

# Exercises for Radiative Transfer in Astrophysics (SS2012)

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Exercise sheet 7

## Spherical circumstellar dusty envelope model (part III)

We continue with the model of an optically thick spherically symmetric dusty cloud around a star of exercise sheet 5 and 6. Now we are going to make it a 2-D axisymmetric model, and we will include a polar cavity created by an outflow.

### 1. The 2-D envelope model with conical polar cavity

- (a) Download the new `problem_setup.f90` code. Compare it to the previous one, and try to understand the differences. Explain in words how this new model is a modified version of the previous one.
- (b) Also download the new `dustkappa_silicate.inp` opacity. What is the difference with the previous one?
- (c) Run the `problem_setup.f90` program (using the new opacity) and calculate the dust temperatures with RADMC-3D in the usual way.
- (d) Compute the SED for face-on inclination ( $i = 0$ ), for edge-on inclination ( $i = 89^\circ$ ) and for an inclination in between ( $i = 35^\circ$ ). Plot all three SEDs in a single plot and explain the differences.
- (e) Use RADMC-3D to make an image at  $\lambda = 1 \mu\text{m}$  at  $i = 30^\circ$ , using the following command: `radmc3d image lambda 1.0 incl 30`. This will produce a file called `image.out`. The RADMC-3D manual can tell you the format of this file. However, this file is not yet directly viewable.
- (f) Now let us make a directly viewable image: a `.bmp` file. Download the program `image_to_bmp.f90` from the lecture website/moodle which will allow you to convert `image.out` into `image.bmp` which is a standard (Microsoft) image format. This program asks you questions such as the minimum and maximum intensity, and whether you wish to use a linear or log scale, and whether you wish to use a greyscale or color table (if you wish to use the color table, then please also download the `ct.inp` file). Play a bit until you are satisfied with the image.

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<sup>2</sup>RADMC-3D still doesn't like exact edge-on images and spectra; bug to be fixed.