DriftKurv & SpinKurv

If u play a slowish thin-thin cannon, u havta allow for driftkurv & spinkurv. **DriftKurv** iz the kurv suffered by a ball hit plainball, due to the nap of the bedkloth. **SpinKurv** iz the kurv suffered by the qball when u uze side. In addition we allso hav swerv due to the mini-massé effect when uzing side, especially when the cue is not horizontal. SpinKurv kan be much more savage than DriftKurv. Unfortunately, the good-old cotton **Janus Cloth** haznt been available since WW2. The major competitions & associations stipulate napped woollen cloths, & so we are stuck with nap effects. **Riso Levi** iz to blame. He hated Janus Cloth, & he sed amazingly stupid good things about napped woollen cloth. Its almost funny, he himself made the same sort of stupid remarks about cloths az he quite rightly accuzed Melbourne Inmann Tom Reece & others of making in relation to ivory balls & compozition balls. What would Riso say about Krapps? He hated ivory balls, & theze were superior to Krapps. Players wonder why the 1000's are so elusiv, it's the Krapps. They would make plenty with ivory. Strangely, old billiards books ignored Drift. Old books do mention SpinKurv (by other names). DriftKurv haz been mentioned in books written about snooker, but none haz ever explained its cauze, except to say that it iz due to the nap of the cloth.

Geza Gazdag The Accomplished Cueman 1991

Geza trys to explain DriftKurv & SpinKurv az follows....

*.....The situation of a ball rolling diagonally across the table against the nap, say from the LH top pocket towards the RH bottom pocket is comparable with that of a runner trying to cross a gently sloping field blindfolded. For a while he would be able to follow a straight line, but as he weakens he would **veer off** towards the slope. The same sort of thing would happen to the ball if it was sent at landing speed in the said direction : the last foot or so it would veer off **'downhill'**, as it were, in the direction of the **nap**. How much? As it depends on the quality and the condition of the cloth, your guess is as good as anybody else's.*

*.....One would expect a similar effect when the ball is played in the opposite direction, for a **blindfolded** runner certainly would **veer** off in the direction of the slope. Well, if the ball deviates at all, it will be negligible.*

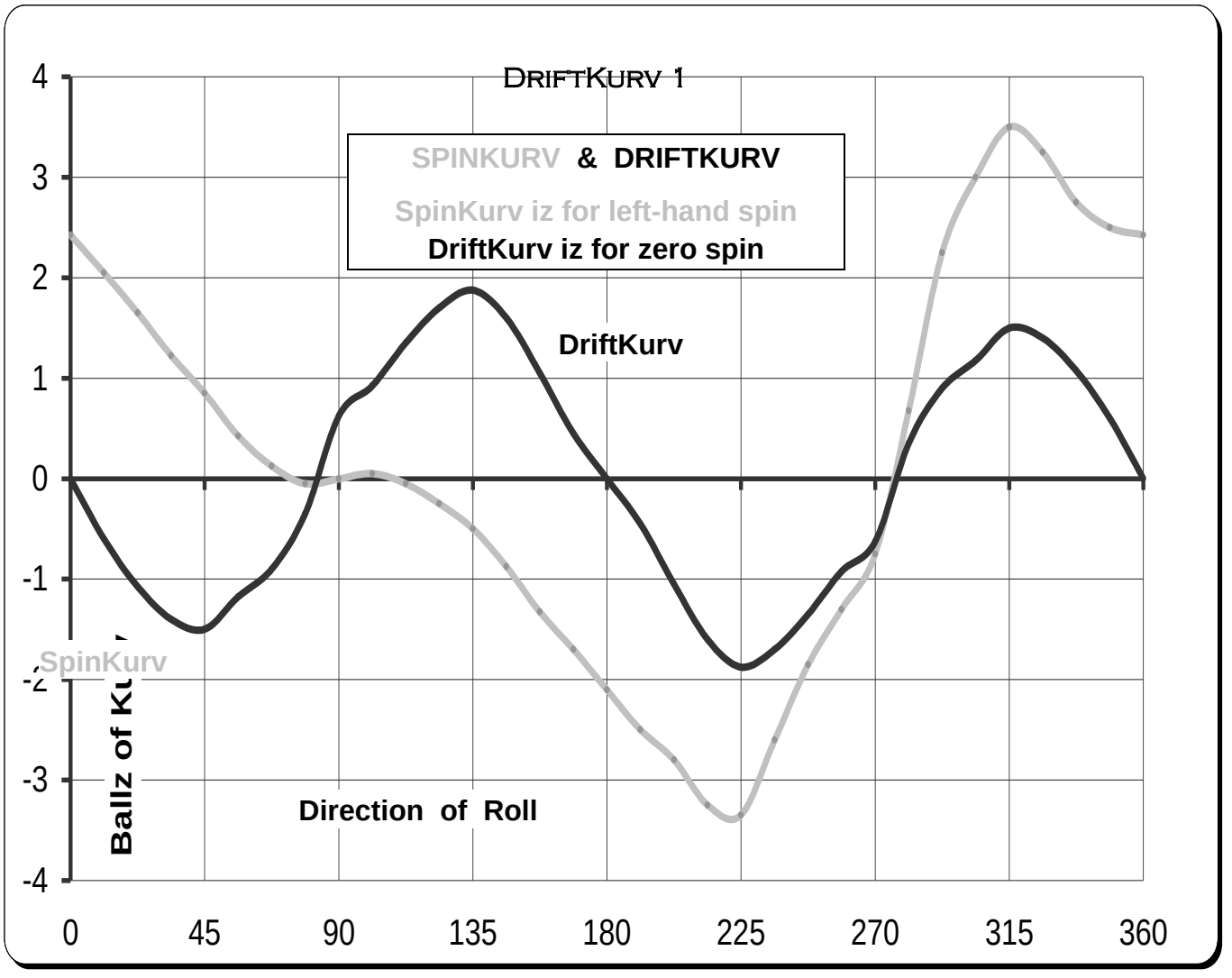
*.....This 'slope effect' of the 'nap' is created by its resisting the ball on the 'uphill' side and assisting it on the 'downhill' side, which becomes even more pronounced when the ball is **spinning** sideways in a humming top fashion. The mechanism of rolling and spinning is identical : half of the ball is moving one way, the other half the opposite way, while the ball as a whole is moving forward. The difference being only in the axis of the rotation.....*

*.....When the ball is travelling against the '**nap'** the side. Left or right, will always be on the resistance side and on the assistance side when it is going down the 'nap'. The deviation on the other hand regardless of the side applied will always be on the assistance side. However, while the deviation from the straight line will be quite dramatic against the 'nap', with the 'nap' it will be next to nothing, if there is any at all.*

Tests & Mezurements

DriftKurv certainly plays an important roll in snooker. For example, to pot a red slowly into a middle pocket you might need to allow for the red kurving say a ½ ball in the direction of the nap. The exact allowance required depends on the direction of the shot relativ to the direction of the nap. Also, most players know that there iz more DriftKurv if the cloth iz thick, & less if the cloth iz fine or worn, more if brushed, but less if smoothed by ironing. It iz also somewhat unrelyable. Besides varying from table to table drift kan change during a game, az the nap rizes, particularly if conditions are very humid.

The first step in developing a theory explaining DriftKurv woz to meazure the DriftKurv & the SpinKurv for varyus directions of travel, the rezults (graffs) are shown in **DriftKurv 1**. Theze were mezured on a thickish (slow) old style billiards cloth, brushed (& padded i think) but not ironed. Cloths are normally replaced when the wear (at the Spot & at the jaws & along the rails) gets too bad, which at The Cheltenham Club iz at 2 to 3 years. Most Clubs replace the cloth on the competition tables each year, alltho the newish old cloths are often relayed onto the second rank tables. Each of the following test rezults (graffs) are the averages of 2 sets of mezurements taken on 6 & 8 Jan 89 on the one table.



A Few Comments

Kurv In DriftKurv Chart 1 it iz convenient to describe the size of the kurv in terms of ball diameters, ie minus 1 iz one ball of kurv to the right, plus 1 iz to the left. **Nap** The direction of the nap iz taken to be 00º, & the other directions are meazured clockwize. So 90° iz across the table from left to right, & 180° iz directly down the table, ie against the nap, & 270° iz across the table from right to left. **Max DriftKurv** Az kan be seen, a ball rolling somewhat against the nap will always drift in the same direction az the nap. The maximum DriftKurv woz found to be 2 balls, & this

occurred when travelling at approximately 135º. Theze tests were on a thickish cloth, brushed not ironed, logically the DriftKurv would be less on a thinnish cloth. The length of roll woz about 1.5m in each case, a longer roll would logically giv more DriftKurv. **Zero DriftKurv** A ball rolling directly up the table (00º, or down the table (180º), will roll straight, ie the DriftKurv iz zero. **Across** A ball rolling directly across the table (90º) will uzually drift a ½ ball in the same direction az the nap. **DriftKurv on an Angle** DriftKurv for travel on an angle (ie neither up & down nor across) iz not straightforward. Az kan be seen, below about 80° the DriftKurv iz against the nap, ie to the right. Abov 80° the DriftKurv iz with the nap, ie to the left. With-the-nap iz shown by the ranges 00° to 90°, & 270° to 360°. **Against-the-nap** iz shown by the range 90° to 270°. **Ironed Cloth** Az karnt be seen, on a smooth ironed cloth, the DriftKurv iz uzually less than on an non-ironed (brushed) cloth. In fact, the DriftKurv on an ironed cloth kan be zero on an angle where a non-ironed cloth would be giving some kurv. In fact, the DriftKurv on an ironed cloth kan be a little in the opposit direktion, eg to the left instead of to the expekted right. **What?** Hence everyone "knows" that a red slowly potted into the right-hand top pocketoff theSpot will drift a little to the left az it nears the pocket, so they are happy to aim for a bit of the right-hand jaw. But sometimes Horror, at another Club the red goze **dead straight,** or even uphill (**right**) a little & hits a lot of the jaw, zero pot. **Brushing** It gets worse. Yor Clubmates allways like to brush the table befor the match. They finish off by brushing along (under) the top-cushion, to the left-top-pocket & to the right-top-pocket, to remoov all of the krap. This brushing along the top-cushion should be done with the tip of a special brush, taking care not to touch the bed-cloth unduly. But yor Clubmates don't take any care, therefor there iz allways a wide band along the top-cushion where the **nap** iz pointing towards the nearest top pocket. Any red running along the top-cushion allways **acquires** some side-spin when it touches the cushion. Now, koz of the wrongly brushed nap, the acquired side spin will urge the red to kurv **away** from the cushion, due to SpinKurv, hence it iz difficult to pot a red uzing slow pace. **High Jinx** Cushion-crawlers had better be aware of what sort of High-Jinx kan be found near the top-cushion, the table level, the bad brushing, the worn groov along the cushion (especially near the jaws). All kan be life or death to a slow stroke, even at nursery cannon range. **Slates** Very old tables uzually hav very old slates, & very old slates are uzually bent, & bent slates kan do funny things. **SpinKurv** At first glance finding a good explanation for the cauze of DriftKurv appears difficult. However, there iz one very good clue. In DriftKurv Chart 1 we hav super-impozed graffs of the SpinKurv & DriftKurv, for comparison. Az kan be seen, the graffs hav a number of differences, but, there iz also a similarity that will reward further examination. **83°** It kan be seen that the DriftKurv iz **zero** at 83º left & at 83º right, & that this iz almost identical to the rezults shown for the **SpinKurv**. **Holy Grails** I think that i kan now solv thoze age-old arguments, ie what cauzes DriftKurv & what cauzes SpinKurv, the Holy Grails of billiards theorists.

Cauzes of DriftKurv

Leaning Ball Earlyer i sed that drift occurs to a ball with no spin. But this iz not so. The Leaning Ball in Billiards Arithmetically Treated explains that a ball rolling across the table to the left cushion acquires clockwize spin & anticlockwize spin when to the right. It woz shown that on a napped cloth there are only two cases in which a ball kan be rolling with zero spin. One iz when the ball iz travelling directly **WITH** the nap, the other iz when the ball iz travelling directly **AGAINST** the nap. The amount of spin acquired iz not large, if a marked ball iz uzed it will be seen that the spin axis might be at most say 10° from horizontal. **SpinKurvs** So, the DriftKurv iz simply another manifestation of the SpinKurv. Both are SpinKurvs. The differences in the graffs are due mainly (not entirely) to the differences in the spin rates. See what i meen? The tests for the SpinKurv were dunn uzing lots of fingerspin. Billiards Arithmetically Treated explains. Anyhow,

befor we look at DriftKurv we firstly look at SpinKurv. SpinKurv iz the eezyst one, DriftKurv iz aktually more komplikated than SpinKurv.

Suspekts

Quest Befor we go looking for what cauzes SpinKurv. But here we hav gotten off to a bad start. **Questions** are difficult, Answers are eezy. Unfortunately we made **SkoolKid Mistake No 1** allmost befor we started. We sed what cauzes a ball to kurv, we didn't think that praps the ball went a bit straight & it woz we that kurved. After we hav found the culprits, we might call them Effekts, but they are forces anyhow. We might mention the energy but energy never mooved (or kurved) anything in its life, only forces kan moov things.

Coriolis We make the world's biggest ice billiard table, 100km long, at the south pole. One ice-end iz exactly on the pole, & we take very great care to orientate the other ice-end directly to the north. We hit an ice-ball from the south pole direktly at the center of the top-ice-cushion. The ball iz suppozed to hit the center of the top-ice-cushion, hard, after rolling for say 50 minutes, & then rebound back to u. But the ball duznt kum back. We send a search party over the horizon to investigate, & they radio back that they found the ice-ball in the left-ice-pocket. The left-pocket iz 25km left-of-center of the table. During the time that it took the ice-ball to reech the top-cushion, the top end of the table haz rotated 25km to the east. So here the qball haz managed to kurv without the existence of any sideways force at all. **SkoolKid Mistake No 2**, we sed that the suspekt had to be a force, but here we hav just shown that u kan hav lots of kurv with zero force. But most of our strokes take say 5 sec not 50 minutes, hence the abov ice-ball would hav hit only 36.4m off center. But most of our tables are only 4m long, hence in 5 sec the abov ice-ball would hav hit only 1.45mm off center. This 1.45mm sounds like a lot, & there iz a manned international ice-station at the icy-pole, & i bet it haz a table. But most of our tables are not at the pole. At the equator the ice-kurv would be near'nuff zero no matter how much time the ice-ball took, it would melt befor it kurved. Anyhow, the Coriolis Effekt iz not a force at all (here).

Inertia The cloth & hairs are unhappy to moov out of the ball's way, they accelerate from zero to ??m/s at about 1000g (g = accel of gravity), & they won't do this without the ball applying some sort of force. This force only occurs where the ball first meets each hair (cloth). It acts in a small area (ring) at the leeding edge of the footprint. It affekts the grade of the hill for a ball.

Rotational Inertia A hill or psuedo hill will slow the progress of a rolling ball. But the ball haz topspin. Even az the hill iz doing its dirty work the topspin iz driving the ball higher. 2/7ths of a rolling ball's momentum & energy iz in the rotation, & 5/7ths iz in the tranzlation. If the retarding force of the hill (ie gravity) iz say 5 Newtons, then the accelerating force iz 2 Newtons, if there iz zero slippage. So, gravity iz retarding the ball, & rotational inertia iz pushing it on. If the hill woz well oiled the ball would reech only say 5/7ths of the height reeched non-oiled, & the ball would still hav its original topspin. So here we hav another force. Or if the ball haz a Brake Pedal, the force iz in the other direction (see Rolling).

Rotational Inertia (gyro) Just looking ahead a little. When we look for a force that makes a rolling-spinning ball kurv, this force needs to akt left or right. This force iz likely to be some kind of cloth force, acting in the footprint. If the force acts say right, the ball will moov (kurv) to the right. But if the ball iz rolling-spinning (which it iz) then it haz rotational momentum, with the axis of rotation horizontal (or 10° or 20° or 30° or ??° down or up from horizontal) & at 90° to the direktion of tranzlation (initially). This rightward force will make the rotational axis of the ball turn left, ie the ball will look az if it iz going (rolling) to the left, while at the same time drifting to the right (u kan check this sort of thing by uzing a bicycle wheel). Something hazta giv. The turned axis meens that the ball's topspin will akt to take it left, ie to straighten it up or even to send it left of the original line, hence there iz a force pushing the ball left **(force L)**. If the axis turns, then this must rezult in a

deficiency in rotation along the original line of travel, hence the ball will skid a bit, there will be a retarding force akting to slow the tranzlation **(force B)**, this force will akt to inkreec the rotation (topspin). This iz now 2 forces **(L & B)**, alltho theze 2 kan possible be treated az 1 force without inkurring demerits. But what happens in the end, duz the original Rightwards force end up by making the ball go (kurv) right, or duz it end up going straight, or duz it even end up going (kurving) left. If it ends up kurving left then we should be looking for a primary force in the footprint that akts to the left if we want to explain the ball going right. **SkoolKid Mistake No 3.** In fakt, we don't necessaryly need a force (a force left or right) at all. A torq might do the trick, ie a twisting force, a bit like 2 oppozing forces. If there woz some kind of torq akting in the footprint, ie akting about a vertical axis, then this would tend to make the balls rolling-spinning axis turn up or down, this would throw the forces in the footprint out of balance, the ball would allmost certainly end up going left or right a bit or a lot. **Suspekts** Ok now we are getting somewhere, we kan safely say that DriftKurv iz cauzed by a force or a torq or something that iznt a force or a torq.

Simple Rolling

Befor we look at forces affekting SpinKurv, we should look again at what we sed about the simple forces affekting simple roll. Theze were i think mentioned in the Chapter 65 Roll. **Cloth-Hill** This we sed woz due to the force exerted by the bed-cloth, in the ball's footprint, & it inklooded the Trap Effekt, which iz due to the direction of the hairs of the nap, & which we sed affekted the grade-of-the-hill in every direction. **Air-Drag** The air pressure at the front of the ball iz greater than at the back. **Cloth-Air-Drag** This woz made up of the pressure of AirSqeez & AirSuck, where the ball sqeezes or sucks air out of or into the footprint. The horizontal components of theze forces retard the ball's progress. **Gravity** duznt hav a direct effekt on the grade-of-the-hill, ie on simple rolling. The sun & the moon moov about, & the earth spins, hence in theory the direction of the nett gravitational pull varys from hour to hour & from day to day. When yor table woz installed it woz installed perfiktly level, at that hour. But the moovments of the moon & sun, & the spin etc of the earth, create changes in the size & direction of the gravitational pull on yor balls. **Inertial Gravity** In addition to the abov change, we allso hav changes in psuedo gravity, arizing mainly from centripital forces. Theze are inertial effekts due to the earth spinning, & due to the **EARTH** rotating around the **SUN** & the **MOON**, mainly the moon. The sun's gravity iz **174** times az strong az the moon's, here i am referring to the effekt on the weight of yor balls. But the sun's gravity iz largely offset by the inertial force of whizzing around it every **365** days, the earth & the players balls are in free orbit, hence the sun's nett gravitational type force iz near'nuff zero. The changes in the size & direktion of the moon's gravitytational pull & associated inertial effekts (centripital force) are larger than the sun's, so this free orbit bizness iz i suppoze nowhere. **Pseudo Gravity** The force of earth's pull etc changes in size az u wander from the poles to the equator, or az u change altitude. The G force pulling on a billiards player's balls changes between about 9.780 & 9.832 N/kg az she goze from the poles to the equator, a change of 0.532%. **Roll** This would affekt the grade-of-the-hill of the Cloth-Hill, a ball rolling **1000mm** at the **Icy-Pole** might roll **1005mm** at the equator. **Half-Ball** And it would affekt her half-ball angle, the ball might spread about 1mm wider befor straightening, for a long-loozer. **Skrew** But skrewing would be eezyer at the **EQUATOR**. This 0.532% would help heaps, koz when the qball gets to the red, it's the rezidual backspin that counts. 0.532% could make the difference regarding having lots of backspin or zero backspin.

Cauzes of SpinKurv

Here we havta look more closely into the forces acting on the balls.

Plumb-Bob If u are paranoid u kan hang a patented Alcock Billiards Plumb-Bob under yor table. But u would find that u wasted yor money, koz all of this gravity stuff mentioned earlyer would never make more than perhaps an occazional ***1 in 500,000*** moovment in the angle of the bob. This daily or weekly moovment would havta be ***100*** times az bad to warrant touching the leg-skrews. Here we are now mainly talking about the affekt on the straight running of a ball, ie the ***kurv***. A 1mm kurv would be potentially worse than a 1mm shortening or lengthening in roll. U would find that any affekt on the grade-of-the-hill itself wouldn't be noticed even if the plumbing woz ***1000*** times worse. If i skrewed a leg on yor table while u were making a cup of tea, u wouldn't know about it untill yor ball kurved off on some particular stroke. So we kan ignore direkt gravity, & that Coriolis stuff mentioned earlyer, its negligible (but not at the icy-poles).

There are 4 spinning effekts (or 6 really) that contribute to SpinKurv, az follows....

1 The RuffEffekt 1.1 Jumbling A spinning ball leevs a clear trail on a freshly ironed table. Spin ruffs-up the nap, & this ruffing iz more-so in some parts of the footprint than in other parts. The ruffer parts will then carry more of the ball's weight, the hairs are more jumbled, hence the ball will tend to fall away from theze parts. The ball feels that the table iznt level. This allways affekts the grade-of-the-hill, & it sometimes rezults in kurv. This iz the RuffEffekt. Friktion creates it & gravity duz the work. It iz difficult to pikture what goze on in the footprint of a rolling-spinning ball. he footprint iz say 7mm in diameter, there iz allways some point in the footprint where that point of the ball acts az a central point, the photo would show the ball in effekt spinning about that point. Except that the ball iz rolling, hence a different atom of the ball acts az central point in its turn, theze lucky points sitting on a line around the lower half of the ball, a sort of Capricorn. So, the nap iz being brushed by the ball in a circular fashion from the nap's point of view. The brushing iz in 3 different direktions, on the left side, in front & on the right-side. Aktually, u kan add to that the backside, different again, alltho the rear of the footprint only carrys about 30% of the weight of the ball most of the time, so the rear iznt very important here. **1.2 With** If the ball's brushing iz with the nap, zero jumbling. **1.3 Across** If it iz across the nap, lots of jumbling. **1.4 Against** If it iz against the nap, potentially the maximum of jumbling. e The RuffEffekt probly duznt change much with speed, but it inkreecez az spin inkreeces. **1.5 Un-Jumbles** I suppoze that the RuffEffekt possibly e un-jumble the nap in some circumstances, ie when with the nap, it flattens the nap. If so, it dekreeces the RuffEffekt in that quarter. A negativ RuffEffekt.

2 The TrapEffekts 2.1 Jumbling Jumbling iz potentially maximized when it iz the ends of the hairs that contact the spinning ball, hence the RuffEffekt iz then potentially maximized. But it iz eezy to pikture that the ball iz more likely to grab the end of a hair when it meets the hair at about 90°. Hence the center of the leeding edge of the footprint enjoys this game when the ball iz rolling against the nap, ie rolling at 180° (00° being direktly with the nap). The 45° part of the left portion of the footprint gets into the act when the ball iz rolling at 225° (mezuring clockwize). The centerline of the footprint affekts the grade-of-the-hill more-so than the left-most & right-most parts, koz the centerline carrys most of the balls weight.. But it iz the side-most parts of the footprint that kan hav a larger effekt on the sideways-grade-of-the-hill, ie on the kurv, hence theze side-most parts are praps more important. But most of this stuff probably belongs to the previous page, the RuffEffekt. The hardcore TrapEffekt follows. **2.2 TrapEffekt** Az we already sed in Ch85 Roll, in some parts of the footprint, in some direktions of travel, the ***end*** of a hair iz likely to be trapped under the ball, & then the ball rolls over (flattens) the rest of the hair. When the end of a hair

iz trapped like this, the hair cannot bend or yield in its normal simple eezy fashion. The hair develops a **WRINKLE,** it duznt flatten so eezyly, theze hairs take more of the **WEIGHT,** if at the side, the ball kurvs (downhill). This complements the RuffEffekt. Trap Effekt iz logically at its maximum at **180°,** & very much reduced at other directions. But here again, it iz the action in the side-most parts of the footprint that haz a greater effekt on kurv, hence it iz angles other than 180° that hav ***most*** effekt. **ZERO TRAPEFFEKT** TrapEffekt must hav allmost zero effekt when the ball iz travelling between ***00°*** & say ***80°***, & between ***280°*** & ***360°*** (360° iz 00°). **NO SPIN NEEDED** The thing about TrapEffekt iz that it duznt need any spin, a ***rolling*** ball kan suffer lots of TrapEffekt. **SPIN** But spin kan hav a big effekt on TrapEffekt, in fakt there are a few things that kan happen az follows....**2.3 TRAPEFFEKT** Clearly, spin kan inkreec TrapEffekt in some parts of the footprint for some direktions of travel, the hairs are pulled around to a pozzy where they are better trapped (not intentionally). **2.4 NEGATIV TRAPEFFEKT** But even more-so, spin kan pull hairs around to where they are not so well trapped. **2.5 UN-TRAPEFFEKT** And even more-more-so, spin kan pull direktly on a hair, & hence reduce the TrapEffekt, & this reduktion duznt need any grabbing of the ends nor pulling around to a different angle.

3 JANUS CLOTH EFFEKTS On a napless cloth, eg the cotton cloth (Janus) of the 1920's & 30's, a ball spinning with left side (clockwize) will kurv a 1/2 ball or thereabouts to the right az it slows & stops. A ball spinning with right side will kurv to the left. I call this the Janus Cloth Effekt. Janus woznt made after WW2, but there iz nothing in the rules requiring u to uze a krappy-nappy-woolly cloth. A napped cloth (ie with a direktional nap) givs rize to much stronger effekts than the Janus Cloth Effekt. But the Janus Cloth Effekt iz allways in there somewhere none-the-less, even tho u karnt allways see it. The Janus Cloth Effekt iz weak, however it iz very interesting & helps our understanding of forces acting on a ball. There are i think 3 possible Janus Cloth Effekts. Each iz due to the ball skidding left or right under the influence of out-of-balance friktion forces in the footprint. Befor looking at the 3 kinds, we firstly look at the Janus Cloth Effekt in a general way az follows.

GENERAL STUFF ON JANUS FORCES The line of the effektiv supporting force of a ball rolling along a yielding surface acts throo a point near the center of the footprint, but this point iz actually slightly ahead of the center of the bottom of the ball. The vizible roll-spin-axis iz the rezult of the combination of the roll-axis & the spin-axis. Spin friktion forces in the footprint act to slow the spinning. The theoretical spin-axis iz not vertical, the axis passes throo the center of the ball (i think) & it passes very near to the point in the footprint where we sed earlyer that the effektiv supporting force passes throo. The friktion forces rezisting spinning tend to be in balance. Any out-of-balance force acting left or right etc will rezult in the spin-axis shifting so that balance iz restored. I uze the right-hand-rule to help me to vizualize the torq & axis & shift involved, the fingers are the spin & also the torq, & the thumb iz the axis. But the friktion forces are never in balance, not while the ball iz rolling. Az the ball slows, the grade-of-the-hill inkreeces or dekreeces, this changes the weight supported forward & aft of the plane of the spin-axis, this changes the size of the friktion forces, it iz the sideways friktion forces that interest us. For clockwize spin the friktion forces act anticlockwize about the spin-axis. The friktion forces are at a maximum at the very bottom dead center of the ball where the footprint iz deepest & the pressure iz greatest. Here they act mainly to the right (or the left) & they overpower the weaker forces forward of the plane of the spin axis, acting mainly left (or right). And so, the ball skids to the right, hence the kurv. A ball spinning anticlockwize would kurv left.

3.1 FRIKTION IN THE LEEDING EDGE Remember earlyer when we looked at Inertial forces. We sed..... **INERTIA** The cloth & hairs are unhappy to moov down out of the ball's way, they accelerate from zero to ??m/s at about 1000g (g = accel of gravity), & they won't do this without the ball applying force. This impakt force occurs where the ball first meets each hair (cloth), it acts in

a small area (ring) at the leeding edge of the footprint. It affekts the grade of the hill for a ball. This impakt force in the leeding edge iz not very large, & it dekreeces with speed. Az it iz in the leeding edge of the footprint, it must giv rize to a sideways friktion force oppozing the spin, for left-hand-spin this sideways force would act to push the ball to the left. Az this force dekreeces (az the speed dekreeces) the frontal sideways friktion force (acting left) bekums less than the sideways friktion force in the rear (acting right), hence the ball moovs (skids) to the right. This new unbalanced torq acting on the ball rezults in the spin-axis dipping towards the vertical, untill the leftward & rightward forces equalize. But by then the ball haz slowed some more, & the whole process haztabe repeated etc.

3.2 Moovment of the Support There are 2 scenarios, (A) the grade-of-the-hill **dekreeces** az speed dekreeces, (B) the grade-of-the-hill inkreeces az speed dekreeces. We will follow throo with A, scenario B would leed to a kurv in the opposit direktion (i reckon that B iz there, sometimes). As rolling slows, the area of contact at the rear grows az the rebounding cloth gradually takes more of the weight. Consequently, az rolling slows, the friktion force in the rear increases, &, for clockwize spin, pushes the ball even more so to the right. However, this effekt duznt bekum great. Koz az the rear of the contact gradually takes more weight, the supporting force in effekt moovs towards the vertical az the ball slows. The spin-axis follows, hence the area of contact forward of the axis increases, hence the friktion force acting left increases untill the leftward & rightward forces equalize. But by then the ball haz slowed some more, & the grade-of-the-hill haz dekreeced some more, & the whole process haztabe repeated etc.

3.3 Near the End Near the end, just befor rolling stops, there iz another little burst of kurv. If the ball iz still spinning az rolling dies, the rear now starts to take a much greater share of the weight, which rezults in inkreeced friktion in the rear, which sends the ball to the right. This force imbalance allso rezults in the spin-axis dipping towards the vertical, & when the ball stops it iz perfiktly vertical, or at least it iz in the vertical plane, alltho some funny things kan happen depending on just how much spin there iz. Anyhow, here we are talking about some very weak forces & weak kurvs. And we are talking about a Janus Cloth, a krappy-nappy cloth creates forces which uzually overpower the Janus Cloth Effekt, but az i sed, it iz still there anyhow, it allways iz.

What Books Say About Janus I hav kum across a few references to Janus Cloth in old books, saying that a ball traveling with side on a Janus Cloth kurvs az if going against the nap on a napped cloth. But most of theze escape me for now. However, i did find the following.

Geza Gazdag The Accomplished Cueman 1991

Geza mentions the Janus Cloth. He sez that an old-timer told him that side on a Janus Cloth had the opposite effekt to what it had on a napped cloth. Which iz what i hav just been saying. But Geza bit the old-timers head off. Geza sez....

> *I did manage to find an old timer* who said of the Janus Cloth & the absence of the *nap.... they had to cope with the side having the opposite effect to what it had on the nap cloth.....*

Geza doesn't believe him & sez.... *I told him that on a napless cloth the side has no effect on the bed of the table therefore one can hardly talk about opposite effect....*

Arthur F Peall
All About Billiards and How To Pot 1925

..... if you play a slow or slowish ball with strong side on a woollen cloth, the ball will turn in the direction of the side when running with the nap, & in the

contrary direction when running against the nap. On a napless cloth, the ball always turns in the direction of the side it carries...

Obviously, Peall got it wrong. He (& Newman) got konfuzed with swerv, u karnt avoid putting on a bit of masse effekt whenever u uze side, the less horizontal the cue the more the swerv.

R M Geyer Precision Billiards 1927

..the surface of this cloth influences the course of the cue ball in the same manner as the surface of the woollen cloth does when the ball travels with the nap.

I don't think Geyer (Indian) ever played on a Janus cloth in hiz life, he did vizit England briefly, i am sure that he merely read Peall's book & he simply relyd on Peall's say so. The paragraff on Janus Cloth woz thrown in (in panik) just befor he published, so pay him no heed. What woz Geyer's first name, i did see it in The Billiard Player. Michael Ferreira told me that Geyer woz an unknown quantity in India, no one appears to know anything about him, a Phantom, but we all know that Geyer used to vizit Thurstons.

4 Air in the Footprint **4.1 Air-Sqeez & Suck** In Ch66 Roll we talked about how Air-Sqeez & Air Suck in the cloth (in the footprint) affekted the grade-of-the-hill for a rolling ball. We didn't mention it at the time but theze same forces kan allso (i kan allmost say must allso) rezult in changes in the sideways grade-of-the-hill, ie what Senior Wranglers call Kurv, here i am talking about a rolling ball. There iz no need to repeat this rolling stuff here. Just re-read this Air-Sqeez & Air-Suck stuff with an eye az to how it might rezult in a different air pressure on the left or the right of the ball, no problem. **4.2 SpinKurv** For a spinning ball, Air-Sqeez & Suck still play the same game, alltho spin-friktion will allmost certainly modyfy some of them some of the time (ie inkreec or dekreec them). U should re-read thoze previous pages on the RuffEffekt & on the TrapEffekt with an eye az to how they might modify the Air-Sqeez & the Air-Suck.

Cauzes of DriftKurv

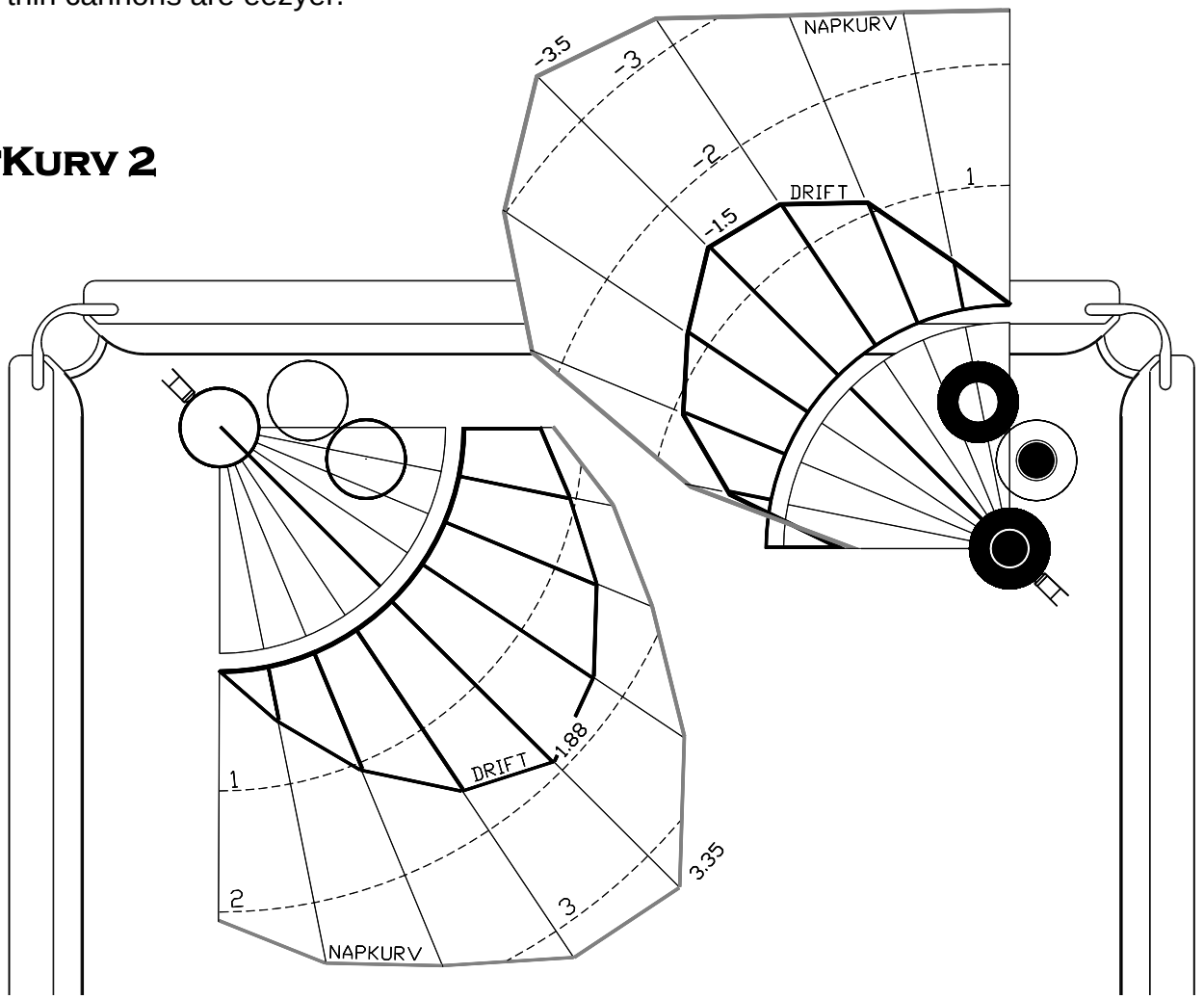
All of the abov SpinKurv stuff applys allso to DriftKurv, the only real differences being in magnitude. But DriftKurv haz at least one other effekt happening.

5 NapSkid Effekt Fifth Cauze But, there iz a fifth cauze, not related to spinning. Do you remember ***The Coin Conundrum?*** (in Billiardz Arithmetically Treated). This explained how the sliding hairs of the nap, cauzing the Leaning Effekt, also cauze the Turning Effekt & the Nap Skid Effekt. Theze 2 effekts obviously apply to balls allso (az for coins, albeit less-so). **5.1 Turning Effekt** The Turning Effekt iz too insignificant to be called the fifth cauze. It haz a large effekt on a coin but little on a ball koz, (a) leaning produces spin on the ball & this limits the ability of the sliding hairs to exert their full effekt, (b) friktion in parts of the contact oppozes the effekt, & (c) any surplus of Turning Effekt iz all lost due to the action of the forces arizing from the accompanying sideslip. **5.2 NapSkid Effekt** The Nap Skid Effekt iz the fifth cauze. It haz a small but significant effekt dezerving mention. It tends to make the ball skid in the direction of the nap, ie towards the top cushion.

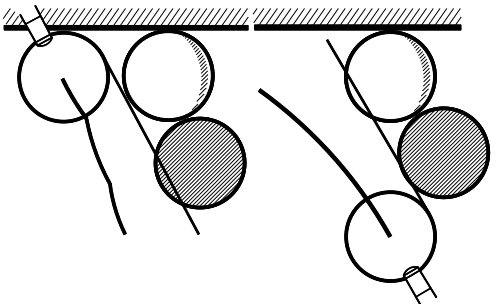
Thin-Thin Cannons Az i sed, if u want to play a slowish thin-thin cannon, u havta allow for DriftKurv, if u don't make an accurate allowance u might miss. In the following drawing, **DriftKurv 2**, we show the DriftKurv for varyus angles, on the top-cushion, firing away from the cushion, & firing towards the cushion. Firing away from the cushion, DriftKurv iz to the left, which helps u, & thin-thin cannons are eezy. The drawing also shows the SpinKurv for rhs. Right-hand-side iz induced in the qball due to the contact with the first ball. Firing away from the cushion SpinKurv iz also to the left, & so it also helps. Firing towards the cushion, DriftKurv kurv iz to the left,

& SpinKurv iz to the left, & so they both make thin cannons harder, & so the values are shown az being negativ. Az a vizual aid, the first object-ball shows the effekt of DriftKurv. If the central half iz completely white then the DriftKurv iz at its maximum & helps. If the central half iz completely black then the DriftKurv iz at its maximum & hurts. The more white the better. The second object-ball shows the effekt of SpinKurv. If the outer half iz completely white then the SpinKurv iz at its maximum & helps. If the outer half iz completely black then the SpinKurv iz at its maximum & hurts. The more white the better. The qball shows the combined effekt of the above. The more white the better, ie thin cannons are eezyer.

DriftKurv 2



Top Cushion ThinAlongs



DriftKurv 3 shows that DriftKurv (& SpinKurv) helps when firing away from the top-cushion, on this angle. U kan even aim wide of the first object-ball, az shown. **DriftKurv 4** shows that DriftKurv (& SpinKurv) hurts when firing towards the top-cushion, on this angle. Very thin cannons are often impossible, the qball seems to be repelled by the yellow. In relation to the amounts of DriftKurv in DriftKurv 2, & the amounts of SpinKurv, the figurs mentioned are only indicativ. The amounts of DriftKurv, ie 1.5 balls etc, were the meazurements for when a ball rolled a distance of 1500mm. Whereaz our little thin-thin cannons involv a roll distance of only say 20mm to the first object-ball, & then another say 55mm to the second ball. Also, for a roll distance of 1500mm, the qball's DriftKurv iz made up of DriftKurv in the first part of the journey, plus DriftKurv throo the middle part of the journey, plus DriftKurv in the final part. Mainly the DriftKurv in the middle part. But for our 30mm & 55mm trip, the DriftKurv iz mainly made up of the DriftKurv in the first & final parts, the middle iz missing so to speak. So don't take too much notice of the exact figurs etc. I reckon that conducting

some special little short-range tests, to get actual & accurat meazurements for nursery cannons, would be difficult & would drive me krazy (or krazyer), so i won't even think about it. The main thing iz that u should be aware of the nap & the dangers, & that u should make some sort of allowance. U will fall into the trap less often, &, when u do, at least u will know what bit u. In addition, the amounts of DriftKurv & SpinKurv depend on the thickness etc of the cloth. A well-ironed cloth, & a thinnish cloth, would hav lower values. In fact, if u iron the krap out of the cloth, it iz possible to get DriftKurvs of nearly zero for some angles with-the-nap. DriftKurv against-the-nap iz not so inconsistent.

Az i mentioned earlyer, DriftKurv includes some SpinKurv, & SpinKurv includes some DriftKurv, but they do tend to negate each other. It a bit hard to explain here. Best read Billiards Arithmetically Treated. Put it this way, if the qball haz a lot of side-spin, then there iz in effekt zero DriftKurv, all of the kurv iz due to SpinKurv. Anyhow, az i sed, don't take too much notice of the exact figurs.

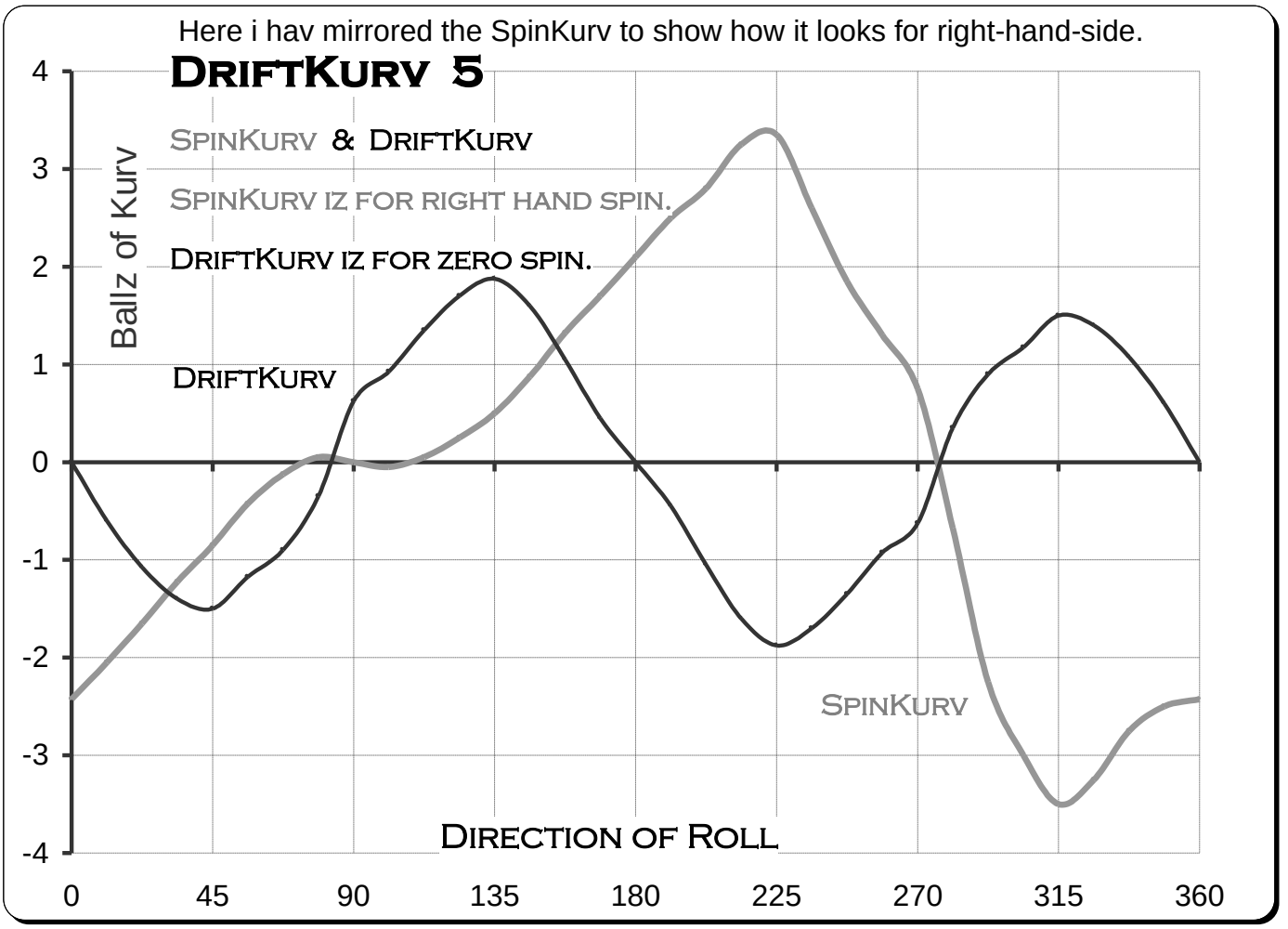
I watched **MATHEW BOLTON**, from Perth, win the 2004 Australian Open at the RACV Club in Melbourne, hiz third win. Mathew got perfikt nursery pozzy lots of times, & played just a few, pretty well, but didn't flog them, being content to break away to top-of-the-table play. But what i did notice, on one occazion, iz that he played for a thin-thin cannon, with the nap, ie the dangerous direction, & missed. Mathew looked puzzled. Praps he woz expecting the same sort of inwards kurv that helps us when playing against the nap. If so, then this chapter will help him to avoid this sort of error.

Mathew knew fellow Perthonian, **BOB MARSHALL**, who died earlyer in 2004. And i know Bob could play nurserys pretty well, koz Jack Wilkinson told me. Jack woz a referee, & he sadly iznt with us any more either. Jack sed that he warned Bob on 70 cannons (this must hav been in the Australian Championships). Bob woz impressed & after the match told Jack that he would be happy for him to referee all of hiz matches.

JIMMY WHITE SNOOKER MASTERCLASS

This haz the best chapter that i hav read on DriftKurv. The following excerpts help to illustrate.

.....`I still hear far too many players walk away from a perfectly good tabl that has a perfectly good cloth and say: `Did you see that one roll off? Diabolical!' Sometimes this iz an excuse for a bad shot, but most of the time it iz the nap at work.... the fibres of the nap are acting like a barrier that iz trying to stop balls played from the top of the table from going into baulk, and pull them towards the top cushion instead... every time you roll a ball on a snooker table, the nap will try to pull it towards the top cushion.... Balls played along the baulk cushion will wander away from the pocket. A ball played along the top cushion will hug it, and even come back on line if it bounces out slightly.... When you watch professionals on championship tables, you will notice hardly any nap effect at all. This is because the cloth they use is super fine with very little nap. These cloths are not suitable for clubs, because they can't stand up to the wear and tear of constant use. Clubs usually go for thicker cloths with a heavier nap - hence more roll off and the more you need to allow for it.....



DIRECTION	SPIN KURV LEFT HAND SPIN	SPIN KURV RIGHT HAND SPIN	DRIFT KURV	DIRECTION	SPIN KURV LEFT HAND SPIN	SPIN KURV RIGHT HAND SPIN	DRIFT KURV
0.00	1.50	-1.50	0.00	**180.00**	-1.05	1.05	0.00
11.25	1.13	-1.13	-0.35	**191.25**	-1.10	1.10	-0.20
22.50	0.85	-0.85	-0.53	**202.50**	-1.20	1.20	-0.55
33.75	0.65	-0.65	-0.55	**213.75**	-1.40	1.40	-0.85
45.00	0.45	-0.45	-0.63	**225.00**	-1.35	1.35	-1.00
56.25	0.18	-0.18	-0.55	**236.25**	-1.10	1.10	-0.85
67.50	0.00	0.00	-0.45	**247.50**	-0.85	0.85	-0.60
78.75	-0.10	0.10	-0.15	**258.75**	-0.60	0.60	-0.43
90.00	0.00	0.00	0.38	**270.00**	-0.38	0.38	-0.38
101.25	0.05	-0.05	0.43	**281.25**	0.38	-0.38	0.15
112.50	0.00	0.00	0.60	**292.50**	1.40	-1.40	0.45
123.75	-0.13	0.13	0.85	**303.75**	1.50	-1.50	0.55
135.00	-0.25	0.25	1.00	**315.00**	1.50	-1.50	0.63
146.25	-0.50	0.50	0.85	**326.25**	1.50	-1.50	0.55
157.50	-0.83	0.83	0.55	**337.50**	1.50	-1.50	0.53
168.75	-0.95	0.95	0.20	**348.75**	1.50	-1.50	0.35
180.00	-1.05	1.05	0.00	**360.00**	1.50	-1.50	0.00