The phase of the ***frequency domain*** radial complex acoustic intensity is:

$$\varphi_{I_a} = \varphi_{z_a} = \varphi_{c_a} = \Delta\varphi_{p-u} = \varphi_p - \varphi_u = \tan^{-1}(1/kr)$$

(a) **In the "near" zone:** $kr \ll 1$, the ***frequency domain*** complex radial acoustic intensity is largely ***imaginary*** (*i.e.* ***reactive***): $\tilde{I}_{a_r}(r,\omega) \sim i\, B_o^2/2z_o kr^3$, with magnitude $\left|\tilde{I}_{a_r}(r,\omega)\right| \sim B_o^2/2z_o kr^3$ (decreasing as $\sim 1/r^3$) and phase $\varphi_I = \varphi_z = \varphi_p - \varphi_u = \tan^{-1}(1/kr) \sim \tan^{-1}(\infty) \sim 90^o$. Again, the complex sound field $\tilde{S}(\vec{r},t)$ in this region is ***inertia***-like (*i.e.* ***mass***-like), because $I_{a_r}^{i}(r) = \text{Im}\{\tilde{I}_{a_r}(r)\} > 0$ for $kr \ll 1$.

(b) **In the "intermediate zone:** $kr \sim 1$, the ***frequency domain*** complex radial acoustic intensity is ~ an equal mix of ***active*** (*i.e.* ***real***) and ***reactive*** (*i.e.* ***imaginary***) components: $\tilde{I}_{a_r}(r,\omega) \sim (1+i) B_o^2/4z_o r^2$, with magnitude $\left|\tilde{I}_{a_r}(r,\omega)\right| \sim B_o^2/4z_o r^2$ (decreasing slightly faster than $\sim 1/r^2$) and phase $\varphi_{I_a} = \varphi_{z_a} = \varphi_{c_a} = \varphi_p - \varphi_u = \tan^{-1}(1/kr) \sim \tan^{-1}(1) \sim 45^o$.

(c) **In the "far" (or radiation) zone:** $kr \gg 1$, the ***frequency domain*** the complex radial acoustic intensity is largely ***real*** (*i.e.* ***active***): $\tilde{I}_{a_r}(r,\omega) = B_o^2/2z_o r^2$, with magnitude $\left|\tilde{I}_{a_r}(r,\omega)\right| = B_o^2/2z_o r^2$ (decreasing as $\sim 1/r^2$) and phase $\varphi_{I_a} = \varphi_{z_a} = \varphi_{c_a} = \Delta\varphi_{p-u} = \varphi_p - \varphi_u = \tan^{-1}(1/kr) \sim \tan^{-1}(0) \sim 0^o$.

The ***frequency domain*** complex acoustic power and its magnitude associated with the point monopole sound source are:

$$\tilde{P}_a(r,\omega) = \int_S \tilde{I}_{a_r}(r,\omega)\hat{r}\bullet d\vec{S} = 2\pi \frac{B_o^2}{z_o}\left[1+\frac{i}{kr}\right] \quad \text{and:} \quad \left|\tilde{P}_a(r,\omega)\right| = 2\pi\frac{B_o^2}{z_o}\sqrt{1+\left(\frac{1}{kr}\right)^2}$$

Notice that both the ***frequency domain*** point monopole complex acoustic power and its magnitude do indeed have an explicit *r*-dependence associated with them – we are used to thinking/told that they are ***not*** supposed to have an explicit *r*-dependence, because this is ***only*** true for the propagating portion of the complex acoustic power – *i.e.* the ***real*** acoustic power!!!

The real and imaginary parts of the ***frequency domain*** complex acoustic power are:

$$P_a^{r}(r,\omega) = \text{Re}\{\tilde{P}_a(r,\omega)\} = 2\pi\frac{B_o^2}{z_o} = constant \neq fcn(r)$$

and:

$$P_a^{i}(r,\omega) = \text{Im}\{\tilde{P}_a(r,\omega)\} = 2\pi\frac{B_o^2}{z_o}\cdot\frac{1}{kr} \Leftarrow explicit\ \ fcn(r)!!!$$

The phase associated with the ***frequency domain*** complex acoustic power is:

$$\varphi_{P_a} = \varphi_{I_a} = \varphi_{z_a} = \varphi_{c_a} = \Delta\varphi_{p-u} = \varphi_p - \varphi_u = \tan^{-1}(1/kr)$$

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