1) 148(4): Metric Elements in Terms of Relative Permittivity and Relative Permeability.

Using the definitions:

$$\underline{D} = \epsilon_r \epsilon_0 \underline{E} \; ; \; \underline{H} = \frac{1}{\mu_0 \mu_r} \underline{B} \quad -(1)$$

and assuming an isotropic material, then:

$$\boxed{\begin{aligned} \epsilon_r &= g^{00} g^{11} = g^{00} g^{22} = g^{00} g^{33} \quad -(2) \\ \frac{1}{\mu_r} &= g^{22} g^{33} = g^{11} g^{33} = g^{22} g^{11} \quad -(3) \end{aligned}}$$

where ϵ_r is the relative permittivity, and μ_r the relative permeability.

Therefore the theory of dielectric loss and power absorption in the electromagnetic spectrum can be expressed in terms of metric elements of electromagnetism. More generally ϵ_r is a tensor so may have diagonal and off diagonal metric elements of e/m in its structure. In general ϵ_r is a complex quantity:

$$\epsilon_r = \epsilon_r' + i \epsilon_r'' \quad -(4)$$

and the dielectric permittivity ϵ_r' and dielectric loss ϵ_r'' are frequency dependent. The power absorption coefficient is defined by:

$$\alpha(\omega) = \frac{\omega \epsilon_r''(\omega)}{n(\omega)} \quad -(5)$$

2)

and occurs across the entire electromagnetic spectrum from radio frequencies to gamma ray frequencies. So all of dielectric theory and absorption theory can be expressed in terms of spacetime metrics.

The Debye theory of dielectric loss works well up to far infra-red frequencies, and three variable Mori theory can be used in the far infra-red.

Finally there should be gravitational analogues of the relative permittivity and the relative permeability. In gravitation the role of ϵ_0 is played by $1/(c^2 k)$ where k is the Einstein constant, and the role of μ_0 is played by k. So we define the relative gravitational permittivity by:

$$k_r = k_r' + i k_r'' \quad - (6)$$

If gravitational radiation exists, it should be absorbed by matter, giving gravitational spectra.