Speed Does Not Enter the Curve of a Spinning Ball Directly

— The sideways displacement is $dy = \frac{\rho A C_L D^2}{4m}$, with no speed in it: the v^2 of the sideways force and the t^2 of the flight time cancel exactly — the separator is whether speed enters the formula directly or only through the spin parameter — [Paper 826]

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— *From thinking to syncing.* —

Abstract

A faster ball is said to curve less.This paper counts that the reason is neither a weaker force nor a shorter flight, but that speed does not appear in the formula at all.No new theorem or law is claimed. First, and this is the core. Speed does not appear in the displacement formula——$dy = \frac{\rho A C_L D^2}{4m}$, because the v^2 of the force and the t^2 of the flight cancel exactly (Section 3). **Second, speed enters only through the spin parameter——$S = r\omega/v$ falls with speed (0.143728 at 40 m/s and 25 rev/s, 0.229965 at 30 m/s and 30 rev/s)** (Section 2). **Third, so the ratio of curves matches the ratio of spin parameters exactly——1.600000 against 1.600000** (Section 3). **Fourth, it matches neither the force ratio nor the time ratio——the force ratio is 0.900000 (the faster ball feels more) and the time ratio 1.333333** (Section 3). **Fifth, the sideways force is of the order of gravity——0.450209 to 0.500232 of it, with a fastball dropping 1.042060 m while moving 0.521272 m sideways** (Section 2). **Sixth, the separator is whether speed enters directly or only through the spin parameter——"a faster ball curves less" is not about a weaker force or a shorter flight** (Section 4). **Keywords**: Magnus effect, spin parameter, lift coefficient, sideways displacement, flight time, representative model.

Scope of this paper (scope note): **No new theorem or law is claimed——that a spinning ball feels a sideways force (the Magnus effect), that its size is written with a lift coefficient, and that the coefficient varies with the spin parameter, are all known.The lift coefficient is a representative model——the fit $C_L = 1.2S$ is used; in reality it varies with S and Reynolds number, and a reverse Magnus effect with the opposite sign is known in the critical range.Drag is not included——deceleration by air, the effect of seams and changes in the direction of the force are not treated.No real pitching is discussed——players and pitch types are not the subject.The reverse effect is not entered——this paper stays on the side where S is small.The values are examples——a radius of 0.0366 m, a mass of 0.145 kg and a distance of 18.44 m are values for comparison.Relation to earlier papers**: **Paper 326 showed that the square-cube "law" is an identity, not a law——this paper stands beside it: the curve formula here is likewise what remains after two factors of v cancel.Paper 300 showed that whether two things share a root is decidable——"feels more force" and "curves more" are distinct roots; the fastball feels more force and curves less.**What is added is **showing that speed drops out of the displacement formula**, **confirming that the displacement ratio matches the spin ratio at 1.600000**, **setting the force ratio 0.900000 and time ratio 1.333333 beside it**, and **placing the separator on direct entry versus entry through the spin parameter**.

1. Notation and the Question

Setting: **a ball of radius r and mass m flies at speed v while spinning at angular rate ω.The sideways force and the displacement over a distance D are**

$$S = \frac{r\omega}{v}, \qquad F = \tfrac{1}{2}\rho v^2 A\, C_L, \qquad t = \frac{D}{v}, \qquad dy = \tfrac{1}{2}\frac{F}{m}t^2$$

The lift coefficient uses the representative fit $C_L = 1.2S$.A baseball is taken with $r = 0.0366$ m, $m = 0.145$ kg, $A = 0.004208$ m², $D = 18.44$ m and $\rho = 1.225$ kg/m³.

Question: **how does speed enter the curve?**

2. Three Balls Compared

Computation 2.1: **speed and spin were varied and the force, time and displacement computed.**

ball	S	C_L	force (vs gravity)	time (s)	sideways (m)
fast (40 m/s, 25 rev/s)	0.143728	0.172473	0.500232	0.461000	0.521272
middling (35 m/s, 27 rev/s)	0.177401	0.212881	0.472719	0.526857	0.643398
slow (30 m/s, 30 rev/s)	0.229965	0.275957	0.450209	0.614667	0.834035

> **Observation 2.2**
>
> the sideways force is of the order of gravity.It is 0.450209 to 0.500232 of it, and the fastball drops 1.042060 m while moving 0.521272 m sideways——the curve is comparable with the drop; the ball falls as it bends.

> **Observation 2.3**
>
> the faster ball feels more force yet curves less.Its force is 0.711312 N against the slow ball's 0.640181 N, while the displacements are 0.521272 m against 0.834035 m——the size of the force does not explain it.

3. Speed Drops Out

Computation 3.1: putting $F = \tfrac{1}{2}\rho v^2 A C_L$ and $t = D/v$ into $dy = \tfrac{1}{2}(F/m)t^2$ cancels v.

$$dy = \frac{1}{2}\cdot\frac{\tfrac{1}{2}\rho v^2 A C_L}{m}\cdot\frac{D^2}{v^2} = \frac{\rho A C_L D^2}{4m}$$

The coefficient is 3.022331, agreeing with the numerical values for all three balls to the 10^{-16} level.

> **Observation 3.2**
>
> this is the core. Speed does not appear in the displacement formula.The v^2 of the force and the t^2 of the flight cancel exactly——what remains is the lift coefficient, and that is the only place speed can enter.

Computation 3.3: the ratios between the fast and slow balls were listed.

compared	slow / fast
spin parameter S	1.600000
sideways force	0.900000
flight time	1.333333
sideways displacement	1.600000

Observation 3.4

the ratio of curves matches the ratio of spin parameters exactly.Both are 1.600000, unlike the force ratio 0.900000 and the time ratio 1.333333——force and time each carry a speed, and the speeds cancel in the product.

4. The Separator

Observation 4.1

the separator is whether speed enters directly or only through the spin parameter.“A faster ball curves less” holds not because the force is weaker or the flight shorter, but because speed sits in the denominator of $S = r\omega/v$——at a fixed spin rate, going faster curves less.

Observation 4.2

spin can buy it back.Since $S = r\omega/v$, raising the speed by $4/3$ is undone by raising the spin by $4/3$——holding the curve while throwing faster means raising the spin rate in proportion to the speed.

Observation 4.3

placed beside Papers 326 and 300.Paper 326 showed that the square-cube “law” is an identity——here too the formula is what remains after two factors of v cancel.Paper 300 showed that sharing a root is decidable——“more force” and “more curve” are distinct roots.

Observation 4.4

what is not said.Drag, seams, the reverse Magnus effect and real pitching are not treated——what is shown is that speed does not enter the curve directly.

5. Census and Closing

1. **fastball S 0.143728** (Computation 2.1): **$r\omega/v$.**
2. **slow ball S 0.229965** (Computation 2.1): **speed in the denominator.**
3. **force 0.500232 of gravity** (Observation 2.2): **the same order.**
4. **more force, less curve** (Observation 2.3): **0.711312 N against 0.640181 N.**
5. **v cancels** (Computation 3.1): **the core.**
6. **coefficient 3.022331** (Computation 3.1): **matching to 10^{-16}.**
7. **displacement ratio 1.600000** (Computation 3.3): **equal to the spin ratio.**
8. **force ratio 0.900000** (Computation 3.3): **the other way.**
9. **time ratio 1.333333** (Computation 3.3): **neither.**
10. **directly or through S** (Observation 4.1): **the separator; Papers 326, 300.**

Closing: **Speed does not enter the curve of a spinning ball directly.The displacement is $dy = \frac{\rho A C_L D^2}{4m}$ with no speed in it, the coefficient 3.022331 matching the numerical values to the 10^{-16} level——the v^2 of the force and the t^2 of the flight cancel exactly.Speed enters only through $S = r\omega/v$, so the fastball at 40 m/s and 25 rev/s has $S = 0.143728$ and moves 0.521272 m, while the slow ball at 30 m/s and 30 rev/s has $S = 0.229965$ and moves 0.834035 m, the ratio 1.600000 matching the spin ratio exactly——unlike the force ratio 0.900000 or the time ratio 1.333333.The sideways force is 0.450209 to 0.500232 of gravity, so the ball falls as it bends.The separator is whether speed enters directly or only through the spin parameter.Placed among the earlier papers——standing beside Paper 326's "identity, not a law", and keeping Paper 300's discipline between force and curve.To be honest——the lift coefficient is the representative fit $C_L = 1.2S$, with neither drag nor the reverse effect included.**

References

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