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Sources and Monitors

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Sources: In general

- A source component generates Monte Carlo neutrons.
In McStas terms this means:
 - Set the neutron state to something representative of the source we are trying to model.
 - i.e.: insert values in the neutron state vector:
 $\{x, y, z, vx, vy, vz, t, sx, sy, sz, p\}$
 drawn from appropriate distributions.
 - EXAMPLE:
 Neutrons from a uniform wavelength distribution emerging from a circular aperture.

Access the docs

IMPORTANT:

All (and more) of this information can be found in the online pdf component documentation, e.g.

https://github.com/McStasMcXtrace/McCode/raw/master/docpkg/manuals/mcstas/Component_manual.pdf

or

<http://mcstas.org/download/components/doc/manuals/mcstas-components.pdf>

- also distributed with your McStas installation - `mcdoc -c`

The component documentation along with the command:

`“mcdoc <component_you_are_searching_for>”`

are your best friends when using McStas



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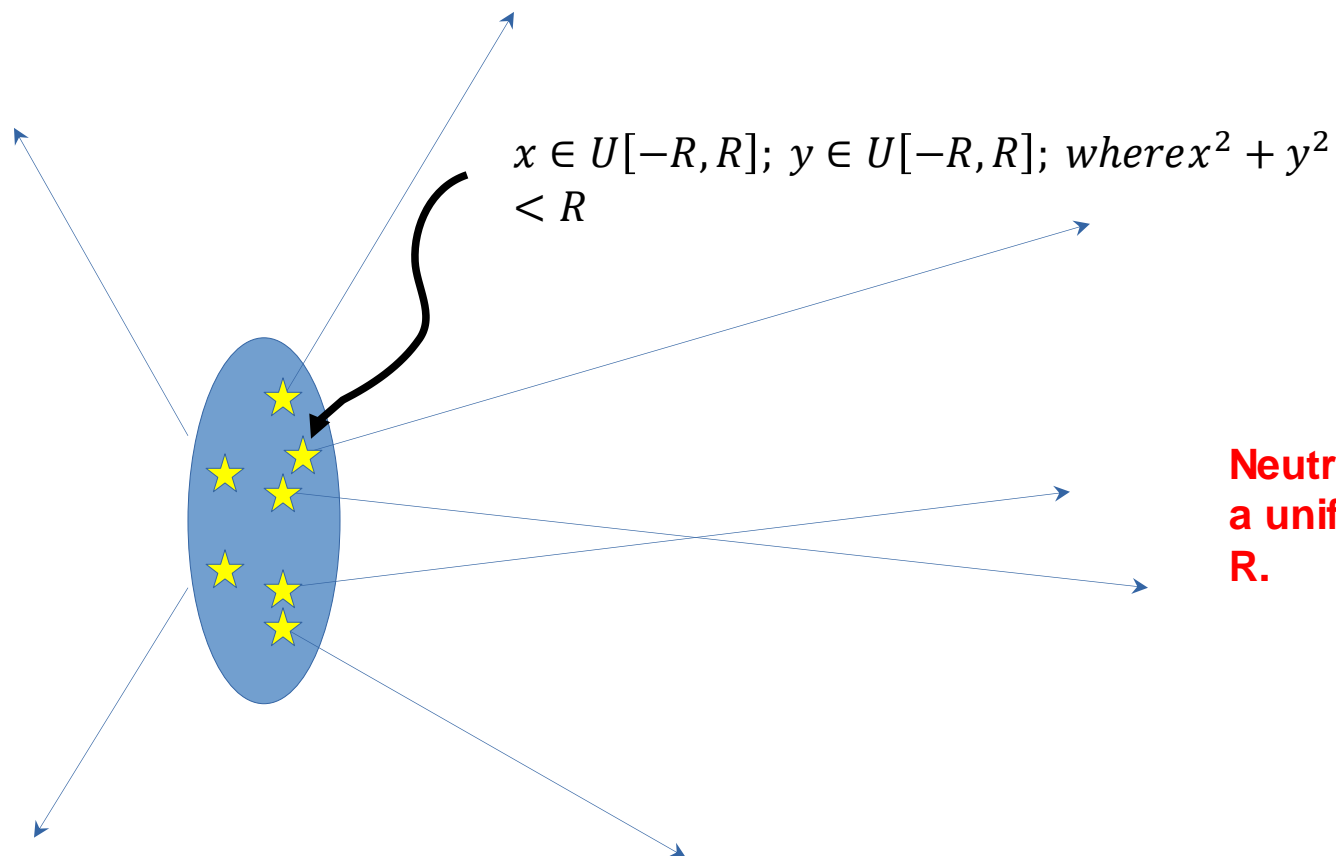
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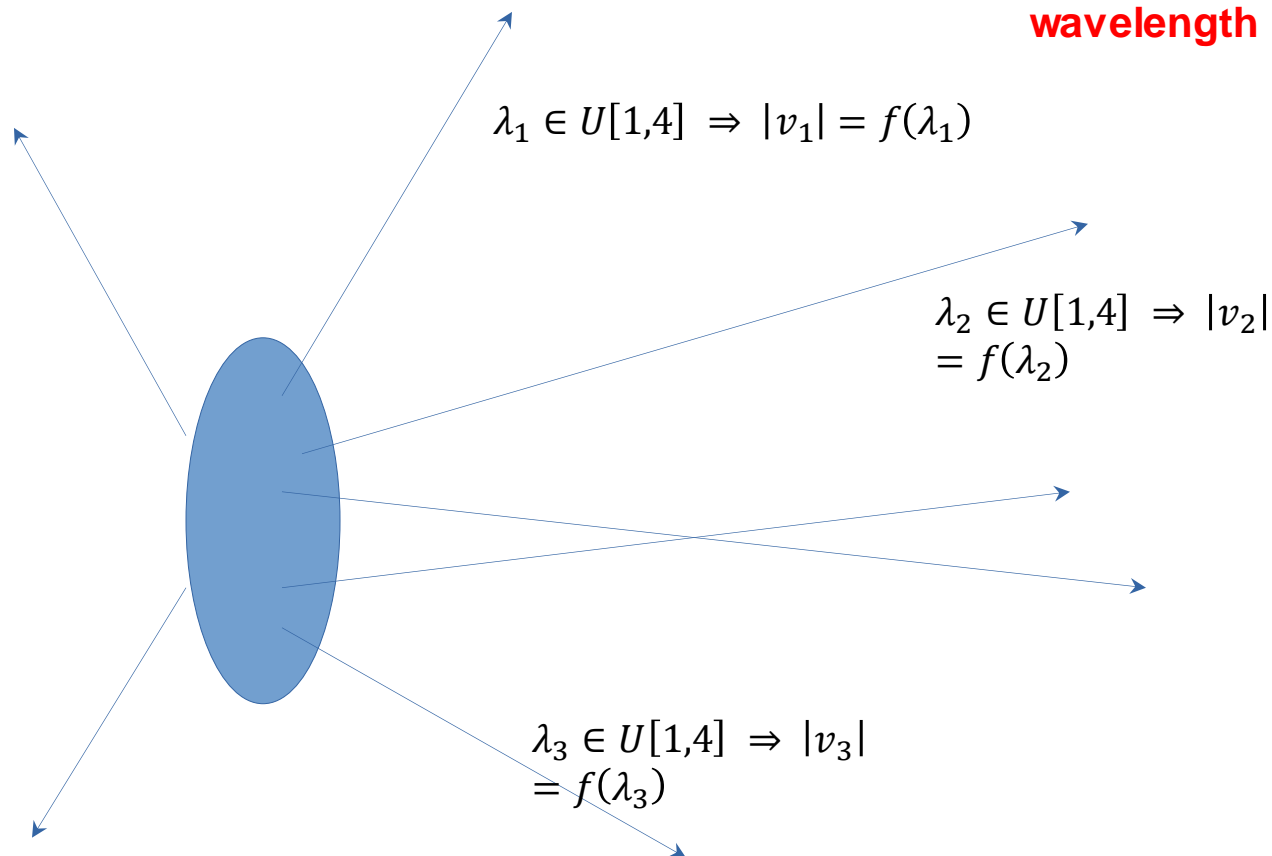
Sources: Example 1



Neutron spatial coordinates are picked from a uniform distribution on a circle with radius R .

Sources: Example 1

Length of the velocity vector encodes the wavelength



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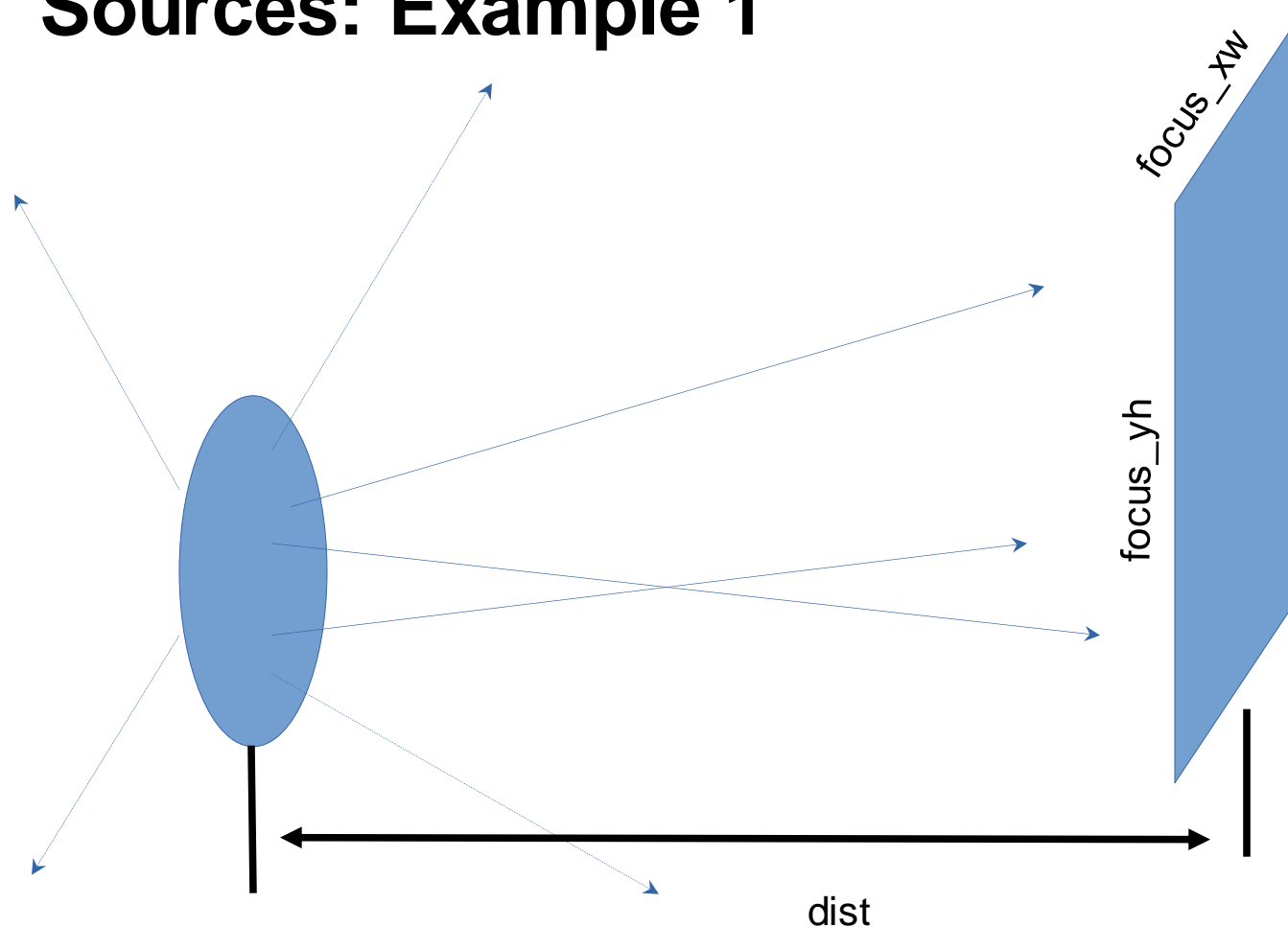
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Sources: Example 1

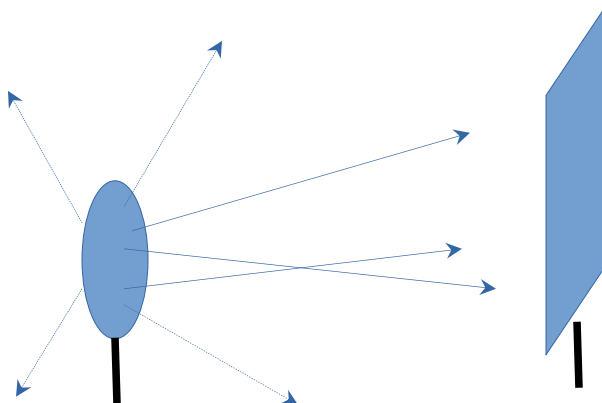


Neutron velocity vector is
picked to point at a ROI.

In McStas: this is defined by
the parameters: focus_xw,
focus_yh, and
dist



Sources: Example 1



TRACE

COMPONENT origin = Progress_bar()

AT(0,0,0) ABSOLUTE

COMPONENT src = Source_simple(

radius=0.05, lambda0=2.5, dlambda=1.5,

focus_xw=0.1, focus_yh=0.1, dist=5)

AT(0,0,0) RELATIVE origin

Monitors: in general

REALITY:

Monitors:

- Intensity probe of the beam
- Transparent to neutrons → Efficiency <1%

Detectors:

- Should detect *all* neutrons → Efficiency as high as possible

SIMULATIONS (McStas):

In McStas:

- We can program monitors and detectors to behave any way we like. We refer to both of those indistinguishably as ‘monitors’.
- E.g. monitor with Efficiency =100% and Transparency=100%
- (With exception of PSD_Detector that models a “physical” He³ detector)



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Monitors: Example PSD_monitor

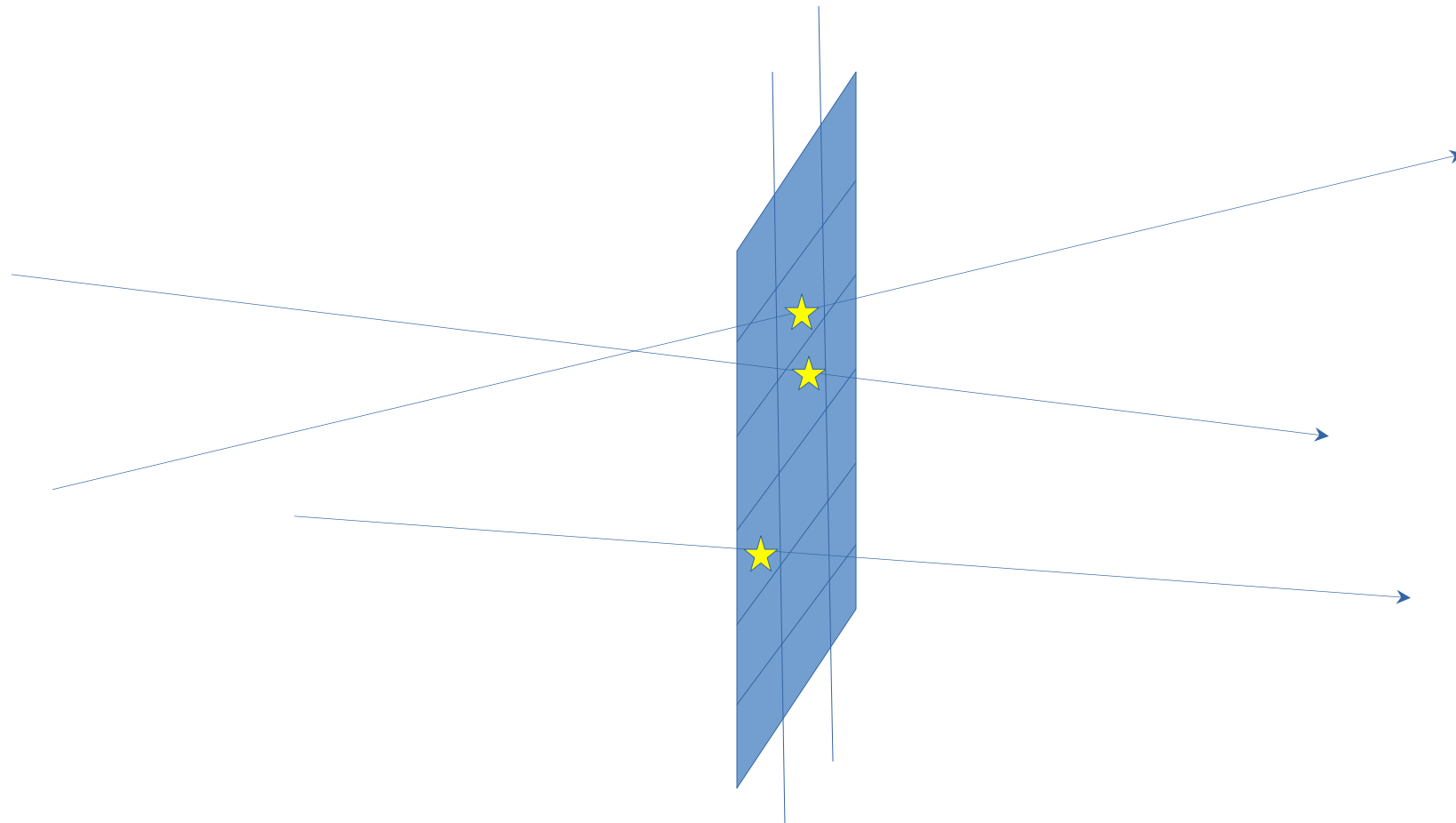
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Monitors: Example PSD_monitor

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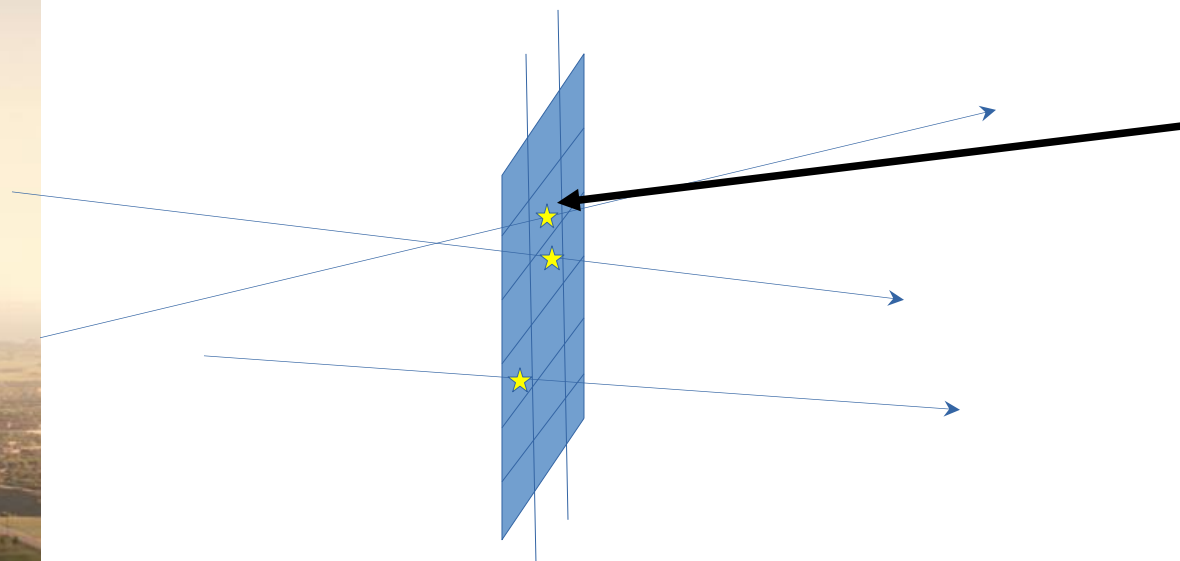
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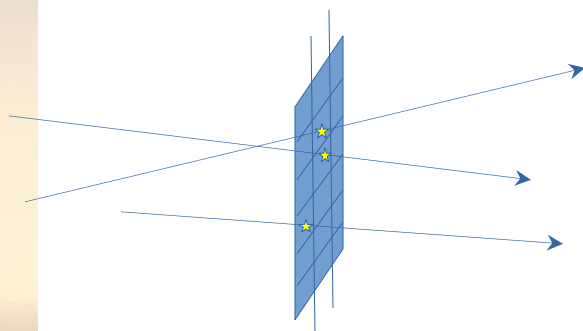


When the simulation has been completed,
the detected intensity in pixel (i,j) is:

$$I(i,j) = \sum_{x_k, y_k \in \text{pixel}(i,j)} p_k ; k \\ = \text{raynumber}.$$

... during simulation, the pixels are
maintained as running sums.

Monitors:
Example PSD_monitor and L_monitor



...

TRACE

```
COMPONENT origin = Progress_bar()  
AT (0,0,0) ABSOLUTE
```

```
COMPONENT src = Source_simple(  
    radius=0.05,    lambda0=2.5, dlambda=1.5,  
    focus_xw=0.1, focus_yh=0.1, dist=5)  
AT (0,0,0) RELATIVE origin
```

```
COMPONENT psd = PSD_monitor(  
    xwidth=0.2, yheight=0.2, filename="psd.dat")  
AT (0,0,5) RELATIVE src
```

```
COMPONENT lm = L_monitor(  
    xwidth=0.2, yheight=0.2, filename="lm.dat",  
    Lmin=0, Lmax=8)  
AT (0,0,5+0.01) RELATIVE src
```

Sources: Mathematical sources

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Source_simple:

- Square or circular surface emitting neutrons from either uniform or Gaussian wavelength (or energy) distribution.
- Neutrons are directed towards a square target.

- Source_div:
- Square surface emitting neutrons from either uniform or Gaussian wavelength (or energy) distribution.
- Neutrons have a divergence defined by either uniform or Gaussian distribution.

Source_simple docs

Try “**mcdoc Source_simple**”

or

(in GUI) **Help** → **mcdoc Component Reference** → (In Webpage) **Source_simple**



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McStas: Source_simple - Mozilla Firefox

McStas: Source_simple x +

file:///usr/share/mcstas/2.5/sources/Source_simple.html

[[Identification](#) | [Description](#) | [Input parameters](#) | [Output parameters](#) | [Links](#)]

The Source_simple Component

A circular neutron source with flat energy spectrum and arbitrary flux

Identification

- **Site:**
- **Author:** Kim Lefmann
- **Origin:** Risoe
- **Date:** October 30, 1997

Description

The routine is a circular neutron source, which aims at a square target centered at the beam (in order to improve MC-acceptance rate). The angular divergence is then given by the dimensions of the target. The neutron energy is uniformly distributed between $\lambda_{\text{bda0}} - d\lambda_{\text{bda}}$ and $\lambda_{\text{bda0}} + d\lambda_{\text{bda}}$ or between $E_0 - dE$ and $E_0 + dE$. The flux unit is specified in $\text{n/cm}^2/\text{s}/\text{st}/\text{energy unit (meV or Angs)}$.

This component replaces Source_flat, Source_flat_lambda, Source_flux and Source_flux_lambda.

Source_simple docs

Try “**mcdoc Source_simple**”

or

(in GUI) **Help** → **mcdoc Component Reference** → (In Webpage) **Source_simple**



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McStas: Source_simple - Mozilla Firefox

McStas: Source_simple

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This component replaces Source_flat, Source_flat_lambda, Source_flux and Source_flux_lambda.

Click “**Input parameters**”

Source_simple docs

Try “**mcdoc Source_simple**”

or

McStas: Source_simple - Mozilla Firefox

McStas: Source_simple x +

file:///usr/share/mcstas/2.5/sources/Source_simple.html#

Input parameters

Parameters in **boldface** are required; the others are optional.

Name	Unit	Description	Default
radius	m	Radius of circle in (x,y,0) plane where neutrons are generated.	0.1
yheight	m	Height of rectangle in (x,y,0) plane where neutrons are generated.	0
xwidth	m	Width of rectangle in (x,y,0) plane where neutrons are generated.	0
dist	m	Distance to target along z axis.	0
focus_xw	m	Width of target	.045
focus_yh	m	Height of target	.12
E0	meV	Mean energy of neutrons.	0
dE	meV	Energy half spread of neutrons (flat or gaussian sigma).	0
lambda0	AA	Mean wavelength of neutrons.	0
dlambda	AA	Wavelength half spread of neutrons.	0
flux	1/(s*cm**2*st*energy unit)	flux per energy unit, Angs or meV if flux=0, the source emits 1 in 4*PI whole space.	1
gauss	1	Gaussian (1) or Flat (0) energy/wavelength distribution	0
target_index	1	relative index of component to focus at, e.g. next is +1 this is used to compute 'dist' automatically.	+1

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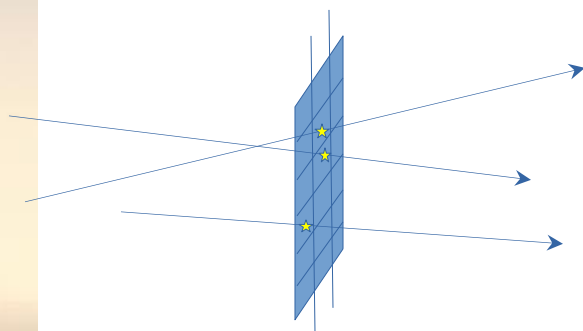
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Monitors: Example PSD_monitor and L_monitor



Let's do a very simple exercise on this:

Head on over to:

[Exercise 1 - Sources and Monitors on github](#)

https://github.com/McStasMcXtrace/Schools/tree/master/ESS_May_2021/Wednesday_May_5th/2_Component_basics/Exercise