Wave

A Very Basic Thing

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Electromagnetic Wave from a Point Source

- Consider the field from one point source lying in the plane
- The electric field at point $\mathbf{r}$ associated with the light emitted from a monochromatic point source at $\mathbf{r_1}$ is a spherical wave radiating from that point

Single Point Source

$$E(\mathbf{r}, t) = \frac{A}{|\mathbf{r} - \mathbf{r_1}|} e^{i(q|\mathbf{r}-\mathbf{r_1}|-\omega t)} \tag{1}$$

where A is a constant.

Electromagnetic Wave from Multiple Point Sources

- Consider the field from multiple point sources lying in the plane
- The electric field at point $\mathbf{r}$ associated with the light emitted from monochromatic point sources at $\{\mathbf{r_i}\}$ becomes

Mulitple Point Sources

$$E(\mathbf{r},t) = e^{-i\omega t}\sum_i^N \frac{A_n}{|\mathbf{r}-\mathbf{r_i}|}e^{i(q|\mathbf{r}-\mathbf{r_i}|)} \quad (2)$$

where A_n are constants.

- For convenience, let us introduce a phasor $\varepsilon(\mathbf{r})$

Phasor

$$\varepsilon(\mathbf{r}) \equiv \sum_i^N \frac{A_n}{|\mathbf{r}-\mathbf{r_i}|}e^{i(q|\mathbf{r}-\mathbf{r_i}|)} \quad (3)$$

Electromagnetic Wave from Multiple Point Sources

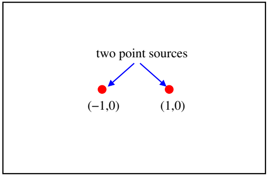
Then Eq. (2) can be expressed as

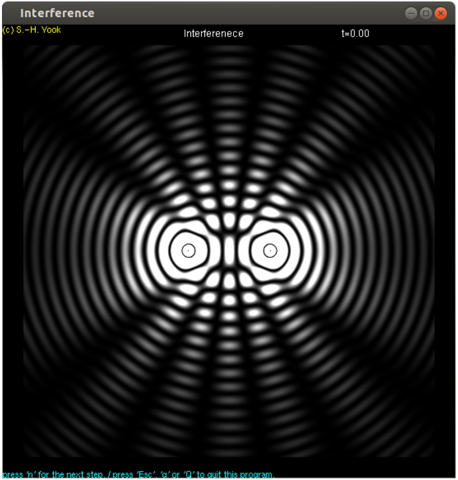
$$E(\mathbf{r},t) = e^{-i\omega t}\sum_{i}^{N}\frac{A_n}{|\mathbf{r}-\mathbf{r_i}|}e^{i(q|\mathbf{r}-\mathbf{r_i}|)} = e^{-i\omega t}\varepsilon(\mathbf{r}). \quad (4)$$

Real part of E($\mathbf{r}$,t) is

$$\mathrm{Re}(E(\mathbf{r},t)) = \mathrm{Re}(\varepsilon)\cos\omega t + \mathrm{Im}(\varepsilon)\sin\omega t \quad (5)$$

Example


two point sources
(−1,0)
(1,0)


Interference
(c) S.-H. Yook
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press 'n' for the next step. / press 'Esc', 'q' or 'Q' to quit this program.