{B}\rangle &= Tr\,(\hat{B}\hat{\rho}) \\
&= Tr\left(\int B_p(\alpha,\alpha^*)\,|\alpha\rangle\langle\alpha|\,d^2\alpha \sum_n |n\rangle\langle n|\ \hat{\rho}\right) \\
&= \int \sum_n B_p(\alpha,\alpha^*)\,|\alpha\rangle\,\langle\alpha|\hat{\rho}|n\rangle\,\langle n|\,d^2\alpha \\
&= \int \sum_n B_p(\alpha,\alpha^*)\,\langle\alpha|\hat{\rho}|n\rangle\,\langle n|\alpha\rangle\,d^2\alpha \\
&= \int B_p(\alpha,\alpha^*) \sum \langle\alpha|\hat{\rho}|n\rangle\,\langle n|\alpha\rangle\,d^2\alpha \\
&= \int B_p(\alpha,\alpha^*)\,\langle\alpha|\hat{\rho}|\alpha\rangle\,d^2\alpha
\end{aligned} \tag{3.111}$$

$$Q(\alpha) = \frac{\langle\alpha|\hat{\rho}|\alpha\rangle}{\pi} \tag{3.112}$$

$$\int Q(\alpha)\,d^2\alpha = 1 \tag{3.113}$$

$$\begin{aligned}
\langle\hat{B}\rangle &= \hat{1}\cdot\hat{\rho}\cdot\hat{1} \\
&= \sum_n |n\rangle\langle n|\cdot\hat{B}\cdot\sum_m |m\rangle\langle m| \\
&= \sum_n\sum_m |n\rangle\,\langle n|\hat{B}|m\rangle\,\langle m| \\
&= \sum_n\sum_m |n\rangle\,B_{nm}\,\langle m|
\end{aligned}$$

$$\begin{aligned}
B_Q(\alpha,\alpha^*) &= \langle\alpha|\hat{B}|\alpha\rangle \\
&= \langle\alpha|\left\{\sum_n\sum_m |n\rangle\,B_{nm}\,\langle m|\right\}|\alpha\rangle \\
&= \sum_n\sum_m \langle\alpha|n\rangle\,B_{nm}\,\langle m|\alpha\rangle \\
&= \sum_n\sum_m e^{-\frac{1}{2}|\alpha|^2}\sum_k \frac{(\alpha^*)^k}{\sqrt{k!}}\langle k|n\rangle\,B_{nm}\,\langle m|\,e^{-\frac{1}{2}|\alpha|^2}\sum_k \frac{(\alpha)^k}{\sqrt{k!}}|k\rangle \\
&= e^{-\frac{1}{2}|\alpha|^2}\sum_n \frac{(\alpha^*)^n}{\sqrt{n!}}\delta_{nn}\,B_{nm}\,\delta_{mm}\sum_m \frac{(\alpha^*)^m}{\sqrt{m!}} \\
&= e^{-|\alpha|^2}\sum_n\sum_m \frac{(\alpha^*)^n(\alpha)^m}{\sqrt{n!\,m!}}B_{nm} \\
&= e^{-|\alpha|^2}\sum_n\sum_m \frac{B_{nm}}{(n!\,m!)^{1/2}}(\alpha^*)^n(\alpha)^m
\end{aligned} \tag{3.114}$$

$$\begin{aligned}
\langle\hat{B}\rangle &= Tr(\hat{B}\hat{\rho}) \\
&= Tr\int \hat{B}\,P(\alpha)\ |\alpha\rangle\langle\alpha|\,d^2\alpha \\
&= Tr\int P(\alpha)\ |\alpha\rangle\,\hat{B}\,\langle\alpha|\,d^2\alpha \\
&= \int P(\alpha)\,\langle\alpha|\hat{B}|\alpha\rangle\,d^2\alpha \\
&= \int P(\alpha)\ B_Q(\alpha,\alpha^*)\,d^2\alpha
\end{aligned} \tag{3.115}$$