Inverse Polygon Mapping – guide

Mediavilla et al., 2006, ApJ, 653, 942

Mediavilla et al., 2011, ApJ, 741, 42

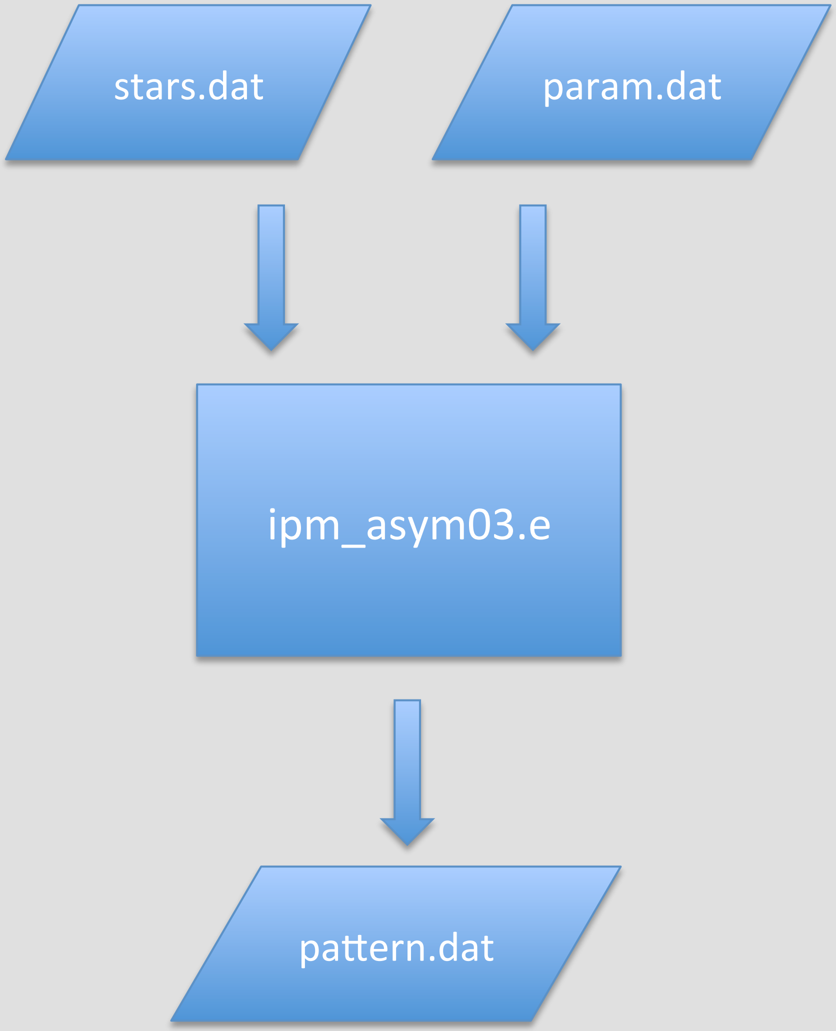
Apportioning transformed cells – algorithm

- We have an algorithm to know what fraction of the image-plane area is collected by each one of the pixels of the magnification map.

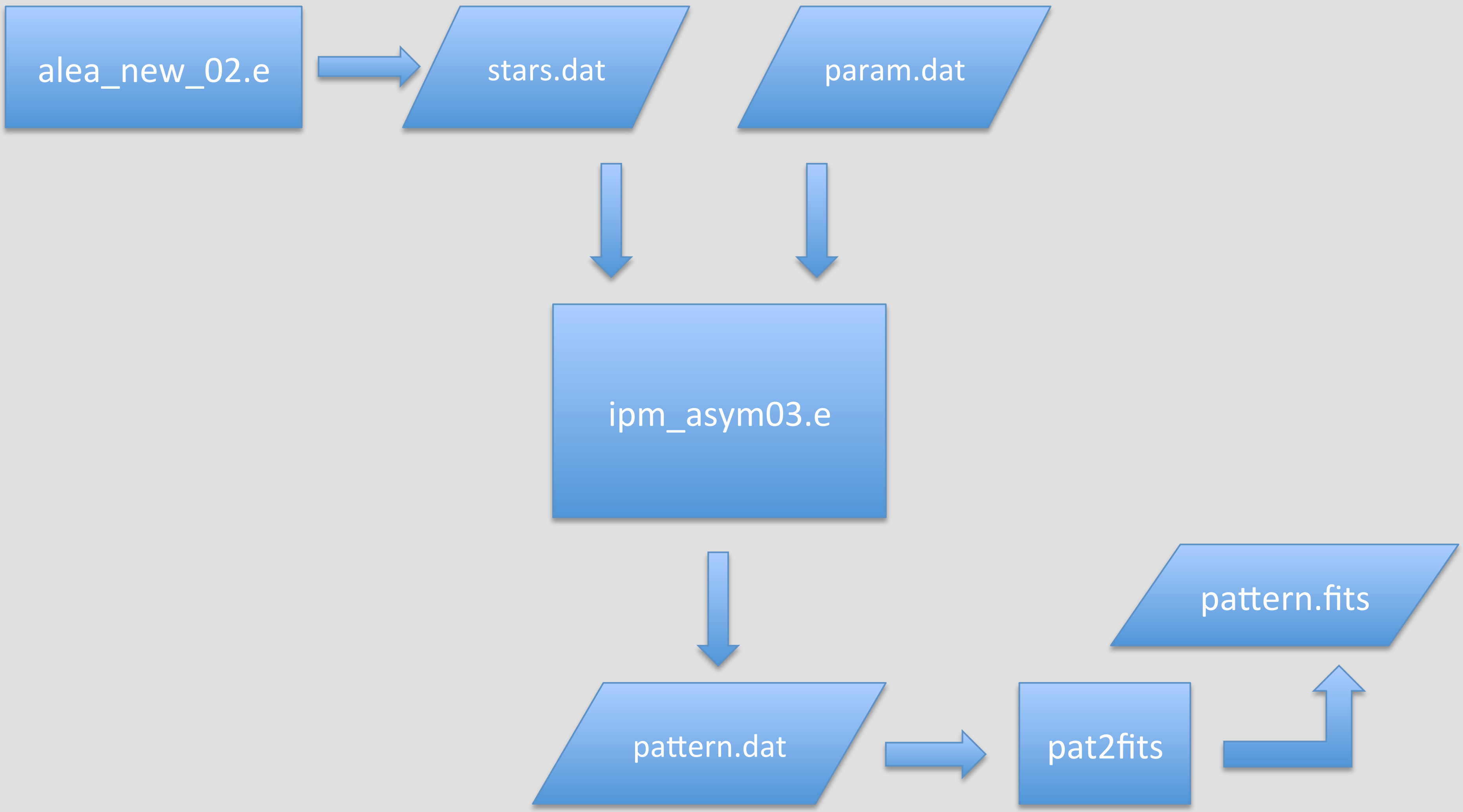
- According to Green's theorem, the area of a simply connected region with boundary C is given by the line integral

$$\int_C -y^2 \, dy^1$$

IPM – code



IPM – code


alea_new_02.e
stars.dat
param.dat
ipm_asym03.e
pattern.dat
pat2fits
pattern.fits

Input data and units – stars.dat

- stars.dat:
  - ASCII file with positions and masses for each microlens:

x_1^1 x_1^2 m_1

x_2^1 x_2^2 m_2

...

x_n^1 x_n^2 m_n

  - m_i in units of a fiducial (arbitrary) mass
  - x_i^1 x_i^2 in units of the Einstein radius of the fiducial mass

Input data and units – param.dat

- param.dat:
  - ASCII file with:

y_l n_y
x_l n_x
k_{stars} k_{smooth} γ
1

  - $2\,y_l$ (size of the magnification map in Einstein radii)
  - $2\,x_l$ (size of the largest dimension of the shooting region, $x_l = 1.5 \times \max(y_l / |1 - k \pm \gamma|)$)
  - $n_y \times n_y$ (number of pixels of the magnification map)
  - $n_x \times n_x$ (number of cells, i.e. rays, at the image plane)

Output data and units – pattern.dat

- pattern.dat:
  - ASCII file with $N=n_y \times n_y$ records (one per magnification map pixel):

μ_1

μ_2

…

μ_N

  - μ_i (pixel magnification, i.e., flux ratio F/F_0)

Optimization – n_{rays}

- All the previous parameters are familiar to IRS users, and can adopt similar values that in IRS except the number of rays (cells), n_x

- In typical IRS applications the critical quantity in terms of accuracy and computation time is the number of rays (cells) per *unlensed* pixel

$$n_{rays} = (n_x \times 2y_1)^2/(n_y \times 2x_1)^2 \approx 10 - 100$$

- Using IPM, the important restriction is that the cell size should be significantly smaller than the Einstein radius, thus the important parameter is n_x and the dependence between computing time and number of pixels, n_y, is weak for IPM.

- Using IPM, a conservative, but easy to use rule, is to adopt $n_{rays}=1$ (for typical applications in which the pixel size is very much smaller than the Einstein radius)

- But substantially smaller values of $n_{rays}<<1$ (i.e. larger cells) can be considered to obtain magnification maps with huge savings in computation time

Summary – IPM

- The concepts and parameters of IPM are very similar to those familiar to IRS users (you can use it with little effort)
- The number of rays per *unlensed* pixel, n_{rays}, can be very much relaxed
- Deliver programs and instructions