Lecture 7

- About LASP visit
- Kronecker and Levi-Civita
- Homework
- Polarimetry → on Monday

Summary of previous lecture

- Index notation
- Observational techniques
- Important contributions to opacity
- LASP visit 8:30-9:45

LASP visit: what was most boring?

A. Aerobee rocket, Mariner, etc
B. Total solar irradiance story
C. Machine workshop
D. Shipping hall and elect. labs
E. Mission control rooms

… and what was most exciting?

A. Aerobee rocket, Mariner, etc
B. Total solar irradiance story
C. Machine workshop
D. Shipping hall and elect. labs
E. Mission control rooms

Quick rehearsal: delta

$\delta_{11} = \delta_{22} = \delta_{33} = 1$
and 0 otherwise

what is δ_{ii} ??

A. 0
B. 1
C. 2
D. 3
E. 4

Levi-Civita tensor

$$\varepsilon_{123} = \varepsilon_{231} = \varepsilon_{312} = 1$$

$$\varepsilon_{321} = \varepsilon_{213} = \varepsilon_{132} = -1$$

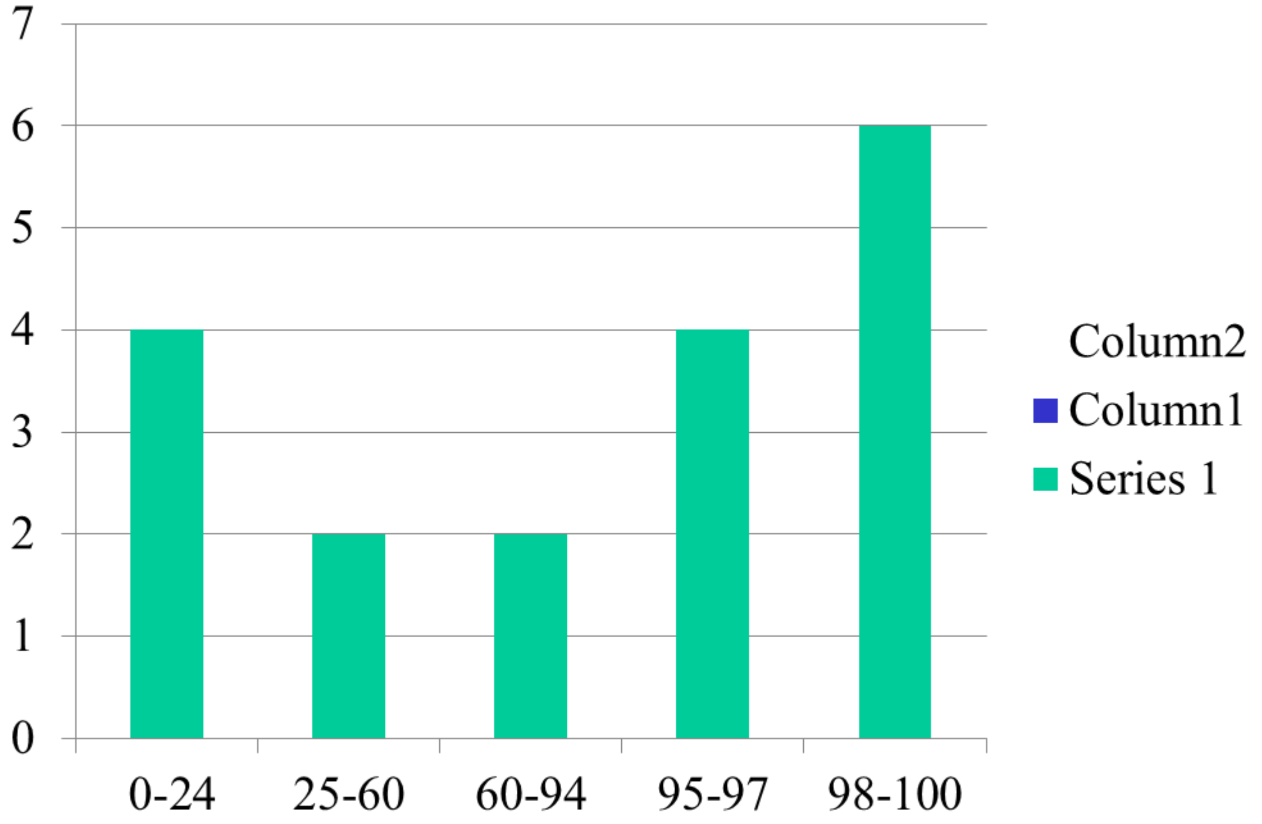
$$\varepsilon_{ijk} = 0 \text{ otherwise}$$

Also: totally antisymmetric tensor

what is $\varepsilon_{ijk}\varepsilon_{ijk}$??

A. 0
B. 1
C. 3
D. 4
E. 6

Homework



Homework issues

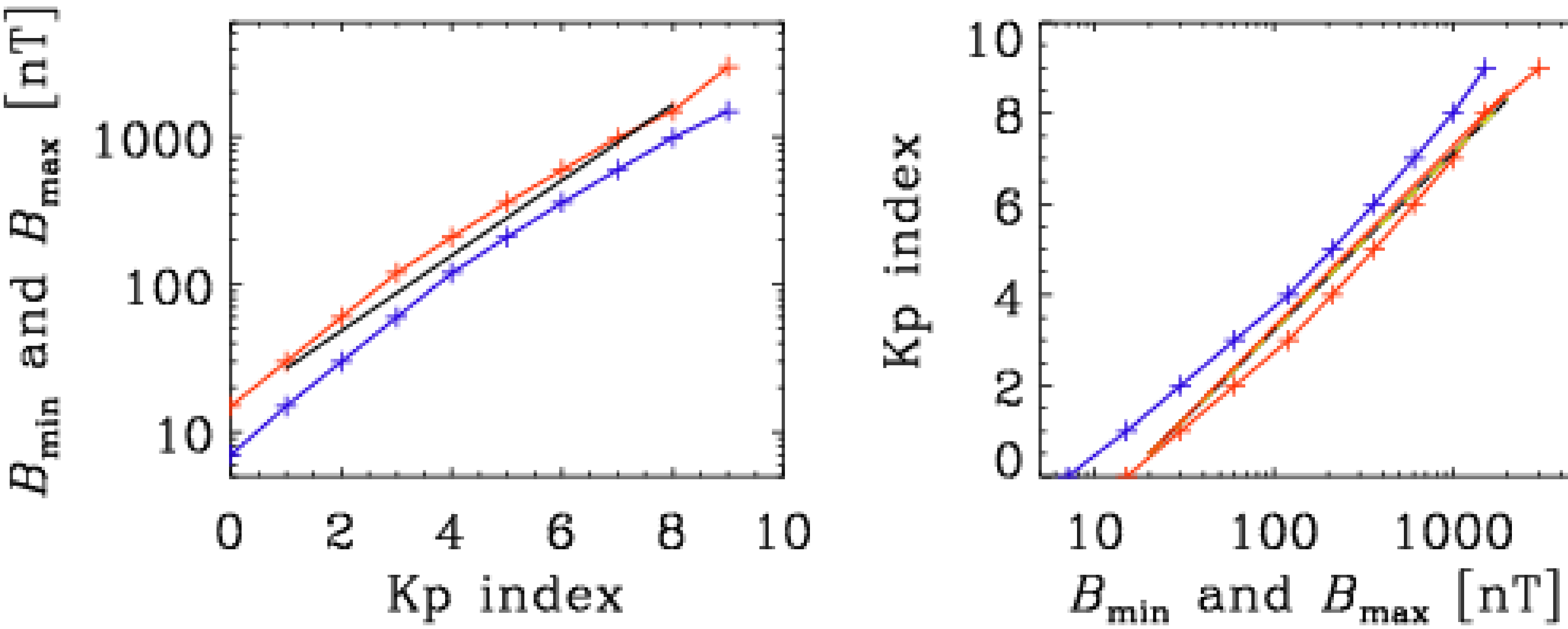
- brackets omitted: don't write $6y^2z - 6y^2z\hat{\boldsymbol{i}}$. always write $(6y^2z - 6y^2z)\hat{\boldsymbol{i}}$.
- there are no point charges in this example
- $\nabla \times \boldsymbol{B} = \mathbf{0}$ would be a current-free magnetic field
- and would be physically ok, provided $\nabla \cdot \boldsymbol{B} = 0$.
- $\nabla \times \boldsymbol{E} = \mathbf{0}$ would mean $\boldsymbol{B}$ is static, so that would be ok.
- conservative means $\nabla \times \boldsymbol{F} = \mathbf{0}$. It is also called irrotational.
- solenoidal means $\nabla \cdot \boldsymbol{F} = \mathbf{0}$. It is also called divergence-free.

Interpreting the K-index based on values from Kiruna

De K-index is just like the Kp-index, a geomagnetic storm index with a logarithmic scale from 1 to 9 but as measured by a single station and not from multiple stations combined. Based on the deflection from the Kiruna magnetometer we can try to determine the K-indice for that specific station. For the station at Kiruna, we do this with the help of the table below. Be aware that, due to it's location, this magnetometer is only be helpful for observers from Europe.

K-index	Deflection in nanoTesla	Storm type
0	0 - 15	Quiet conditions
1	15 - 30	Quiet conditions
2	30 - 60	Quiet conditions
3	60 - 120	Unsettled geomagnetic conditions
4	120 - 210	Active geomagnetic conditions
5	210 - 360	G1 - Minor geomagnetic storm
6	360 - 600	G2 - Moderate geomagnetic storm
7	600 - 990	G3 - Strong geomagnetic storm
8	990 - 1500	G4 - Severe geomagnetic storm
9	1500 and more	G5 - Extreme geomagnetic storm

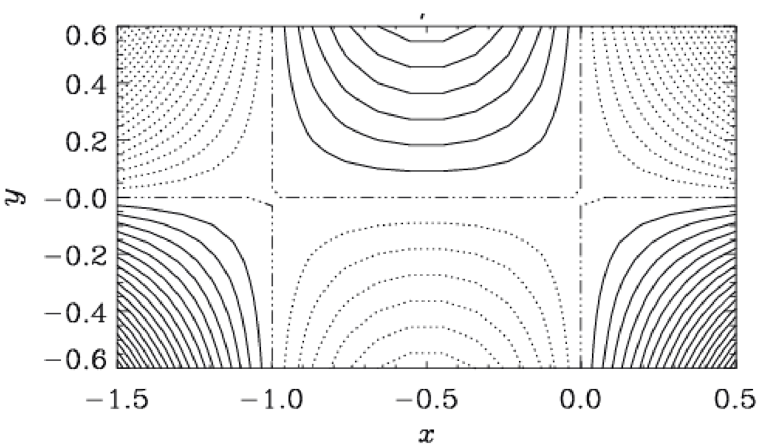
Goal: as linear as possible

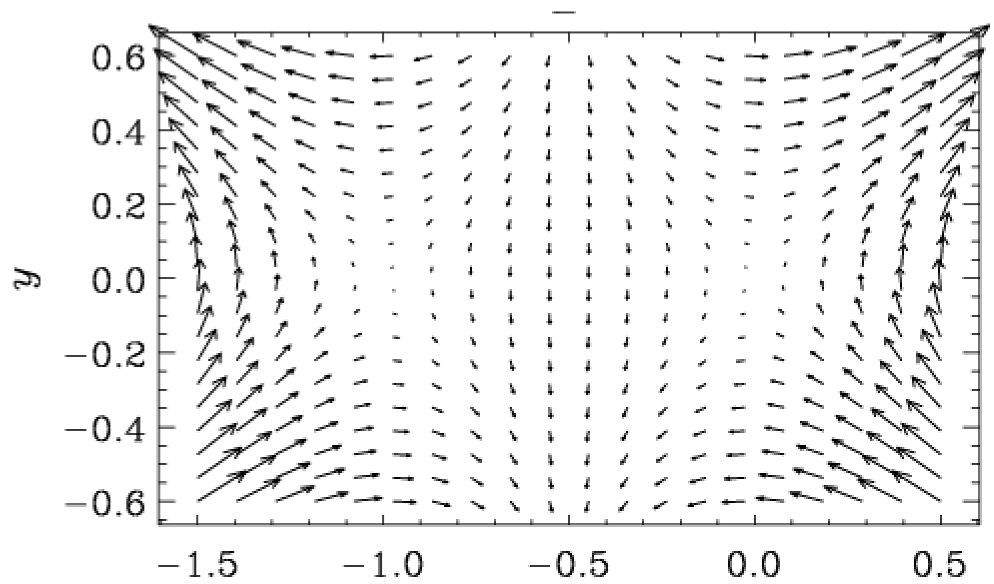


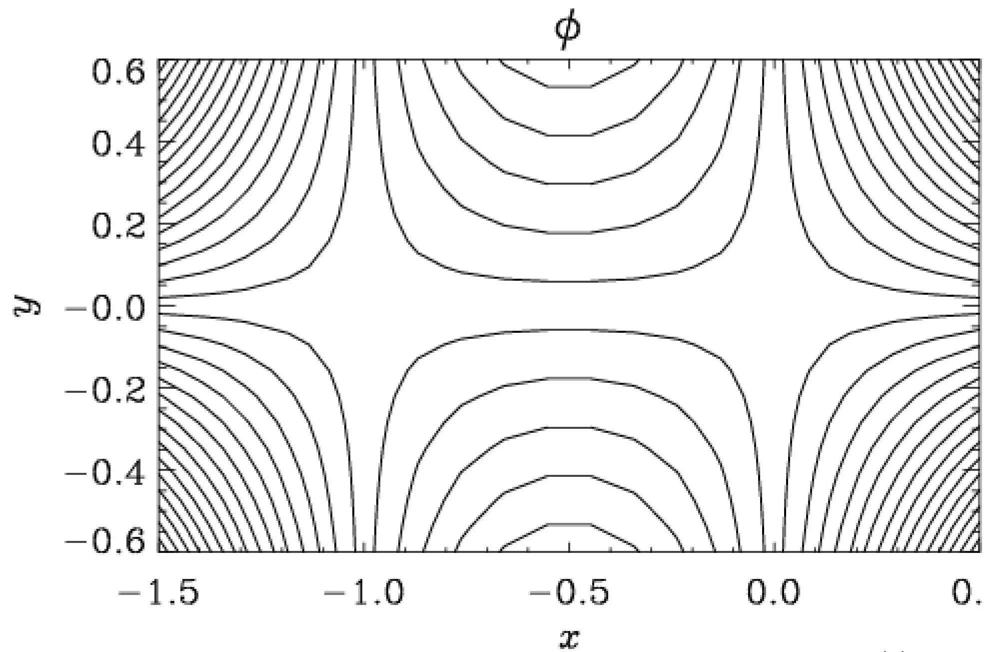
- other examples: finite time blowup

E vector

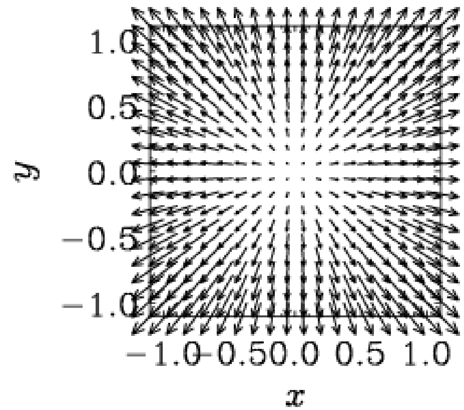
- Contours are perpendicular to ***E*** vectors
- 3 pos and 3 neg charge distributions

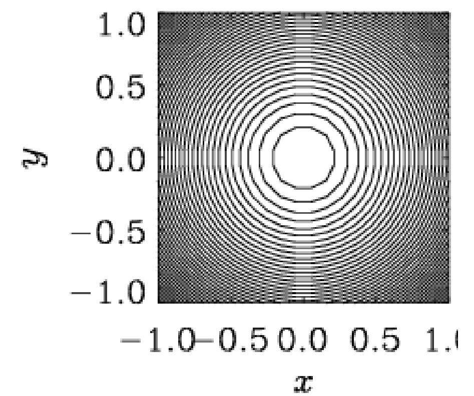


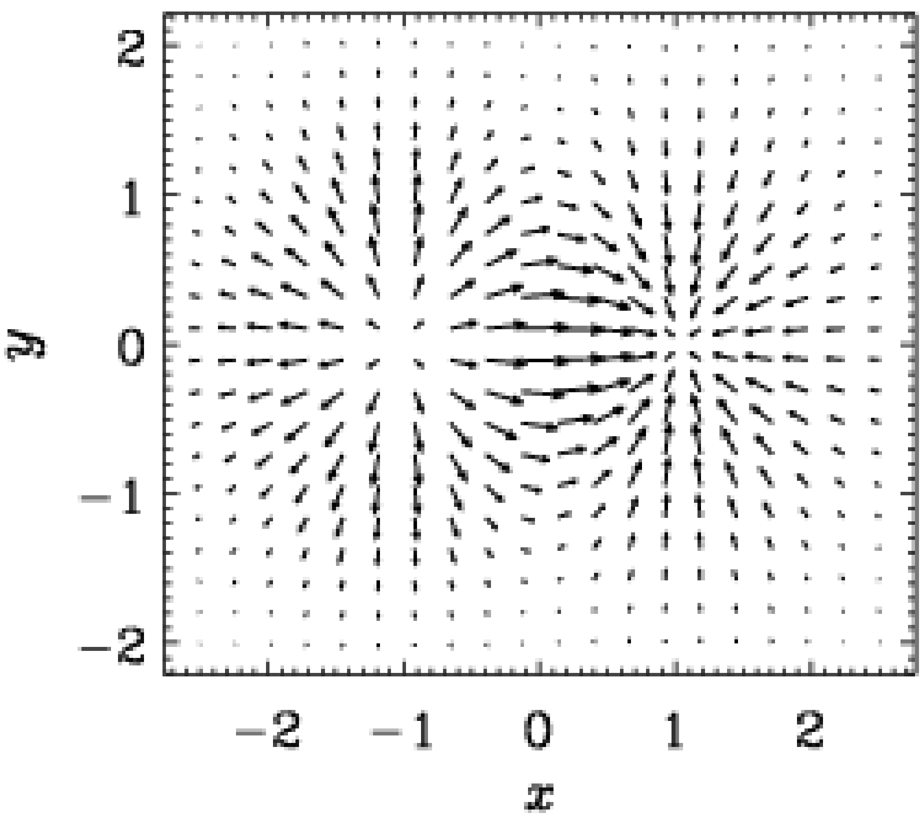


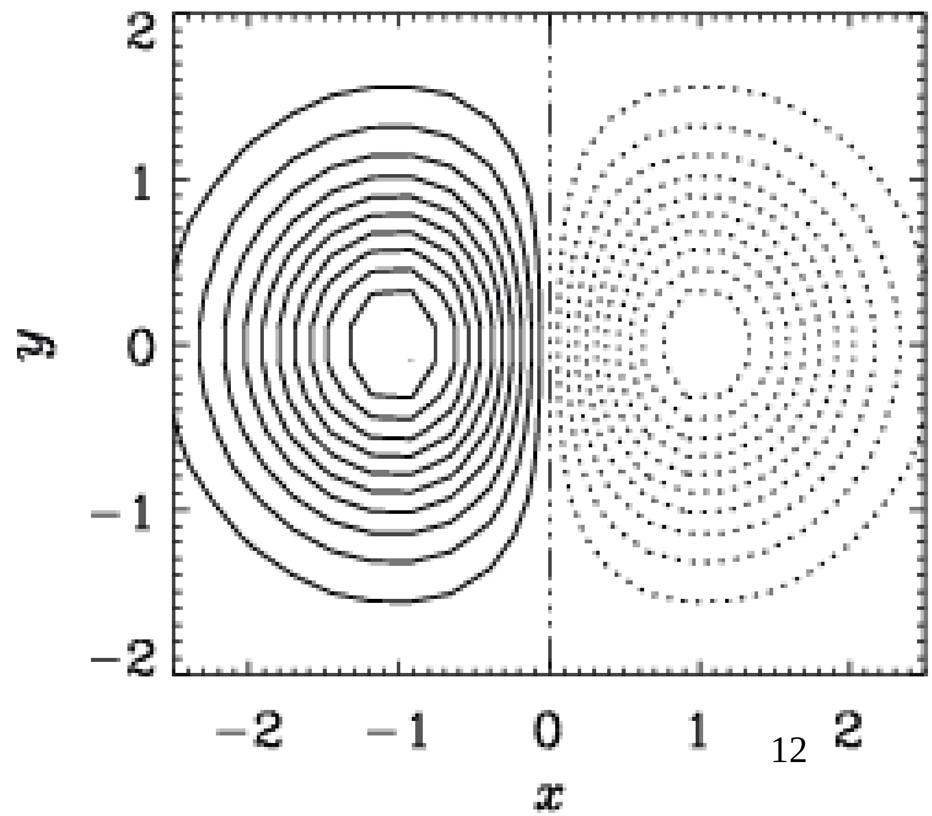


- Infinite energy density??
- 2 gaussian humps









Transfer eqn w/ integrating factor

We can sort of separate the variables to get

$$\frac{dI}{dx} + \alpha I = \alpha S,$$

but we can't quite integrate this equation yet unless we introduce a so-called integrating factor $e^{-\alpha x}$ and substitute

$$I(x) = e^{-\alpha x} \tilde{I}(x).$$

Inserting this gives

$$-\alpha I + e^{-\alpha x} \frac{d\tilde{I}}{dx} + \alpha I = \alpha S$$

where the αI cancels, so we have

$$e^{-\alpha x} \frac{d\tilde{I}}{dx} = \alpha S, \qquad (1)$$

or

$$\frac{d\tilde{I}}{dx} = \alpha S e^{\alpha x}, \qquad (2)$$

which can now be solved by separation of variables, i.e.

$$\tilde{I} - \tilde{I}_0 = \alpha S \int_0^x e^{\alpha x'} \, dx',$$