‘Rotation’

Geoffrey Constable

Louis Walter Alvarez (1911-1988) American Physicist

- ‘There is no democracy in physics. We can’t say some second-rate guy has as much right to an opinion as Fermi.’

Albert Einstein (1879-1955)

- ‘Common sense is nothing more than a deposit of prejudices laid down in the mind before you reach 18.’

Rotation – problem 1

- Common sense (plus special relativity) says linear velocity is relative, not absolute.
- Observation says angular velocity is absolute, not relative.
- Does this make sense?

A datum for measuring rotation

- The Earth? No, rotates every 24 hours.
- The Solar System? No, Sun orbits relative to Milky Way at 220 km/sec.
- The Milky Way Galaxy? No, orbits at 600 km/sec relative to ‘extra-galactic frames of reference’.
- The entire universe?

Rotation of the Universe

- Inertial navigation devices show universe rotates $< 10^{-5}$rads/year.
- Initial analysis of Cosmic Microwave Background Radiation (CMBR) isotropy gave $< 10^{-9}$ rads/year.
- Later analysis of CMBR gives 10^{-13}rads/year.
- Assume universe sets datum for zero rotation within the universe.

Problem 2.

- How does a gyroscope know what the most distant parts of the universe are doing?
- Does the structure of the gyroscope extend to the boundaries of the universe?
- Is there instantaneous communication between the gyroscope and such boundaries?
- Does the boundary structure of the universe extend to the gyroscope? Probably.

Quantum Jelly (QJ)

- Some particles ‘pop’ into existence elsewhere as ‘short-lived and transient’ entities.
- Such entities may act on each other and may form a lattice – ‘Quantum Jelly’.
- Such a lattice might resemble a solid and might transmit waves.
- It would permeate the universe and might serve, therefore, as the fabric of space.

The Argument for Quantum Jelly

- Electron radius $< 10^{-15}$cms.
- But electron has angular momentum of $\hbar/_2$.
- The moment of inertia of a sphere is $\frac{2}{5}$mr^2.
- Maximum angular momentum from spinning electron is $\frac{2}{5} M_e r c$ ('r' is electron radius, 'c' is maximum possible equator speed).
- Thus, min. electron radius would be $\frac{5\hbar}{4M_e c} = 10^{-10}$cms.
- Hence, an electron must orbit about a mean point.

What sort of orbit? Schrödinger to the Rescue

In 3D, $-\frac{\hbar^2}{2m}\nabla^2\psi + V(r)\psi = E\psi$

$$\nabla^2\psi = \frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{d\psi}{dr}\right) = \frac{1}{r}\frac{d^2}{dr^2}(r\psi)$$ ignore θ,ϕ

$$\therefore\ -\frac{\hbar^2}{2m}\frac{d^2}{dr^2}(r\psi) + V(r).(r\psi) = E(r\psi)$$

Write the single function u(r) for the product rψ

$$-\frac{\hbar^2}{2m}\frac{d^2u}{dr^2} + V(r)u = Eu \qquad (1)$$

Desired wave function $\psi = u/r$

More Schrödinger

The previous equation can be solved in terms of 'u', and the wave function 'ψ' obtained via ψ = $\frac{u}{r}$.

If there are no potentials, V(r) = 0.

If the electron orbits, energy E = ½ mv^2

But $\frac{\hbar}{2} = mvr$, $so \quad mv = \frac{\hbar}{2r}$

or ½ m$v^2 = \frac{\hbar^2}{8mr^2}$

Substituting in equation (1) yields

$$\frac{d^2u}{dr^2} + \frac{u}{4r^2} = 0 \qquad (2)$$

One solution is u = $\sqrt{Ar}, or \quad \psi^2 = \frac{A}{r}$ (A is a constant)

Comments on eqn (2). $\frac{du^2}{dr^2} + \frac{u}{4r^2} = 0$

- Very simple.
- Independent of ‘m’.
- $r_{max}$is large - $2^{128} \times \frac{\hbar}{m_e c}$
- Volume of a shell = $4\pi r^2 \Delta r$ but probability is $\frac{A}{r}$.
- Eqn. (2)inaccurate due to quantisation of ‘r’.
- ‘Particle/wave duality’ to be replaced by ‘particle/periodicity’ duality.

QJ as the ether

- Speed of waves '*v*' in a solid $\propto \sqrt{\frac{E}{\rho}}$
- $E = {}^{stress}/_{strain} = \frac{\frac{force}{unit\ area}}{\frac{extension}{unit\ length.}}$
- Imagine 1 cm cube of QJ with 'n' lattice cells/cm.
- And force per cell $\propto \Delta r\ (extension/contraction)$.
- ∴ Force/cube face $\propto n^2 \Delta r$.
- Extension of cube = nΔr
- $\therefore E \propto \frac{n^2 \Delta r}{n \Delta r} = n$
- $\rho \propto n^3$, so $\frac{E}{\rho} \propto \frac{1}{n^2}$, and $v = \sqrt{\frac{E}{\rho}} \propto \frac{1}{n}$
- Thus $v + dv = A\frac{1}{n+dn} = \frac{A}{n(1+\frac{dn}{n})} = \frac{A}{n}(1 - \frac{dn}{n}) = \frac{A}{n}(1 - B\frac{M}{r})$
- Einstein derived $c = c_o(1 + \frac{\phi}{c^2}) = c_0(1 - \frac{GM}{rc^2})$

Measuring rotation by gyro

- Position gyro. Mounted on gimbals. Conservation of gyro ang. mom. enables angular shift of frame to be measured.
- Rate gyro. Torque from suppressed precession drives gyro frame into a spring.
- Tuning fork gyro. Vibrating tines plus Coriolis Force cause oscillatory torque about fork axis.
- Coriolis gyro. Distortion of flywheel due to Coriolis sensed electronically.
- Laser gyro. Laser light is split and sent in opposite directions round a closed optical path. Fringes show rotation of optical system.

QJ requirements for such measurements to be possible.

- An angle relative to QJ to be real.
- Velocity relative to QJ to be imaginary.
- Angular velocity relative to QJ to be real.
- Force created by QJ to be real.

How is it possible for QJ to meet such requirements?

- For almost all particles, being present at a particular location in QJ will be extremely rare.
- Assume that such particles at that location have imaginary mass.
- Assume that QJ lengths, say from one particle to another, are imaginary.
- Assume that QJ time is real.

Consequences of a QJ with imaginary length and mass.

- An angle $(^{L}/_{L})$ is real.
- Angular velocity $(^{1}/_{t})$ is real.
- Linear velocity $(^{L}/_{t})$ is imaginary.
- Force (MLt^{-2}) is real but negative.

Problem 4. How exactly does a gyro interact with QJ?

Don’t know, but there are clues.

- This interaction is between mass (atomic nuclei) and a quasi-solid (QJ), not between electrons.
- The equivalence principle suggests that exploring the causes of gravity may show the way ahead.
- This comment endorsed by Einstein’s $c = c_0\left(1 +\right.$

Summary

- This contribution is more work-in-progress than firm conclusion.
- That the universe sets the datum against which angular velocity can be measured seems likely.
- Whether QJ serves as the ether, the datum for sensing angular velocity, and the fabric of space remains ‘on the table’.
- Some of our prejudices, gained prior to the age of 18, may be at risk.