Computational light scattering (PAP315)

Lecture 4b

Antti Penttilä

Department of Physics, University of Helsinki, Finland

You will need ADDA for this (see Lecture 3b from last time)

- ADDA works if the command ‘adda –V’ from your command line gives output something like this:

```
ADDA v.1.4.0 (2f6acaf)
Sequential version
Built with GNU compilers version 11.3.0 (64-bit)
Extra build options: FFT_TEMPERTON
…and so forth
```

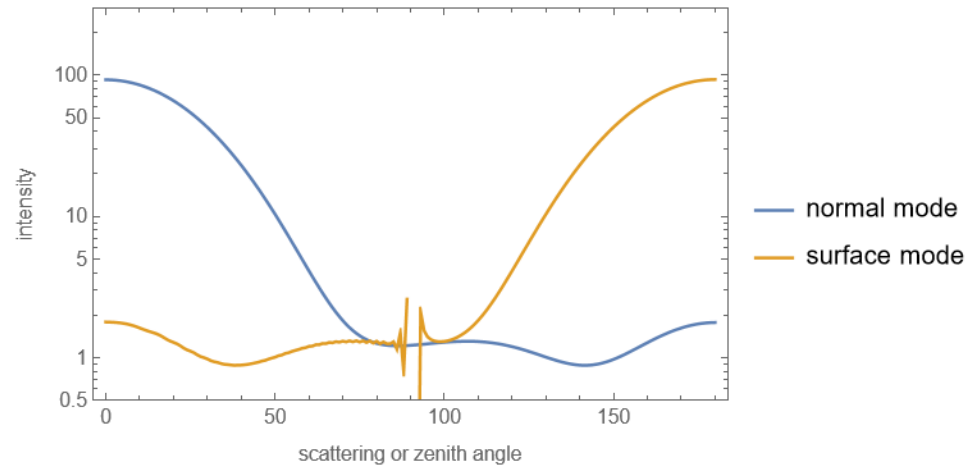
- See section *7: Surface mode* from ADDA manual

Testing an example – spherical particle in vacuum or above (infinite) surface

- One sphere in empty space:

```
adda -dir sphere -shape sphere -
size 6.234 -m 1.5 0.001 -prop 0
0 -1
```

- To be consistent with the surface version, we define a propagation direction here with '-prop'



- One sphere above 'surface' that is vacuum

```
adda -dir sphere-test -shape
sphere -size 6.234 -m 1.5 0.001
-prop 0 0 -1 -surf 100 1.001 0
```

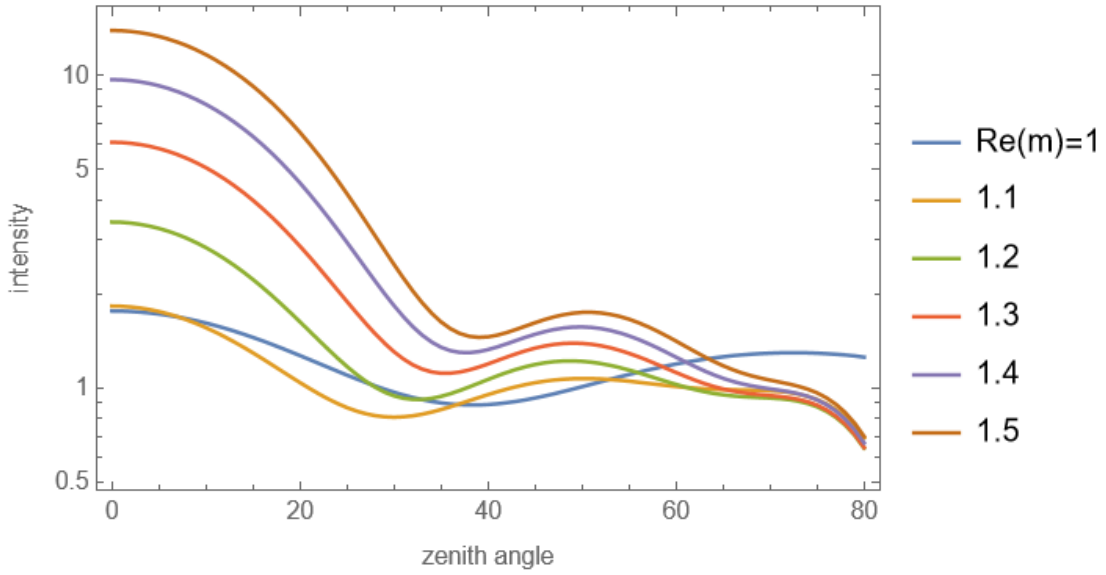
- Note that the angles in resulting mueller matrix are defined differently for normal and surface modes:
  - In normal mode, angle is scattering angle, counted from the direction of incident radiation
  - In surface mode, surface is along xy-plane, angle is counted from z-axis, and it is the 'zenith' angle

What happens to a particle close to surface with increasing *m* of the surface

- Sphere close to surface, increase the real refractive index of the surface:

```
adda -dir sphere -
ref[0/1/2/3/4/5] -shape sphere
-size 6.234 -m 1.5 0.001 -prop
0 0 -1 -surf 4
[1.001/1.1/1.2/1.3/1.4/1.5] 0
```

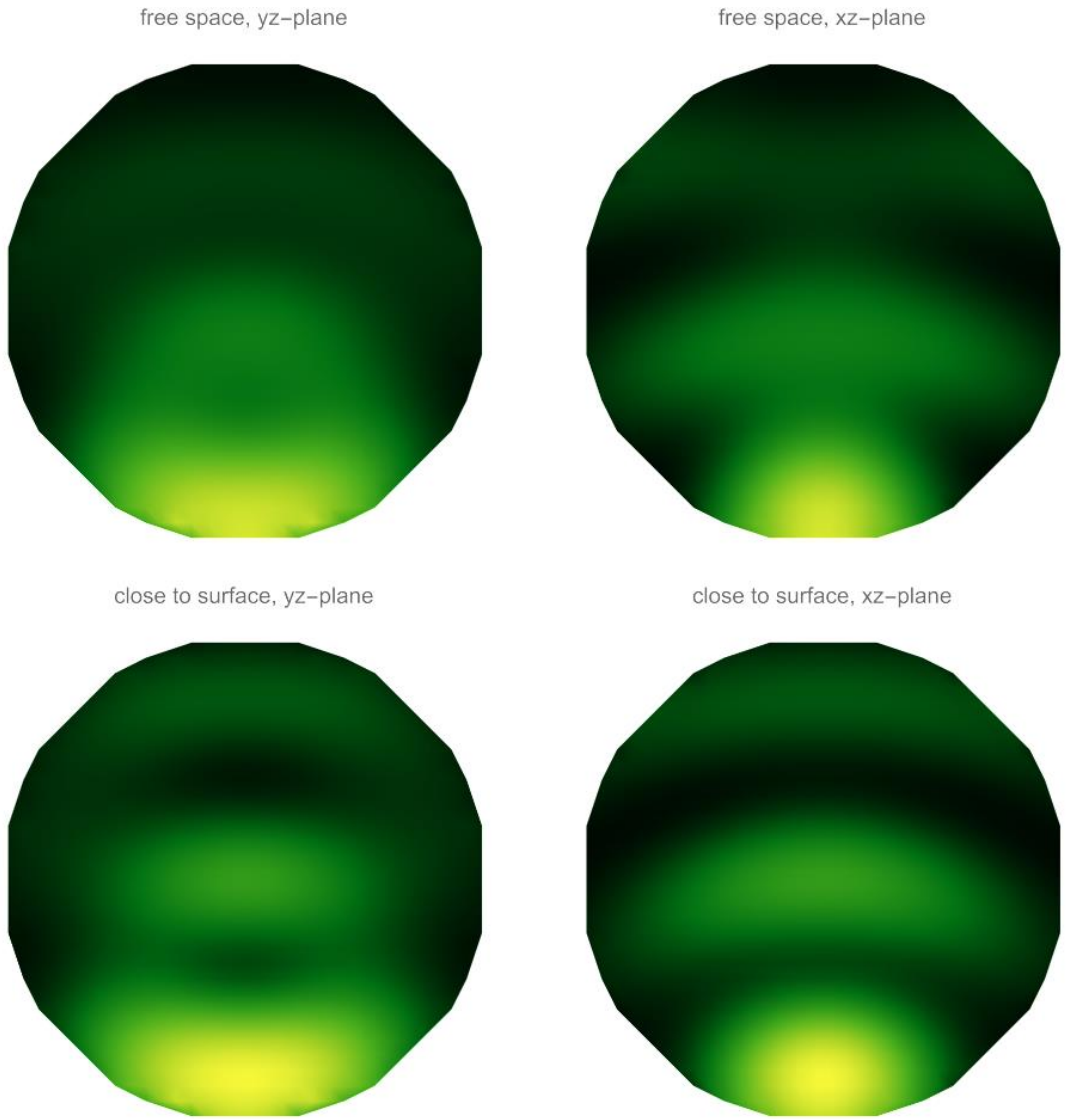
- The sphere gets more incoming power from the reflections from the surface when the surface has higher refractive index
- For example, scattering efficiency Q_{sca} can be >5 for a sphere above reflecting surface



Internal fields

```
adda -dir sphere-int[-close]
-shape sphere -size 6.234 -m
1.5 0.001 -prop 0 0 -1 [-surf
4 1.5 0] -no_vol_cor -
store_int_field -dpl 32.2524
```

- We increase ‘dpl’ for more detailed grid
- Internal field saved in file ‘IntField-Y’
- Near-fields using additional software from ‘adda/misc’ -folder



Near-fields

```
adda -dir spherebox-nearf[-
close] -shape spherebox
0.77925 -size 8 -m 1.0001 0
1.5 0.001 -prop 0 0 -1 [-surf
4 1.5 0] -no_vol_cor -
store_int_field -dpl 32.2524
```

- Near-field saved again in file ‘IntField-Y’
- With spherebox, one can surround the spherical shape with box, and make the surrounding dipoles ‘vacuum’, hence getting the near-field