Our Universe

Inspired by chapters 1 and 2 of Matter &
Interactions, by Chabay & Sherwood
Sung to the rhythm of "Siempre Soñé"
Music: círculo de sol (G,Em,Am,D7)

Our universe
is made of particles
atoms, nuclei,
and many molecules
solids, liquids, gases
and so much more that doesn't
shine

All this groovy stuff
cruising round the 'verse
travels near and far
But let's not be too terse
three spatial dimensions
mean we need vectors to say
which way

Vectors do the job
to systematically
tell you both which way
and the magnitude
i-hat j-hat k-hat
unit vectors pointing down the
x-
and y
and z- axes.

By Pythagoras
you get the magnitude
from the components
squaring and summing
Don't forget to square root.
Check your units and you've
got it nailed.

Let's use calculus.
Define some quantities.
Start with position
and take d by dt.
Tells you both which way you
go
and has the speed for
magnitude my dear...

That's velocity.
Its instantaneous.
Its derivative
is acceleration.
That's just kinematics.
You need something more to
know its course,
Of course!

Consider momentum
mass times velocity
times Lorentz' gamma
if speeds are close to c.
Change it and you must say
interactions are at play today
Hey hey...

Momentum principle
Change in the momentum
We call it delta p
Requires interaction
Delta p equals net force times
duration
That's the principle.
Simple...

You can go so far
with this one principle
Like a recipe
Follow the steps with me
First choose the system
on which the surroundings
cause the net force
(and add 'em as vectors)

Update momentum
Find average velocity
Update the position
Your nearly done you see
Repeat these steps as needed
Vpython, with loops makes it
so fun!