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comments on Talman SPIN2016 19Oct2016 Appendix

Talman has circulated an Appendix to his SPIN2016 paper in which he now claims that $\boldsymbol{\Omega} \cdot \boldsymbol{s}$ is *not* the correct spin-orbit coupling term to employ in the Hamiltonian, to treat a single-pass passage of a charged particle (electron) through a quadrupole. Quoting from Talman:

> Based on its universal correct applicability in atomic physics, it has been argued that the appropriate spin-orbit Hamiltonian for the electron-in-quadrupole system is $\boldsymbol{\Omega} \cdot \boldsymbol{s}$. This is a correct additive perturbation on the average for periodic, more or less elliptical motion, but it is an incorrect complete Hamiltonian potential for brief passage through a quadrupole, for which the unperturbed motion is $x'(t) = y'(t) = 0$.

The Hamiltonian $\boldsymbol{\Omega} \cdot \boldsymbol{s}$ for the spin-orbit has been employed with success in many single pass systems, such as polarized electrons at the SLC, to calculate the spin precession in the SLC arcs (for example). Hence given Talman's statement above, demonstrate the answer to the following calculation:

> *Calculate the spin precession angle for single passage through a skew quadrupole, where the initial orbital coordinates are* **off-center**, *say $x'(0) \neq 0$ (and $y'(0) = 0$). Demonstrate that the spin precession angle is* **not** *that given by the use of the lab frame Hamiltonian $\boldsymbol{\Omega} \cdot \boldsymbol{s}$. An impulse approximation will suffice.*

References

[1] Wiki page at JLAB with title 'Resonant Polarimeter'
https://wiki.jlab.org/ciswiki/index.php/Resonant_Polarimeter

[2] Talman's original presentation for SPIN 2016 (slides)
https://indico.cern.ch/event/570680/contributions/2310168/attachments/
1341808/2026008/Talman_Spin2016-talk.pdf

[3] Talman's revised paper for the SPIN 2016 proceedings, dated 7 Oct 2016
https://wiki.jlab.org/ciswiki/images/5/57/Talman_Spin2016-paper_07Oct2016.pdf

[4] My comments on Talman's original SPIN 2016 talk
https://wiki.jlab.org/ciswiki/images/4/44/Talman_SPIN2016_Sateesh_comments.
pdf

[5] My comments on Talman's revised paper of 7 Oct 2016
https://wiki.jlab.org/ciswiki/images/d/d2/Talman_SPIN2016_07Oct2016_comments.
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