

### Comment on “Experimental Evidence of Zero Forward Scattering by Magnetic Spheres”

In a recent Letter [1], the authors obtain experimental patterns of micron sized magnetic spheres dispersed in a ferrofluid as a function of the intensity of a constant magnetic field applied to the sample. The authors claim that the zero forward scattering obtained at a certain critical value of the magnetic field can be explained in the frame of the predictions made by Kerker *et al.* [2] for magnetic particles ( $\mu \neq 1$ ) much smaller than the incident wavelength. Their statement that the observed effect can be attributed “solely” to the zero forward scattering by magnetic spheres as predicted by Kerker *et al.* in [2] is not correct. First of all, the results of Kerker *et al.* are only applicable to particles much smaller than the incident wavelength in an isotropic media, while this experiment was carried out in the visible for micron sized particles embedded in an anisotropic media. So, the necessary conditions demanded by Kerker’s theory are not fulfilled. Mehta *et al.* do not give values of the optical constants involved [we want to remark that Kerker’s theory presents two important exceptions,  $\varepsilon = \mu = 1$  (obvious) and  $\varepsilon = \mu = -2$  (resonant behavior) [3–5], in which forward scattering is not zero]. This is crucial to clarify their statement that for absorbing particles, the scattering coefficients of Rayleigh and Rayleigh-Gans scatterers are nearly equal. In addition, although the experimental conditions allowed that Rayleigh-Gans and Rayleigh scatterers are equal in forward scattering, we think that this is not sufficient to apply the theory exposed by Kerker *et al.* The nonforward scattering in Kerker’s theory is intimately related to the magnetic character of the particles. In Mehta’s experiment, both magnetic particles and magnetic medium, where they are immersed, play a role. In fact, if the medium changes, the effect disappears. In this sense, Mehta *et al.* confirm it in their Letter saying that “the zero forward scattering occurs only when the dispersed phase is magnetic and the medium is ferrofluid.” Because of that, we think that the zero forward observed can be due to the magnetic

character of the sample (spheres and ferrofluid) and not only to the magnetic spheres as Kerker’s theory predicts and the authors defend previously in [1], “We attribute this effect to the zero forward scattering by magnetic spheres.”

Finally, we think that Mehta *et al.* make a very remarkable experiment that has to be studied in more detail, but it is not an experimental verification of Kerker’s theory. It is just a very nice observation of zero forward scattering. Perhaps the observed result in [1] can be due to a combination of effects from the magnetic particles and the anisotropy induced in the medium in which they are immersed (ferrofluid), or it could be due to a differential reflectance (parallel and perpendicular to the applied field) from the air to the ferrofluid, but in any case, Kerker predictions should not be applied.

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B. García-Cámara,\* F. Moreno, F. González, and J. M. Saiz  
Grupo de Óptica  
Departamento de Física Aplicada  
Universidad de Cantabria  
39005 Santander, Spain

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\*Corresponding author: [braulio.garcia@unican.es](mailto:braulio.garcia@unican.es)

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