

Electrostatics of equal-sized spheres at small separation

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Abstract—We analyze the electrostatic interaction between two equal-sized charged conducting spheres in the limit when they are about to touch each other. We obtain expressions of the electrostatic force as a linear combination of two parts, one is always attractive and the other one is always repulsive. Using newly obtained asymptotic expansions of Lambert series [1], we show that the attractive part always dominates the repulsive part at sufficiently small distances. Therefore, the electrostatic force is always attractive at small distances (even for positively charged spheres) unless the coefficient of the attractive part is exactly zero. The coefficient of the attractive part is zero only if the two spheres carry exactly the same charge or are held at the same voltage. Our results agree with Lekner’s proof for the electrostatic interaction of two spheres [2].

REFERENCES

- [1] S. Banerjee and B. Wilkerson, “Asymptotic expansions of Lambert series and related q -series,” *International Journal of Number Theory*, Mar. 2017. Available: <https://doi.org/10.1142/S1793042117501135>
- [2] J. Lekner, “Electrostatics of two charged conducting spheres,” *Proc. Roy. Soc. A*, vol. 468, pp. 2829–2848, May. 2012. Available: <https://doi.org/10.1098/rspa.2012.0133>