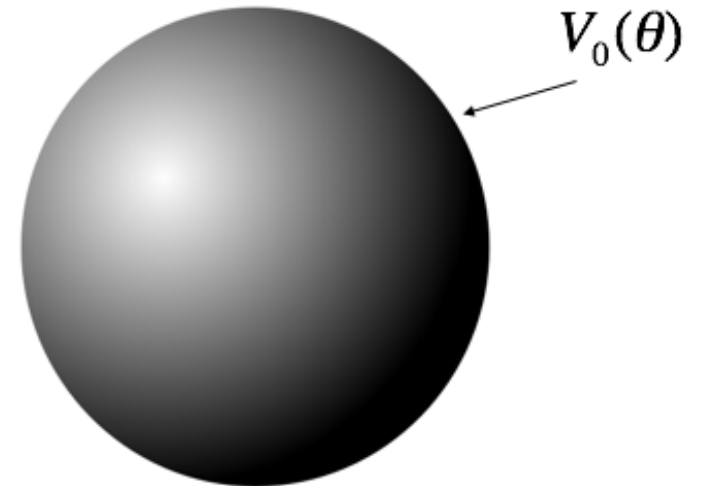


How many boundary conditions (on the potential V) do you use to find V inside the spherical plastic shell?

- A. 1
- B. 2
- C. 3
- D. 4
- E. It depends on $V_0(\theta)$



$$V(r, \theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+1}} \right) P_l(\cos \theta)$$

Suppose V on a spherical shell is:

$$V(R, \theta) = V_0 (1 + \cos^2 \theta)$$

Which terms do you expect to appear when finding **$V(\text{inside})$** ?

- A. Many A_l terms (but no B_l 's)
- B. Many B_l terms (but no A_l 's)
- C. Just A_0 and A_2
- D. Just B_0 and B_2
- E. Something else!

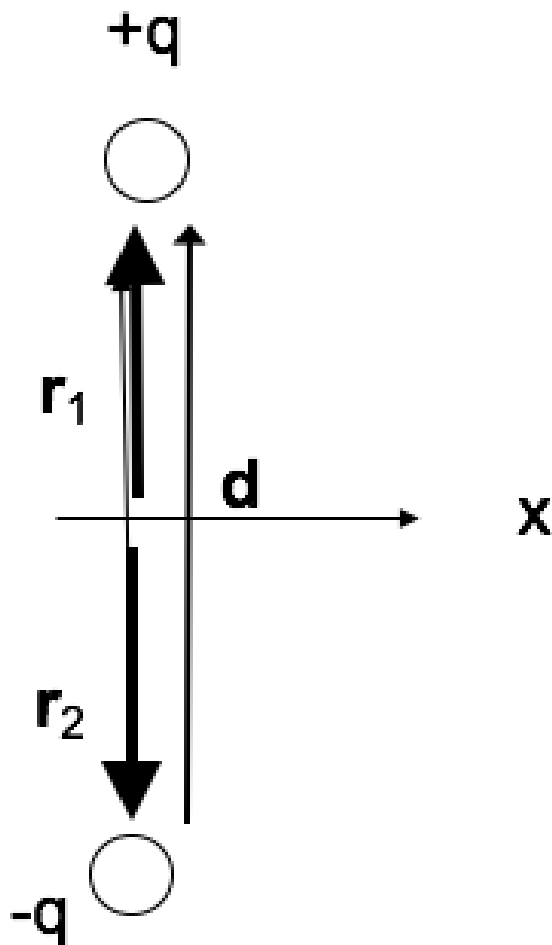
$$V(r, \theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+1}} \right) P_l(\cos \theta)$$

Suppose V on a spherical shell is:

$$V(R, \theta) = V_0 (1 + \cos^2 \theta)$$

Which terms do you expect to appear when finding **$V(\text{outside})$** ?

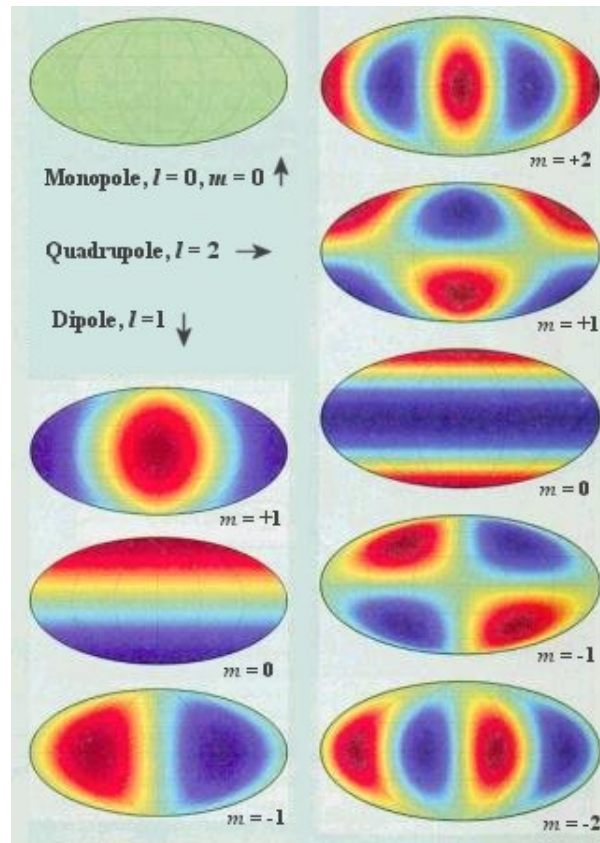
- A. Many A_l terms (but no B_l 's)
- B. Many B_l terms (but no A_l 's)
- C. Just A_0 and A_2
- D. Just B_0 and B_2
- E. Something else!



Two charges are positioned as shown to the left. The relative position vector between them is \mathbf{d} . What is the value of the dipole moment? $\sum_i q_i \mathbf{r}_i$

- A. $+q\mathbf{d}$
- B. $-q\mathbf{d}$
- C. Zero
- D. None of these

MULTIPOLE EXPANSION



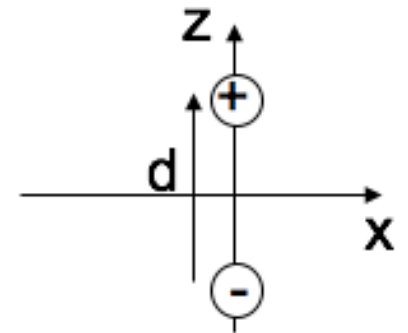
Multipole Expansion of the Power Spectrum of CMBR

For a dipole at the origin pointing in the z-direction, we have derived:

$$\mathbf{E}_{dip}(\mathbf{r}) = \frac{p}{4\pi\epsilon_0 r^3} (2 \cos \theta \hat{\mathbf{r}} + \sin \theta \hat{\boldsymbol{\theta}})$$

For the dipole $\mathbf{p} = q\mathbf{d}$ shown, what does the formula predict for the direction of $\mathbf{E}(\mathbf{r} = 0)$?

- A. Down
- B. Up
- C. Some other direction
- D. The formula doesn't apply



IDEAL VS. REAL DIPOLE

