JP's Arcade Physics v3.02
(jpsalas 2022. 3ᵗʳᵈ edition)

(This is a short introduction to my physics settings for authors who want to try them.)

Why new physics settings?

For several years I have been using the default VPX physics, which are explained in the file PhysicValues.txt, and they are quite good. But there were always a few things that I always felt they could be better. Many other authors have made their own changes and all them are quite good (like ClarkKent, nFozzy and Rothbauer). But I wanted to use what VPX has to offer, and simply adjust some parameters to make the tables play a little closer to a real pinball. I always felt the default physics make the ball feel more like a football (a soccer ball) or even a billiard ball, more than a pinball ball. The same for the flippers which were missing some functionality, and the shooting angles were not optimal.

Here it is what I wanted to accomplish:

- Stop the ball making strange stops and changes in speed or direction.
- Increase side to side action.
- Do some flipper tricks like drop catches, cradle separation and backhand shots.
- Consistent flipper shooting angles, including backhands shots.
- Reduce ball rebound on top of a flipper when it is up.
- Better ball bounce on objects, mostly rubbers, both at higher and lower speeds.
- Easy way to control the ball speed.
- The settings should not hogg the cpu.

To do all these I wanted a set of values that should be the same on all the tables, older and newer, and they should be easy to add to a table. Rubbers should be rubbers on all the tables, they should not change elasticity or friction values, and the same applies to metals, plastics and wood. Flippers should work just as good on older tables than in new tables.

I called these physics "JP's Arcade Physics 3.0", because, yes, they are my third effort to get them right, and are the result of many months of testing. Why the name "Arcade", well, I had to call them something :)

These physics 3.0 set started when I was watching the PAPA videos to learn to make flipper tricks. They were using the Stern Star Trek pinball machine, so I build my own VPX Start Trek and I started testing flipper settings. There is only one flipper trick I didn't managed to do, and this is a flipper pass by tapping the flipper button. If I changed the flippers to do this trick then those settings ruined the normal flipper behavior, and they felt sluggish.

You will find several files in the download zip:

- JP's Arcade Physics v3.0.pdf   *this file which explains all the settings*
- JP's Rubber_Objects.vpx   *all the rubber objects you can cut & paste to your own tables*

- JP's Elasticity_Test.vpx   *a simple visual test of the new elasticity settings*
- JP's Arcade Physics v3.0.vpp   *table and flipper settings that you can import*
- JP's Physics Materials v3.0.mat   *the physic materials for easily change the object properties. I recommend using collections.*
- JP's Arcade Physics v3.0.vbs   *a simple script you can copy & paste from.*

All my tables released after 2020 include these settings.

The Settings

To make these settings easier to add to the objects just load inn "JP's physics materials rev3.02 for VPX.7.mat" and apply those materials to all the objects that are in contact with the ball. Put those objects in Collections so the sound routines will play the hit sounds (see the vbs script).

	Metals	Plastic	Wood	(made mostly with wall objets)
Elasticity	0,2	0,15	0,25	*very low compared to rubbers*
El. FallOff	0,25	0,25	0,25	
Friction	0,15	0,15	0,15	*also very low values*

Rubbers	Elasticity	Elasticity FallOff	*(made also mostly with wall objets)*
(posts)	0,95	0,5	*normal sized rubber. Thick plastic or metal pegs with a round rubber*
(pins)	0,85	0,55	*thinner rubber. These are metal pegs with just a thinner round rubber*
(pegs)	0,9	0,5	*thin rubber. I call "pegs" those metal pegs with a thin rubber sleeve.*
(long bands)	0,95	1,7	*+ - very long rubbers so they can absorb high speed balls*
(short bands)	0,95	0,75	*+ - a little less bouncing that on posts*

Other rubber bands with different lengths should have FallOff values between 0,75 and 1,7 depending on the length of the rubber, this FallOff value will make the rubber to absorb more or less strength.

Friction   0,25

Rubber Objects Hit height   27

Rubber Objects Height   30   *pins are a little higher, at 32, but the hit height should still be 27 for better VPX collision and physics.*

I prefer to user the rubber objects just for looks, and use walls around to ensure a nice collision hit, and to separate hit sounds and the physics. Take a look at the "JP's Rubber_Objects 3.2.vpx" for a better explanation of how I make the rubbers in my tables. Good rubber behavior is essential for nice physics.

Scatter Angle   5 +   *on everything. Bumpers can usually be 10 or higher.*

Flippers

Flipper size 2"
      Rubber: 5,9, 17,6 , 23,5
      Size: 22,6 14,1 , 78

Flipper size 3" (Williams/Stern/Gottlieb – mostly modern flippers)
      Rubber: 5,9, 17,6 , 23,5
      Size: 20,6 11,7 114,7

Flipper size 3" (Bally/Gottlieb - older thicker flippers)
      Rubber: 5,9, 17,6 , 23,5
      Size: 24, 14, 114,7

      Angle: between 50-53 degrees, f ex.
      Start angle: 118 to 122, depending on the table. This angle should be aligned with the inlane plastic, so the ball should not jump or change its speed.
      End angle: 68 to 72. 68 will give you better strait up angle shots and backhand shots. It will make it easier to trap the ball.
      End angle of 70 is average, but backhands will be weaker.
      End angle of 72 will make it harder to catch the ball, but it will make it easier for the ball to pass from one flipper to the other. Backhands shots will be harder to do.

Flipper settings (all flippers: 2.5"and 3")

Mass	1,5	
Strength	5000	very strong, use Const maxvel to limit ball speed in rolling sub
Elasticity	0,85	thin rubber, but can be changed to thick rubber (0.95)
Elasticity Falloff	1,2 +-	from 0,5 to 1,7, 1.7 gives hard rubbers, this is easy flippers.
Friction	0,25	
Return Strength	0,15	

Coil Ramp up	0	
EOS Torque	0,75	(it is adjusted in the script's flipper subs from 0,1 to 0,75) EOS
Torque Angle	10	

The first time I saw the strong flippers and the heavy ball where in ClarkKent mods, and they work very well to get better and predictable shooting angles, and to stop the rebound when the flipper is up.

Adjust the Elasticity FallOff to make the flippers more or less bouncy.

These settings will give nice all-round flippers but with some limitations. A two-leaf trigger for the flippers should be the best to be able to do all kind of tricks, as the settings could be coded differently for each trigger.

Other objects

Ramps	same as metal/plastic
Bumpers strength	15++
Slingshots strength	15++
Plunger strength	160++

Playfield settings

Gravity constant	0,980665		
Playfield friction	0,025		
Playfield Elasticity	0,2		
Contact Scatter Angle	5		
Min & Max Slope	4 +- (EM)	5+ (early SS)	6 +- (newer SS)

Script changes

Take a look at the file JP's Arcade Physics v3.02.vbs to cut & paste the code to your tables.

The changes in the script are minimal. Just 3 main changes:

- the ball size and mass
- the flipper section with the EOS changes
- the rolling sound routine which includes the ball speed control.

Ball: Size: 50

Mass: 1,7   this value fits well to a flipper's mass, and it was first mentioned by Clarkkent in his flipper settings.

Due to this higher ball mass, the bumpers & plunger need to increase their force. With the ball speed controll it is not a necessity to use this higher ball mass, but it will give you a better range of strength values on the bumpers, and the ball will make some more small bounces on the rubbers at low speeds.

Flippers:

The script will change EOSTorque value when the keyup or keydown is pressed to reduce the rebound when the flipper is up, as this value will be high, and at the same time to enable some flipper tricks like cradle separations and also drop catches when the flipper is on its way down.

Ball speed control:

Added to the ball rolling routine. Change then **maxvel** constant according to table, for ex. 25-30 for EM, 30-40 early SS or 40-50 for modern tables with high ramps. It all depends of the speed you want to give to the table and how high ramps are on the table.