

# Re: Coulomb Force Between A Charge Rod & A Particle

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On Wed, 30 Aug 2006, Adam Teasdale Hartshorne wrote:

Randy Poe wrote:

Adam Teasdale Hartshorne wrote:

I have a simple physics question, which I wonder if somebody could help me with as I am a computer science person trying to use Coulomb force as an error metric.

In 3D space, if I have a charged rod, (length  $l$  with start and end points,  $r_1$  and  $r_2$ ) and an oppositely charged particle positioned at  $p_1$ , what is the coulomb force between them?

I am assuming you have to integrate the standard coulomb force between two particles along the rod (Excuse the poor english),

That is correct. However, it isn't a very difficult integral.

See here:

<http://www.phys.uri.edu/~gerhard/PHY204/ts131.pdf>

I think you will find "Electric Field of Charged Rod (2)" most useful. There are expressions for the  $x$  and  $y$  components of the vector electric field. The force on the particle at  $p_1$  is  $E$  times the charge at  $p_1$ .

What about in 3d?

## Re: Coulomb Force Between A Charge Rod & A Particle

It's effectively a 2D problem. What is the "most natural" coordinate system to use? How about cylindrical coordinates with the rod on the z-axis, at the origin? The x and y components above are then the r and z components, and you have the full 3D solution, straight from the 2D simplification. If you want to use a less convenient coordinate system, just transform coordinates and E field vectors as needed (wherein one might find a nice lesson in the difference between coordinates and vector components!).

Exercise: why is the phi component zero?

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E-prints: [http://eprint.uq.edu.au/view/person/Nieminen\\_Timo\\_A..html](http://eprint.uq.edu.au/view/person/Nieminen_Timo_A..html)

Shrine to Spirits: [http://www.users.bigpond.com/timo\\_nieminen/spirits.html](http://www.users.bigpond.com/timo_nieminen/spirits.html)

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