**Week #6:** Tuesday, Feb 11 - Tuesday, Feb 18  
**Reading:** Sakurai: Chapter 3.

**Homework #6:** Due Wednesday, Feb 25, 5 PM.

Problem 0. Prepare a summary, including a detailed calculation, of your project. Include the final list of references.

Problem 1. Compute \( \langle j, m | J_x | j, m \rangle \) and \( \langle j, m | J_x^2 | j, m \rangle \).

Problem 2. Use the result from Problem 1 to find the dispersion of \( J_x \) in an eigenstate of \( J_z \) and \( J^2 \). Now, \( j \) is the angular momentum (in what units?). Can you recover the classical angular momentum in the limit of large \( j \)?

Sakurai, Chapter 3: Problems 3, 8, 12, 14, 20

Please turn your solutions in to Rafe Howell.

Hint: for problem 3.3, set up a representation for the coupled electron-positron system. For example,

\[
|11\rangle = |++\rangle \\
|10\rangle = \frac{1}{\sqrt{2}} [|--\rangle + |-+\rangle] \\
|1-1\rangle = |--\rangle \\
|00\rangle = \frac{1}{\sqrt{2}} [|--\rangle - |-+\rangle]
\]

then compute the matrix elements of \( H \) for the required spin function. It’s convenient to define an angle \( \theta \): \( \tan \theta \equiv \frac{2eB}{meA\gamma} \).

Note: Be sure you know problem 3.20 well enough so that you could (on demand) do a similar problem: \( j_1 = \frac{1}{2}, j_2 = \frac{1}{2} \).