```python
import Analysis

#[ ..., [r,m,Num_bosons,sigma,Num_stars],...]
Args = [
    [0.5,1.0,0,1,10000],
    [0.5,1.0,10000,1,10000],
    [1,0.5,20000,1,10000],
    [5,0.1,100000,1,10000],
    [10,0.05,200000,1,10000],
    [50,0.01,1000000,1,10000],
    [0.5,1.0,10000,1,0]
]

for args in Args:
    print("----------New Analysis--------")
    print(
        f"r = {args[0]}",
        f"mu = {args[1]}",
        f"Num_bosons = {args[2]}",
        f"sigma = {args[3]}",
        f"Num_stars = {args[4]}"
    )
    Analysis.analysis(*args)
```
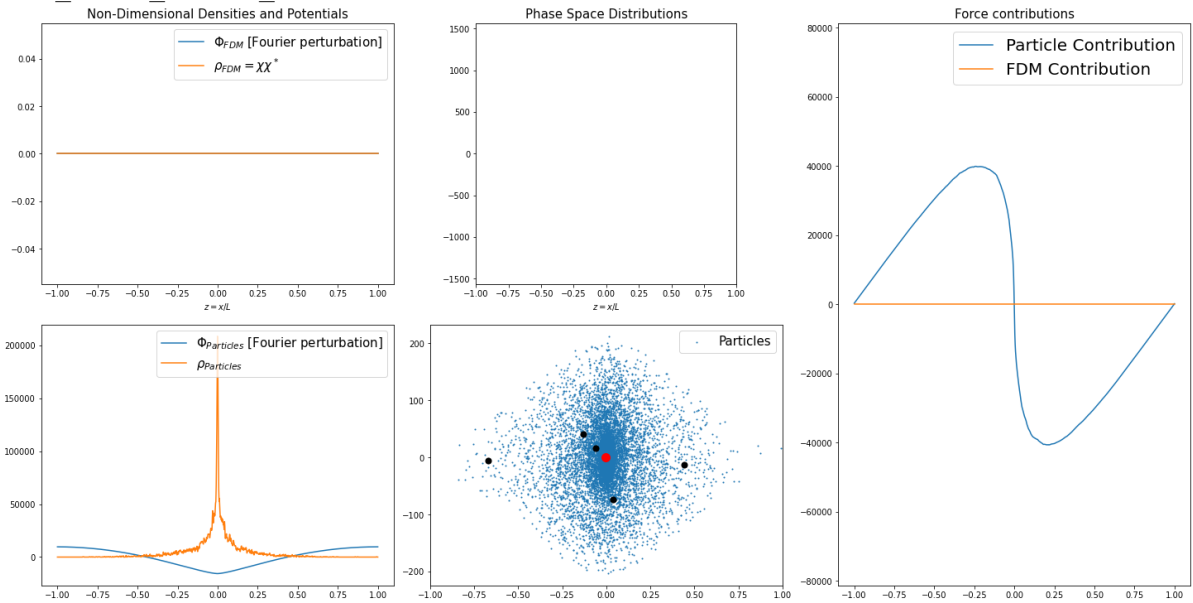
```
/home/boris/Documents/Research/Coding/1D_Codes/Non-Dim/Analysis
----------New Analysis--------
r = 0.5 mu = 1.0 Num_bosons = 0 sigma = 1 Num_stars = 10000
```
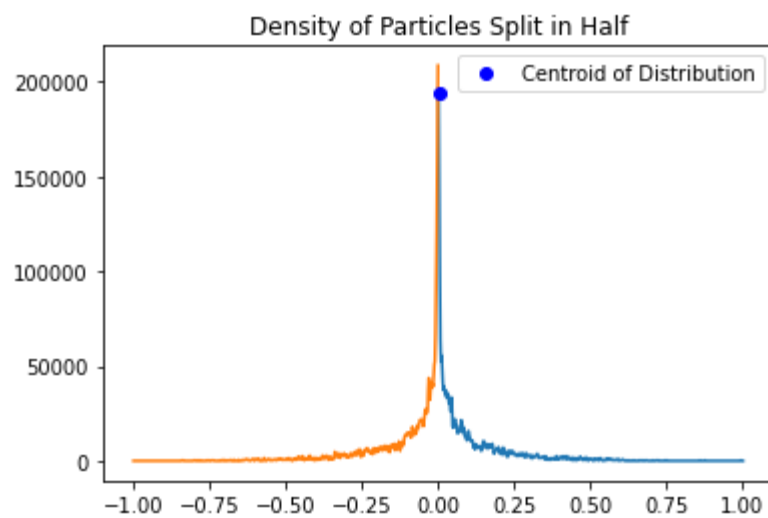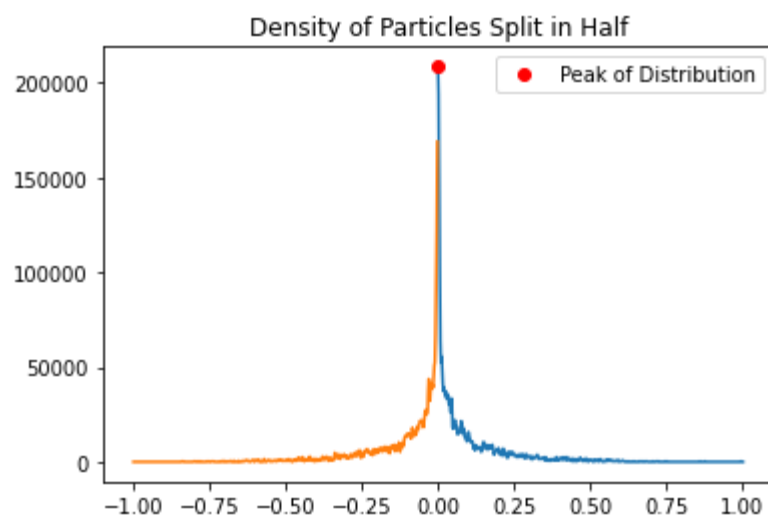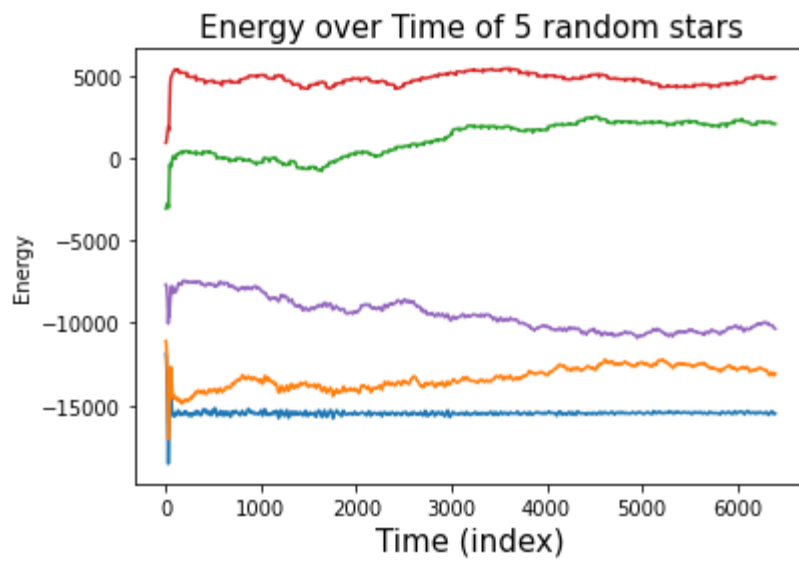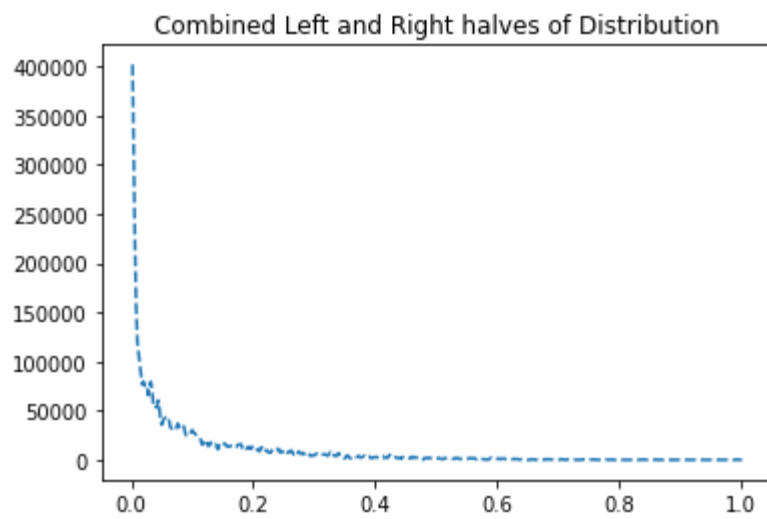
/home/boris/Documents/Research/Coding/OneD/WaveNonDim.py:128: RuntimeWarning: invalid value encountered in true_divide
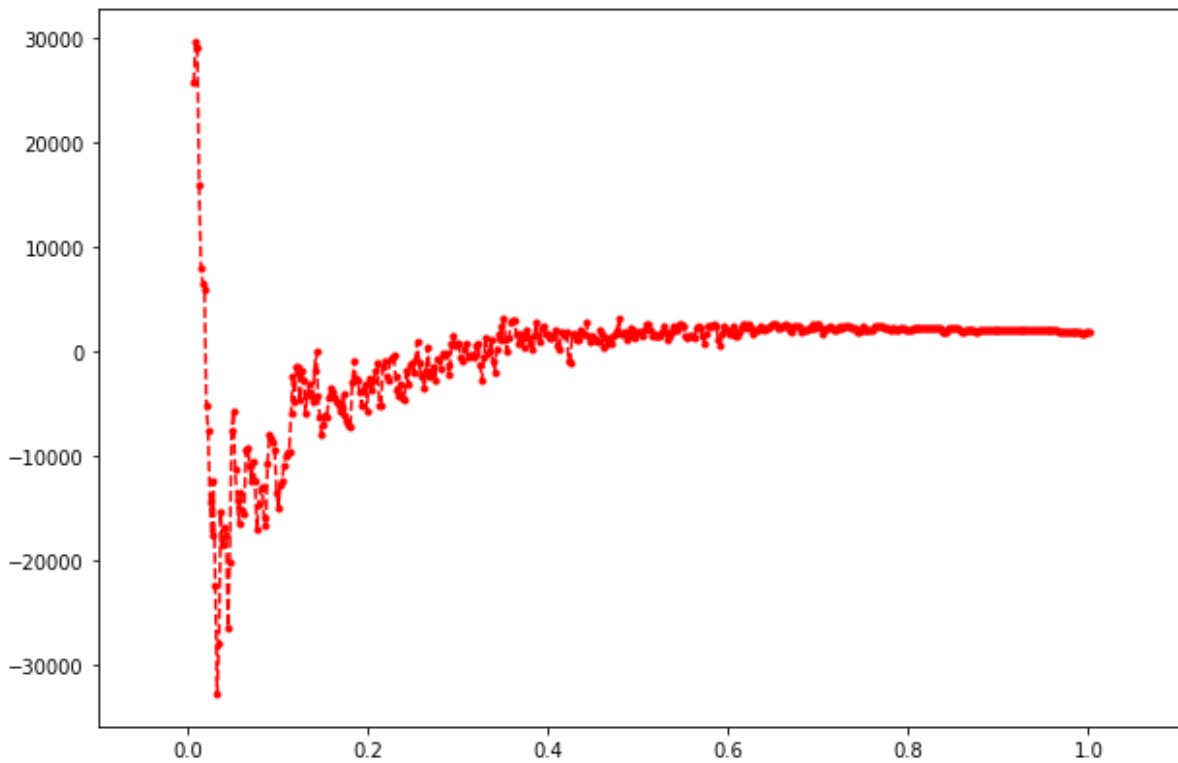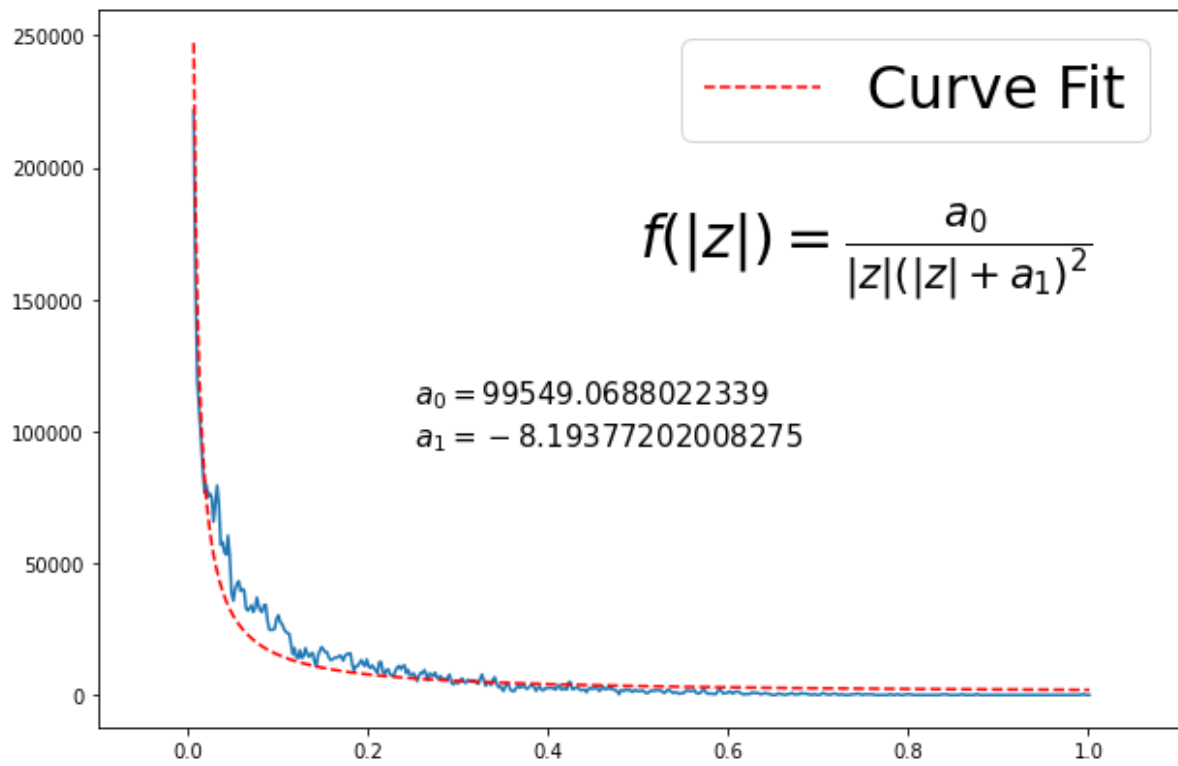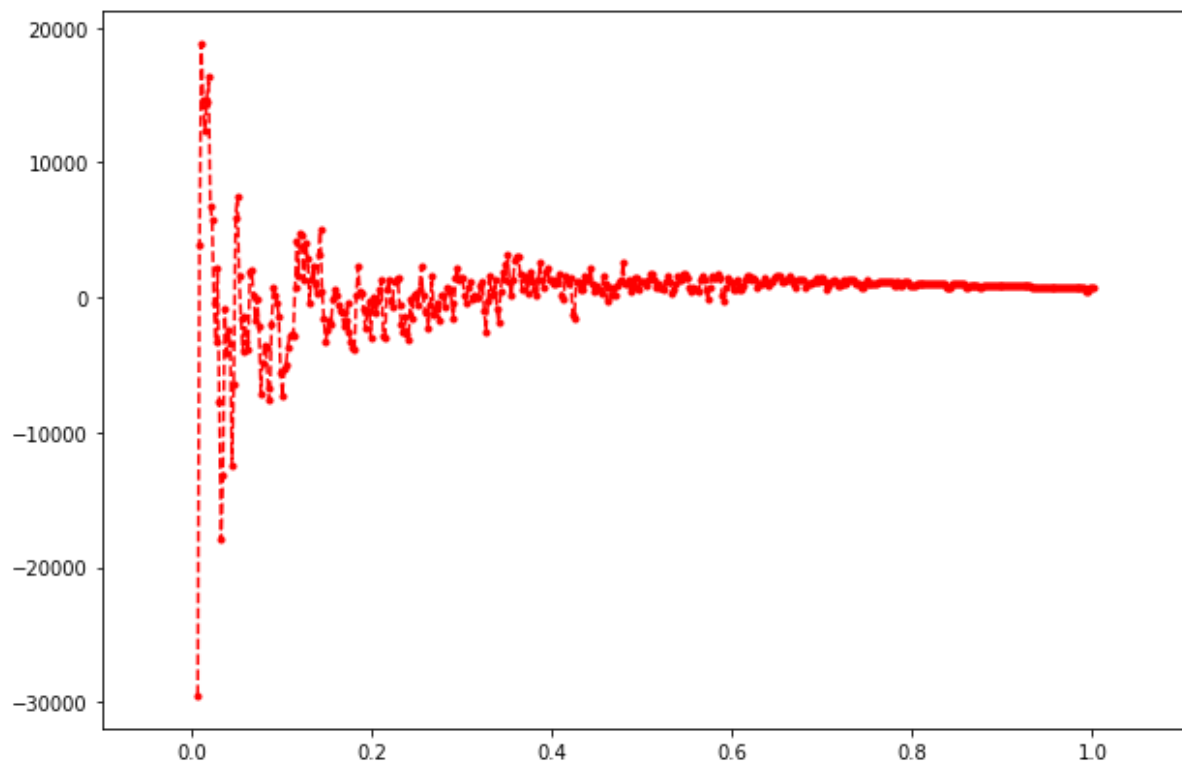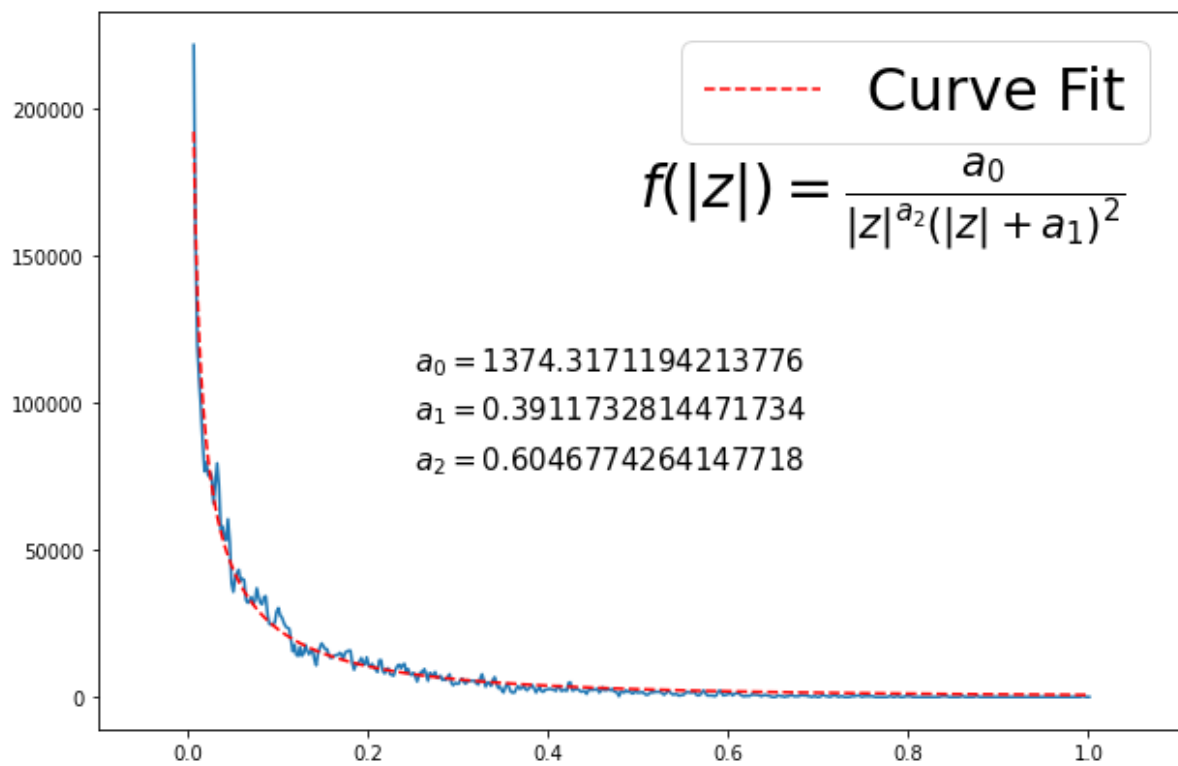  F_s = F_s/Norm_const

Energy over Time of 5 random stars



Density of Particles Split in Half



Density of Particles Split in Half

0.0020020020020002068

Combined Left and Right halves of Distribution

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2}$$

$a_0 = 99549.0688022339$
$a_1 = -8.19377202008275$



chi^2 = 1069130.1514376372

Density vs |z| with Curve fit
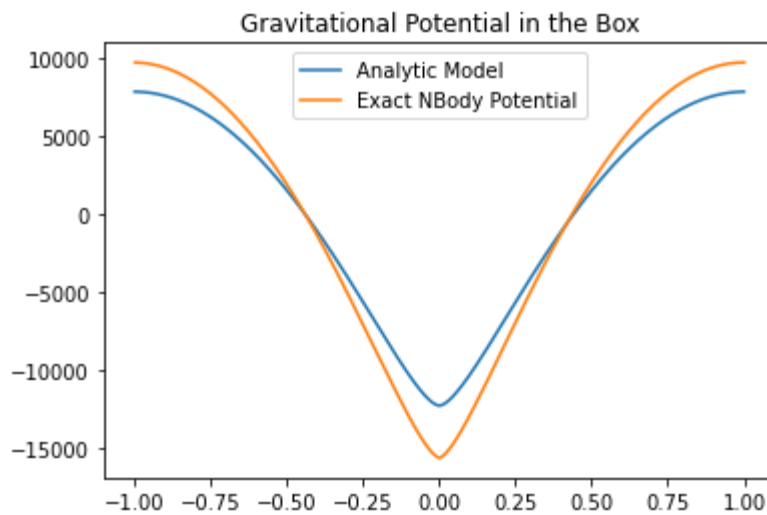


$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^2}$$

$a_0 = 1374.3171194213776$
$a_1 = 0.3911732814471734$
$a_2 = 0.6046774264147718$



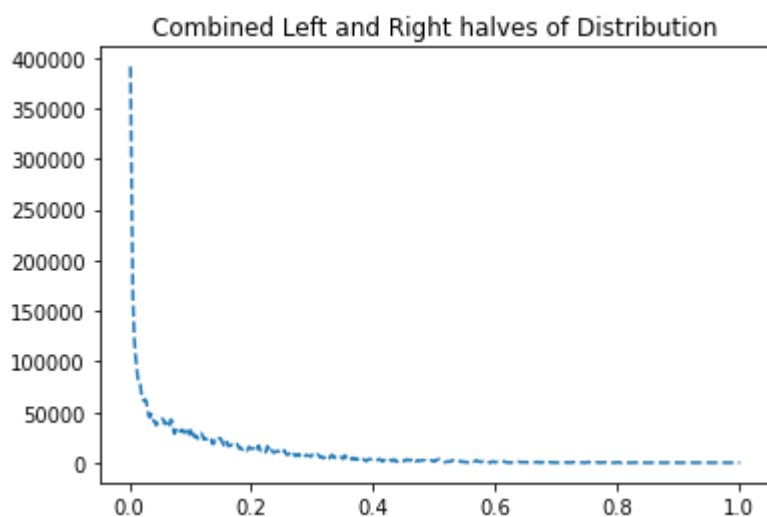chi^2 = 331220.8341718659

Gravitational Potential in the Box

----------New Analysis--------

r = 0.5 mu = 1.0 Num_bosons = 10000 sigma = 1 Num_stars = 10000

Non-Dimensional Densities and Potentials

Phase Space Distributions

Force contributions

Energy over Time of 5 random stars

Density of Particles Split in Half



Density of Particles Split in Half

0.002002002002002068



Combined Left and Right halves of Distribution

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2}$$

$a_0 = 14988.548962204422$
$a_1 = -3.4599370263244946$
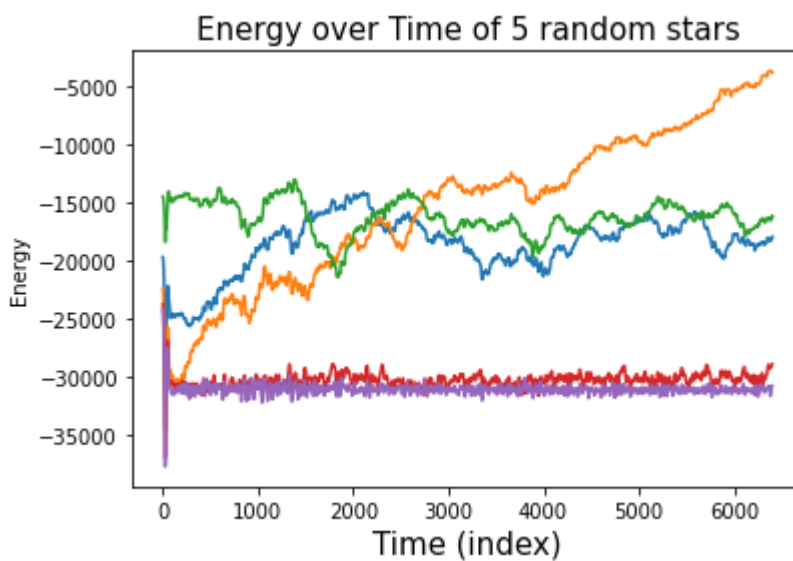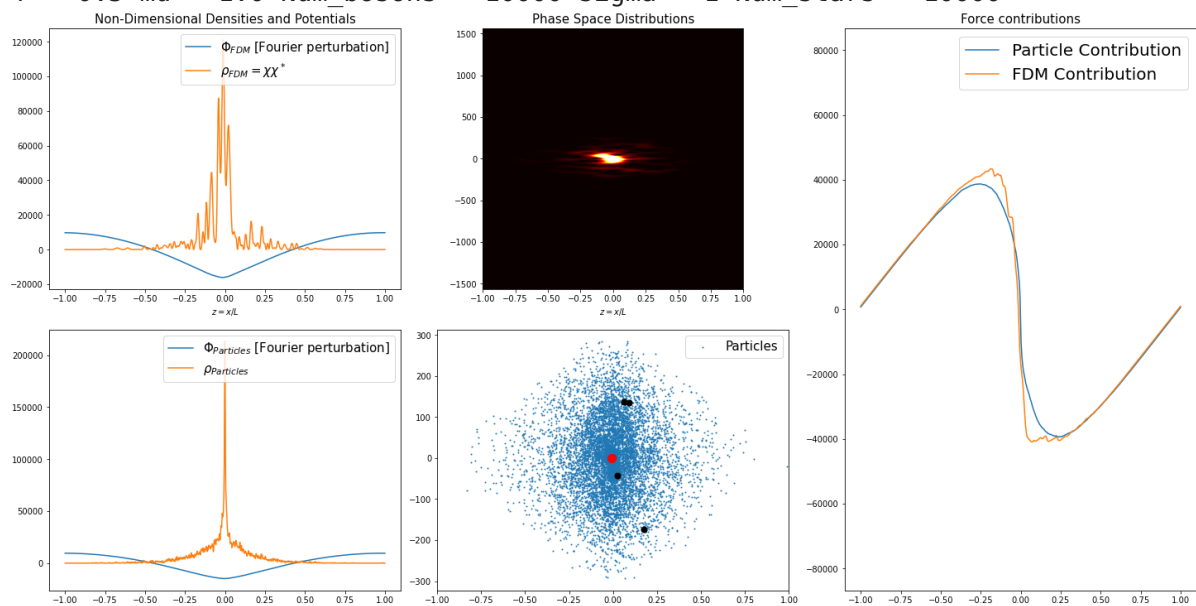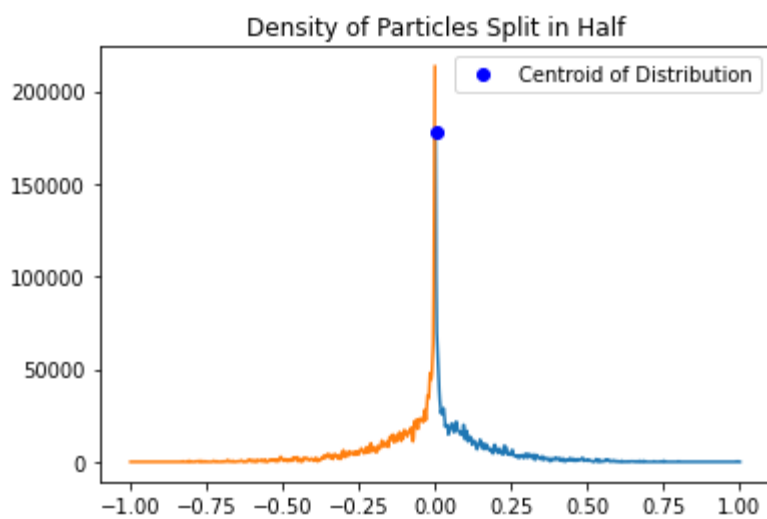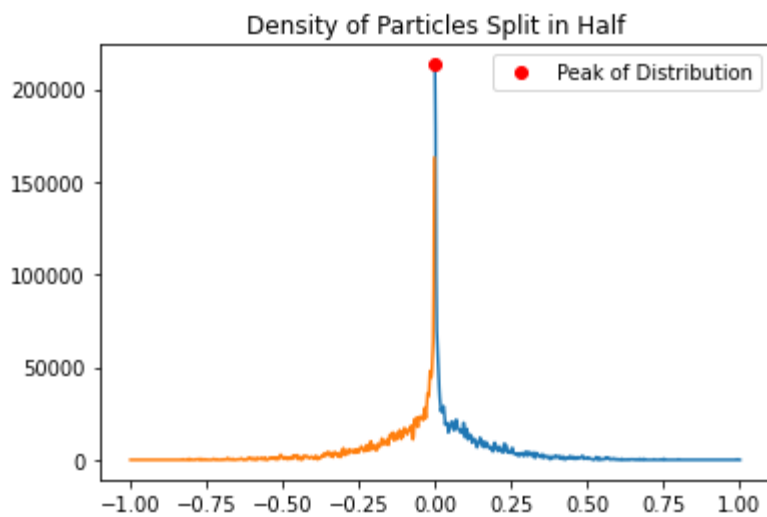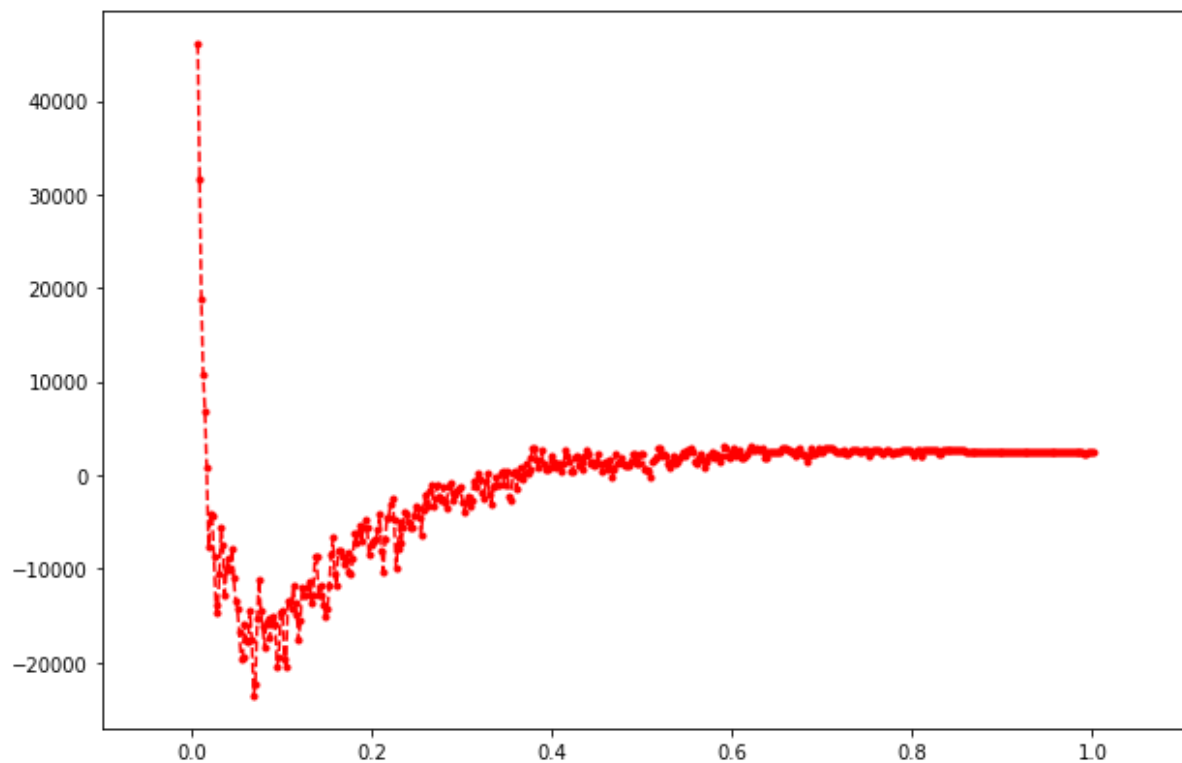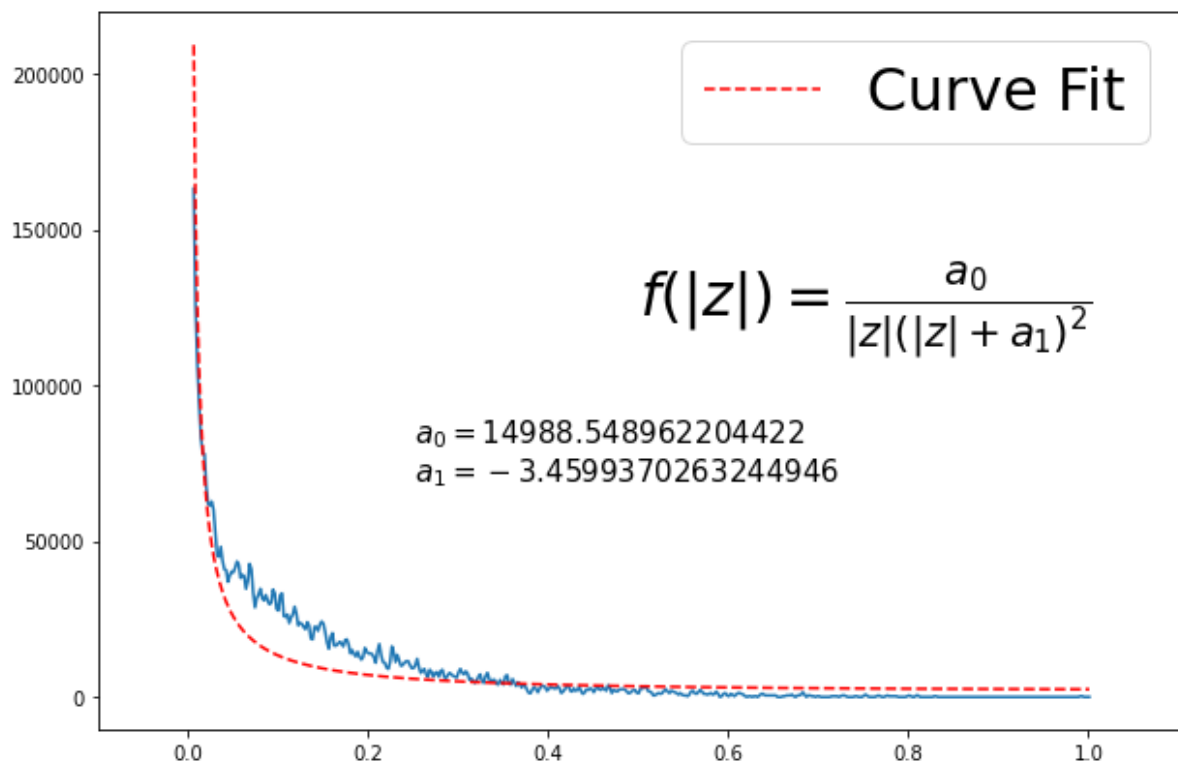


chi^2 = 1923005.6906601514
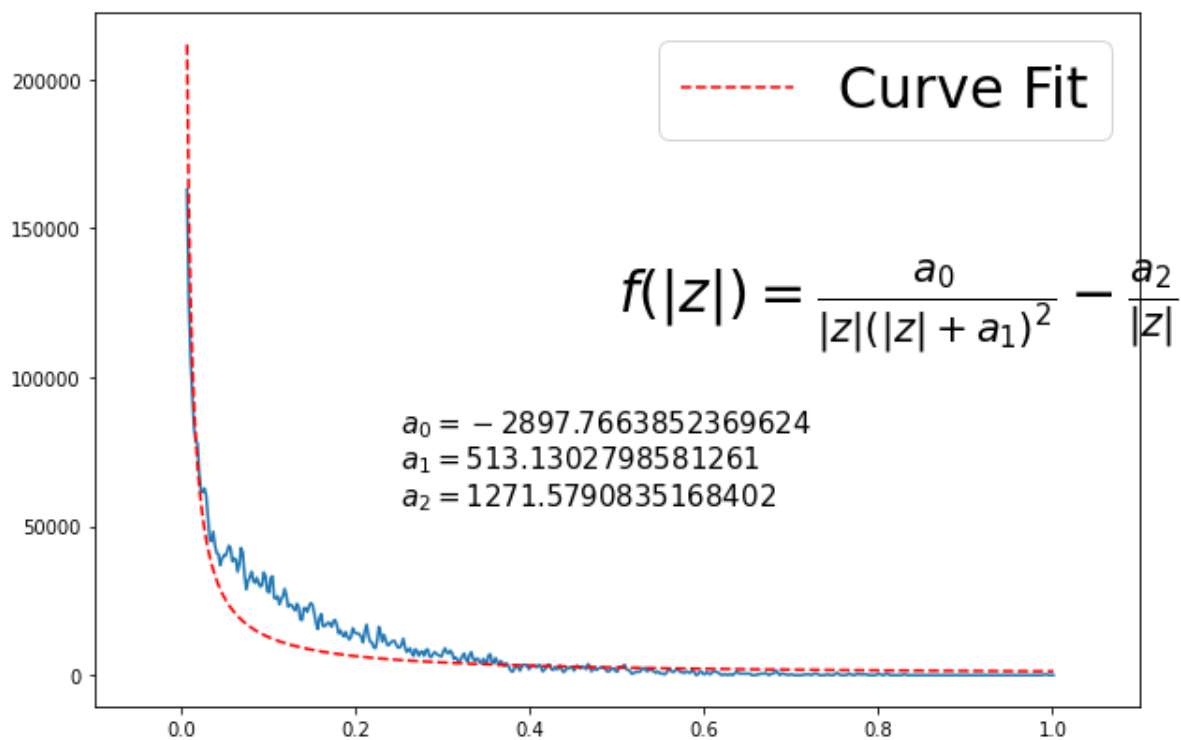
Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2} - \frac{a_2}{|z|}$$

$a_0 = -2897.7663852369624$
$a_1 = 513.1302798581261$
$a_2 = 1271.5790835168402$
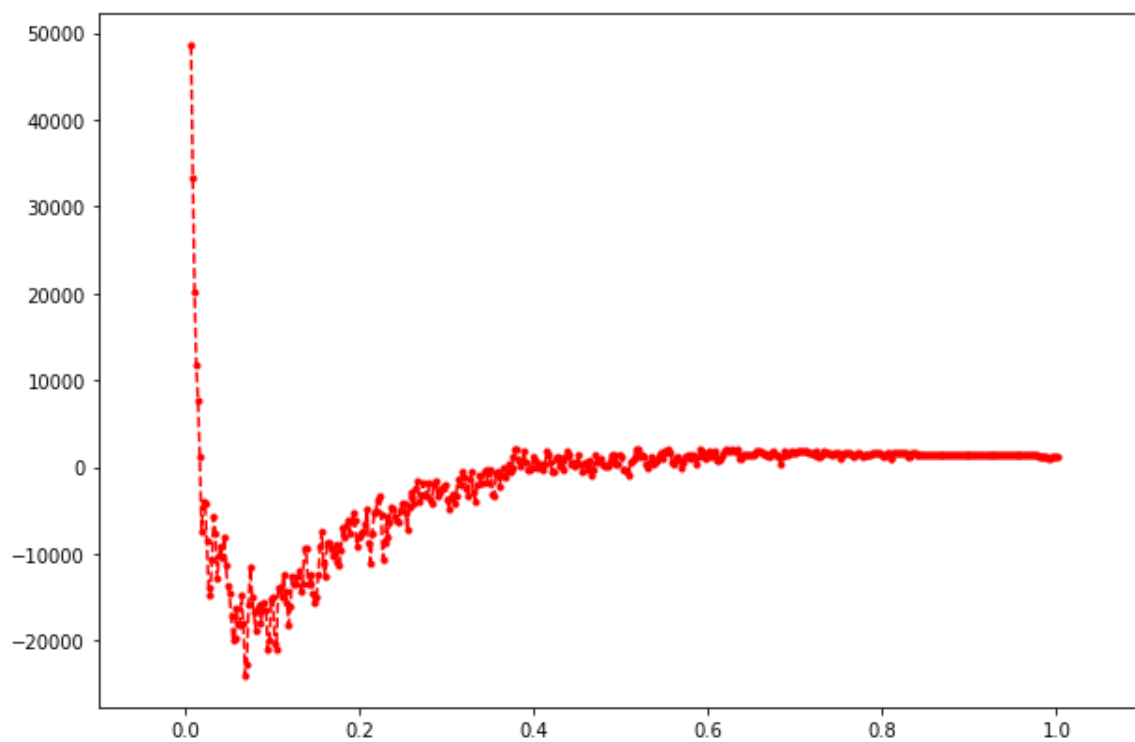


chi^2 = 1931769.6458091086

Density vs |z| with Curve fit
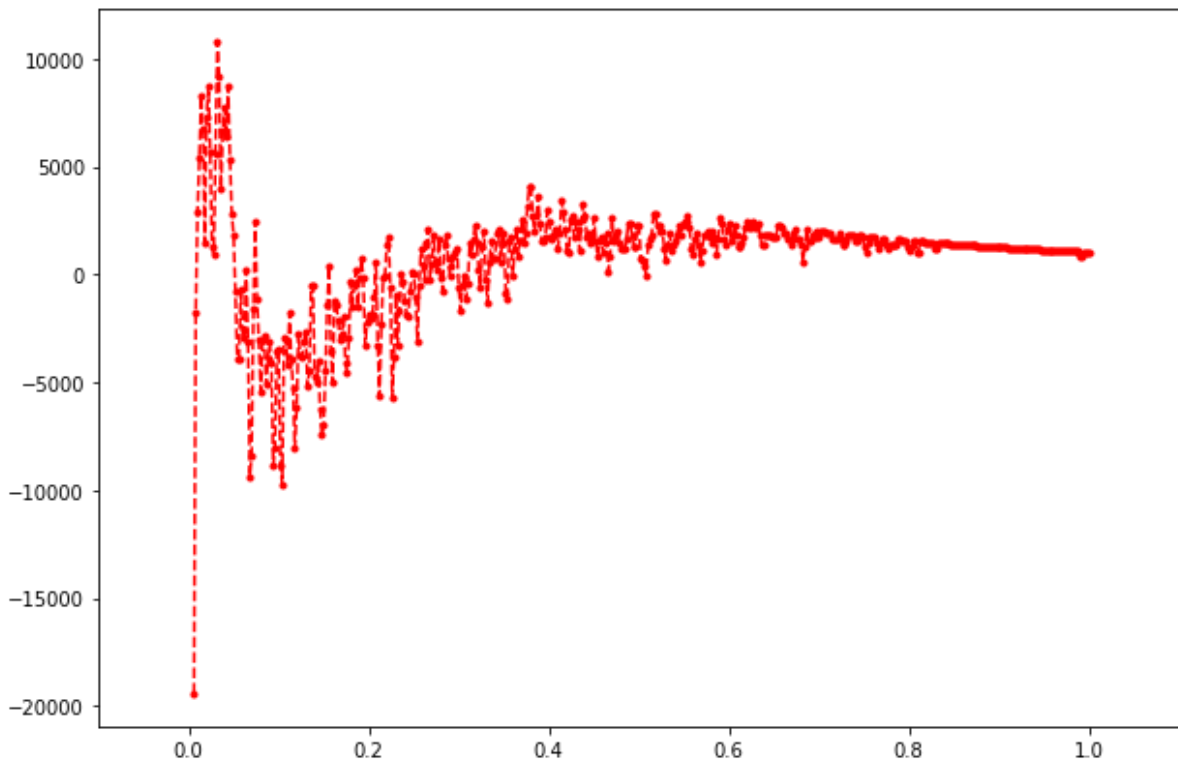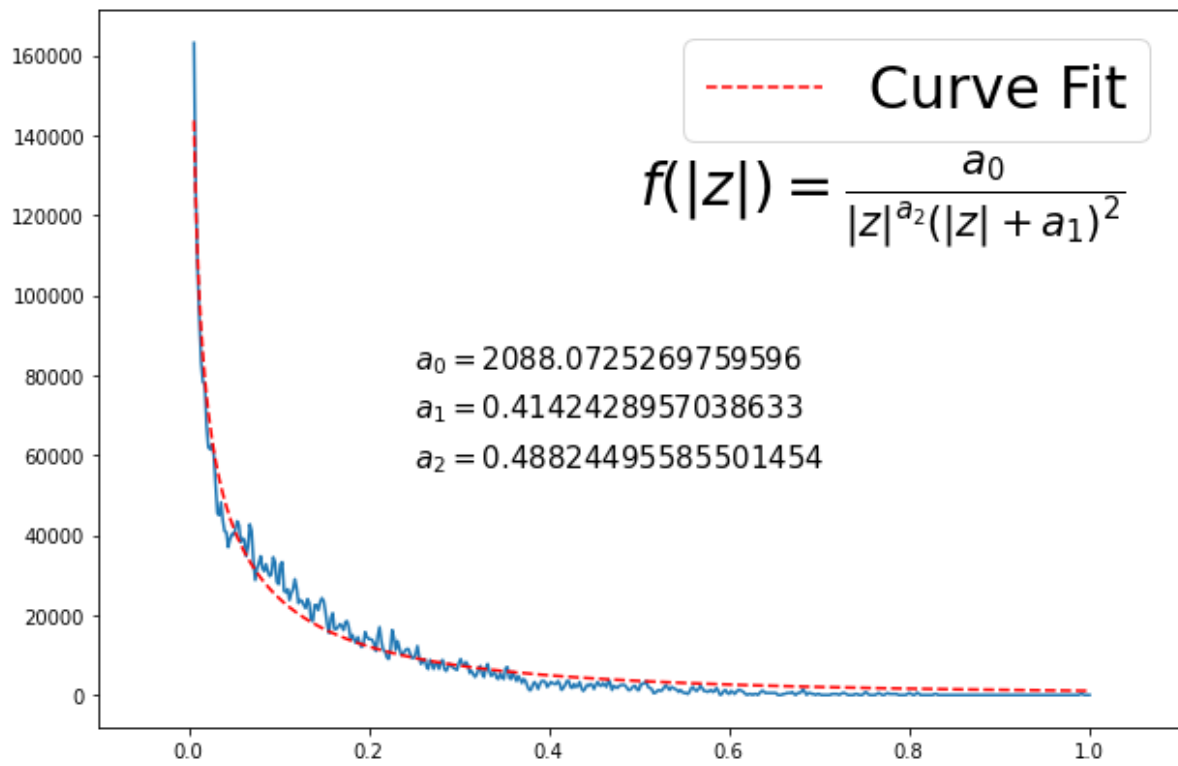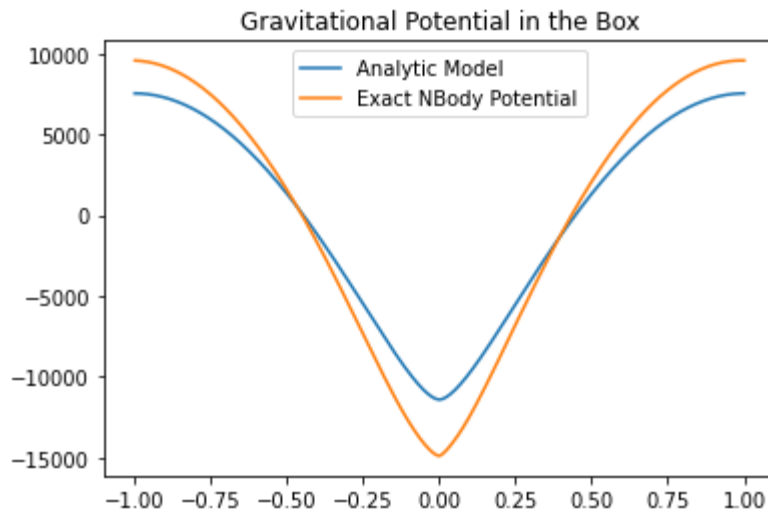


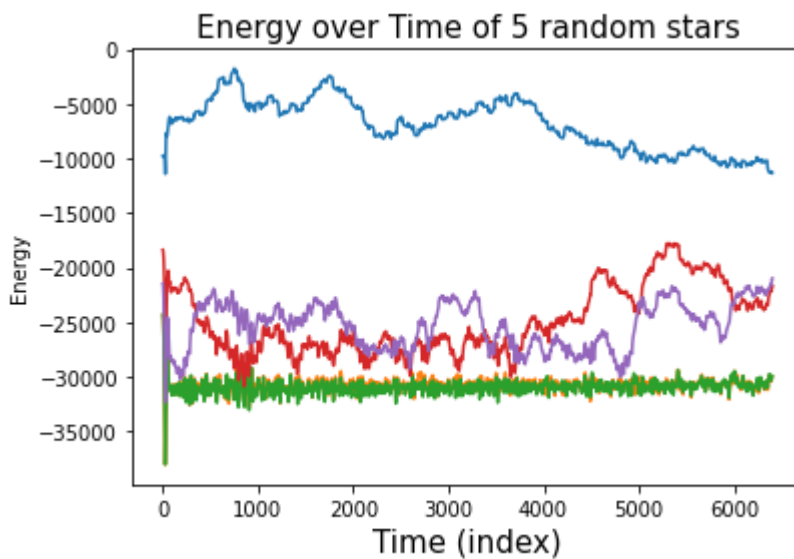$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^2}$$

$a_0 = 2088.0725269759596$
$a_1 = 0.4142428957038633$
$a_2 = 0.48824495585501454$



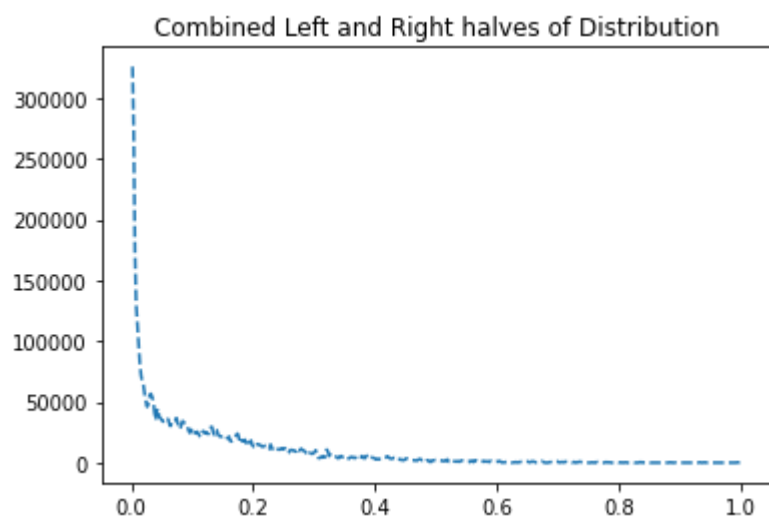chi^2 = 500753.0354785936

Gravitational Potential in the Box

----------New Analysis--------
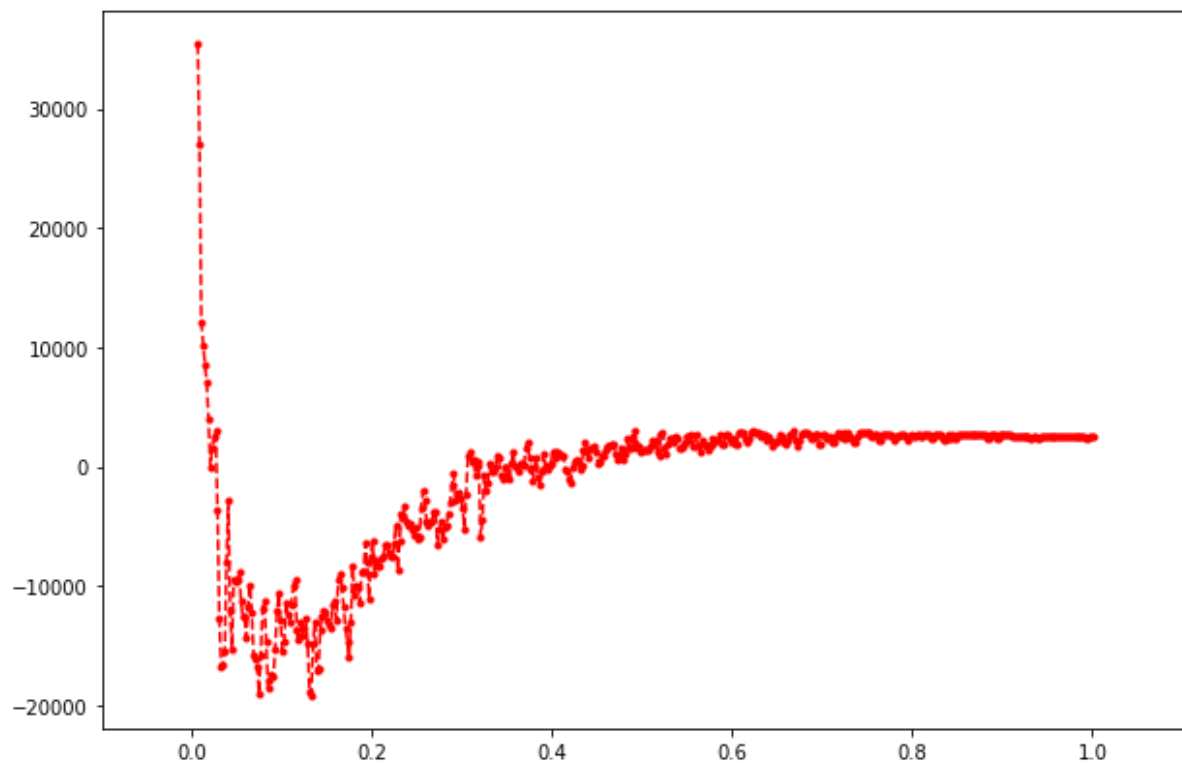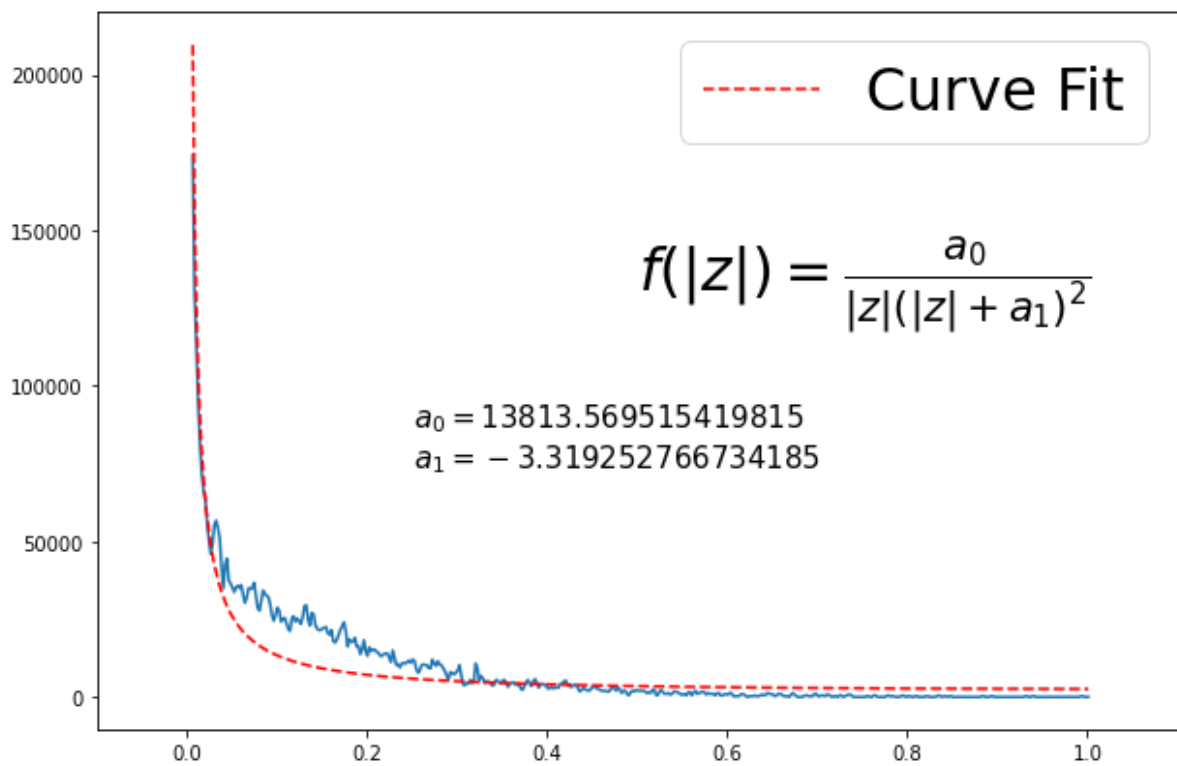
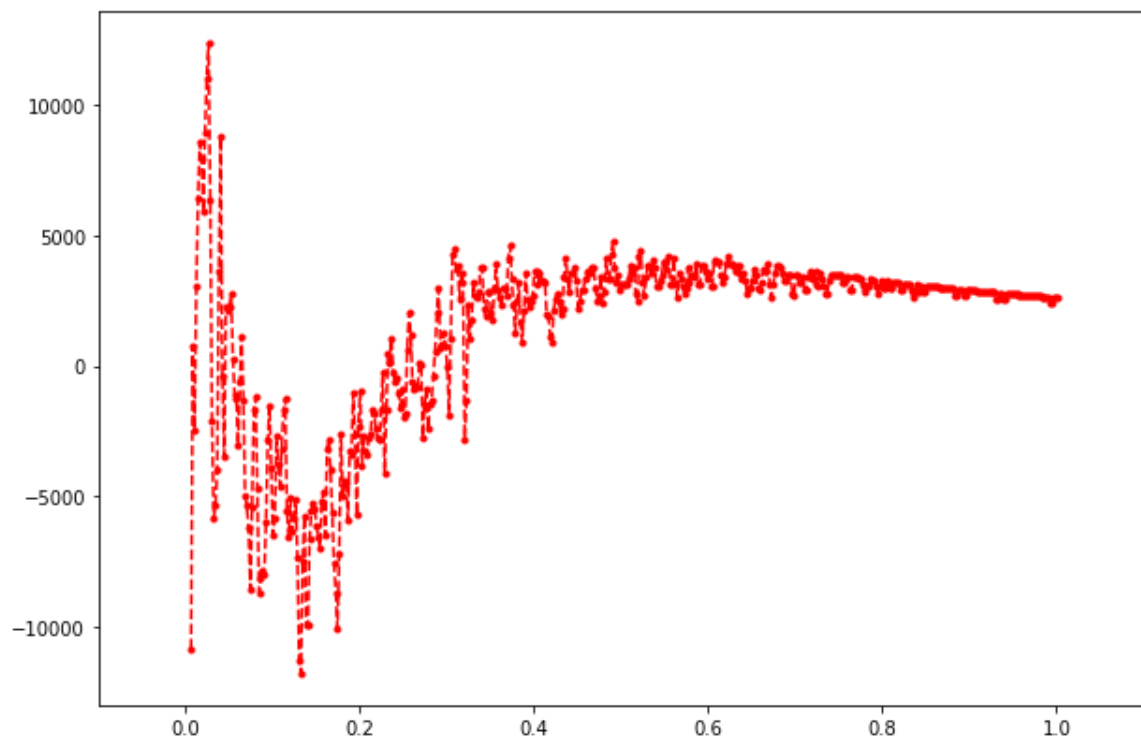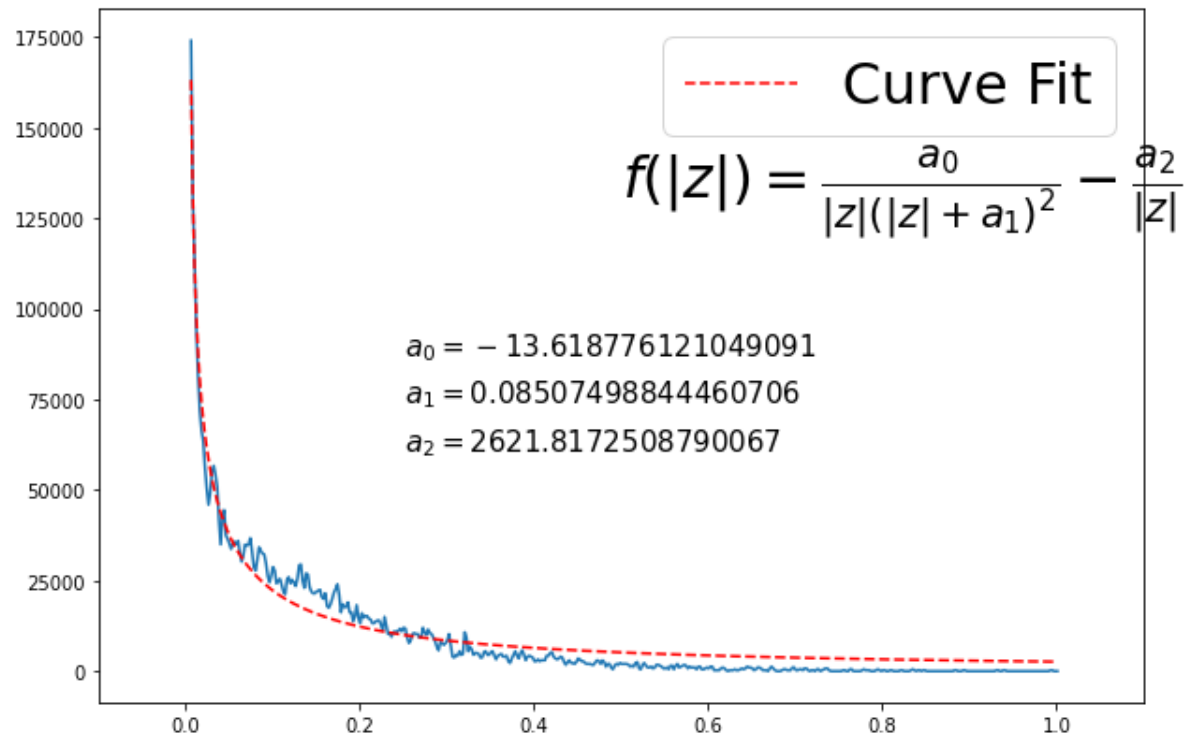r = 1 mu = 0.5 Num_bosons = 20000 sigma = 1 Num_stars = 10000



Energy over Time of 5 random stars

Density of Particles Split in Half



Density of Particles Split in Half

0.002002002002002068

Combined Left and Right halves of Distribution

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2}$$

$$a_0 = 13813.569515419815$$
$$a_1 = -3.319252766734185$$
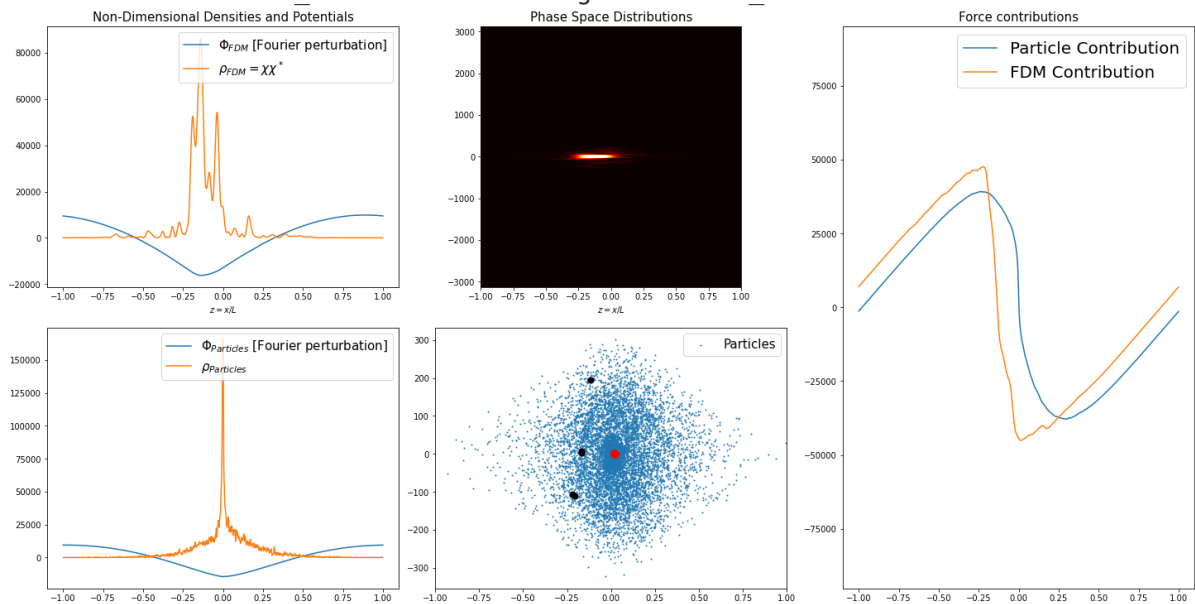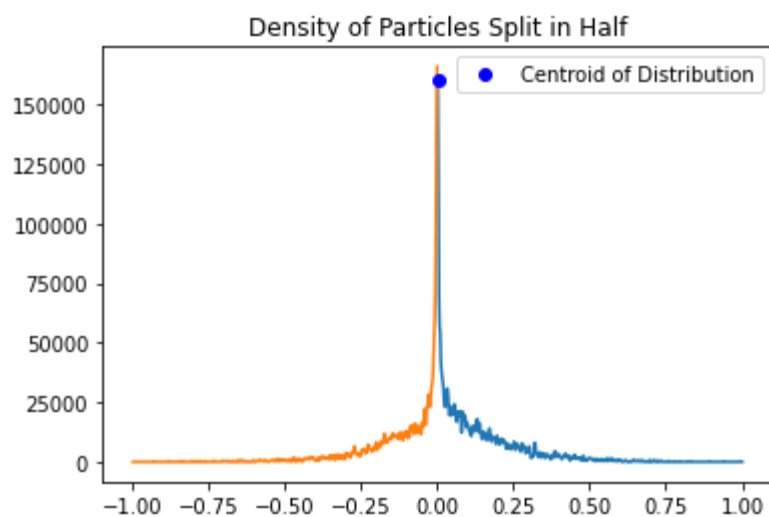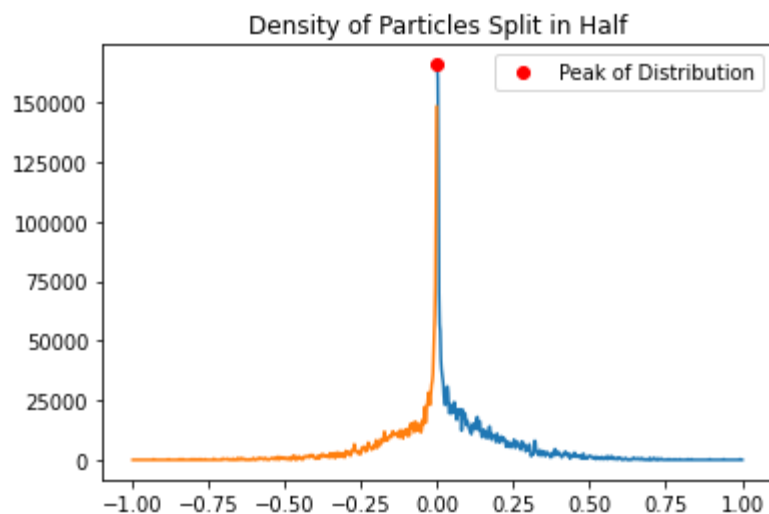


chi^2 = 2025205.074171987

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2} - \frac{a_2}{|z|}$$

$a_0 = -13.618776121049091$

$a_1 = 0.08507498844460706$

$a_2 = 2621.8172508790067$



chi^2 = 1022913.9619586606

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^2}$$

$a_0 = 3271.546799223289$
$a_1 = 0.6150076473316409$
$a_2 = 0.5619616099089577$



chi^2 = 617435.4881954561

Gravitational Potential in the Box
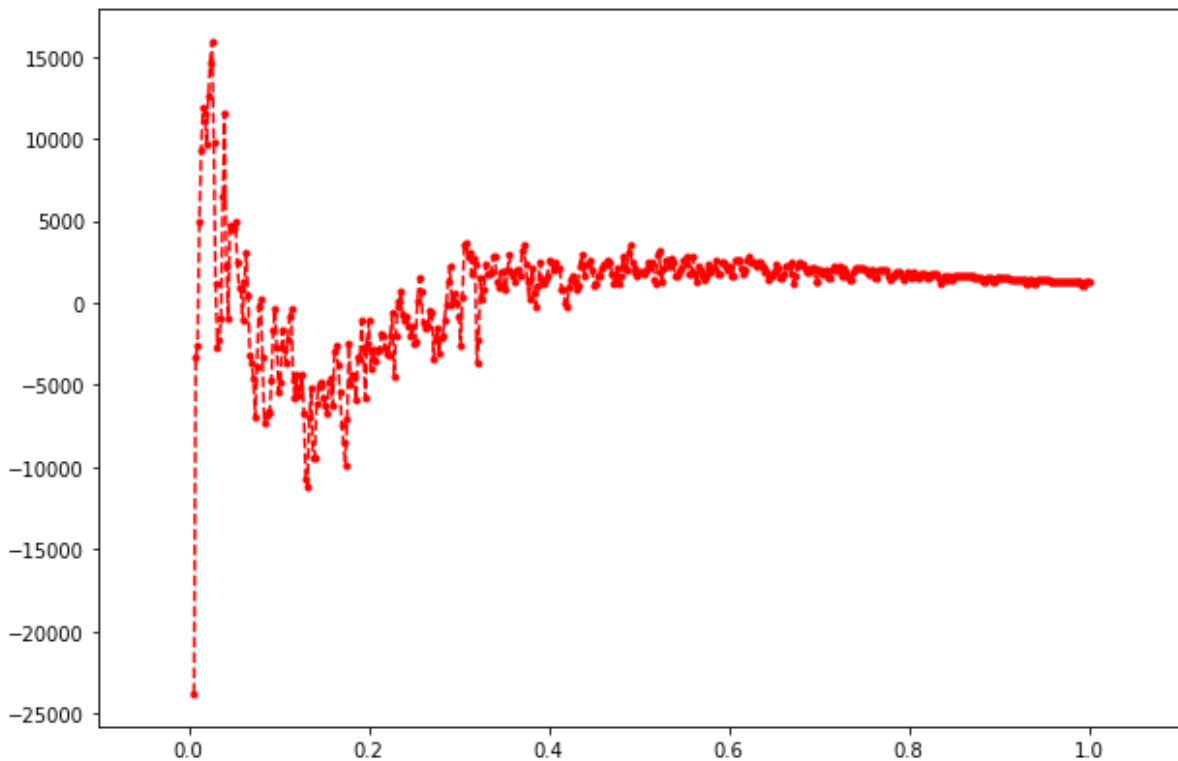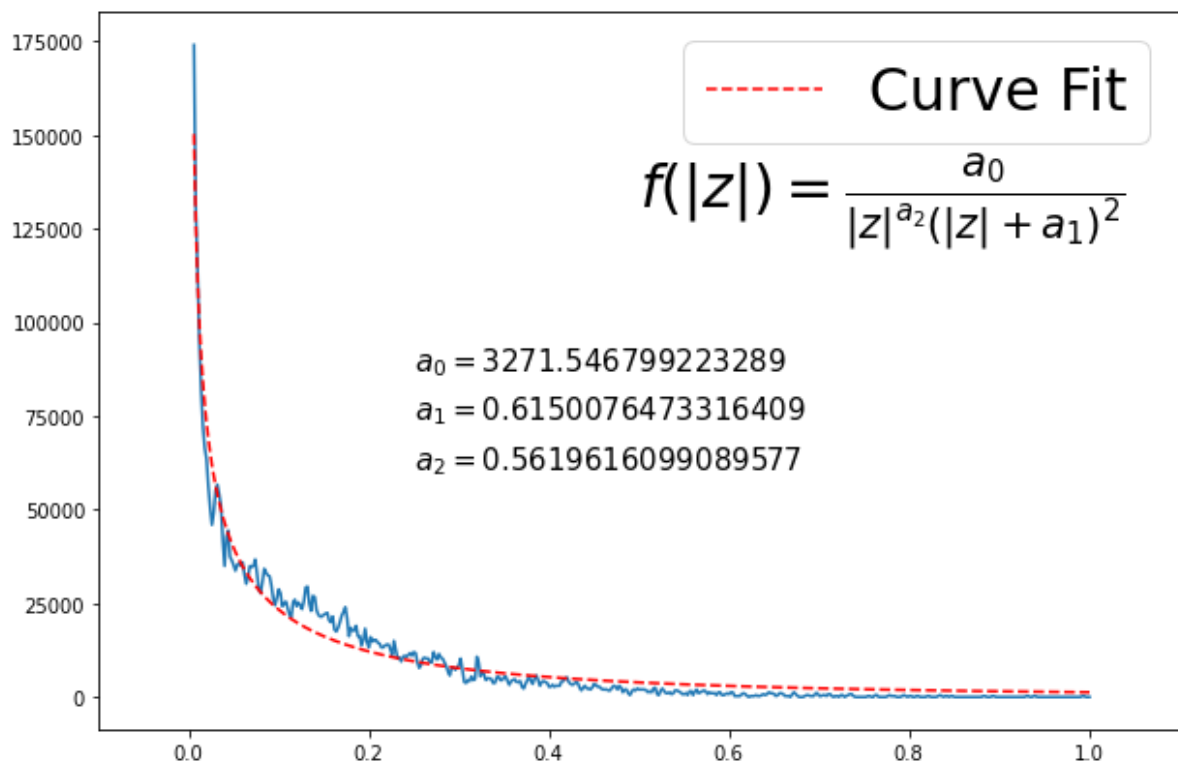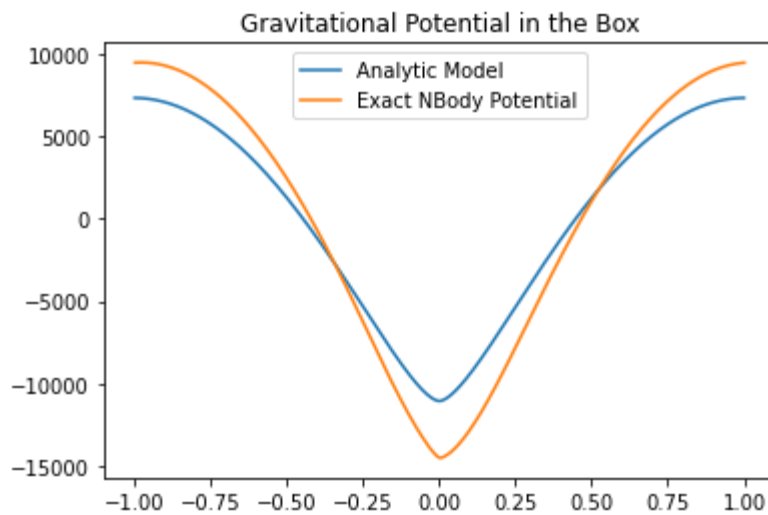
----------New Analysis--------

r = 5 mu = 0.1 Num_bosons = 100000 sigma = 1 Num_stars = 10000



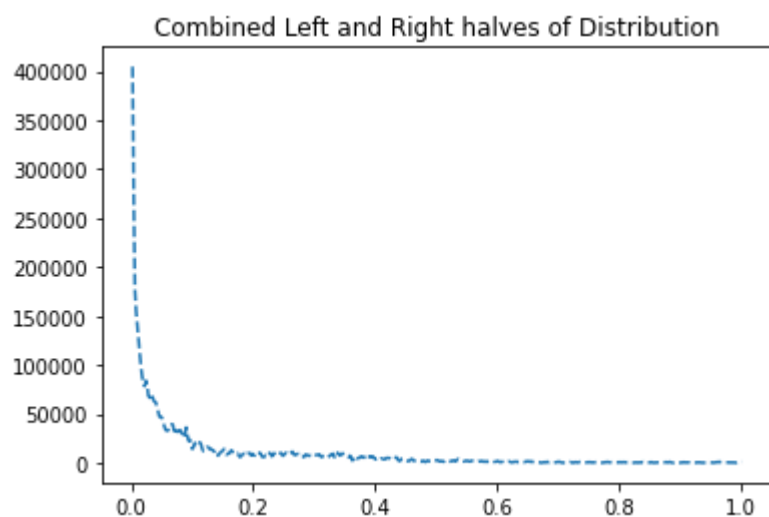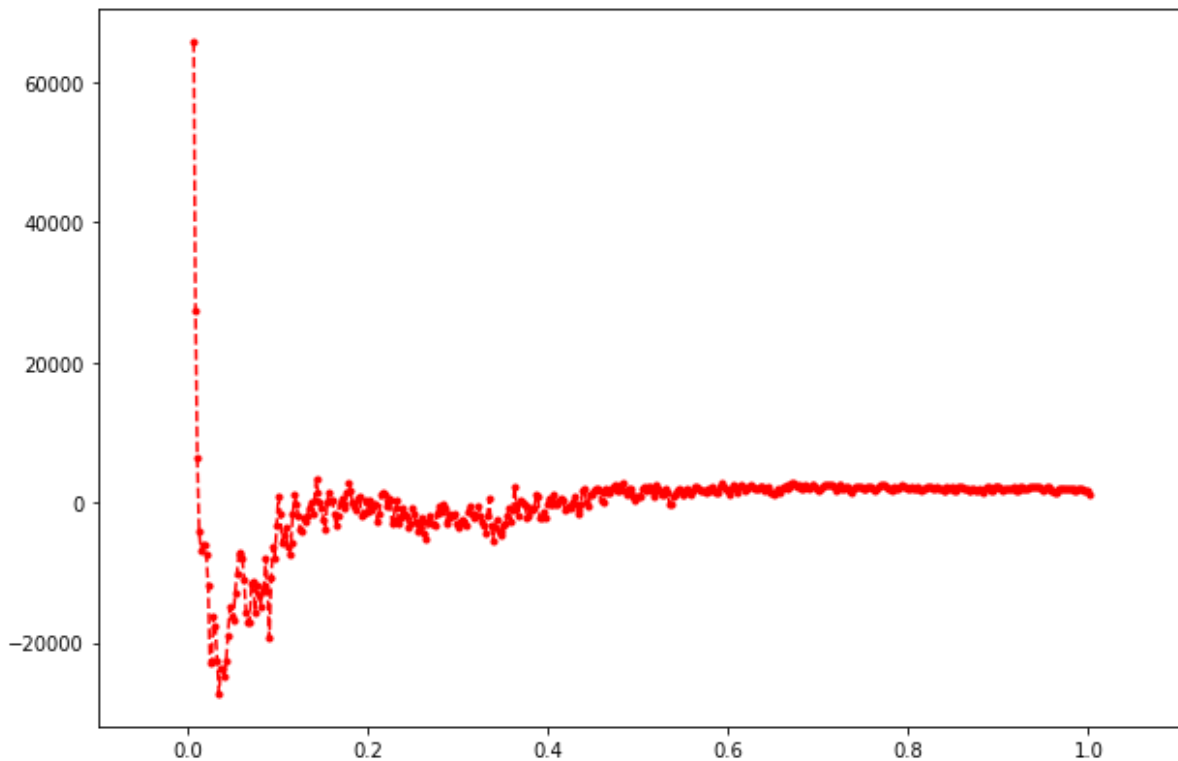Energy over Time of 5 random stars

Density of Particles Split in Half



Density of Particles Split in Half

0.002002002002002068



Combined Left and Right halves of Distribution

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2}$$

$a_0 = 54012.22535688232$
$a_1 = -6.099964111589275$
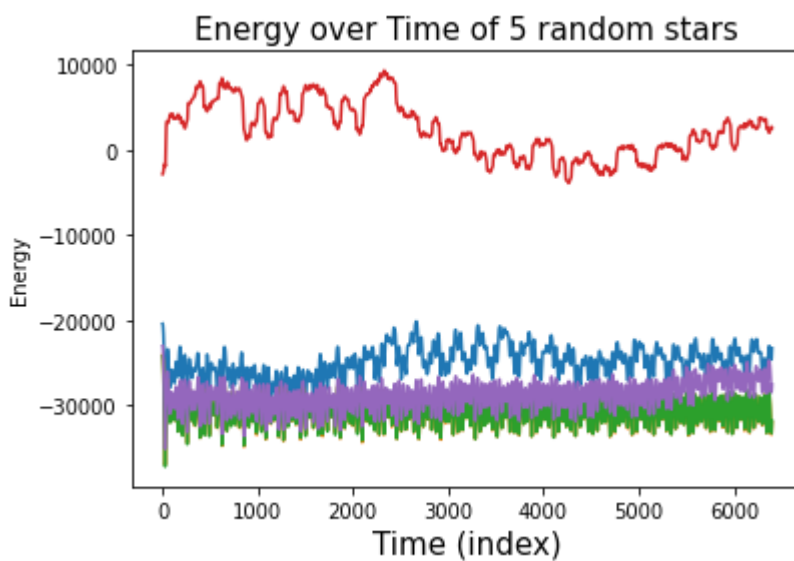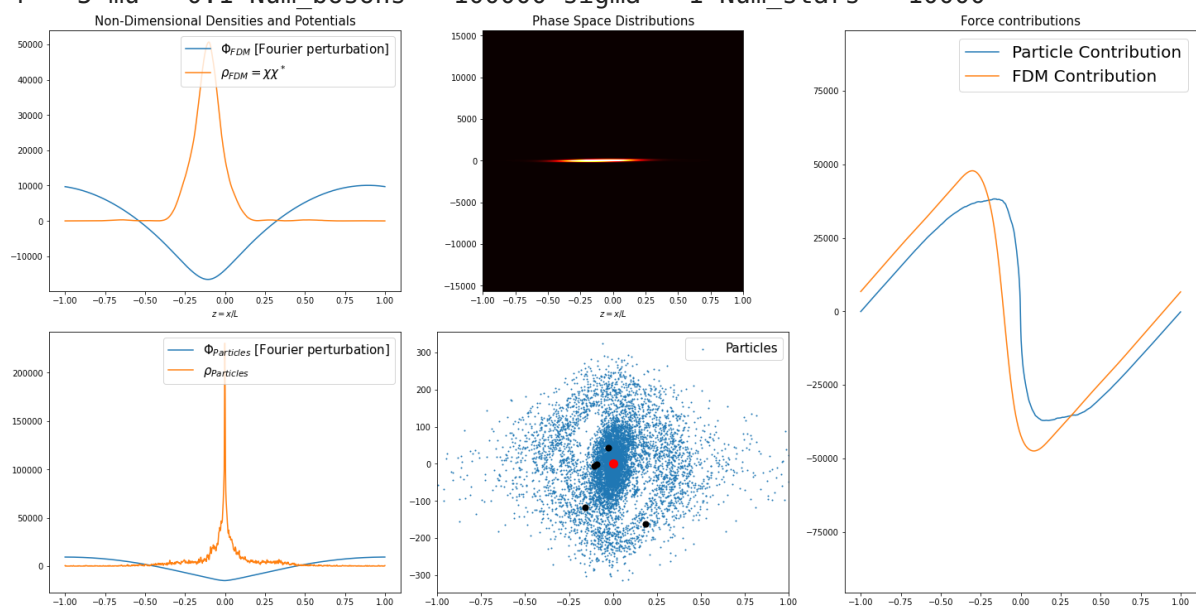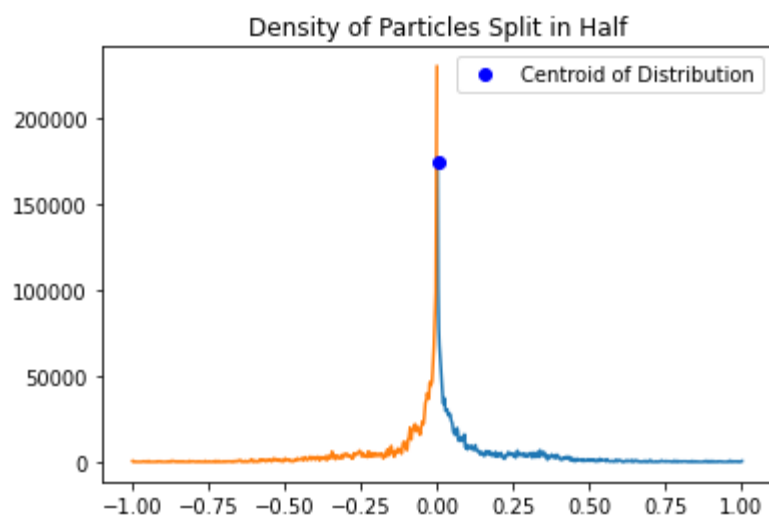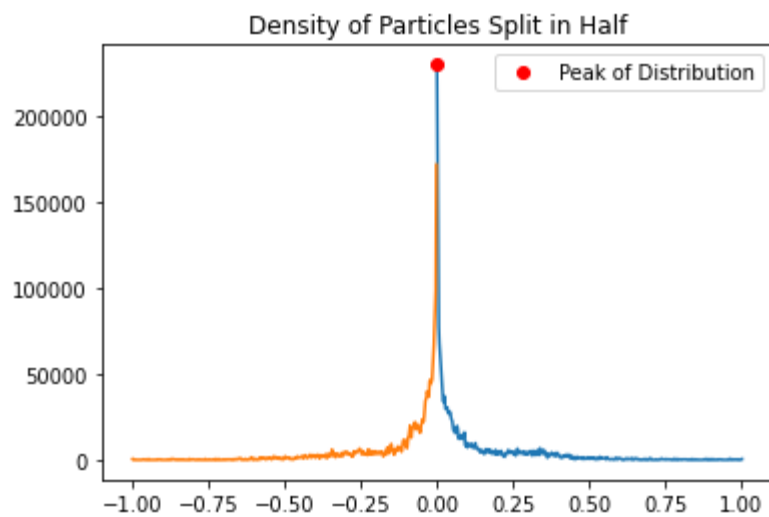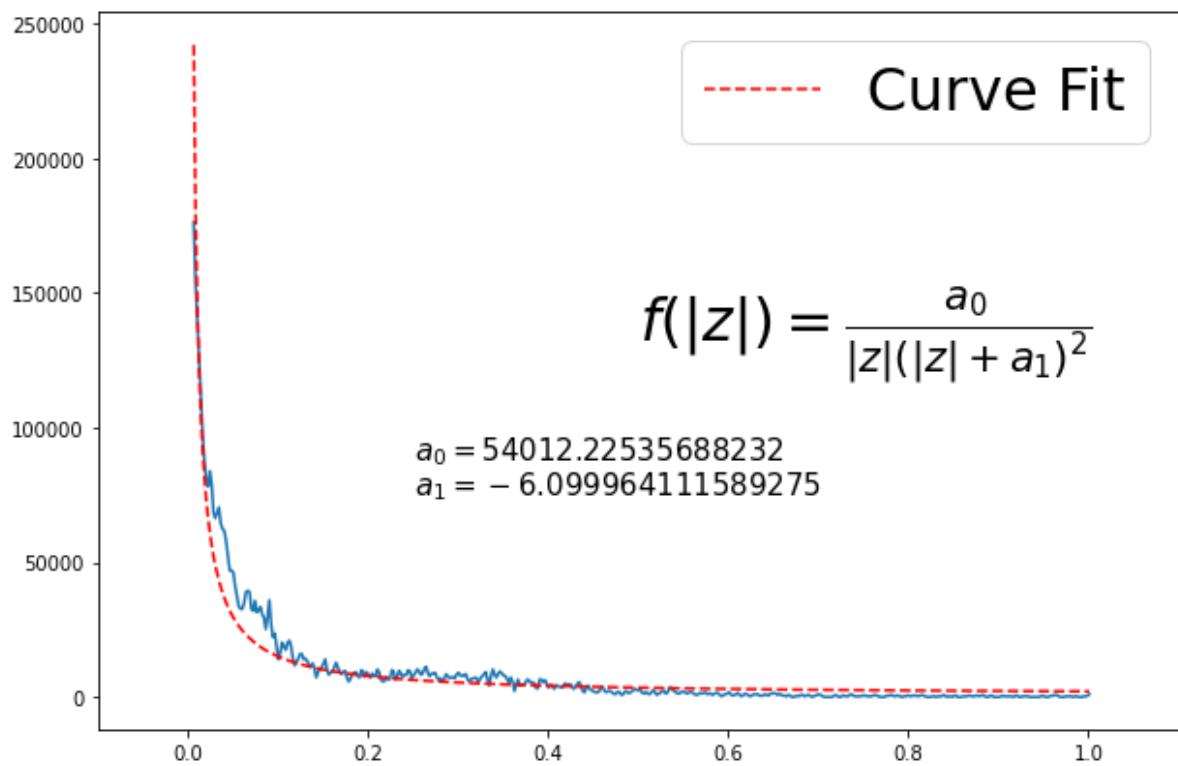


chi^2 = 916046.8264148047

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2} - \frac{a_2}{|z|}$$

$a_0 = -2628.611951359927$
$a_1 = 1472.4827578443321$
$a_2 = 1464.6934221739239$
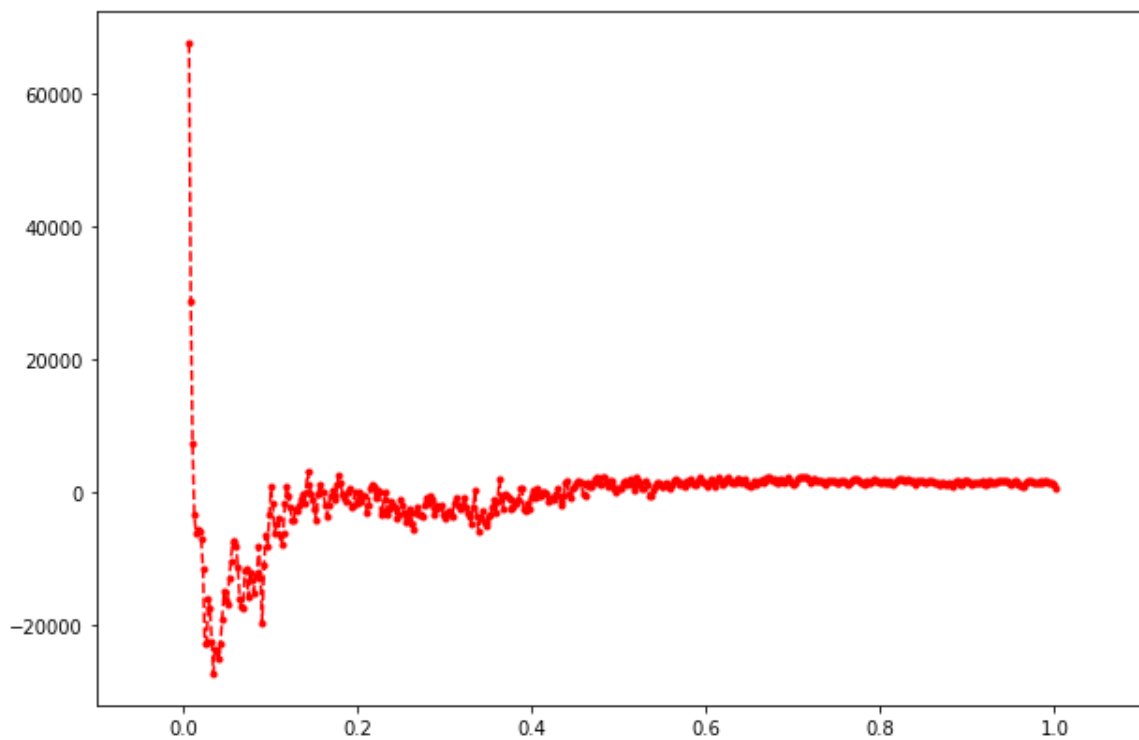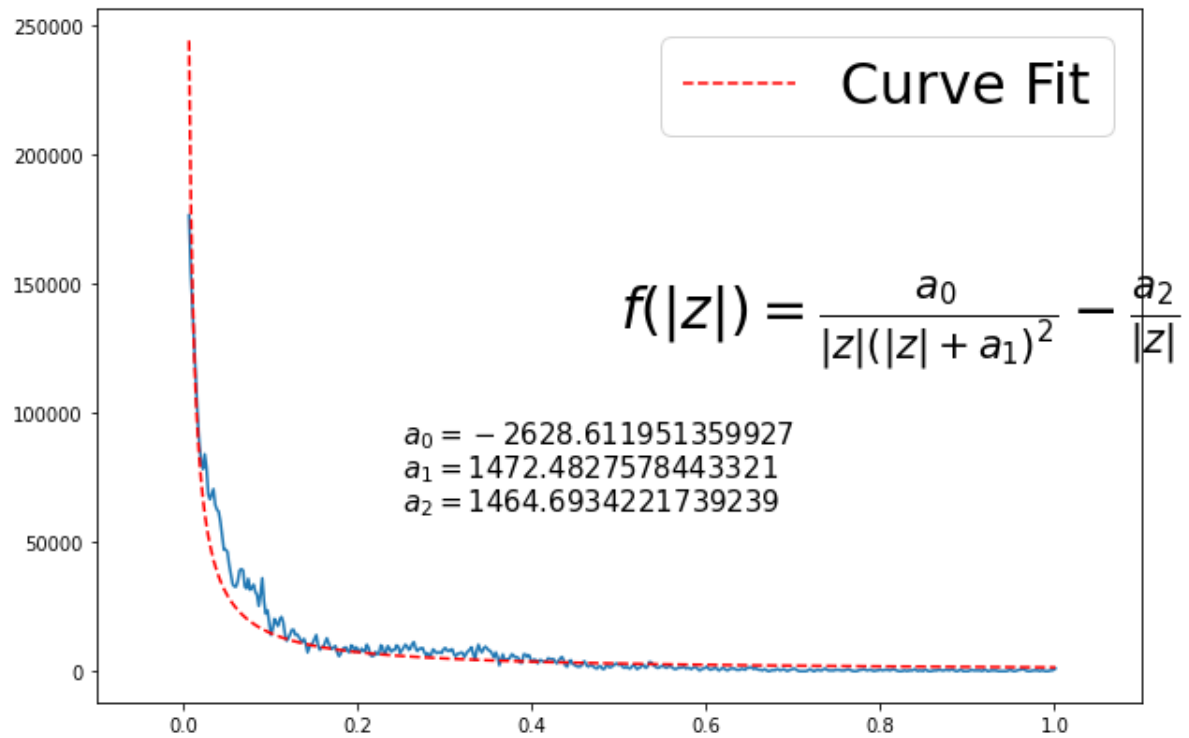


chi^2 = 851932.3919991729

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^2}$$

$a_0 = 699.0928854758467$
$a_1 = 0.20148198074438986$
$a_2 = 0.46836161110824676$
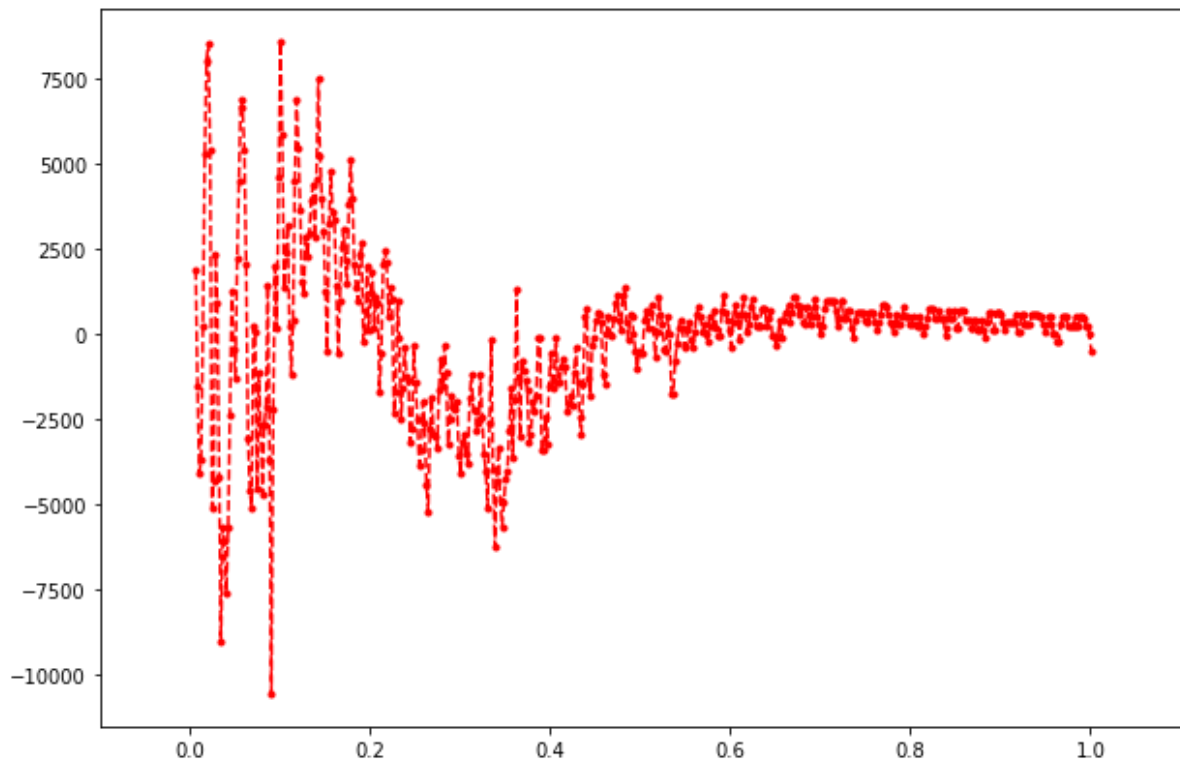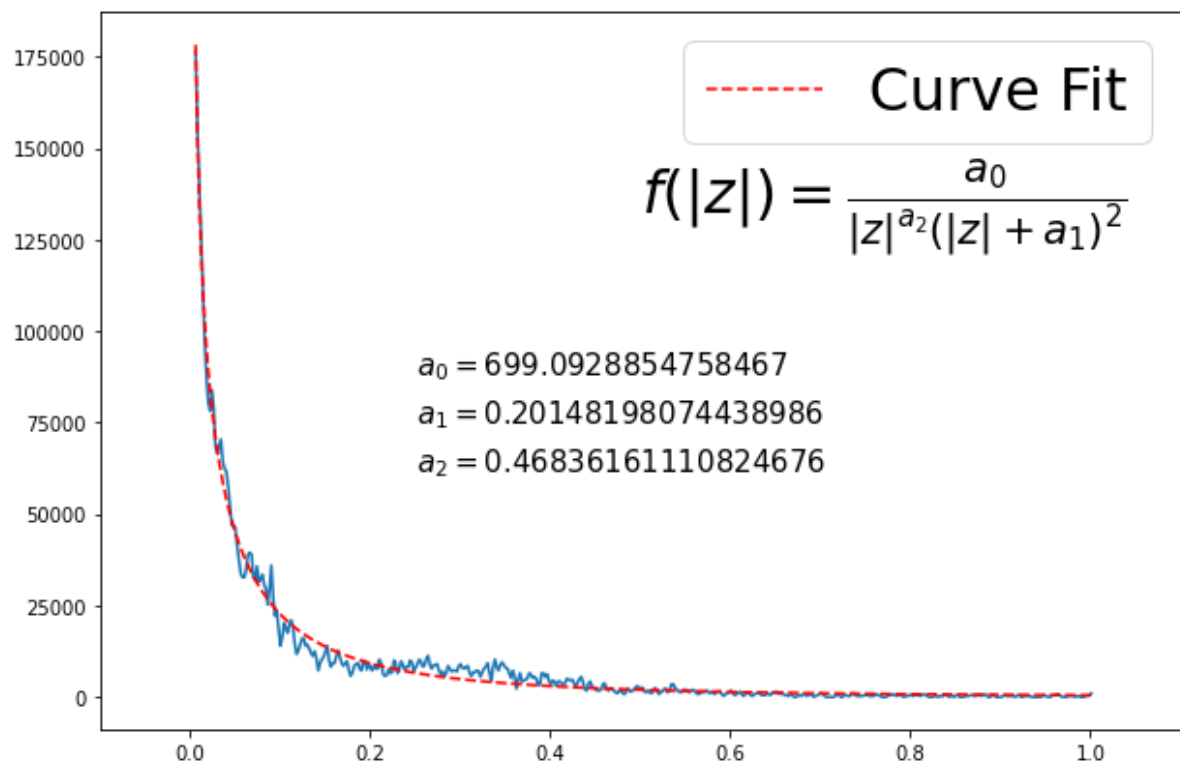


chi^2 = 328193.44588331267

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^{a_3}}$$

$a_0 = 809.4422586449801$

$a_1 = 0.10565158040813516$

$a_2 = 0.41534063306152924$

$a_3 = 1.487251279486427$



chi^2 = 330860.4024658548

Gravitational Potential in the Box
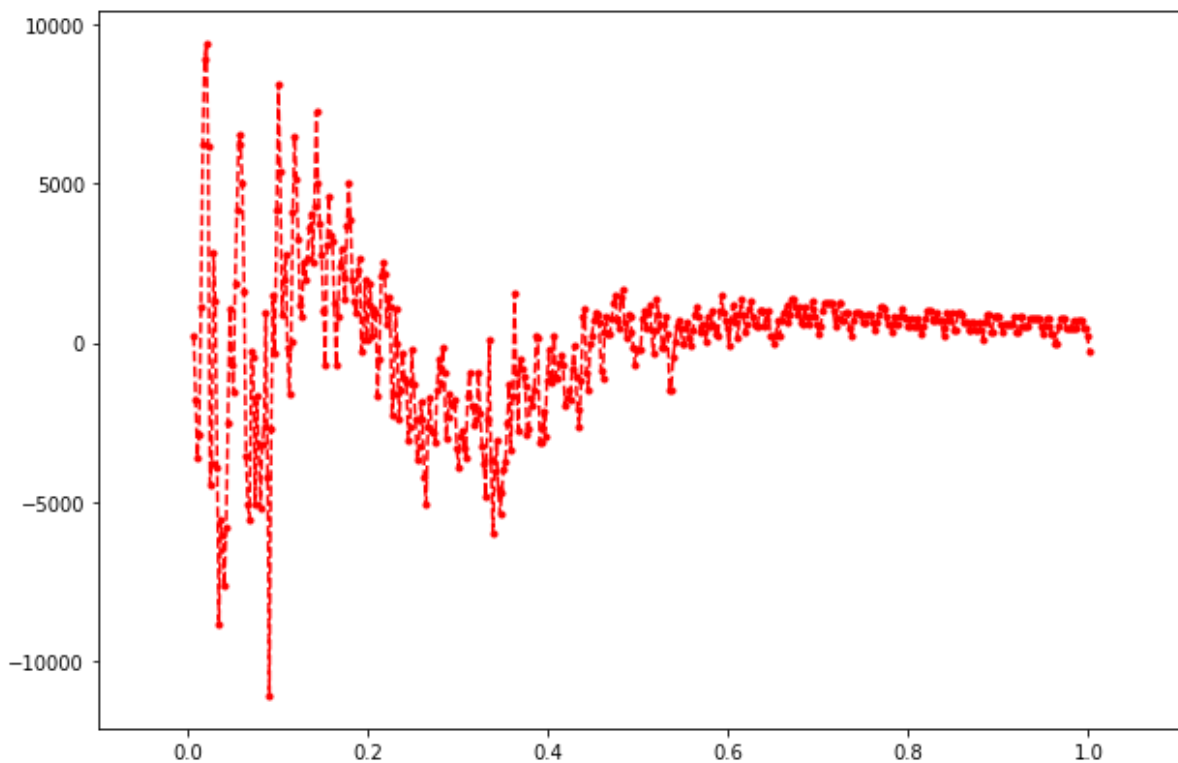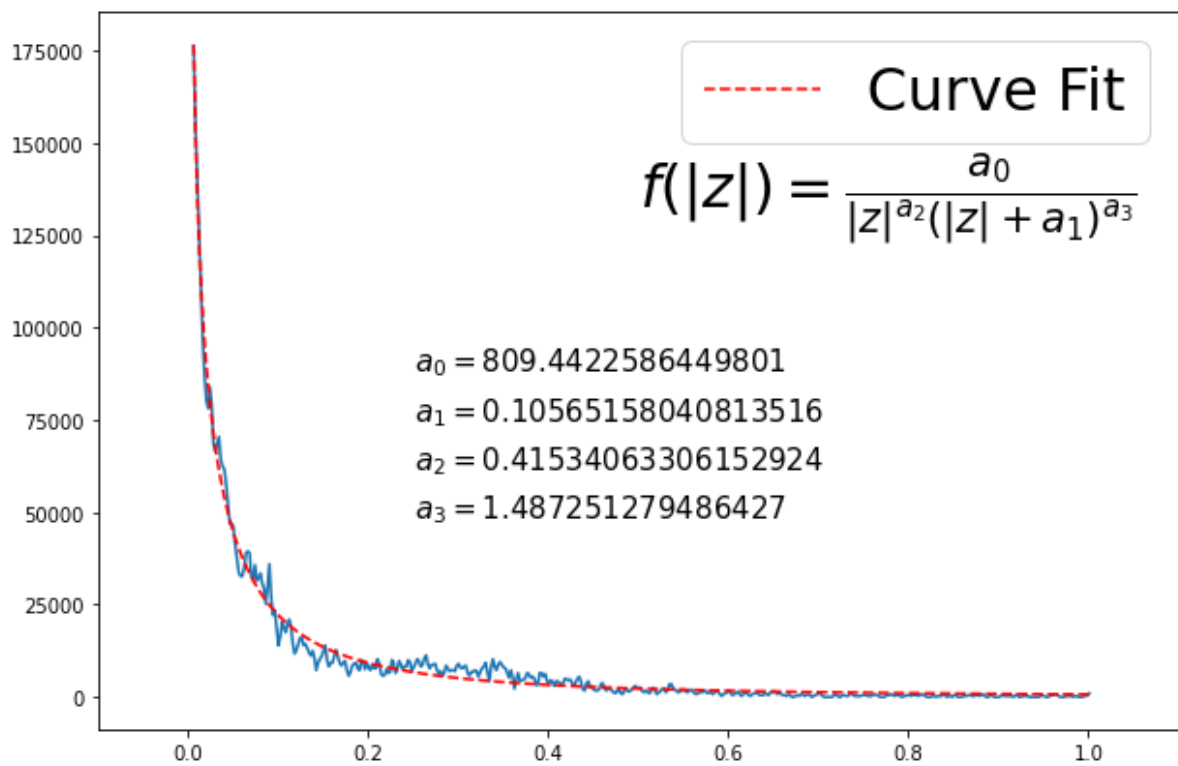
----------New Analysis--------

r = 10 mu = 0.05 Num_bosons = 200000 sigma = 1 Num_stars = 10000



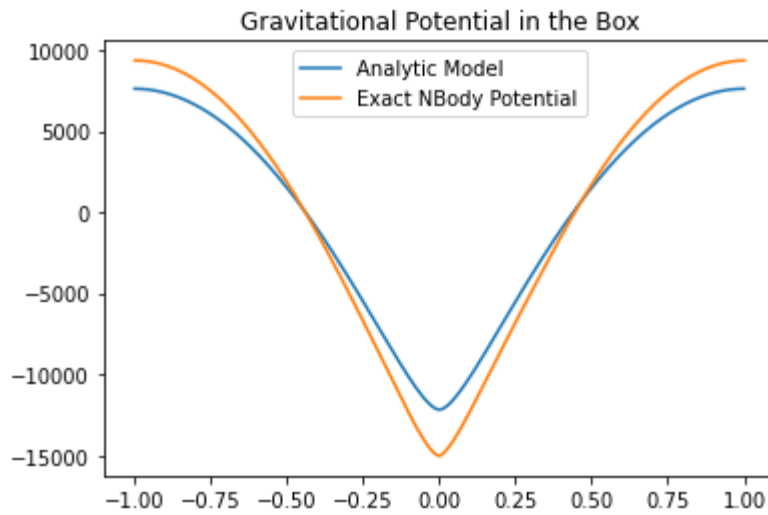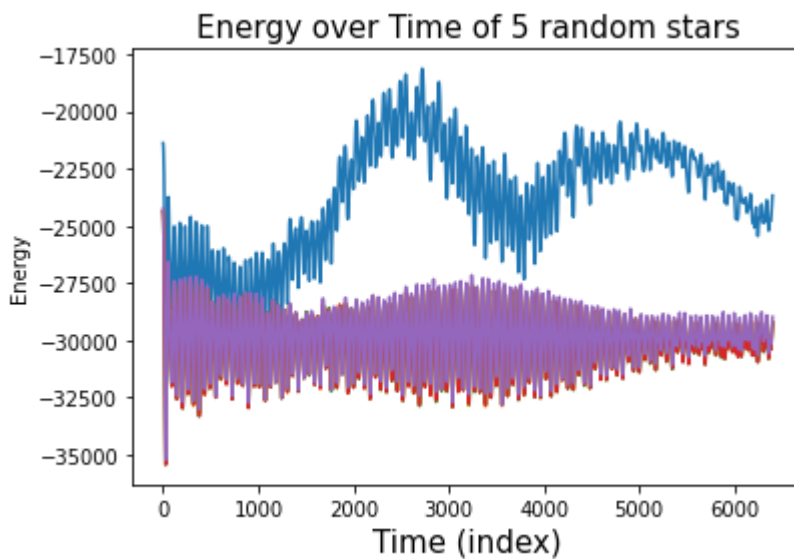Energy over Time of 5 random stars

Density of Particles Split in Half



Density of Particles Split in Half

0.0



Combined Left and Right halves of Distribution

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2}$$

$a_0 = 10869.806427327638$
$a_1 = -3.1394710967083754$
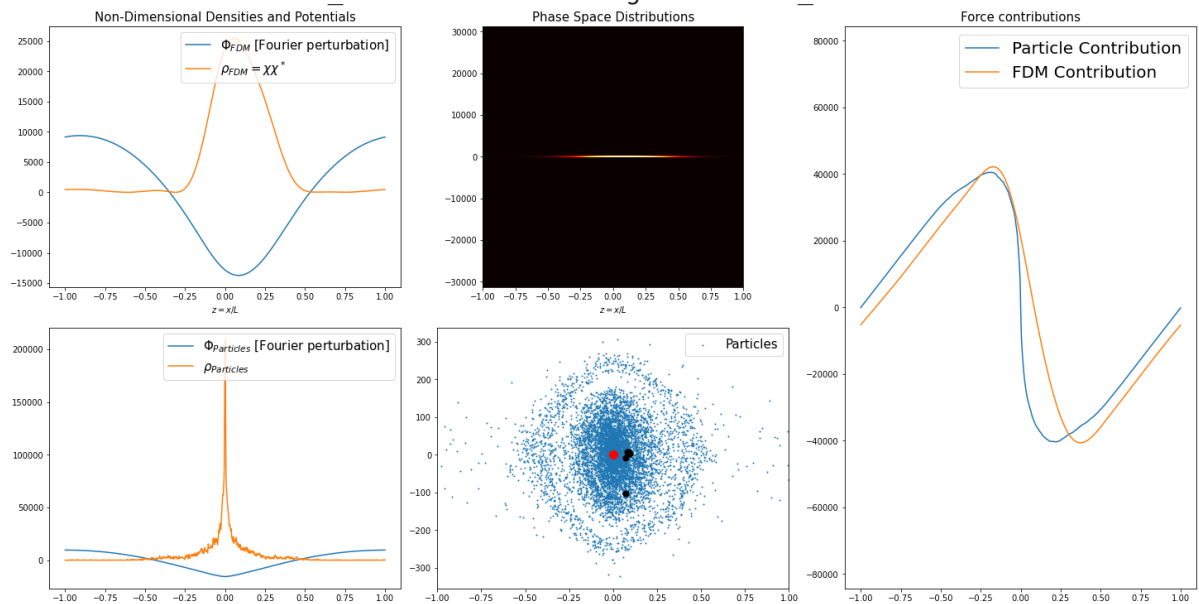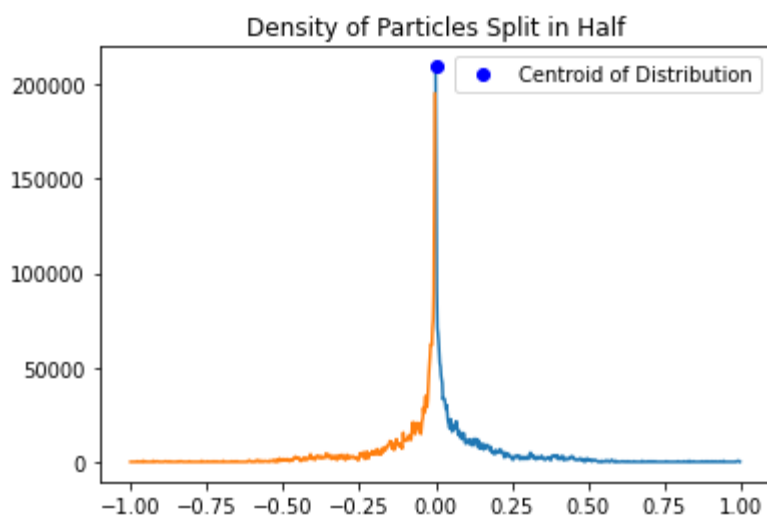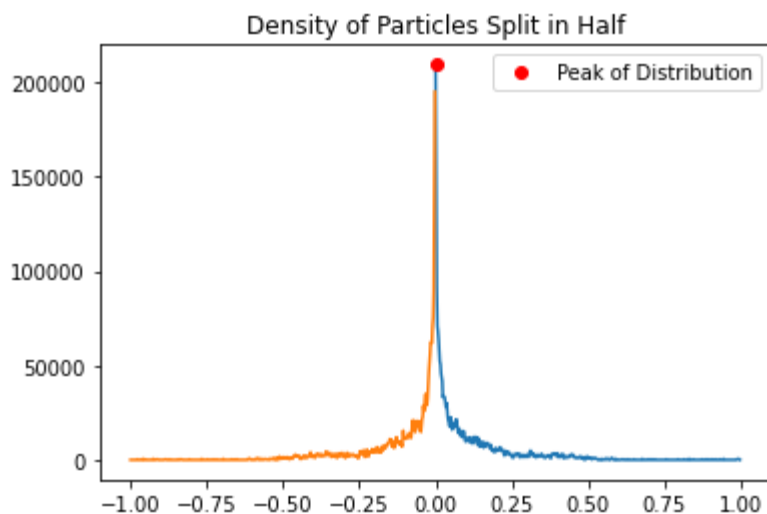


chi^2 = 1738057.7770754427

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2} - \frac{a_2}{|z|}$$

$a_0 = 4586.810848628751$
$a_1 = 2341.230232754192$
$a_2 = 1115.2868703655536$
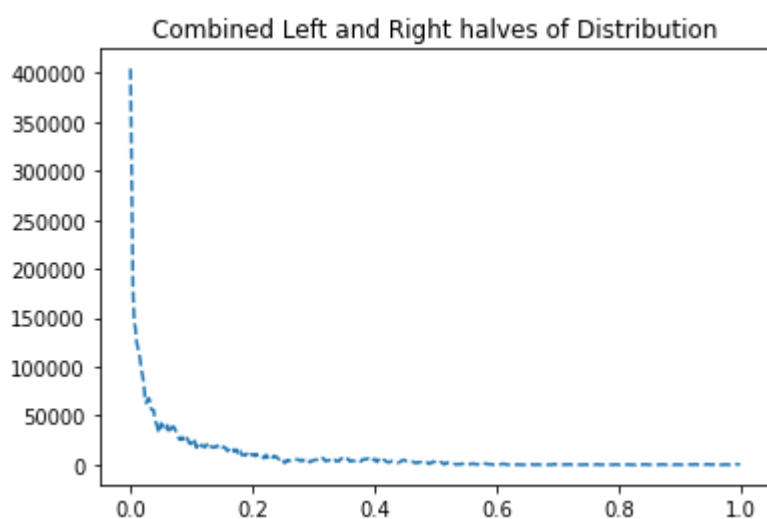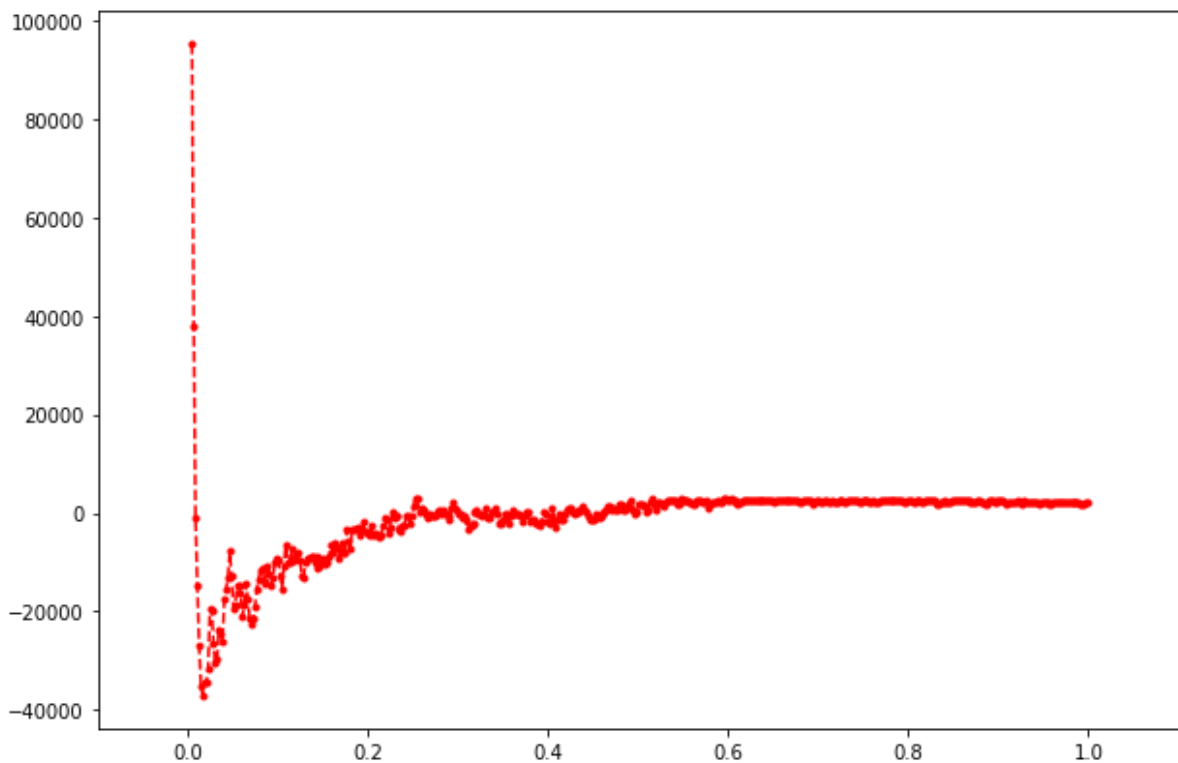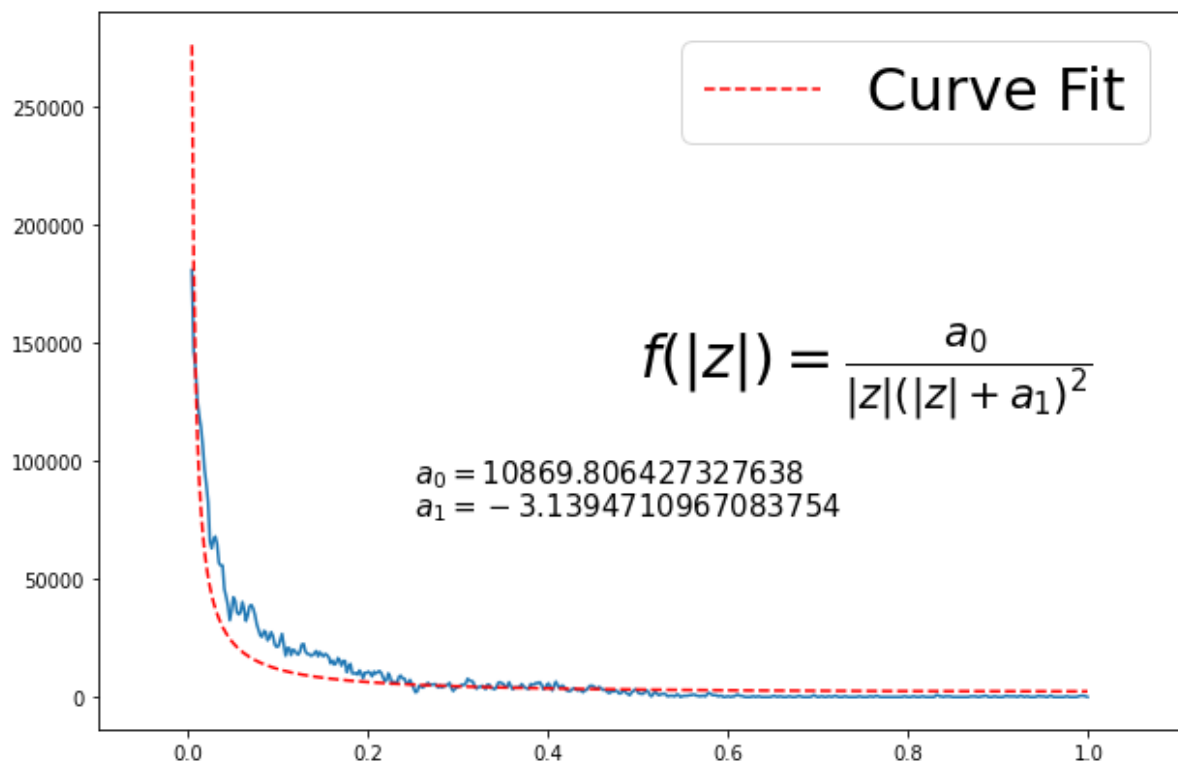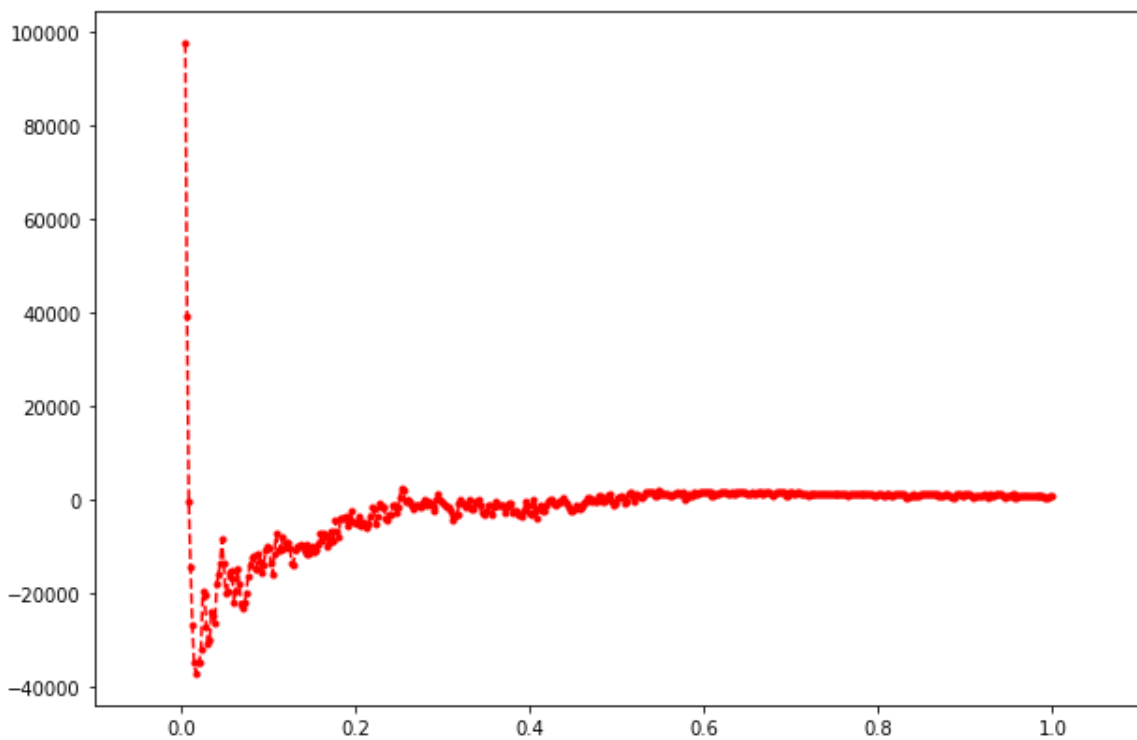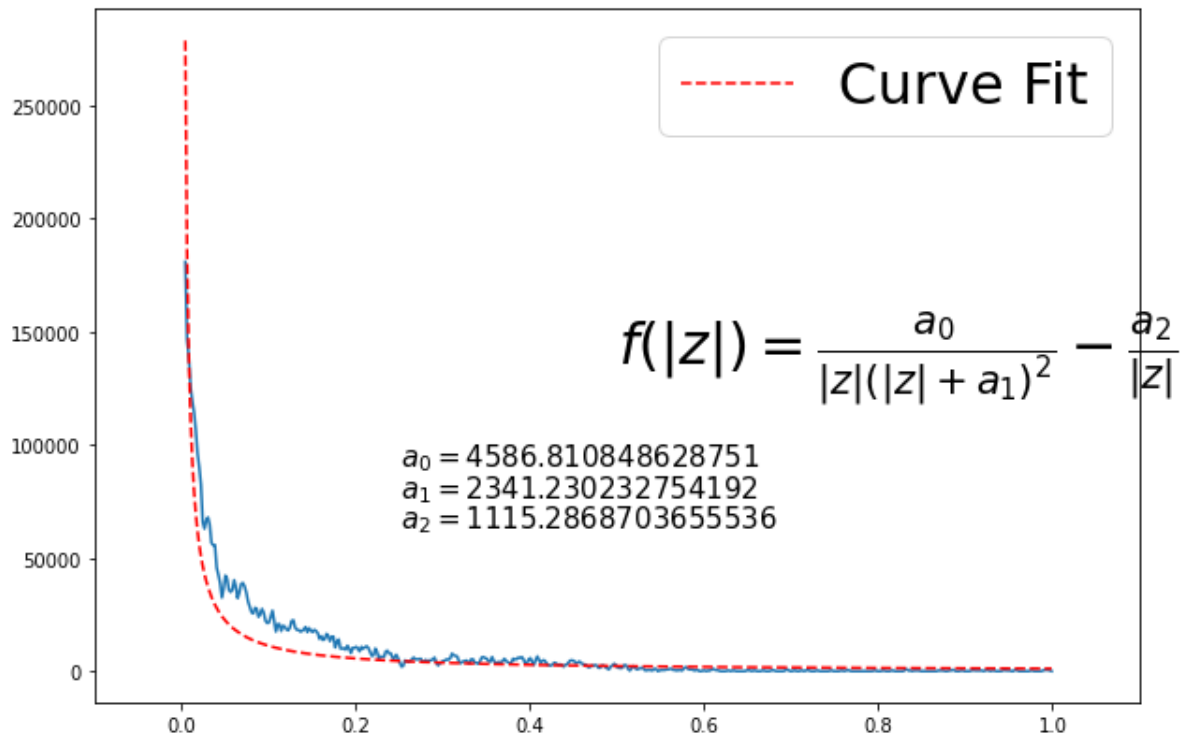


chi^2 = 1716889.4310029696

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^2}$$

$a_0 = 711.412916912438$
$a_1 = 0.17323595015177085$
$a_2 = 0.38023568861346146$



chi^2 = 284629.91746737063

Density vs |z| with Curve fit
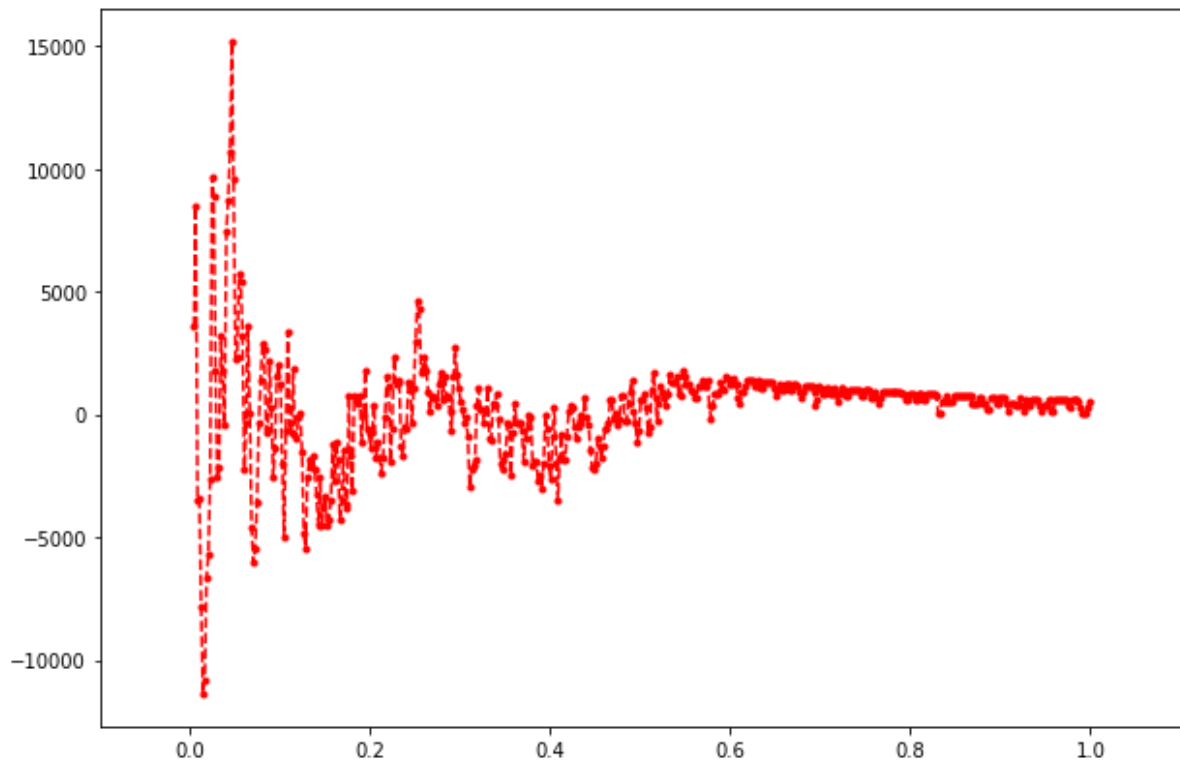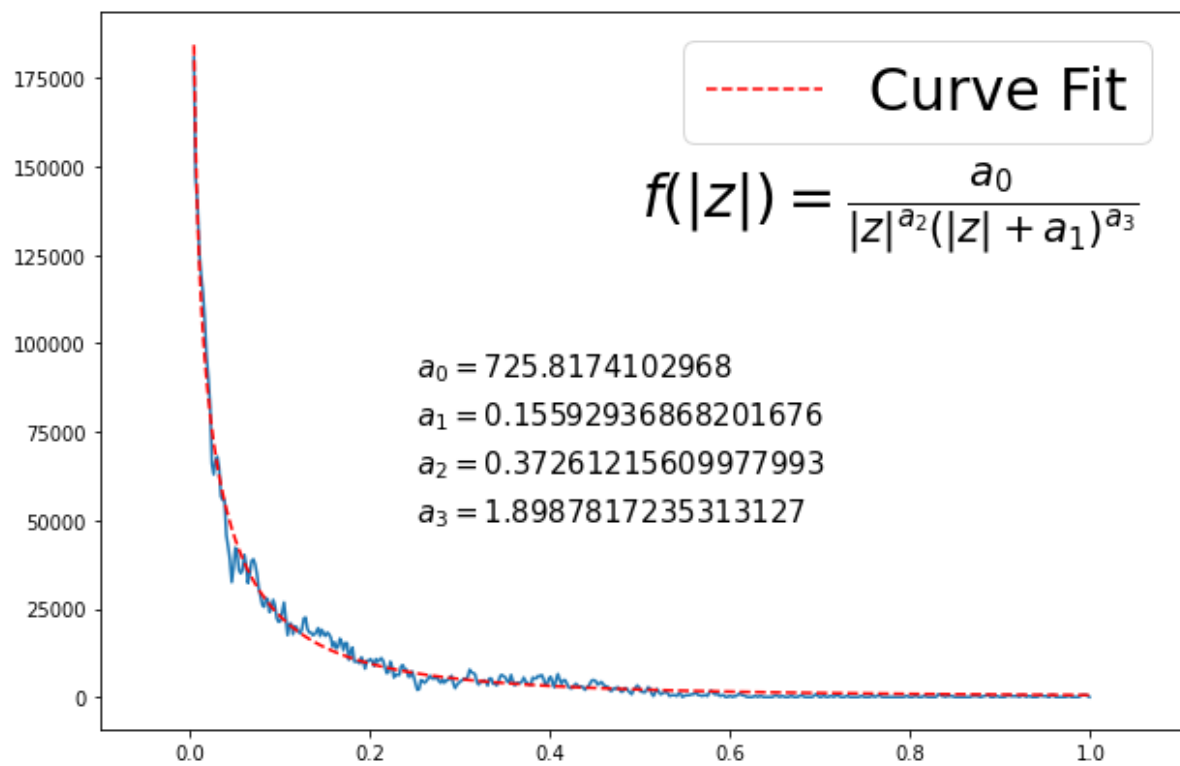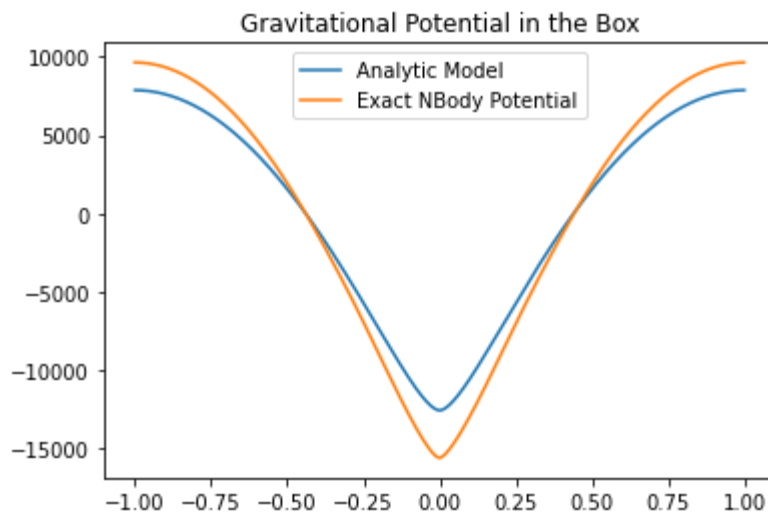


$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^{a_3}}$$

$a_0 = 725.8174102968$

$a_1 = 0.15592936868201676$

$a_2 = 0.37261215609977993$

$a_3 = 1.8987817235313127$



chi^2 = 291832.4249495785

## Gravitational Potential in the Box



----------New Analysis--------

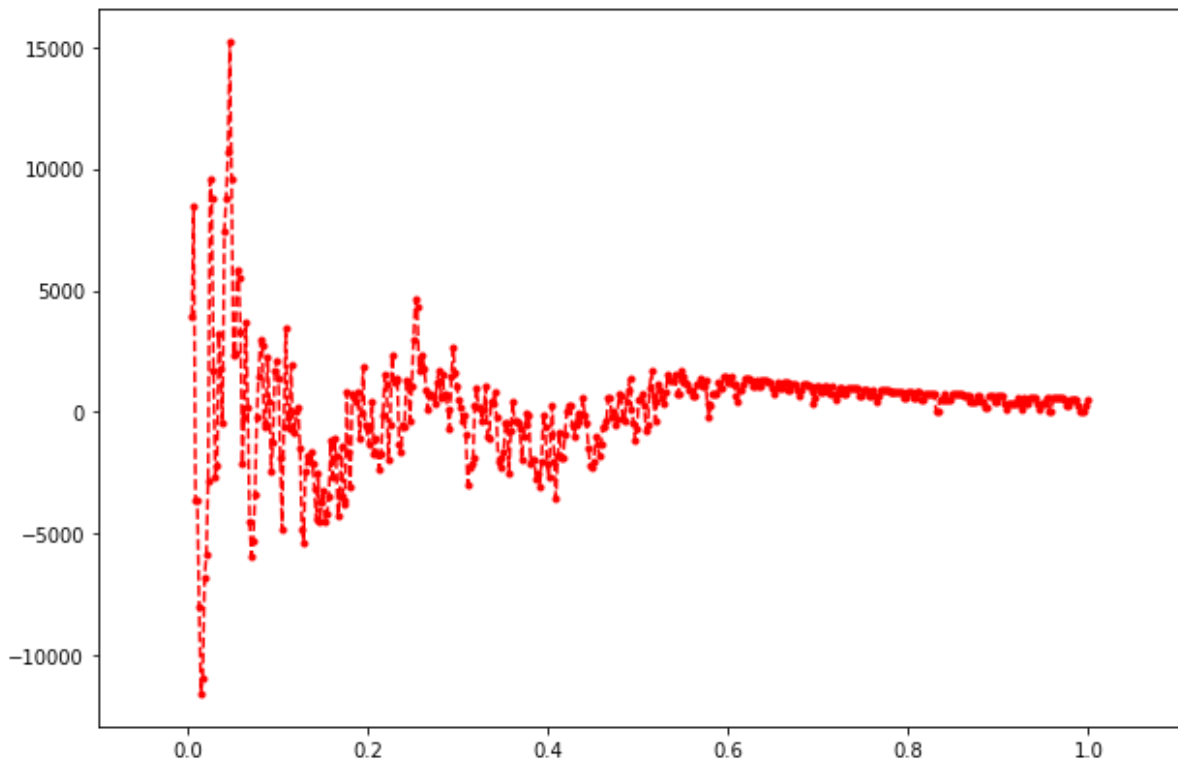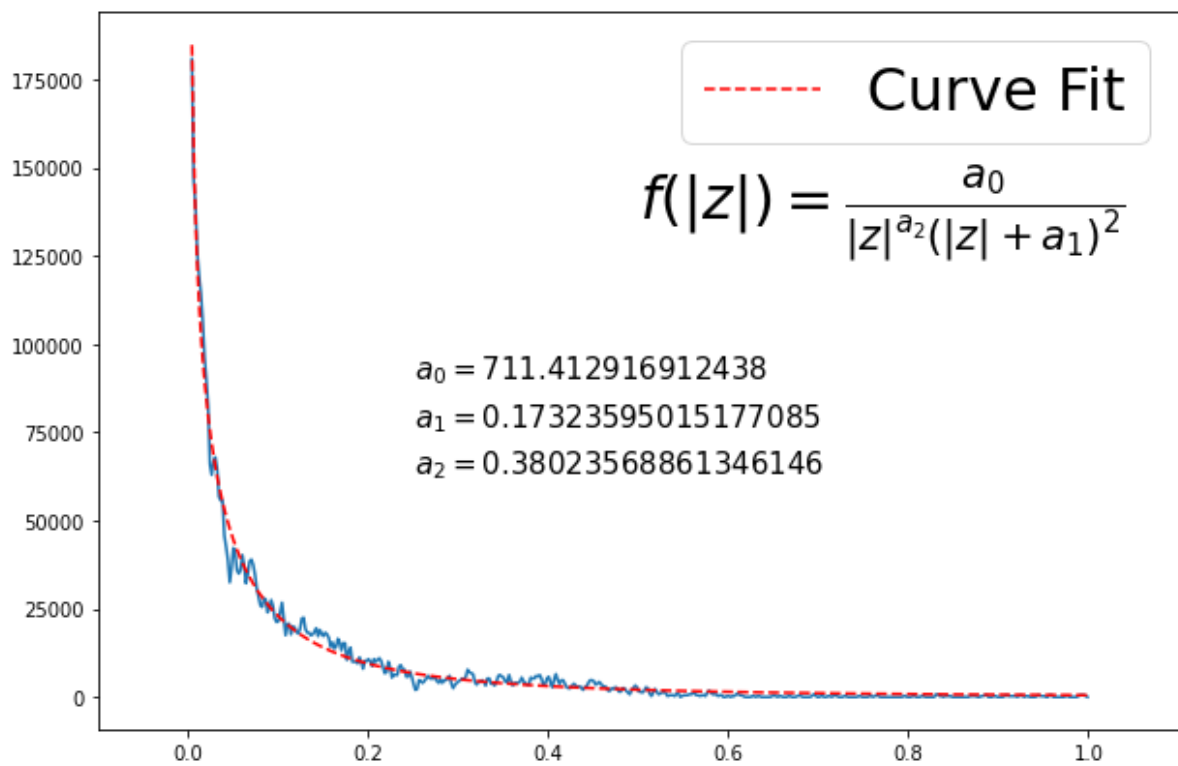r = 50 mu = 0.01 Num_bosons = 1000000 sigma = 1 Num_stars = 10000



## Energy over Time of 5 random stars

Density of Particles Split in Half



Density of Particles Split in Half

0.002002002002002068



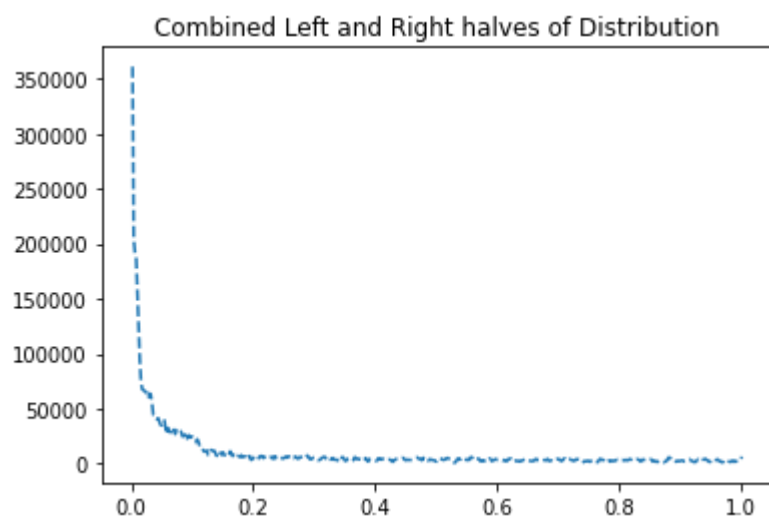Combined Left and Right halves of Distribution

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2}$$

$a_0 = 12873.144706339755$
$a_1 = -3.029125591794052$
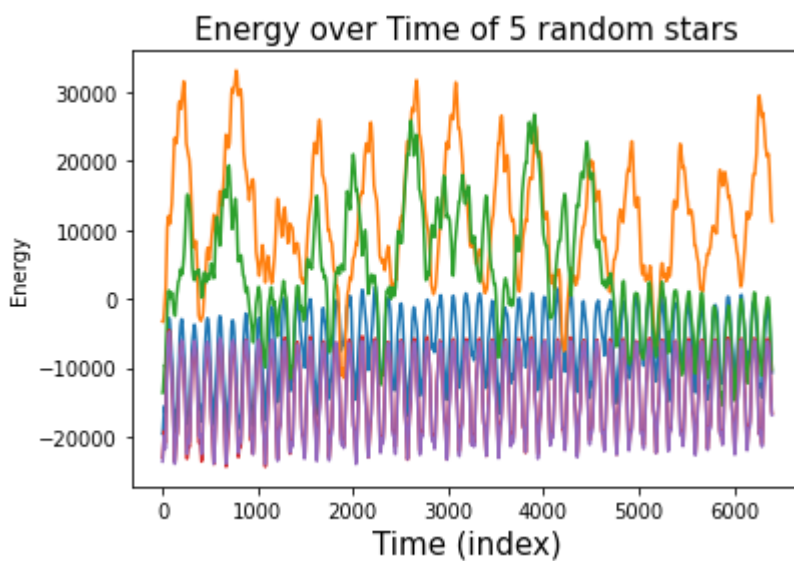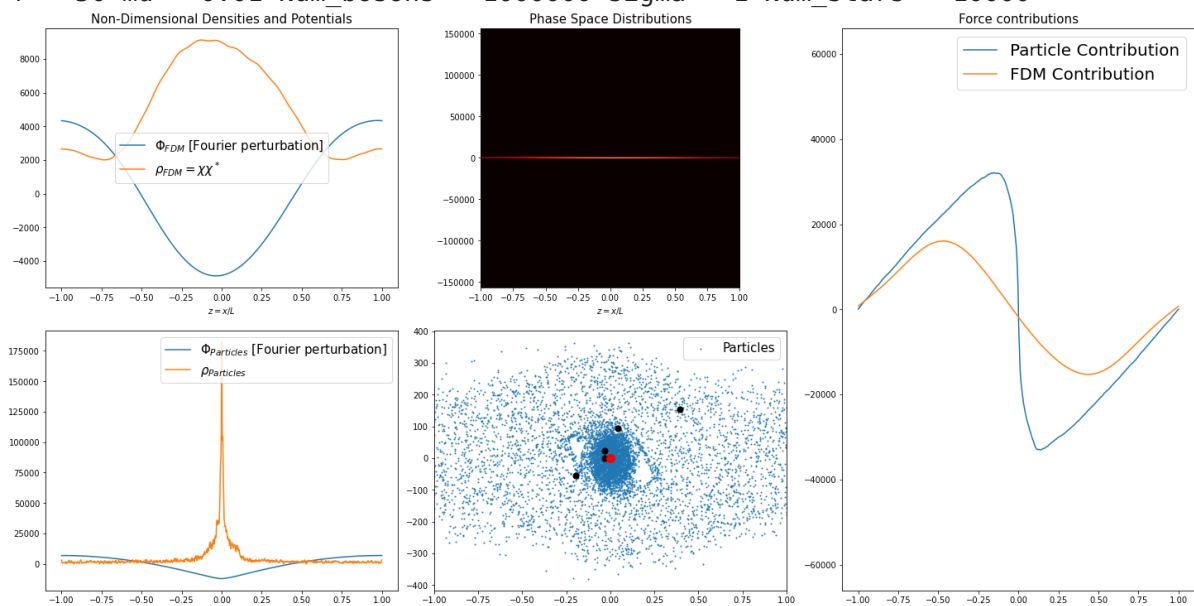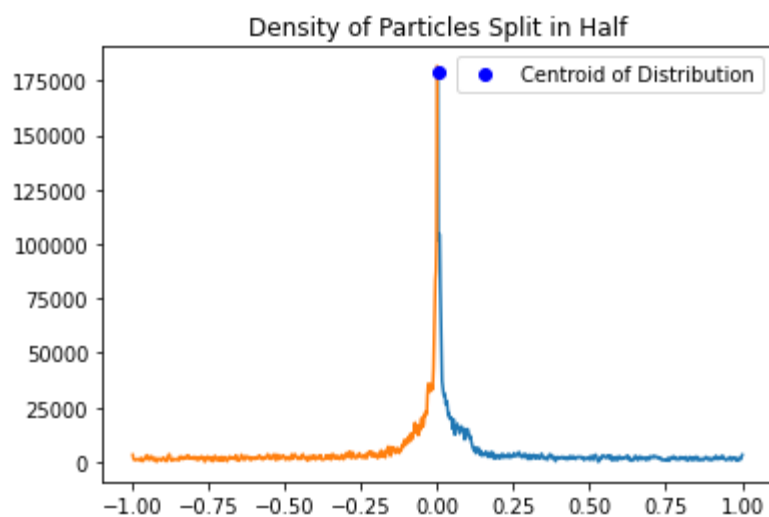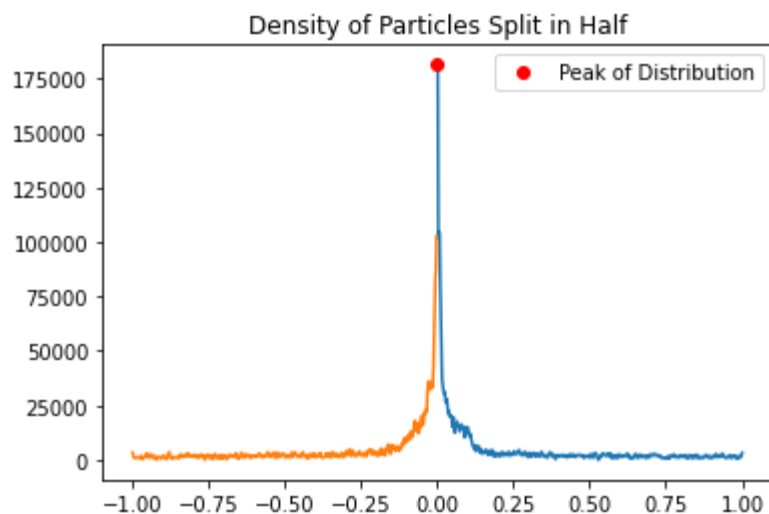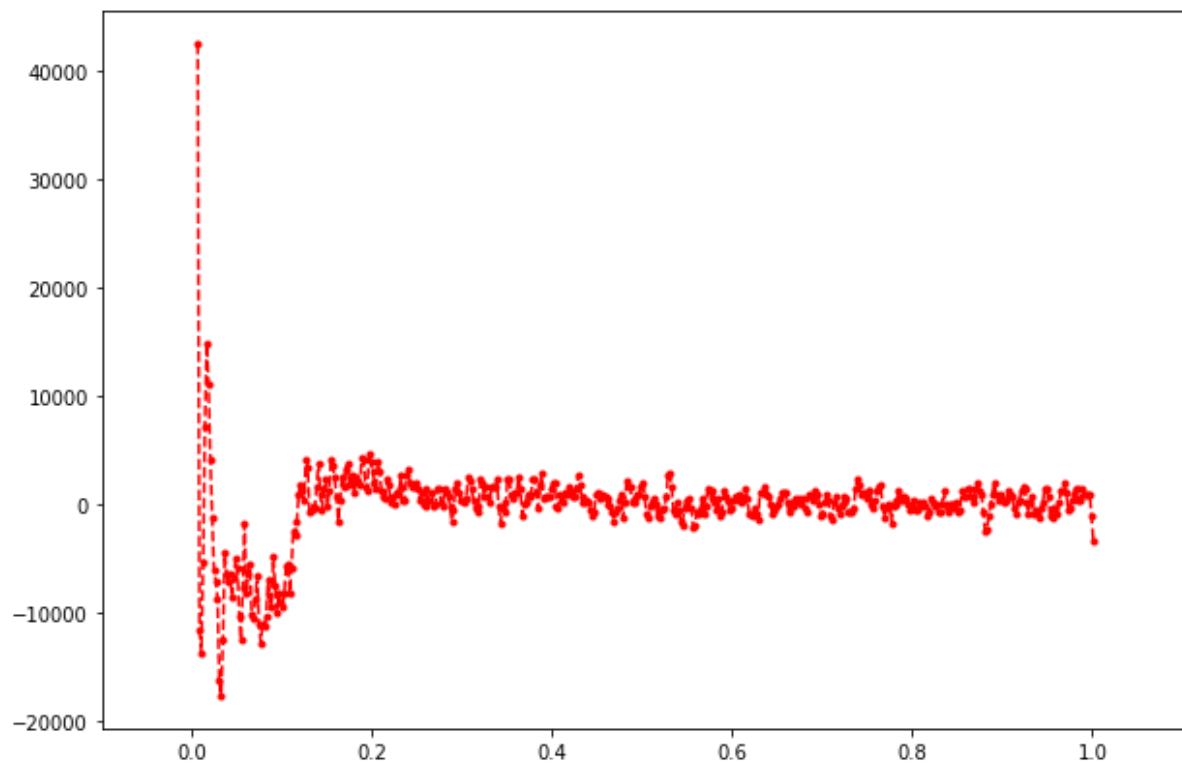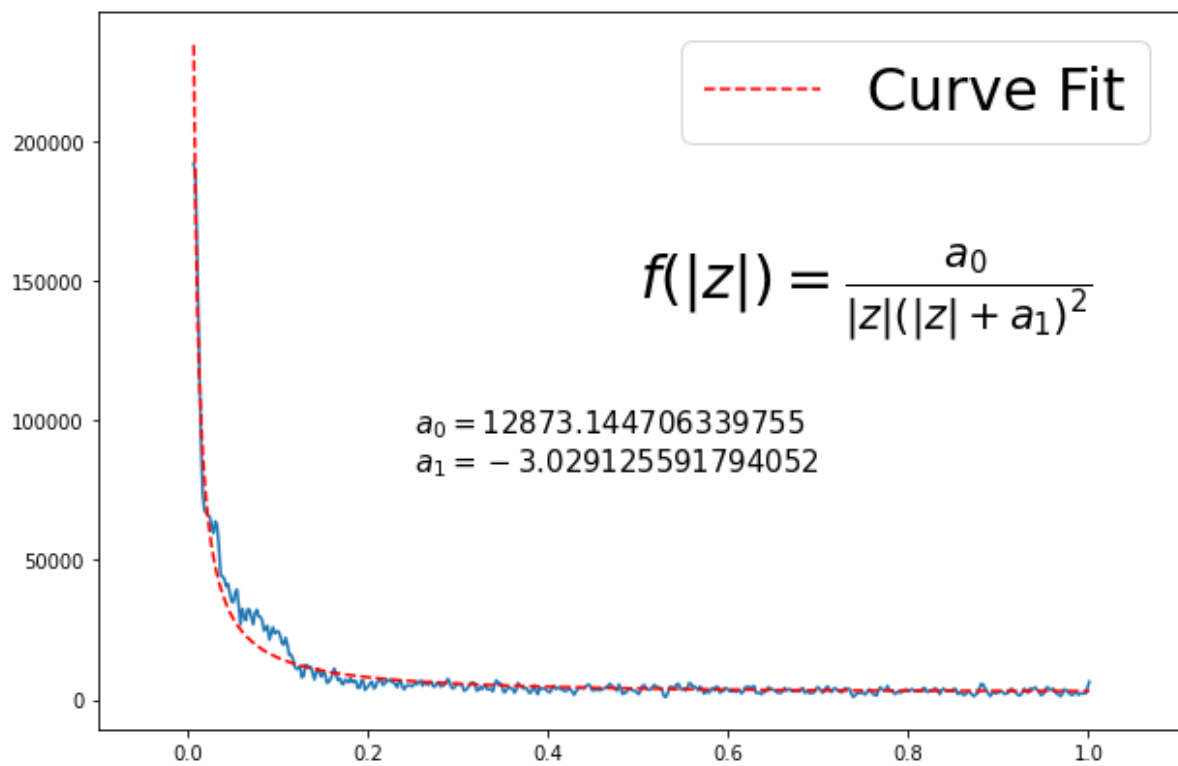


chi^2 = 309143.8474700038

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|(|z| + a_1)^2} - \frac{a_2}{|z|}$$

$a_0 = -0.500326180710871$

$a_1 = 0.02317286766118812$

$a_2 = 1830.0312447285025$
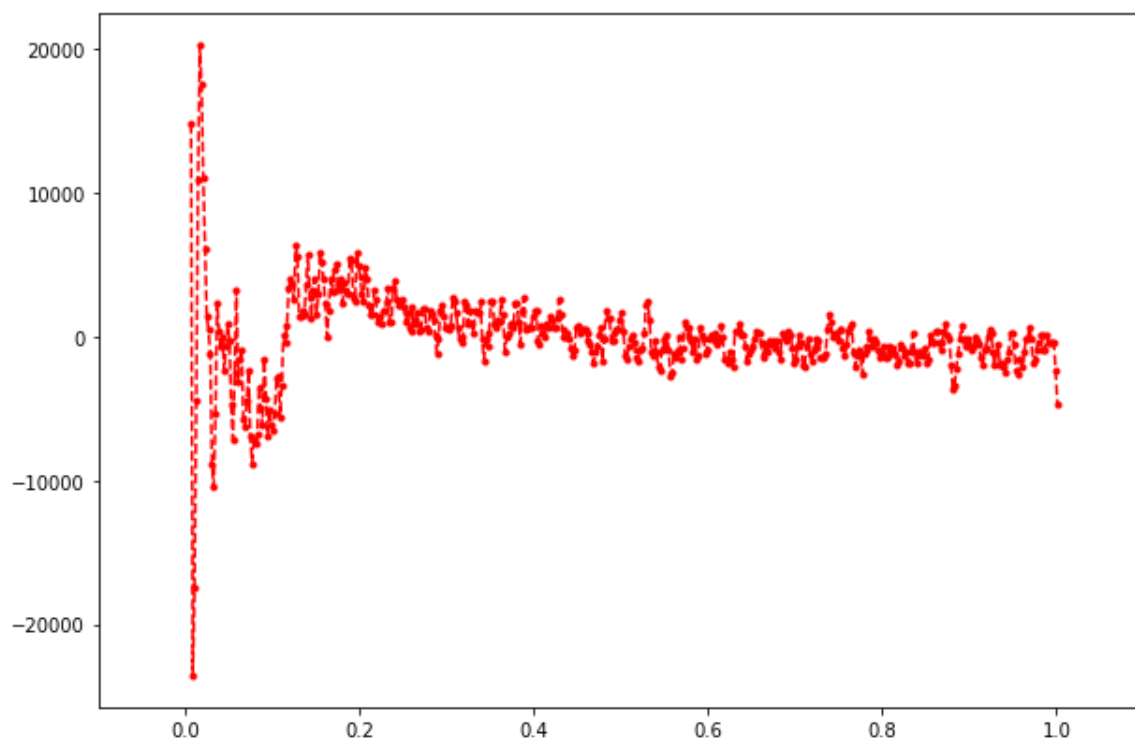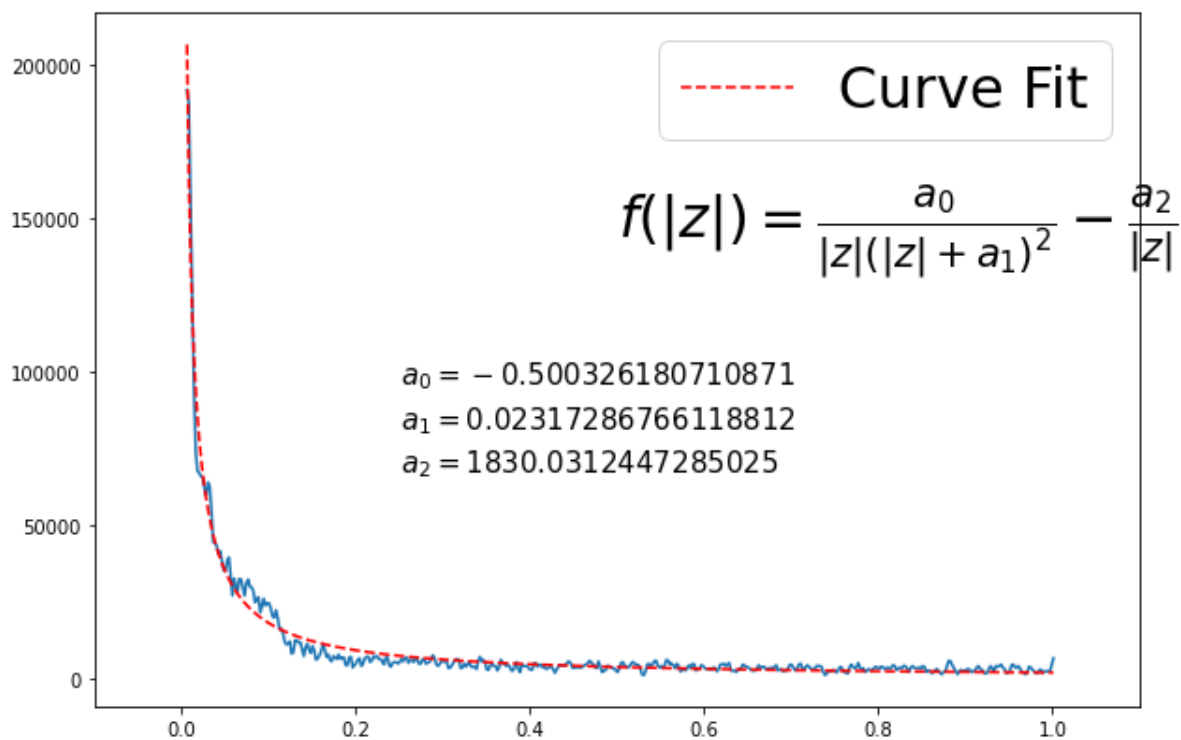


```
chi^2 = 321876.3329614536
```

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^2}$$

$a_0 = 10589.669492214212$
$a_1 = 1.8600389412940905$
$a_2 = 0.8281372372346367$
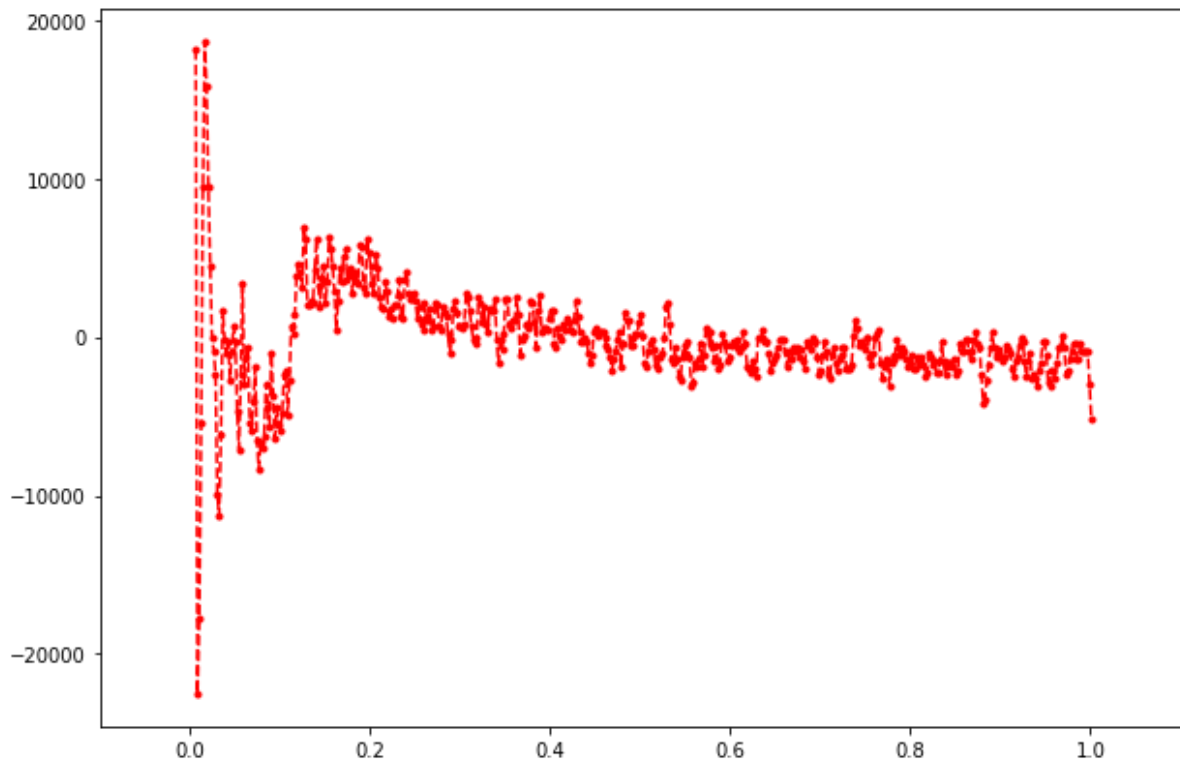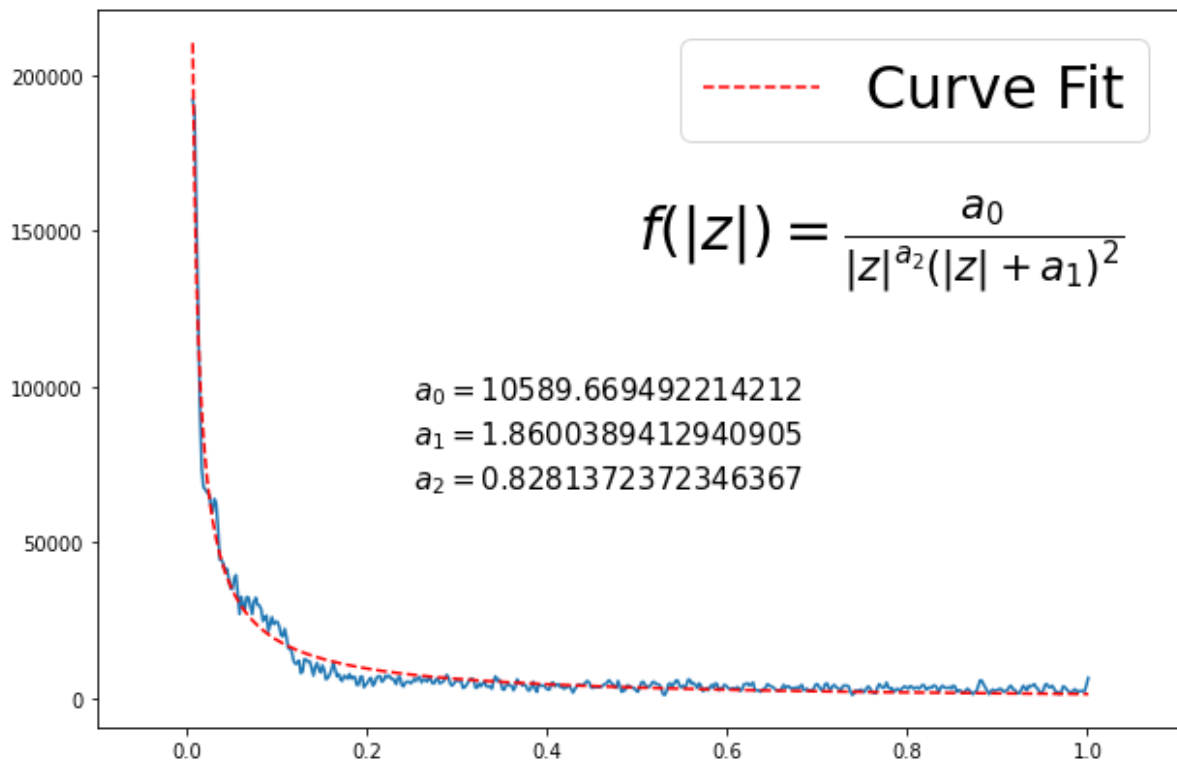


chi^2 = 494952.2346602648
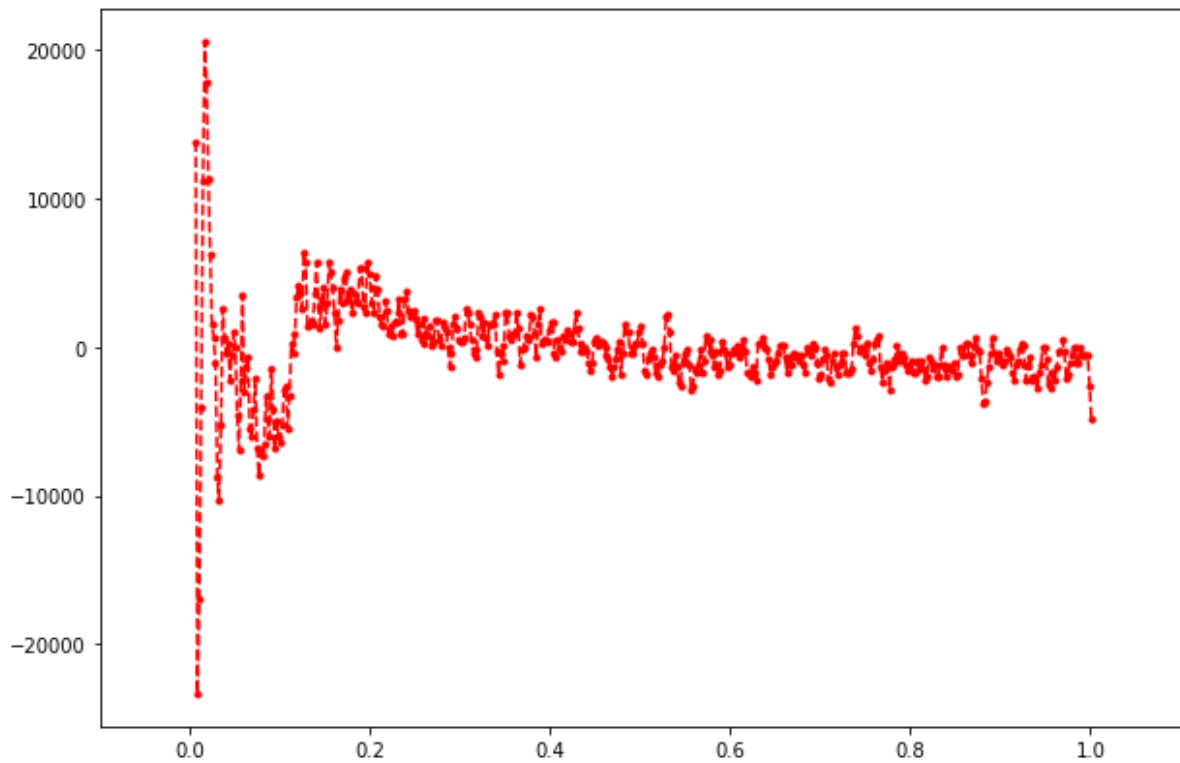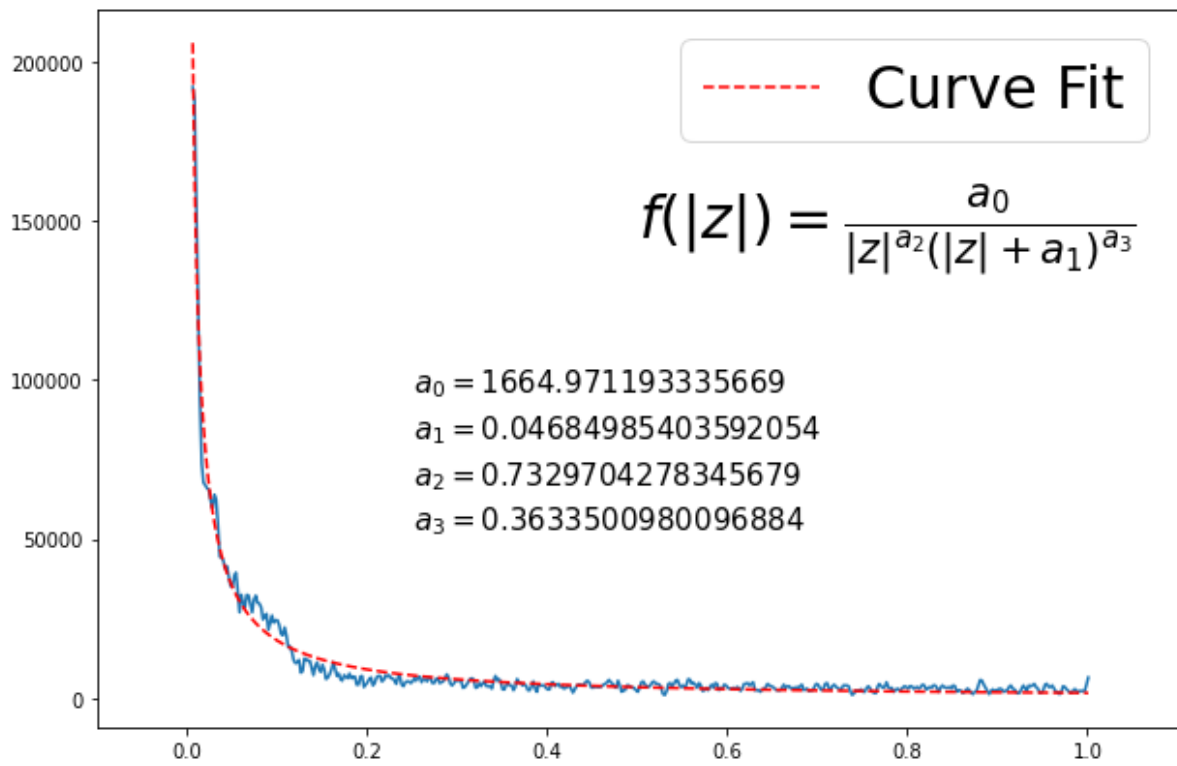
/home/boris/Documents/Research/Coding/1D_Codes/Non-Dim/Analysis/Analysis.p
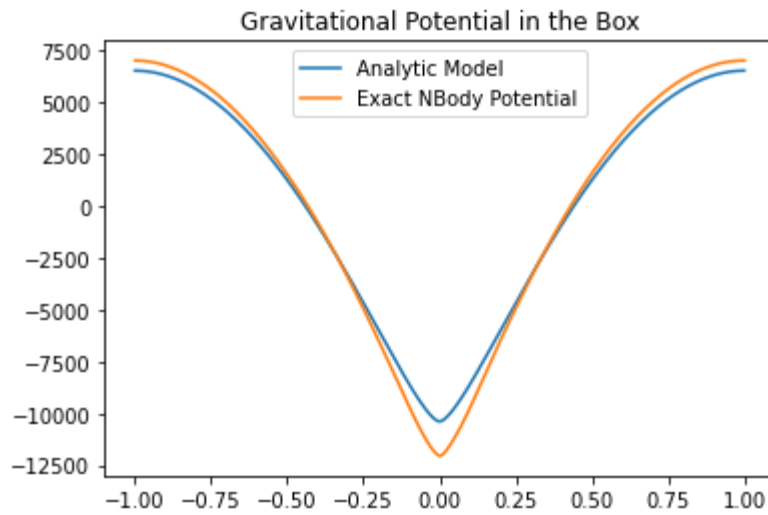y:437: RuntimeWarning: invalid value encountered in power
  og = a0/((z**a2) * (z+a1)**a3)

Density vs |z| with Curve fit



$$f(|z|) = \frac{a_0}{|z|^{a_2}(|z| + a_1)^{a_3}}$$

$a_0 = 1664.971193335669$
$a_1 = 0.04684985403592054$
$a_2 = 0.7329704278345679$
$a_3 = 0.3633500980096884$



chi^2 = 367295.279247727

Gravitational Potential in the Box

----------New Analysis--------
r = 0.5 mu = 1.0 Num_bosons = 10000 sigma = 1 Num_stars = 0