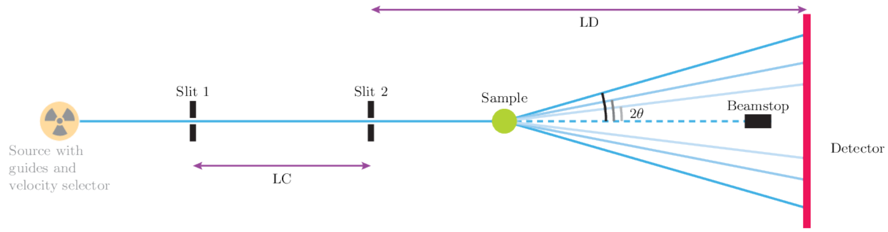
A SANS Instrument

Based on the output of the earlier exercises, we will now assemble a SANS instrument. Here is a sketch of what we want to construct:



TASKS

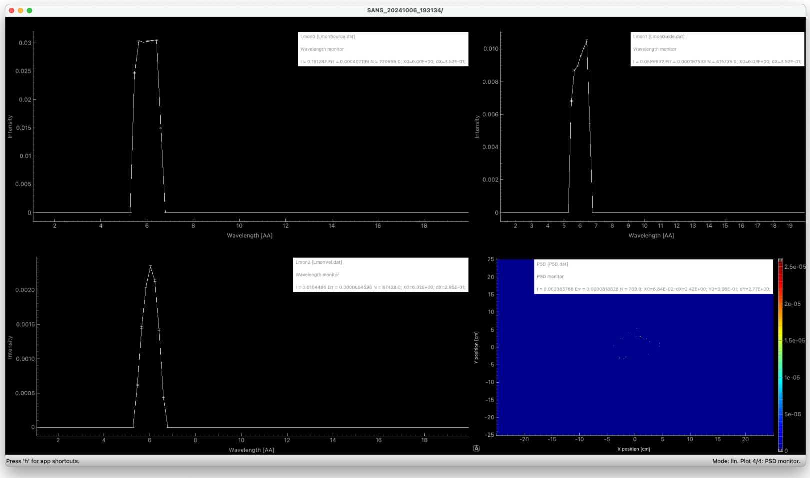
1. Find back your solution to the velocity selector exercise or use the solution provided here
2. As we learned earlier, the bandwidth of a v-selector is ~10%, so please
    - Remove the input-parameters `src_lam_min` and `src_lam_max`
    - Remove the related `if` statement in the `INITIALIZE` block
    - Change the `Source` parametrisation to use `lambda0 = lambda, dlambda = 0.1*lambda`
3. Next, add 4 input parameters, defining
    - Radius of first slit `slit1=0.02` unit: m
    - Radius of second slit `slit2=0.02` unit: m
    - Distance between the slits aka. collimation distance `LC=3` unit: m
    - Distance from last slit to detector `LD=3` unit: m
    - Radius of "hard spheres in thin solution" `R=150` unit: Å
4. Position a first `Slit` component 1mm after the last component in your instrument, set its `radius=slit1`
5. Position a second `Slit` component `LD` after the first slit, set its `radius=slit2`
6. Add this type of sample definition - and use `mcdoc` to understand the parameter significance

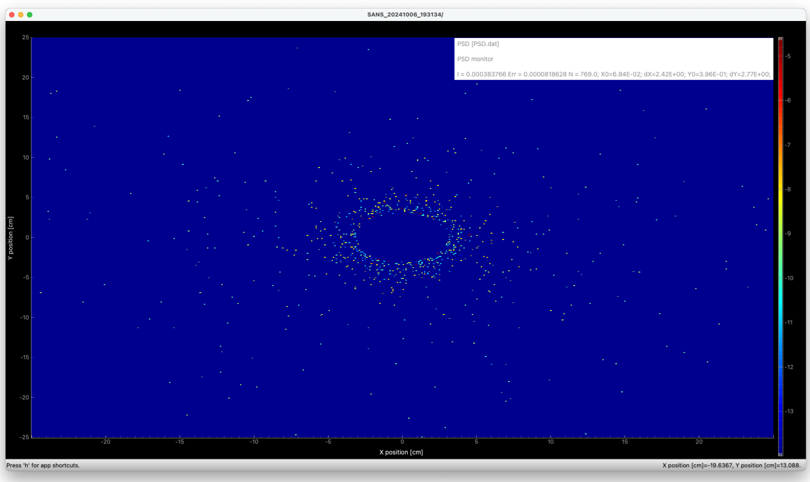
```
SPLIT 100 COMPONENT Sample = SANS_spheres2(xwidth=0.1,yheight=0.1,R=R)
  AT(0,0,0.1) RELATIVE slit2
```

7. Add a `Beamstop` of `radius=0.03` at distance `LD-0.1` from `slit2`

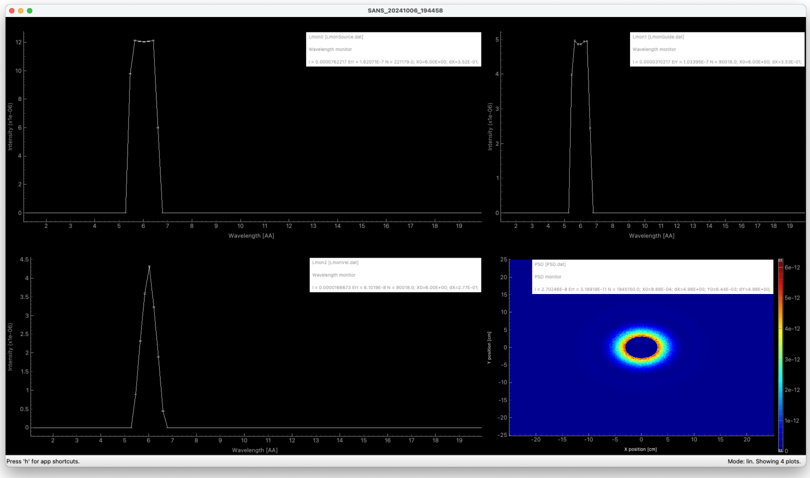
8. Add a `PSD_monitor` of dimension `xwidth=0.5,yheight=0.5` and pixellation `nx=512,ny=512`. Place it `AT(0,0,LD) RELATIVE slit2`

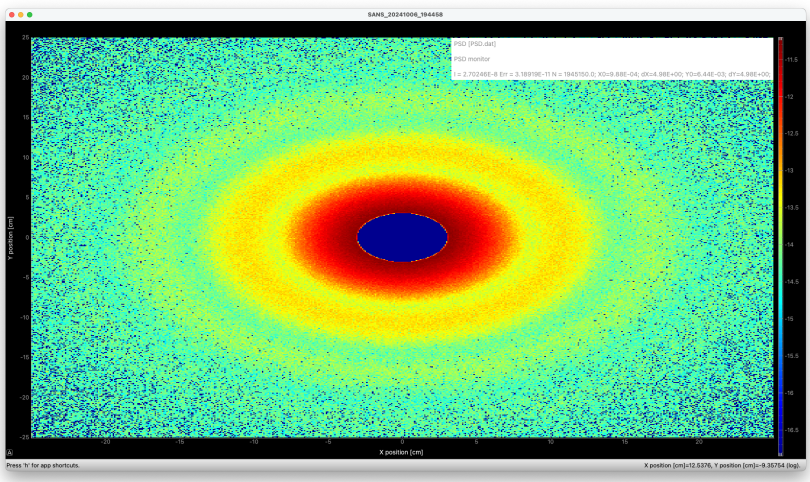
9. Run a simulation with default settings, output should look something like this, ie. not a lot





10. We now need to apply some variance reduction, we are wasting lots of statistics:
    - On the source, we will now select "region of interest" to be the second slit, set `focus_wx=slit2, focus_yh=slit2`
    - To automatically calculate the distance to the slit, set dist=0 and set `target_index=7` (7 should be the number of components to the slit, counted from the source - check your own file)
    - Further, let us use `SPLIT 100` on the sample to repeat any neutron making it through the pinhole 100 fold.
11. Rerun simulation with default settings, output should now instead look something like this, ie. much better!





12. Finally, the current detector measures in real-space, let us add a Q-sensitive detector instead, add something like this after your PSD:

```
COMPONENT detector2 = PSD_monitor_rad(rmax=0.5, nr=500, filename="PSDr.dat", filename_av="PS
  AT (0, 0, 0.001) RELATIVE PSD
```

13. We are now finally ready to explore:
    - Investigate how the pattern changes with varying `R` of the sample

    - Investigate how the pattern changes with varying `lambda`
    - Investigate how the resolution of the pattern changes with varying `LC`
    - Investigate how the resolution of the pattern changes with varying `LD`
    - Investigate how the resolution of the pattern changes with varying `slit1` and `slit2`