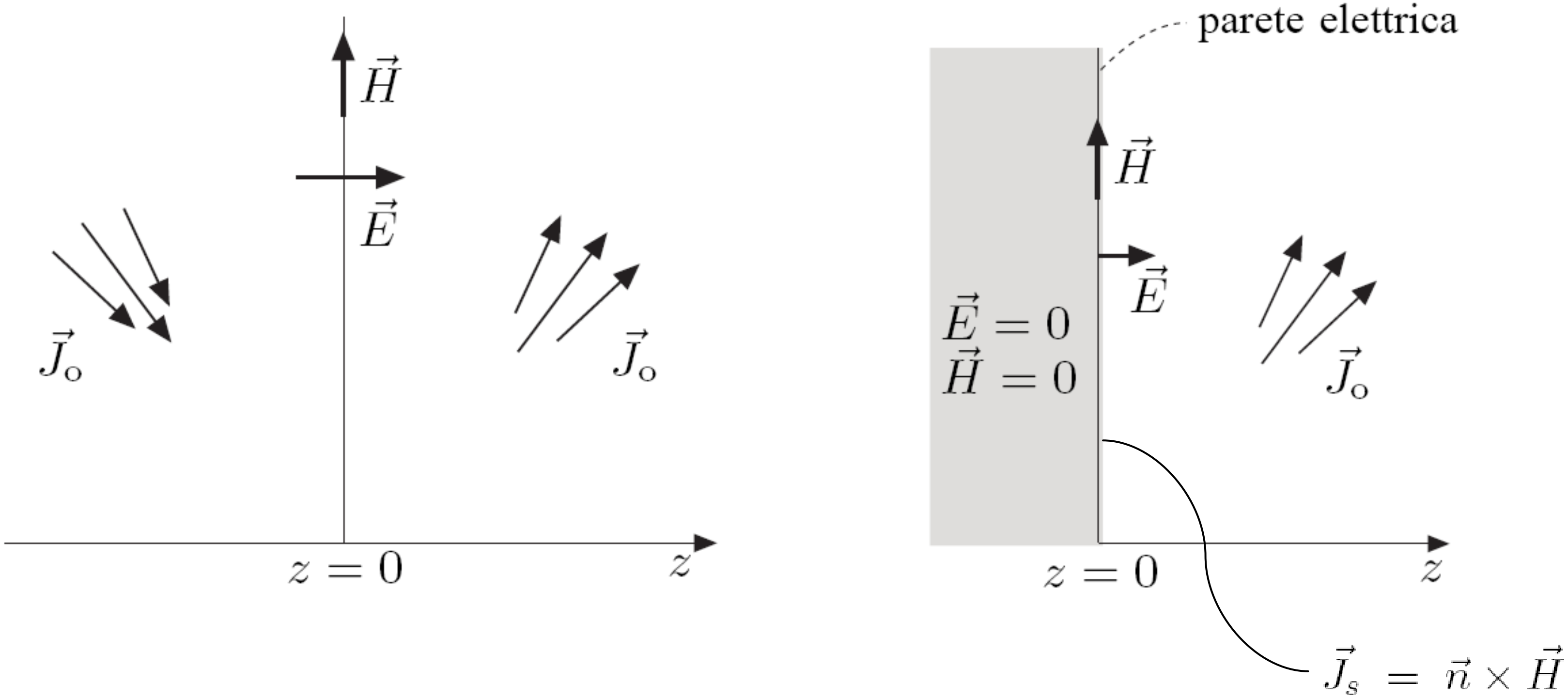
simmetria

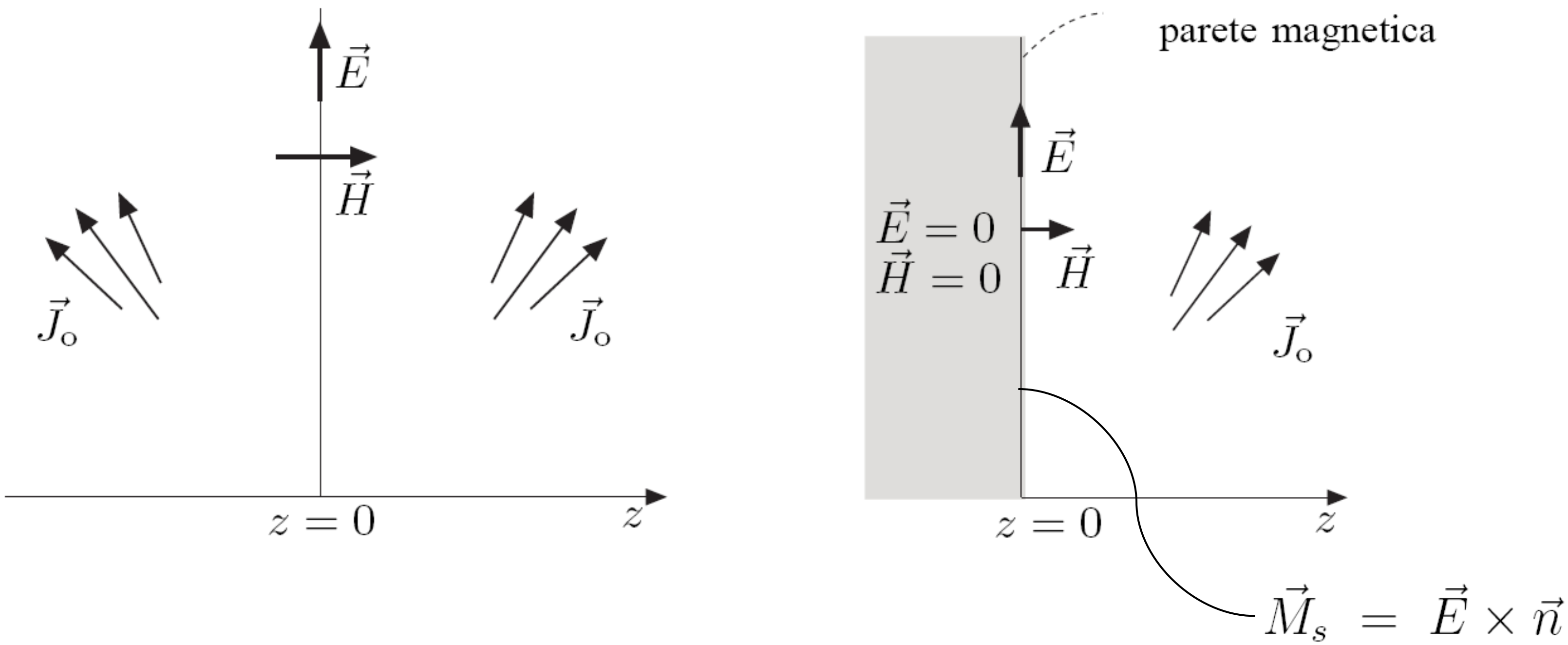
$$
\begin{aligned}
V_x(x,y,-z) &= \pm V_x(x,y,z) \\
V_y(x,y,-z) &= \pm V_y(x,y,z) \\
V_z(x,y,-z) &= \mp V_z(x,y,z)
\end{aligned}
\qquad \Rightarrow \qquad
\begin{aligned}
\left.\frac{\partial V_x}{\partial z}\right|_{x,y,-z} &= \mp \left.\frac{\partial V_x}{\partial z}\right|_{x,y,z} \\
\left.\frac{\partial V_y}{\partial z}\right|_{x,y,-z} &= \mp \left.\frac{\partial V_y}{\partial z}\right|_{x,y,z} \\
\left.\frac{\partial V_z}{\partial z}\right|_{x,y,-z} &= \pm \left.\frac{\partial V_z}{\partial z}\right|_{x,y,z}
\end{aligned}
$$

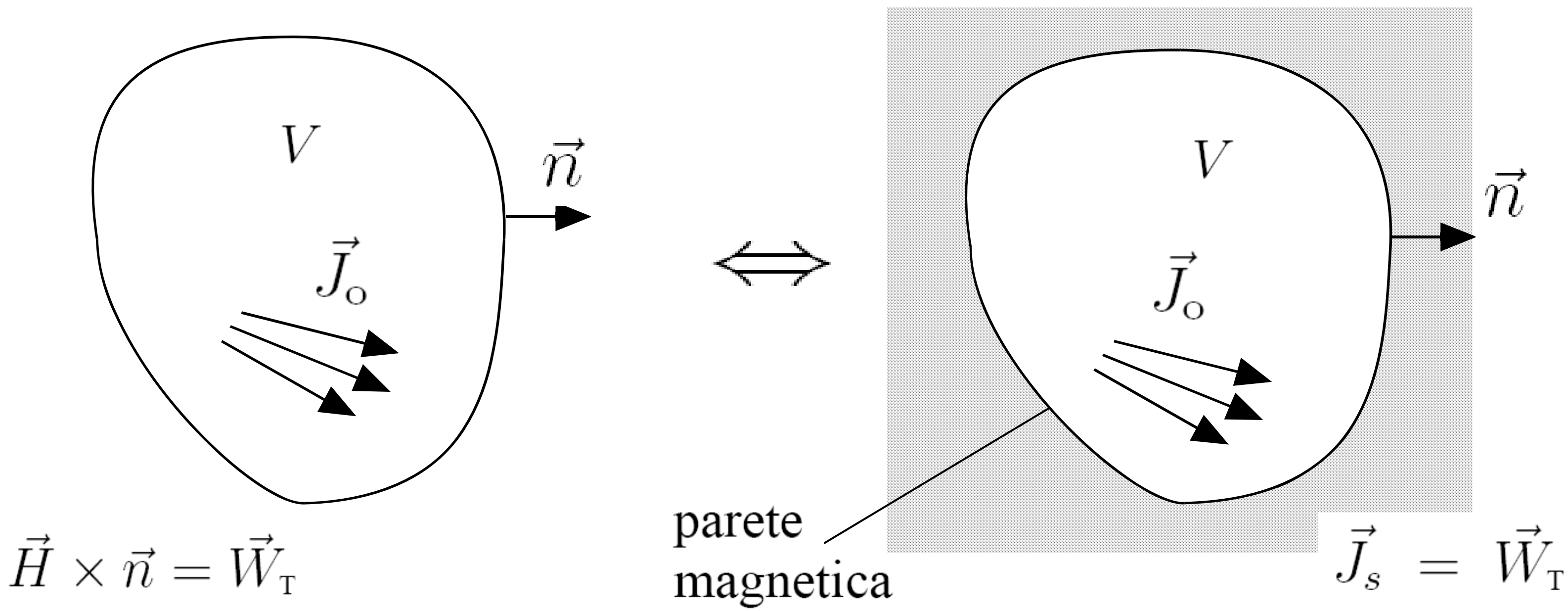
$$
\begin{aligned}
\left.\vec{u}_x \cdot \nabla \times \vec{V}\right|_{x,y,-z} &= \left(\frac{\partial V_z}{\partial y} - \frac{\partial V_y}{\partial z}\right)_{x,y,-z} = \mp\left(\frac{\partial V_z}{\partial y} - \frac{\partial V_y}{\partial z}\right)_{x,y,z} = \mp \left.\vec{u}_x \cdot \nabla \times \vec{V}\right|_{x,y,z} \\
\left.\vec{u}_y \cdot \nabla \times \vec{V}\right|_{x,y,-z} &= \left(\frac{\partial V_x}{\partial z} - \frac{\partial V_z}{\partial x}\right)_{x,y,-z} = \mp\left(\frac{\partial V_x}{\partial z} - \frac{\partial V_z}{\partial x}\right)_{x,y,z} = \mp \left.\vec{u}_y \cdot \nabla \times \vec{V}\right|_{x,y,z} \\
\left.\vec{u}_z \cdot \nabla \times \vec{V}\right|_{x,y,-z} &= \left(\frac{\partial V_y}{\partial x} - \frac{\partial V_x}{\partial y}\right)_{x,y,-z} = \pm\left(\frac{\partial V_y}{\partial x} - \frac{\partial V_x}{\partial y}\right)_{x,y,z} = \pm \left.\vec{u}_z \cdot \nabla \times \vec{V}\right|_{x,y,z}
\end{aligned}
$$

simmetria dispari

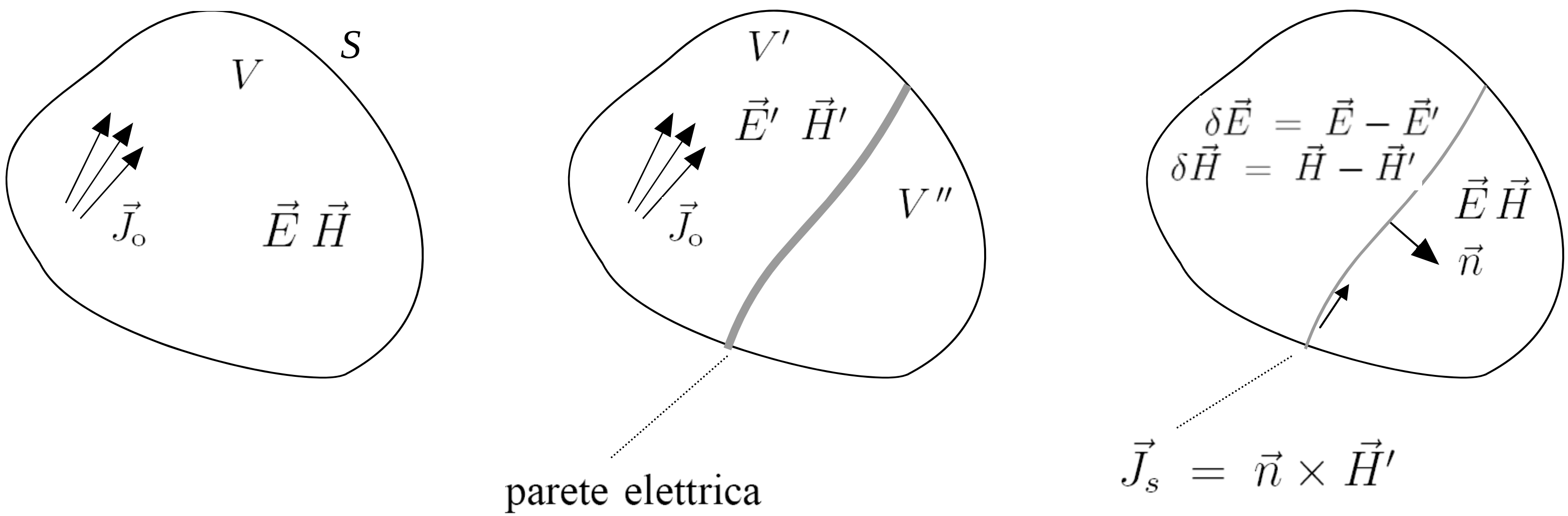


simmetria pari





condizioni non omogenee $\longrightarrow$ condizioni omogenee



condizioni omogenee su *S*

equazioni di Maxwell generalizzate

$$
\begin{aligned}
-\nabla \times \vec{E} &= j\omega\mu\vec{H} + \vec{M}_{\mathrm{o}} \\
\nabla \times \vec{H} &= j\omega\epsilon\vec{E} + \vec{J}_{\mathrm{o}}
\end{aligned}
$$

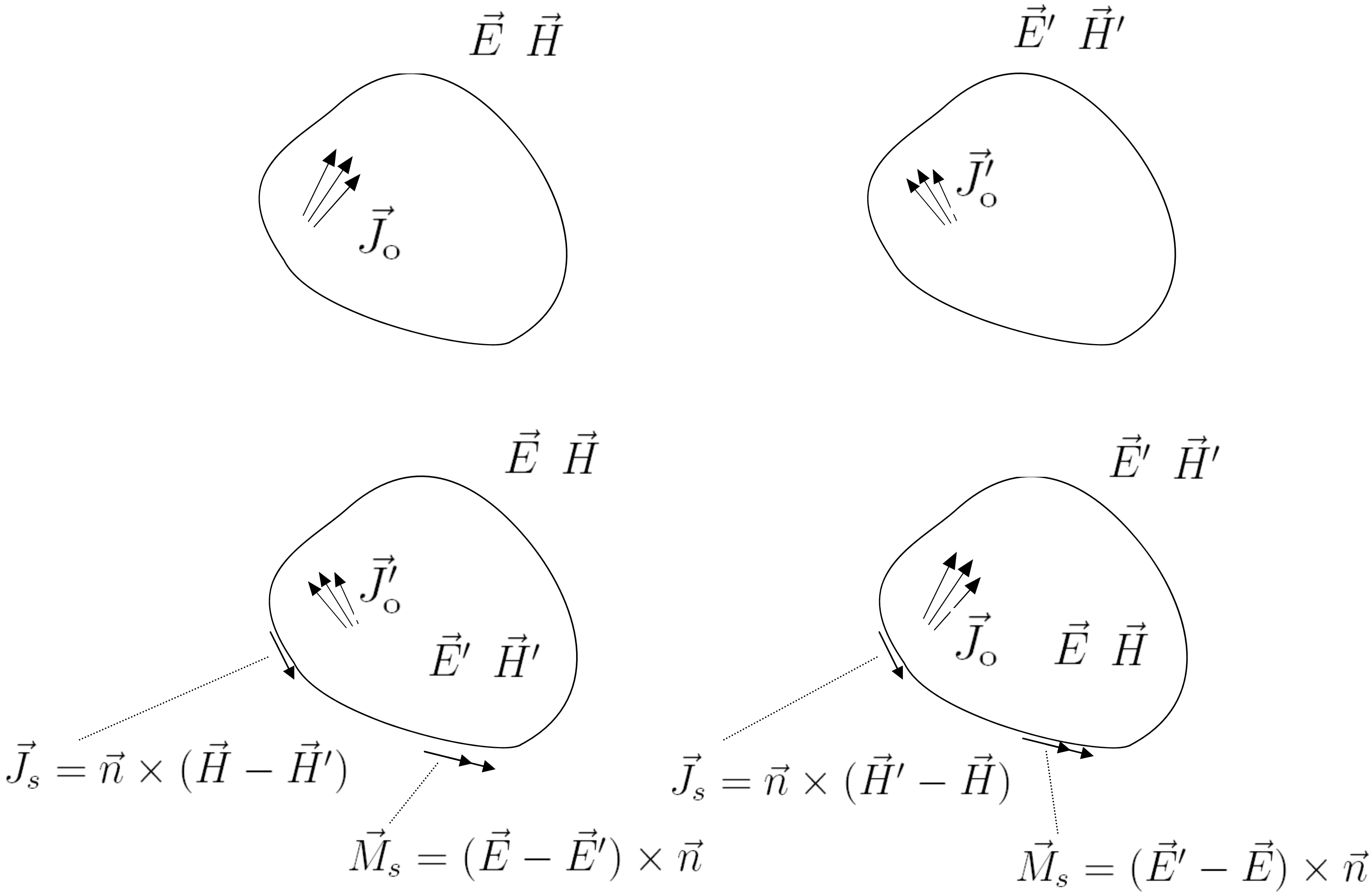
← densità di corrente magnetica impressa [V / m^2]

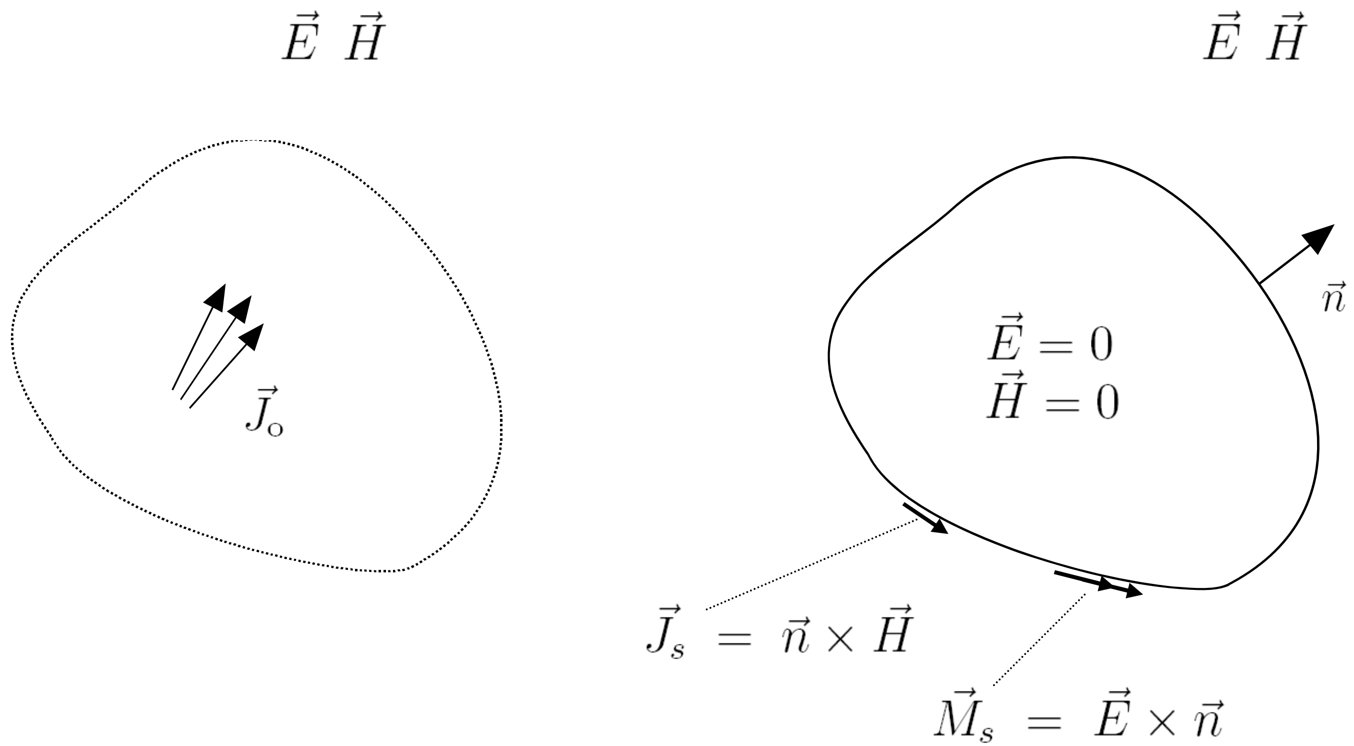
$$
\begin{aligned}
\vec{n} \times (\vec{H}^{+} - \vec{H}^{-}) &= \vec{J}_s \\
(\vec{E}^{+} - \vec{E}^{-}) \times \vec{n} &= \vec{M}_s
\end{aligned}
$$

← densità di corrente magnetica superficiale [V / m]

dualità

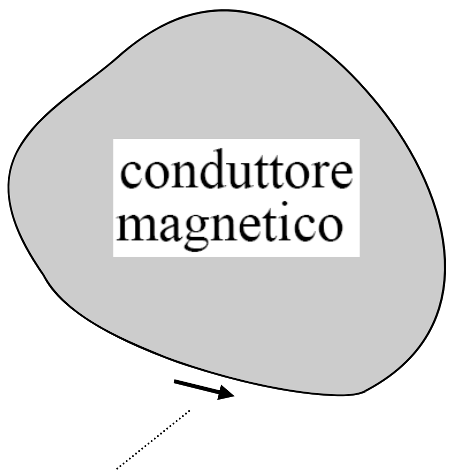
$$
\begin{array}{ccc}
\vec{E} & \Rightarrow & \vec{H} \\
\vec{H} & \Rightarrow & -\vec{E} \\
\vec{J}_o \quad \vec{J}_s & \Rightarrow & \vec{M}_o \quad \vec{M}_s \\
\vec{M}_o \quad \vec{M}_s & \Rightarrow & -\vec{J}_o \ -\vec{J}_s \\
\epsilon & \Leftrightarrow & \mu
\end{array}
$$


$\vec{E}\ \vec{H}$
$\vec{J}_o$
$\vec{E}'\ \vec{H}'$
$\vec{J}'_o$
$\vec{E}\ \vec{H}$
$\vec{J}'_o$
$\vec{E}'\ \vec{H}'$
$\vec{J}_s = \vec{n} \times (\vec{H} - \vec{H}')$
$\vec{M}_s = (\vec{E} - \vec{E}') \times \vec{n}$
$\vec{E}'\ \vec{H}'$
$\vec{J}_o$
$\vec{E}\ \vec{H}$
$\vec{J}_s = \vec{n} \times (\vec{H}' - \vec{H})$
$\vec{M}_s = (\vec{E}' - \vec{E}) \times \vec{n}$



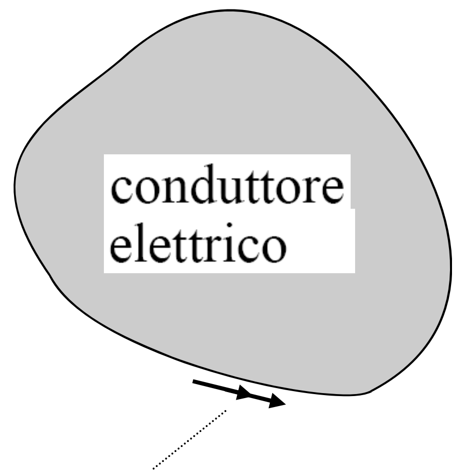
$\vec{E}\ \vec{H}$
$\vec{J}_o$
$\vec{E}\ \vec{H}$
$\vec{n}$
$\vec{E} = 0$
$\vec{H} = 0$
$\vec{J}_s = \vec{n} \times \vec{H}$
$\vec{M}_s = \vec{E} \times \vec{n}$

$\vec{E}\ \vec{H}$



$$\vec{J}_s = \vec{n} \times \vec{H}$$

$\vec{E}\ \vec{H}$



$$\vec{M}_s = \vec{E} \times \vec{n}$$