When an over-pressure $\tilde{p}(\vec{r},t) = \tilde{p}_o(\vec{r})e^{i\omega t}$ is present at the diaphragm of the microphone, located at the listener point $\vec{r}$, if the characteristic size of the microphone – *e.g*. the radius of the microphone diaphragm $a_{dia} \ll \lambda$, the variation of the over-pressure amplitude $\tilde{p}_o(\vec{r})$ over the surface of the microphone diaphragm is ~ negligible, *i.e*. $\tilde{p}_o(\vec{r}) \simeq \tilde{p}_o$ for $a_{dia} \ll \lambda$. The {net} force acting on the diaphragm {+ coil} of mass m_{dia} is $\tilde{\vec{F}}(t) = \int_{A_{dia}} -\tilde{p}(\vec{r},t)\overrightarrow{da} \simeq -\tilde{p}_o\vec{A}_{dia}e^{i\omega t}\ (N)$ {where $\vec{A}_{dia} = A_{dia}\hat{n}$ and $\hat{n}$ is the outward-pointing normal to the diaphragm} , accelerating it {by Newton's 2nd law: $\tilde{\vec{F}}(t) = m_{dia}\tilde{\vec{a}}_{dia}(t)$ if no other forces acting on the diaphragm are present - which, in general, there are – see Appendix to these lecture notes...} thereby causing it to vibrate/oscillate, which in turn induces a voltage signal in the coil due to the time rate of change of magnetic flux $\tilde{\Phi}_m(t) = \tilde{\vec{B}}(t) \bullet \vec{A}_{coil}$ threading the coil as it vibrates along its axis. The induced *EMF* in the coil of the dynamic microphone is: $\tilde{\varepsilon}_{coil}(t) = -N_{coil}\, d\tilde{\Phi}_m(t)/dt = -N_{coil}\left(d\tilde{\vec{B}}(t)/dt\right) \bullet \vec{A}_{coil} \quad (Volts)$.

Note that the basic physics of how a dynamic microphone works is simply the time-reversed physics of how a dynamic loudspeaker works – arising from the manifest time-reversal invariant nature of the *EM* interaction at the microscopic level!

Because of the need to attach a coil (usually copper wire) to the diaphragm, the diaphragm + coil assembly of a dynamic microphone is considerably heavier than the pressure-sensitive elements associated *e.g*. with condenser microphones. Thus, dynamic microphones often do not have as flat a frequency and phase response as condenser microphones for this (and other) reason(s) – hence dynamic microphones are not often thought of as "research/lab-grade" quality… However, the intrinsic output impedance of dynamic microphones is (relatively speaking) quite low (the industry standard is 600 Ω) which is very appealing *e.g*. for use in live performances of music, from the {important} perspective of noise immunity…

If the microphone element is completely ***sealed*** (as in the above figure), the over-pressure sensed by the device is the instantaneous ***difference*** between pressure on the front *vs*. back side of the diaphragm. This is an ***omni-directional*** microphone – for frequencies f with wavelengths $\lambda = v/f$ that are ***large*** in comparison the physical size a_{dia} of the microphone, it responds uniformly to sound coming from any/all directions, as shown in the polar plot below: