(1) P1 Courtesy of ANDREA BIANCHINI

(a)

I chose $N = 10000$ and $m = 1000$ so the density is 0.1

The $|\vec{K}|$ dependence is shown in the first figure.

When $\frac{a_0}{\lambda} << 1$ the sample behaves like a small object whose size is way smaller than λ. So all the scatterers are coherent and, as expected, $I_{SCATT} \propto m_S^2$

When the $\frac{a_0}{\lambda}$ becomes comparable to 1 we are back to the usual case of a distribution of random scatterers with distance of the order or smaller than the wavelength: only in this case we can talk of scattering

$I_{SCATT} \propto m_S$ as expected from the theory.

Fig. 2: highlights that there isn't dependence on the direction of $\vec{K}$. The oscillations are way smaller than the average value and are just noise.

(b)

Fig. 3 shows the dependence on the density. The behavior is like $x(1-x)$ so that $I_{SCATT} = 0$ when there are very few scatterers or when the ~~matrix~~ is completely filled up. Again there are some fluctuations due to a non perfect averaging

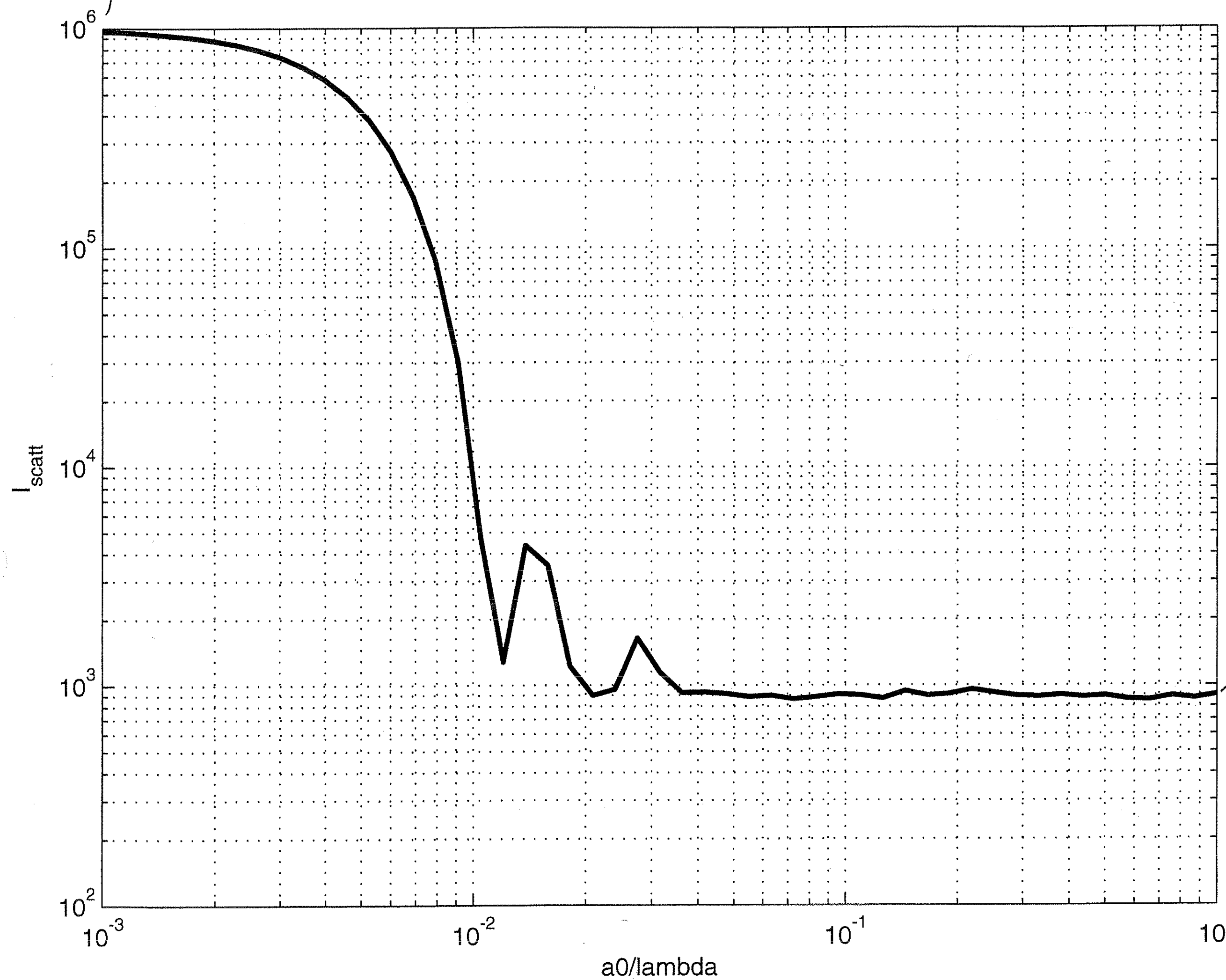
When we introduce the luxler clusters the ISCATT peaks at roughly $\lambda/2 = m a_0$, a_0 being the lattice parameter. It is visible also a second peak at 1.5λ (like a second harmonic).

$n\_scatter = 1000$

$\theta = \pi/6$

$\boxed{I \text{ vs } |\vec{K}^D|}$

$(n\_s)^2$



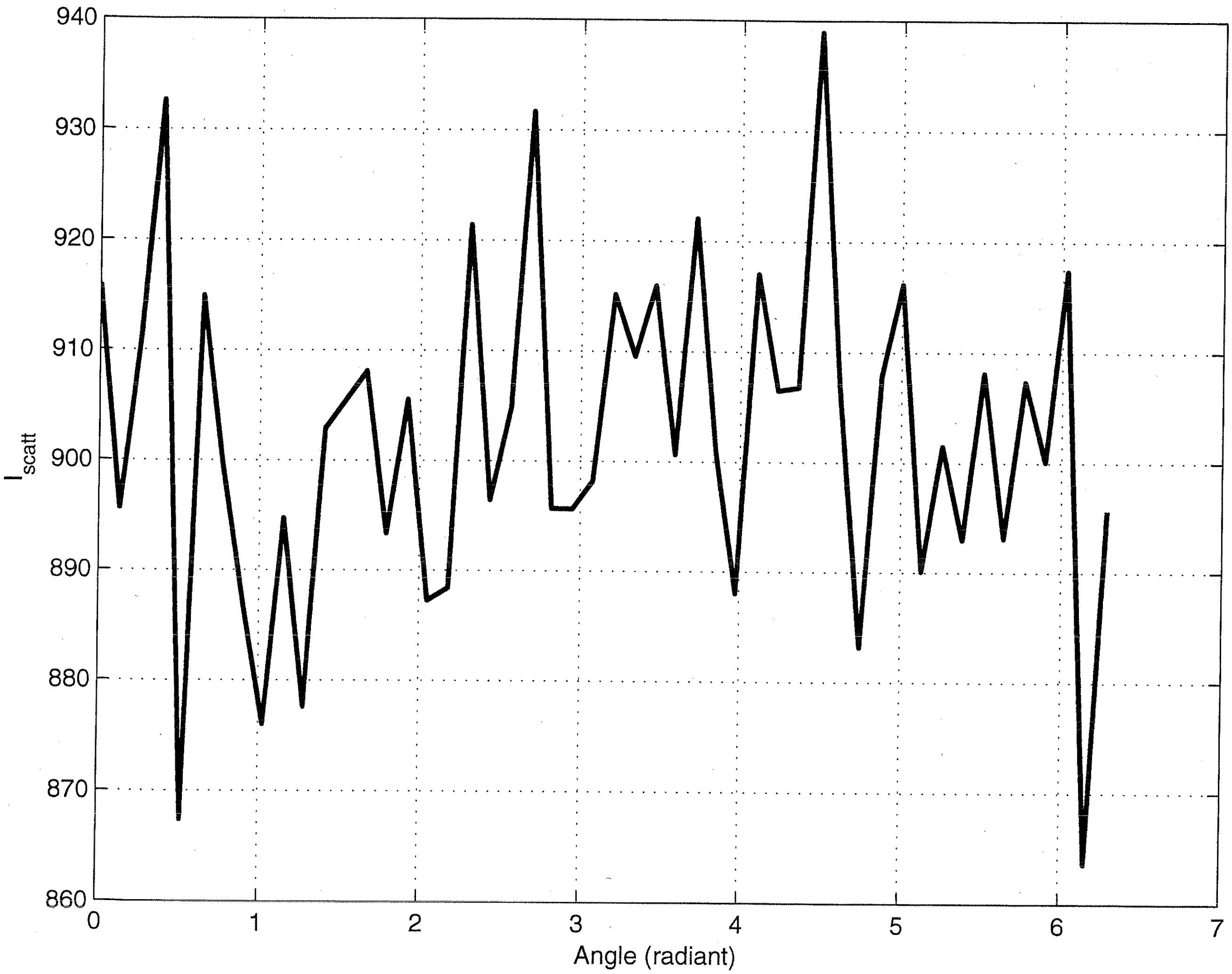
n_s

$N_{TOT} = 10000$

$n = 1000$

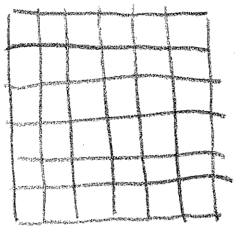
$\Omega = 0.1 = \frac{a_0}{\lambda}$

I VS ANGLE



The fluctuations are just noise ✓

$\boxed{I \text{ VS DENSITY}}$

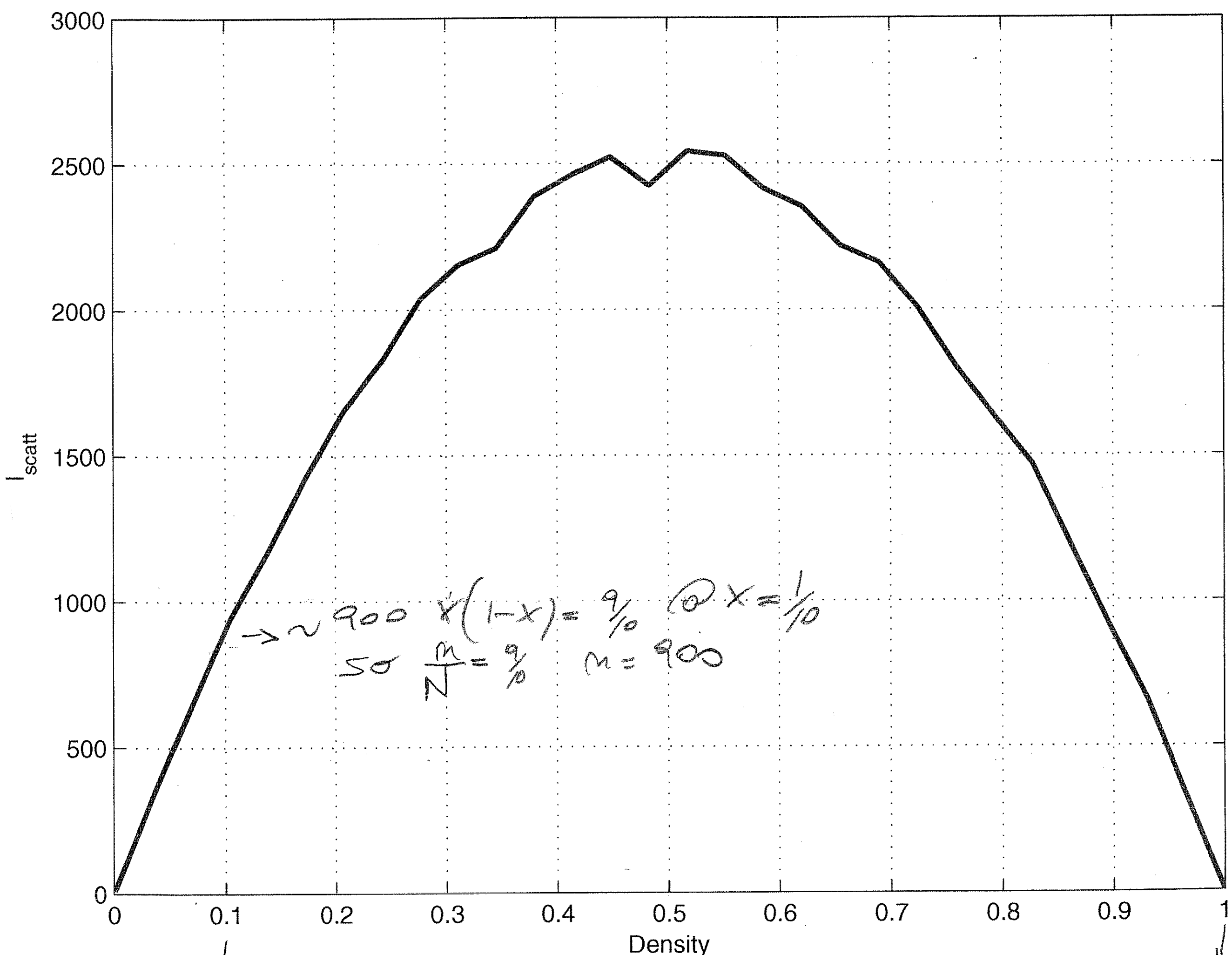


$N = 10000$

Averages $= 6000$

$\frac{a_0}{\lambda} = 0.1$

$\theta = \frac{\pi}{6}$



$n \cong 1000$

$n = 10000$

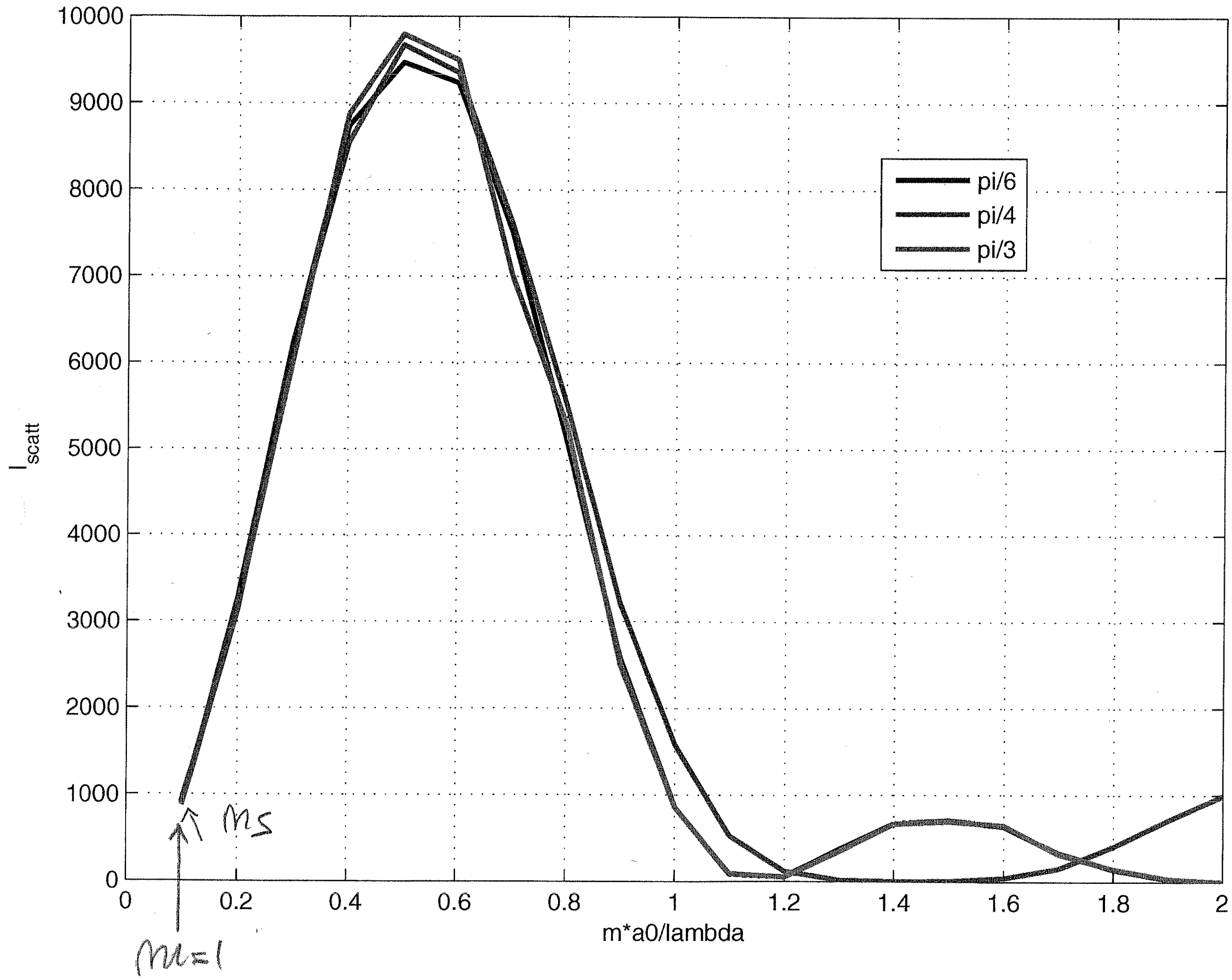
If we use $I_{SCATT} \propto$ density(1 − density) we can easily fit the curve

✓

$N_{TOT} = 10000$ Average #: 2000

$ms = 1000$

I vs m



✓