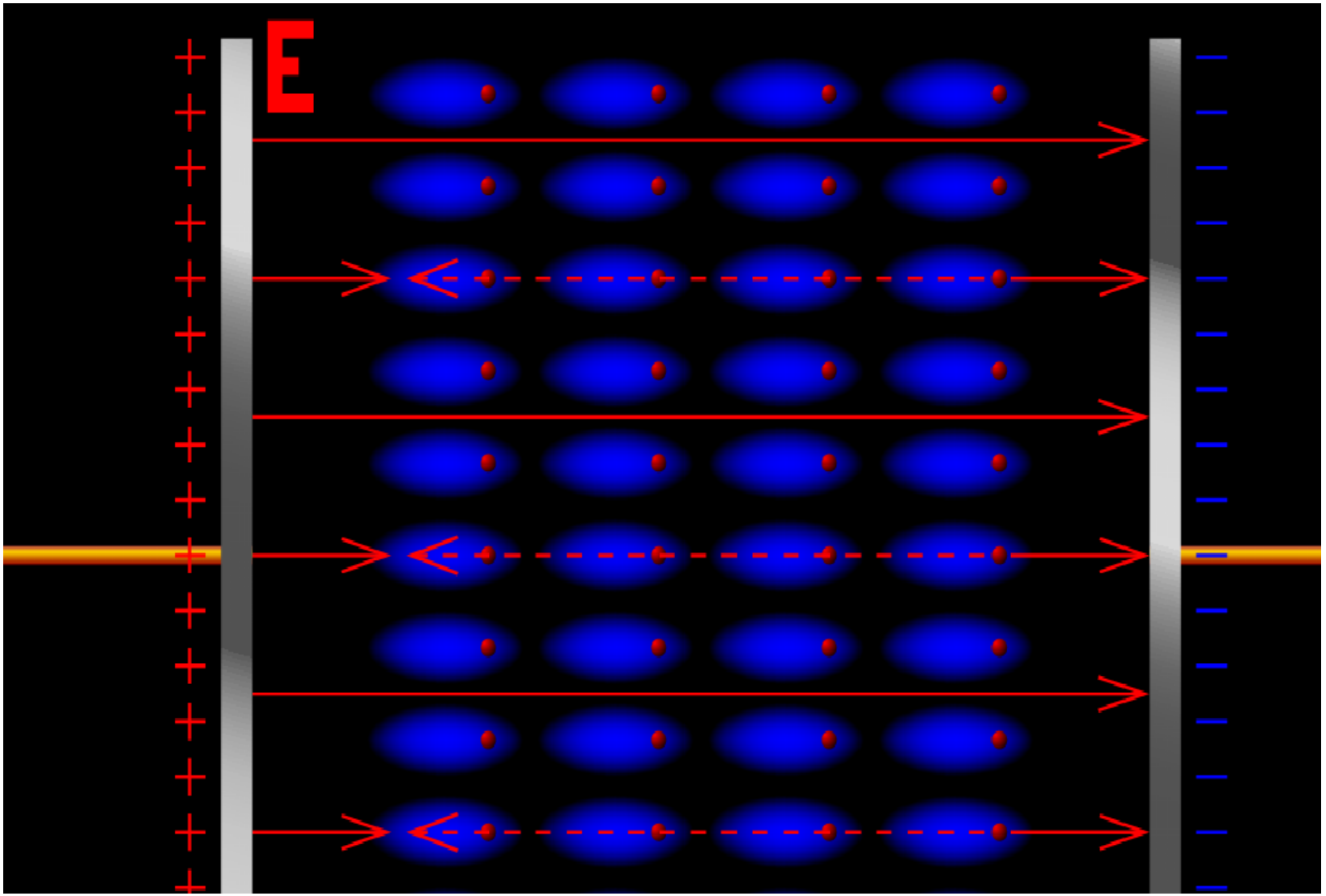
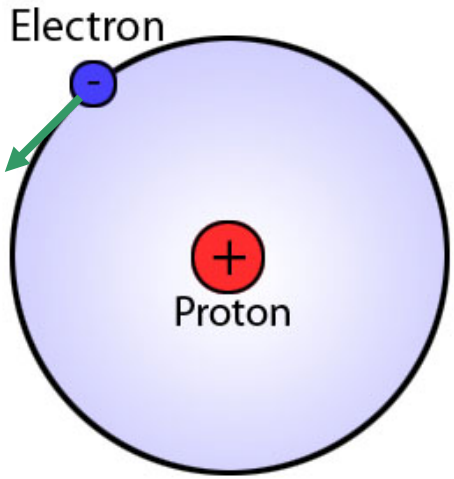
Electricidad

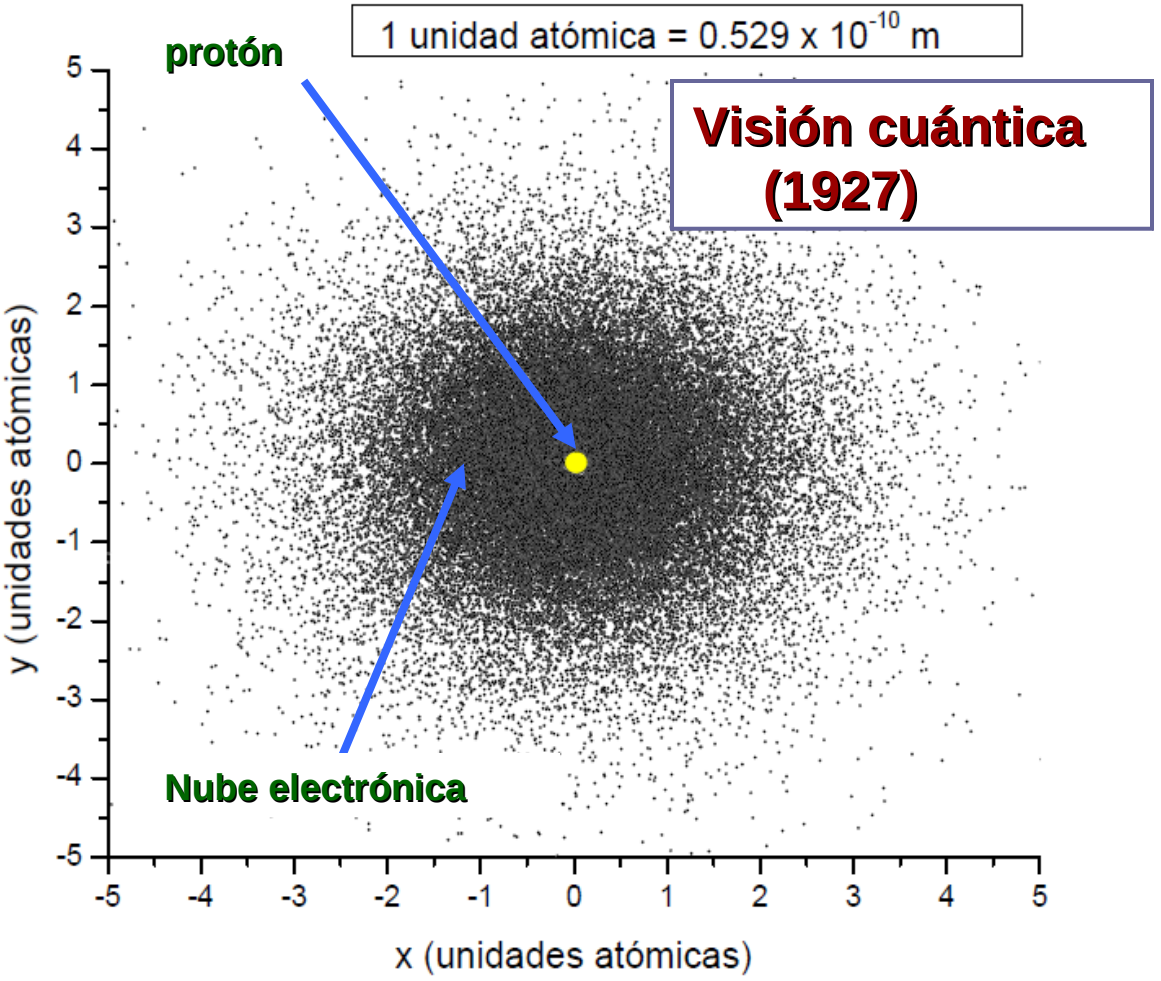


El átomo de hidrógeno

Visión Clásica (1913)



Analogía: imaginarse una gota de agua convertida en vapor. La masa es la misma pero distribuída sobre un mayor volumen espacial



Repaso

$$\rho = \frac{q}{\frac{4}{3}\pi a^3}$$

$$E = \frac{qd}{4\pi\varepsilon_0 a^3}$$

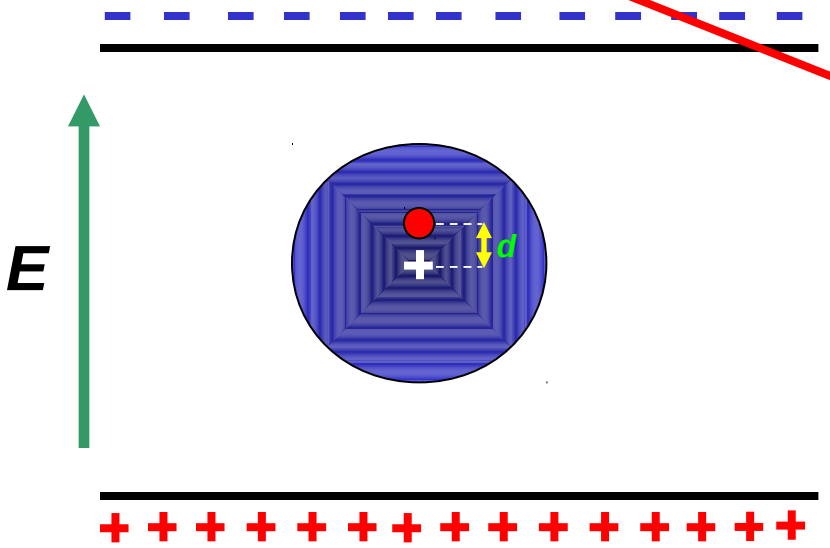
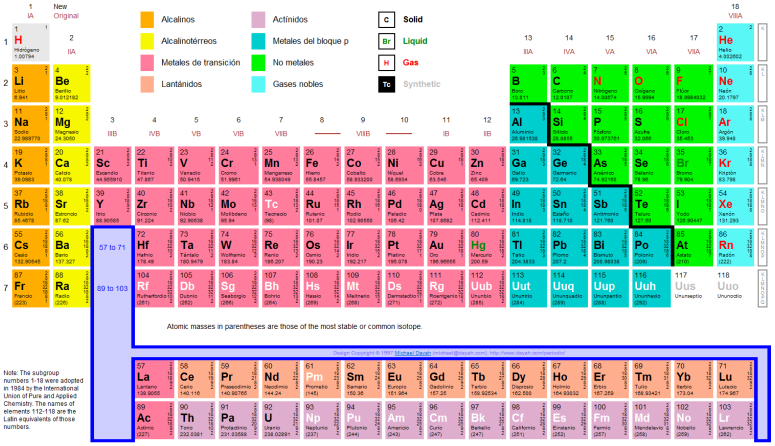


Tabla Periódica de los Elementos

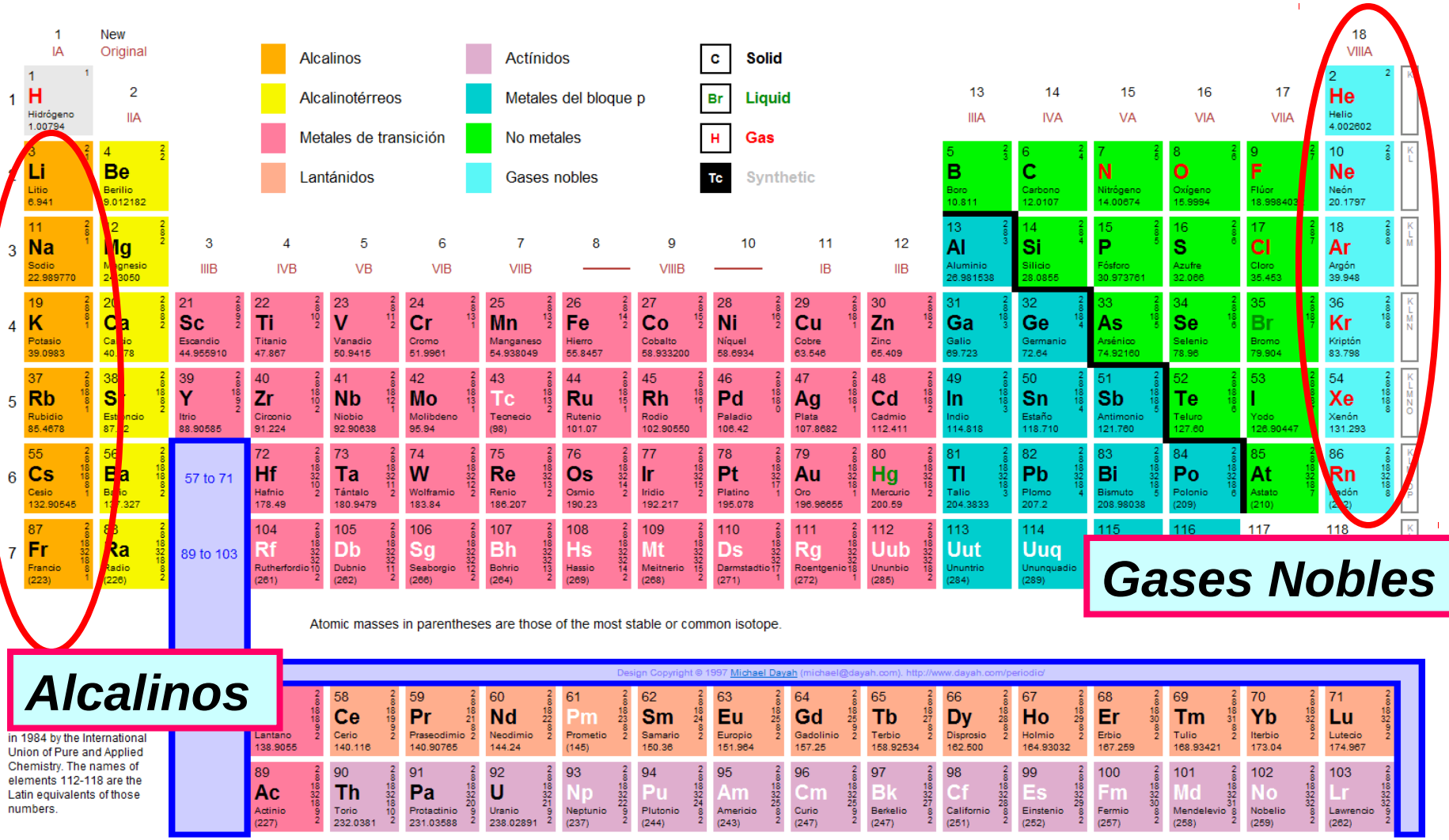


Polarizabilidad Atómica

$$\vec{p} = \alpha \vec{E}$$

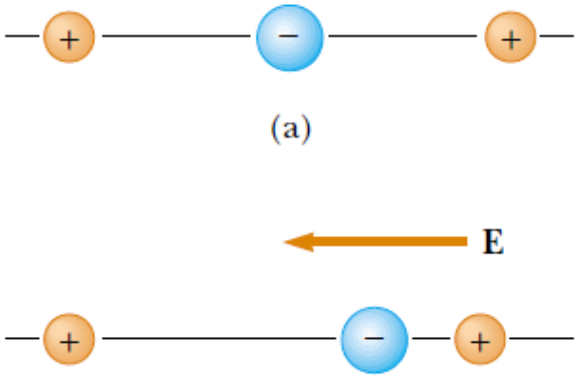
Los metales alcalinos son fácilmente polarizables.

Tabla Periódica de los Elementos



Universidad Nacional del Sur, Septiembre de 2016

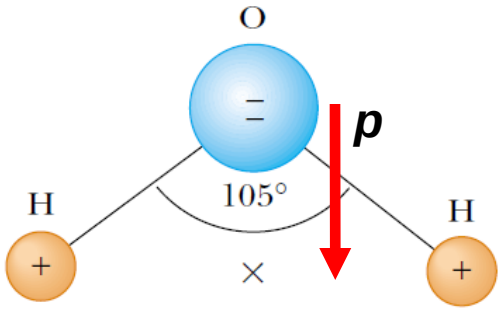
Polarización de moléculas



Molécula no polar

No polariza por igual en distintas direcciones:

p *no es necesariamente paralelo a* ***E***

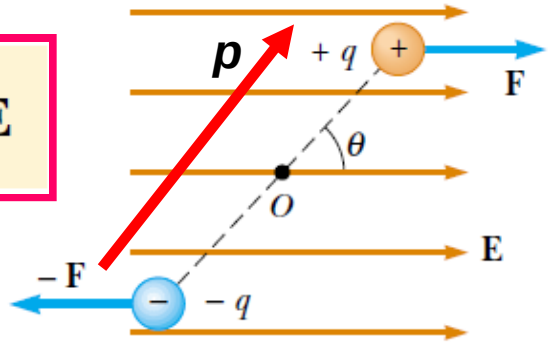


Molécula polar

momento dipolar permanente

Polarización de moléculas

$$\tau = \mathbf{p} \times \mathbf{E}$$

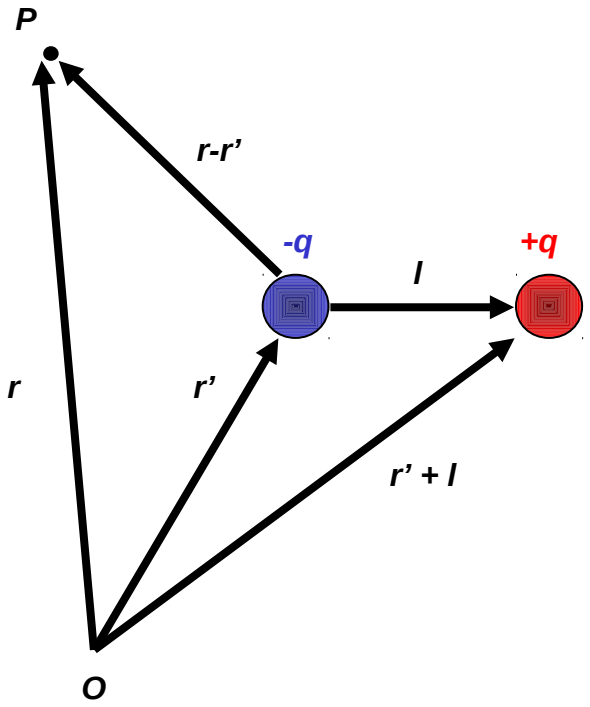


Una molécular polar se orienta ante un campo eléctrico externo

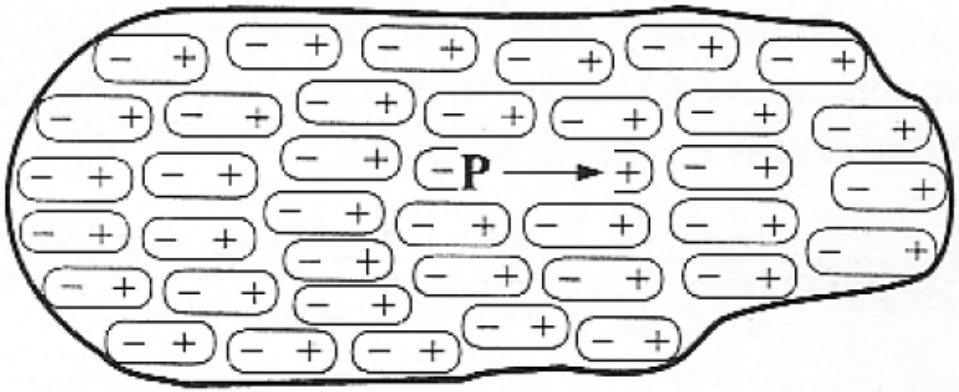
Recordemos

$$V(\mathbf{r}) = \frac{q}{4\pi\epsilon_0} \frac{(\mathbf{r} - \mathbf{r}') \cdot \boldsymbol{l}}{|\mathbf{r} - \mathbf{r}'|^3}$$

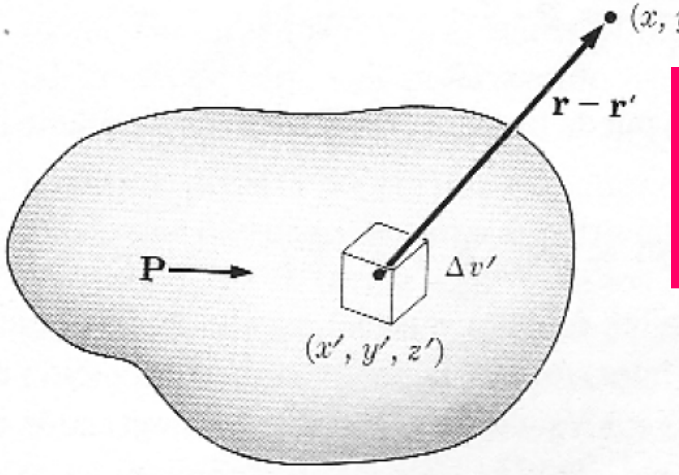
En el límite l < < |r-r' |



Vector Polarización



$$\mathbf{P} = \frac{\Delta \mathbf{p}}{\Delta v}$$



Campo fuera de un medio dieléctrico

$$\Delta V(\mathbf{r}) = \frac{\Delta \mathbf{p} \cdot (\mathbf{r} - \mathbf{r}')}{4\pi\epsilon_0 |\mathbf{r} - \mathbf{r}'|^3} = \frac{\mathbf{P}(\mathbf{r}') \cdot (\mathbf{r} - \mathbf{r}')\, \Delta v'}{4\pi\epsilon_0 |\mathbf{r} - \mathbf{r}'|^3}$$

$$V(\mathbf{r}) = \frac{1}{4\pi\epsilon_0} \int_{V_0} \frac{\mathbf{P}(\mathbf{r}') \cdot (\mathbf{r} - \mathbf{r}')\, dv'}{|\mathbf{r} - \mathbf{r}'|^3}$$

Polarización

$$V(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\oint_{S_0}\frac{\mathbf{P}\cdot\mathbf{n}\,da'}{|\mathbf{r}-\mathbf{r}'|} + \frac{1}{4\pi\epsilon_0}\int_{V_0}\frac{(-\nabla'\cdot\mathbf{P})\,dv'}{|\mathbf{r}-\mathbf{r}'|}$$

$$\sigma_P \equiv \mathbf{P}\cdot\mathbf{n} = P_n \qquad \rho_P \equiv -\nabla\cdot\mathbf{P}$$

densidades de carga de polarización

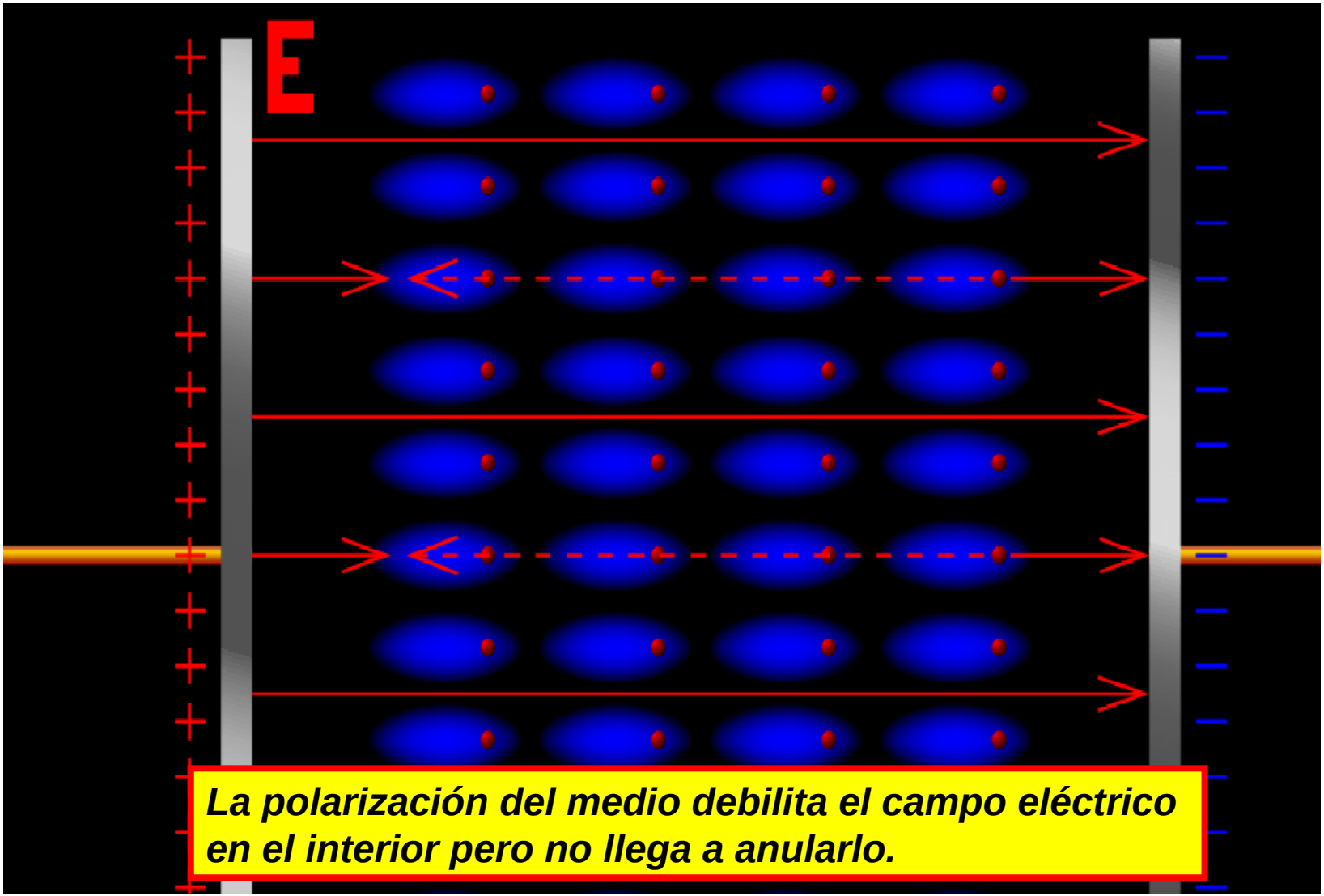
$$V(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\left[\oint_{S_0}\frac{\sigma_P\,da'}{|\mathbf{r}-\mathbf{r}'|} + \int_{V_0}\frac{\rho_P\,dv'}{|\mathbf{r}-\mathbf{r}'|}\right]$$

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\left[\int_{S_0}\sigma_P\frac{(\mathbf{r}-\mathbf{r}')}{|\mathbf{r}-\mathbf{r}'|^3}\,da' + \int_{V_0}\rho_P\frac{(\mathbf{r}-\mathbf{r}')}{|\mathbf{r}-\mathbf{r}'|^3}\,dv'\right]$$

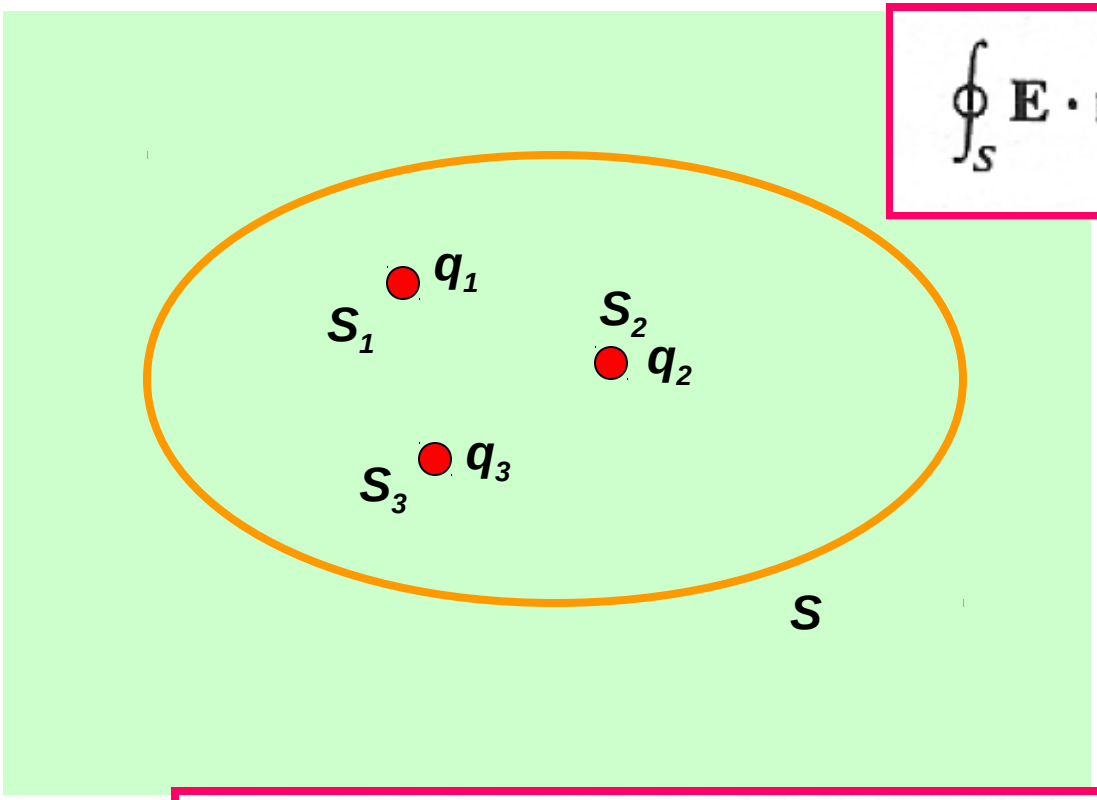
$$Q_P = \int_{V_0}(-\nabla'\cdot\mathbf{P})\,dv' + \oint_{S_0}\mathbf{P}\cdot\mathbf{n}\,da'$$

Carga de polarización

Polarización



Ley de Gauss para dieléctricos



$$\oint_S \mathbf{E} \cdot \mathbf{n}\, da = \frac{1}{\epsilon_0}(Q + Q_P)$$

$$Q = q_1 + q_2 + q_3$$

$$Q_P = \int_{S_1+S_2+S_3} \mathbf{P} \cdot \mathbf{n}\, da + \int_V (-\nabla \cdot \mathbf{P})\, dv$$

Ley de Gauss para dieléctricos

$$Q_P = -\oint_S \mathbf{P} \cdot \mathbf{n}\, da$$

$$\oint_S (\epsilon_0 \mathbf{E} + \mathbf{P}) \cdot \mathbf{n}\, da = Q$$

$$\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$$

Vector desplazamiento

$$\oint_S \mathbf{D} \cdot \mathbf{n}\, da = Q$$

Ley de Gauss para dieléctricos

$$\nabla \cdot \mathbf{D} = \rho$$

Forma diferencial