6) During this mighty struggle, we have generated the boxed equation in Eq. (15). This has an important (~ pictorial) interpretation regarding how some $\vec{T}$-vector "moves" in a given eigenstate of $\vec{J}$ momentum.

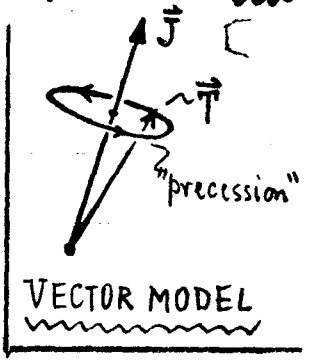
Set $\alpha' = \alpha$ and $m' = m$ in Eq. (15), so that you are in a given eigenstate. The expectation value of $\vec{T}$ in that state can then be written...

$$\rightarrow \langle \alpha j m | \vec{T} | \alpha j m \rangle = \left[\frac{\langle \alpha j m | \vec{J} \cdot \vec{T} | \alpha j m \rangle}{\langle \alpha j m | \vec{J} \cdot \vec{J} | \alpha j m \rangle} \right] \langle \alpha j m | \vec{J} | \alpha j m \rangle , \qquad (16)$$

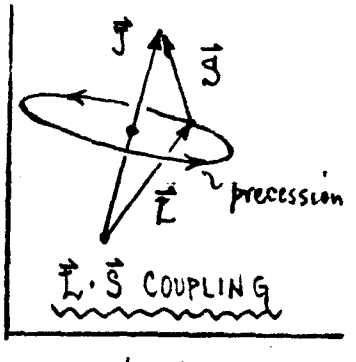
or, symbolically...

$$\boxed{\langle \vec{T} \rangle = \langle \hat{n} \cdot \vec{T} \rangle \langle \hat{n} \rangle}, \quad \hat{n} = \vec{J}/|\vec{J}| = \text{unit vector along } \vec{J}. \qquad (17)$$

The interpretation is this : in a given state of $\vec{J}$ momentum $\vec{J}$, the only component of $\vec{T}$ which survives a QM averaging (expectation value) is the $\vec{T}$-component along $\vec{J}$. It is as though $\vec{T}$ precesses rapidly about $\vec{J}$, so as to average-to-zero all its components $\perp \vec{J}$. This (somewhat fanciful) picture is known as the Vector Model, as shown.



The Vector Model can be used to "see" what happens when two $\vec{J}$ momenta couple. Suppose the orbital $\vec{L}$ and spin $\vec{S}$ $\vec{J}$ momenta couple to form the total system $\vec{J}$ momentum: $\vec{J} = \vec{L} + \vec{S}$. Then $\vec{L}$ & $\vec{S}$ rapidly precess about $\vec{J}$, and their only observable components are their projections along $\vec{J}$. In this sense, $\vec{J}$ (or more accurately $\hat{z} J_z$) serves as a true quantization axis for the system.



φ507 : Coming Attractions

21 Feb. 94

	DATE	LECTURE	ASSIGNMENT
	Mon. 21 Feb.	HOLIDAY (President's Day)	-
(17)	Wed. 23 "	Matrix Elements of $\vec{\pi}$-vectors.	-
	Fri. 25 "	Magnetic Interactions in Atoms.	#⑳ Probs. 65- [#⑲ due]
	Mon. 28 Feb.	Fine-structure in H-like atoms.	-
(20)	Wed. 2 Mar.	Thomas precession. Pauli's correction.	-
	Fri. 4 "	Klein-Gordon Eqtn for the H-atom.	no assignment [#⑳ due]
	Mon. 7 Mar.	Integral Formulation of QM: I.	#㉑ (due 21 Mar)
(23)	Wed. 9 "	Integral Form^{n} II: Propagators.	-
	Fri. 11 "	Integral Form^{n} III: Free-particle G-fcn.	-
	Mon. 14 Mar.	SPRING BREAK	no assignment
	Wed. 16 "	" "	-
	Fri. 18 "	" "	-
	Mon. 21 Mar.	MID-TERM EXAM (in class, 2 hrs open book & notes)*	#㉒ (due 28 Mar.)
(26)	Wed. 23 "	Integral Form^{n} IV: Scattering.	-
	Fri. 25 "	Integral Form^{n} V: S-Matrix & Pert^{n} Thy.	-

* The MID-TERM will cover material through lecture of 11 Mar.