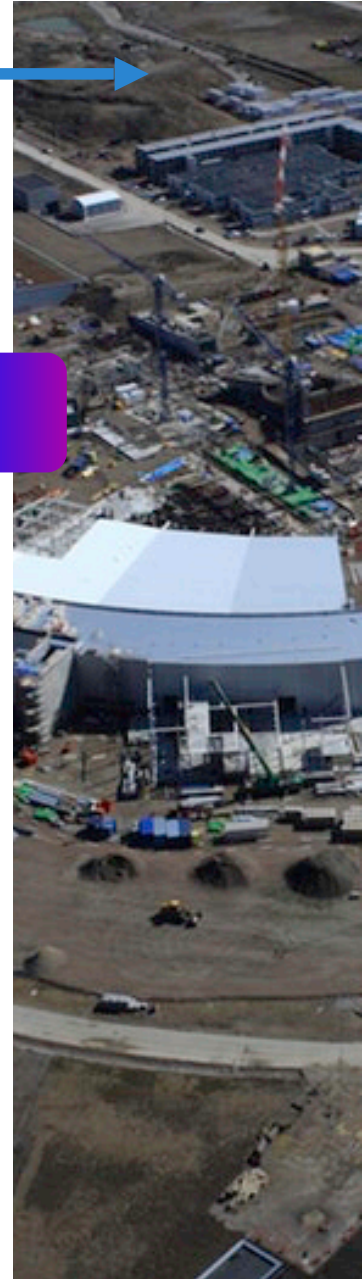


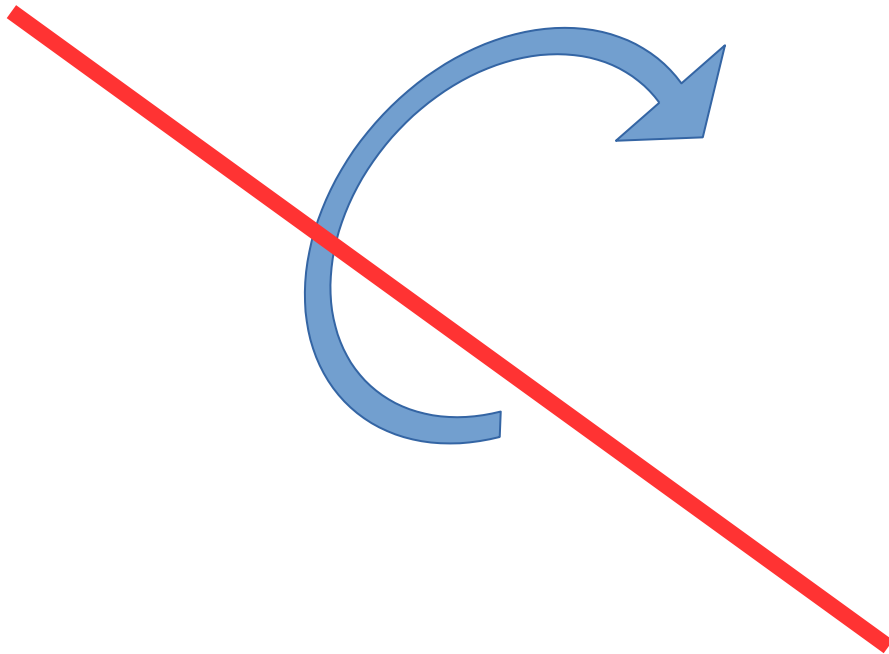
## 4 - *Moving Optics*

- *Velocity selector*
- *Disk Chopper*
- *Fermi Chopper*

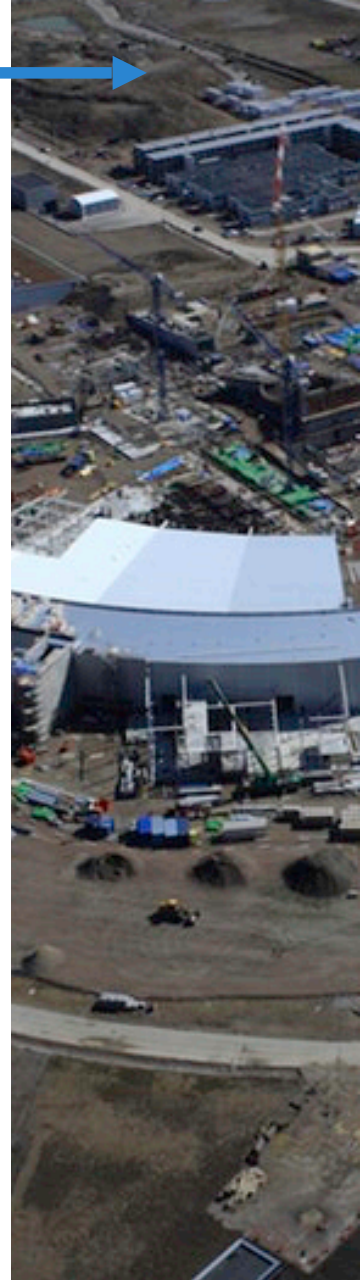


*Moving optics*

*Not optics that move*



*...optics with moving parts*



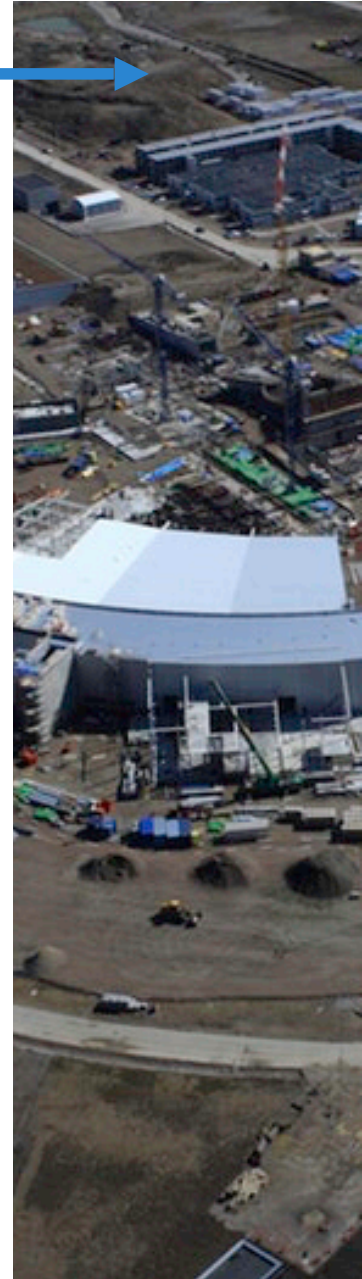
## Moving optics

---

*I.e. we can't do:*

```
COMPONENT something = Sometype(  
    par1=value1, par2=value2, ...)  
AT( f_x(t), f_y(t), f_z(t) )RELATIVE someother
```

So what **can** we do?



## Moving optics

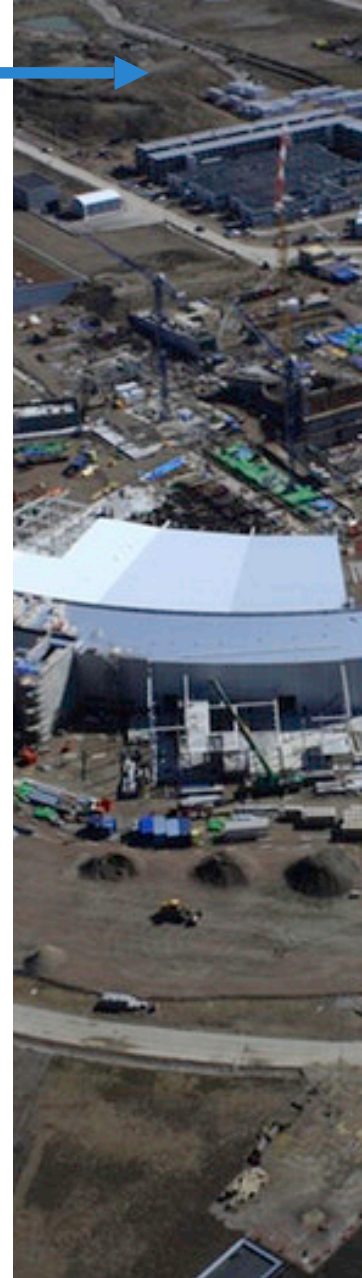
---

*I.e. we can't do:*

```
COMPONENT something = Sometype(  
    par1=value1, par2=value2, ...)  
AT( f_x(t), f_y(t), f_z(t) )RELATIVE someother
```

So what **can** we do?

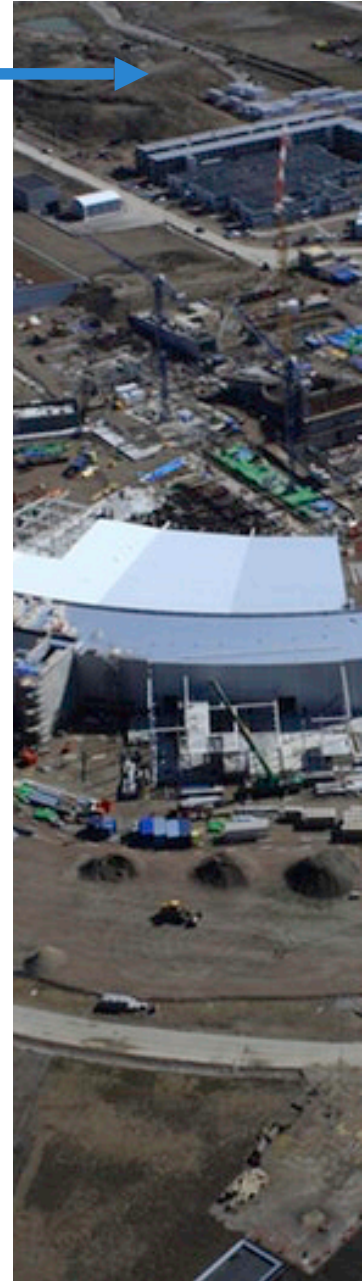
*Instead, we operate internally in the component on the neutron state, e.g. “rotate” the neutron etc.*



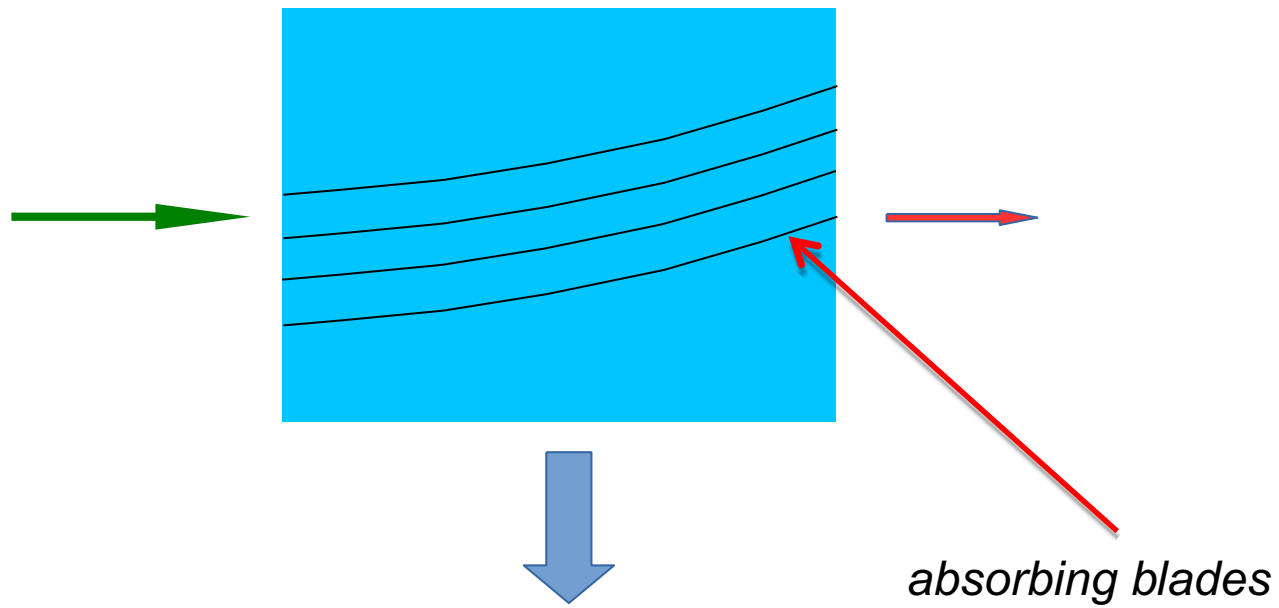
# *Velocity Selectors*

-

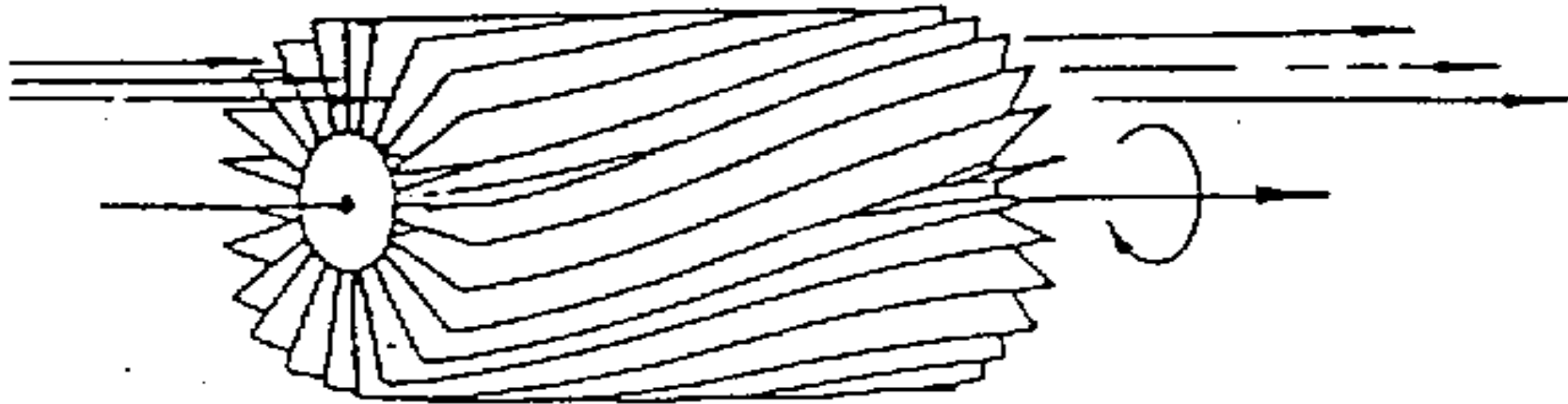
*Select the neutron energy you want*



# Velocity Selectors

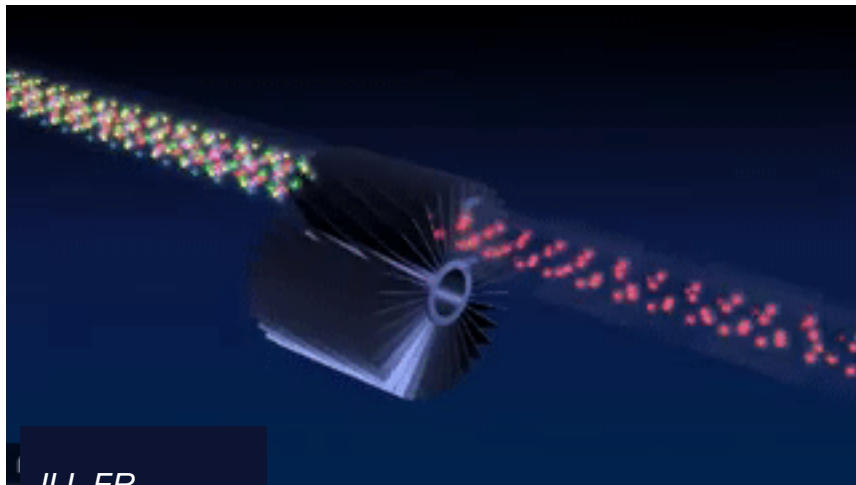


## Velocity Selectors



## Velocity Selector

*'broad' monochromatization*  $\delta\lambda/\lambda \approx 10\%$





## Input parameters

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

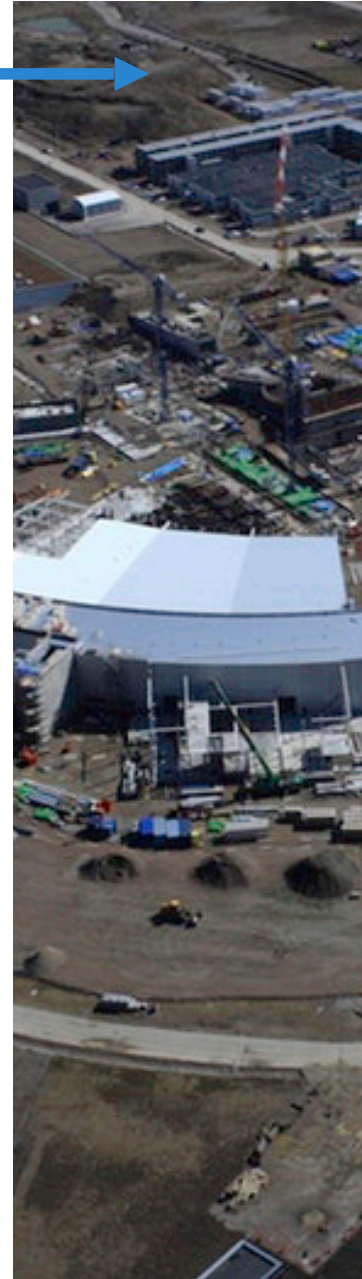
<b>Name</b>	<b>Unit</b>	<b>Description</b>	<b>Default</b>
xwidth	m	Width of entry aperture	0.03
yheight	m	Height of entry aperture	0.05
zdepth	m	Distance between apertures, for housing containing the rotor	0.30
radius	m	Height from aperture centre to rotation axis	0.12
alpha	deg	Twist angle along the cylinder	48.298
length	m	Length of cylinder/rotor (less than zdepth)	0.25
d	m	Thickness of blades	0.0004
nu	Hz	Cylinder rotation speed, counter-clockwise, which is ideally $3956 \cdot \alpha \cdot \text{DEG2RAD} / 2 / \text{PI} / \text{length}$	300
nslit	1	Number of Soller blades	72



## Velocity Selector

### **Exercise 4.1**

- Open the *Ex\_4\_1\_selector.instr* instrument
- Notice the use of wavelength monitors *L\_mon*
- Notice the use of the *V\_selector* component
- Input parameter defines selector rotational
  - *velocity/frequency (Hz)*



## Exercise 4.1 cont'd

Perform a TRACE at the default  $f=300\text{Hz}$

- Perform a SIMULATE of  $1e7$  neutrons at default  $f$
- Perform a series of simulations in the range:  $150 < f < 800$  (e.g. 5 steps)
- Compare the transmitted beam in the different cases
- Question: What is the ideal rotational speed to select neutrons of  $10 \text{ \AA}$  with the selector from Ex 7.1 (Hint  $l[\text{\AA}] \sim 3956 / v [\text{m/s}]$ )

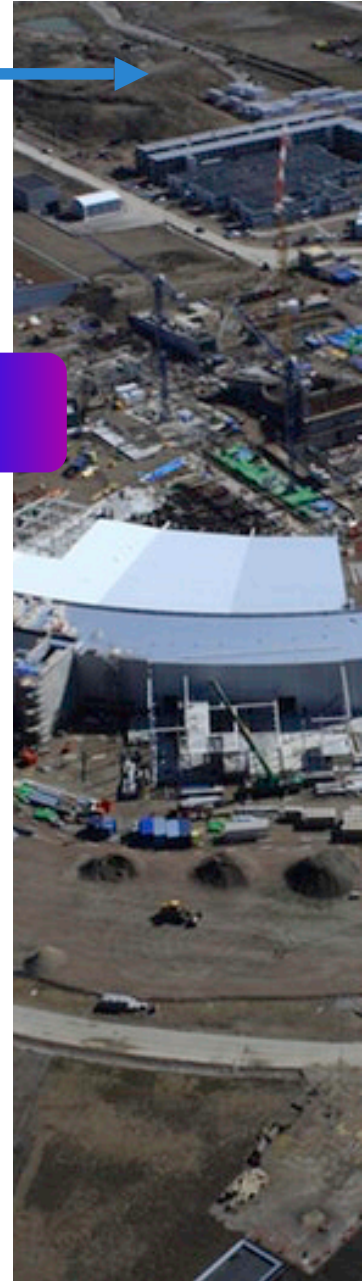


## Choppers – Fermi and Disk

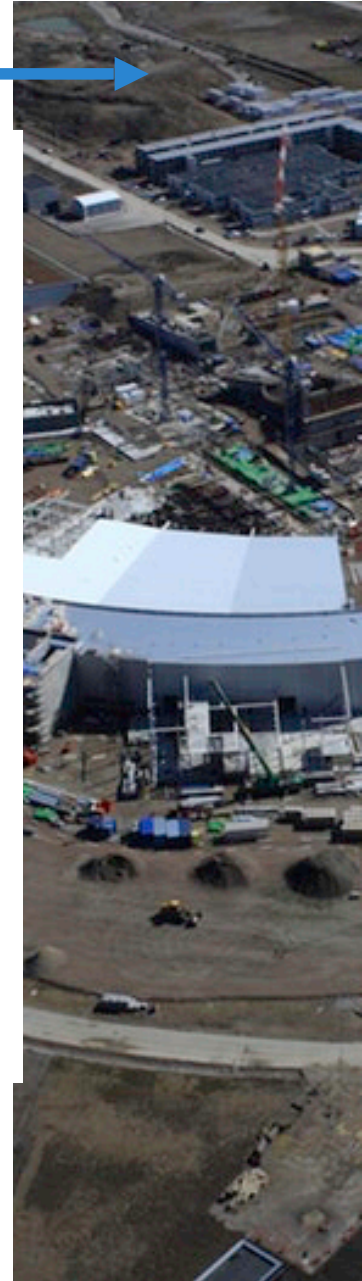
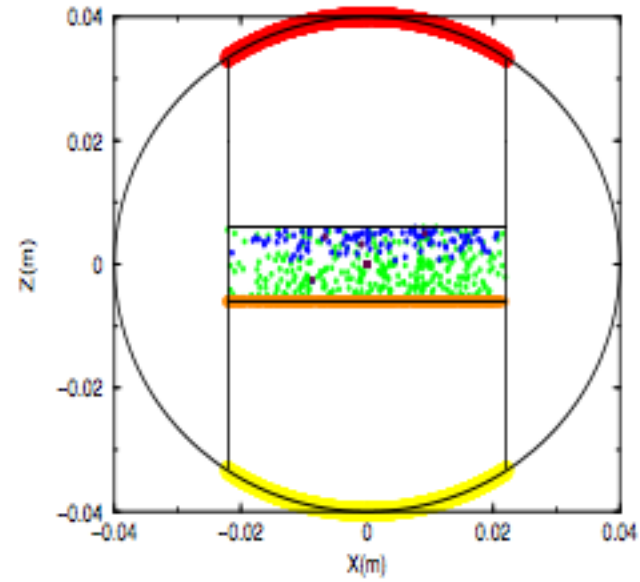
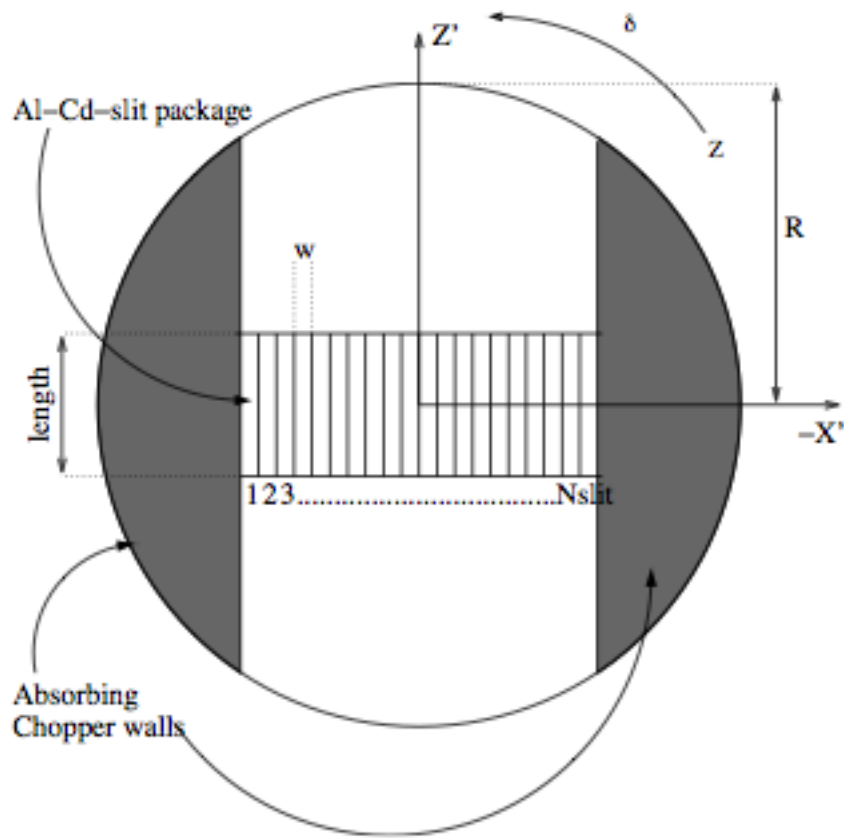


*Define time structure of the beam*

*Time Of Flight (TOF) measurements*



# Fermi Chopper

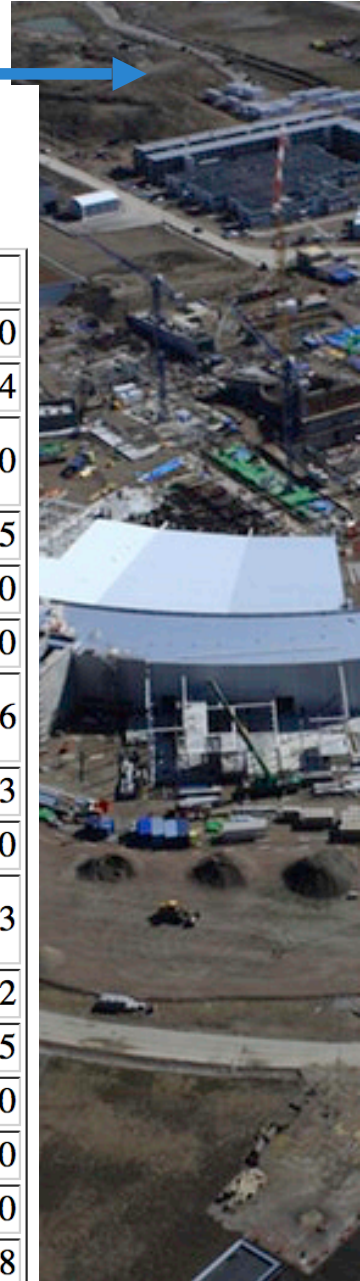


# Fermi Chopper

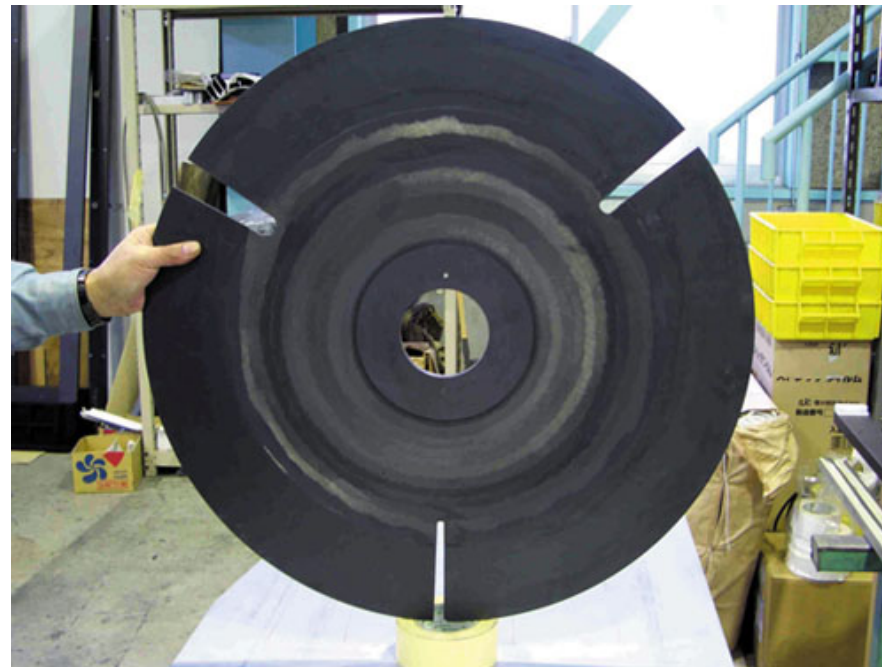
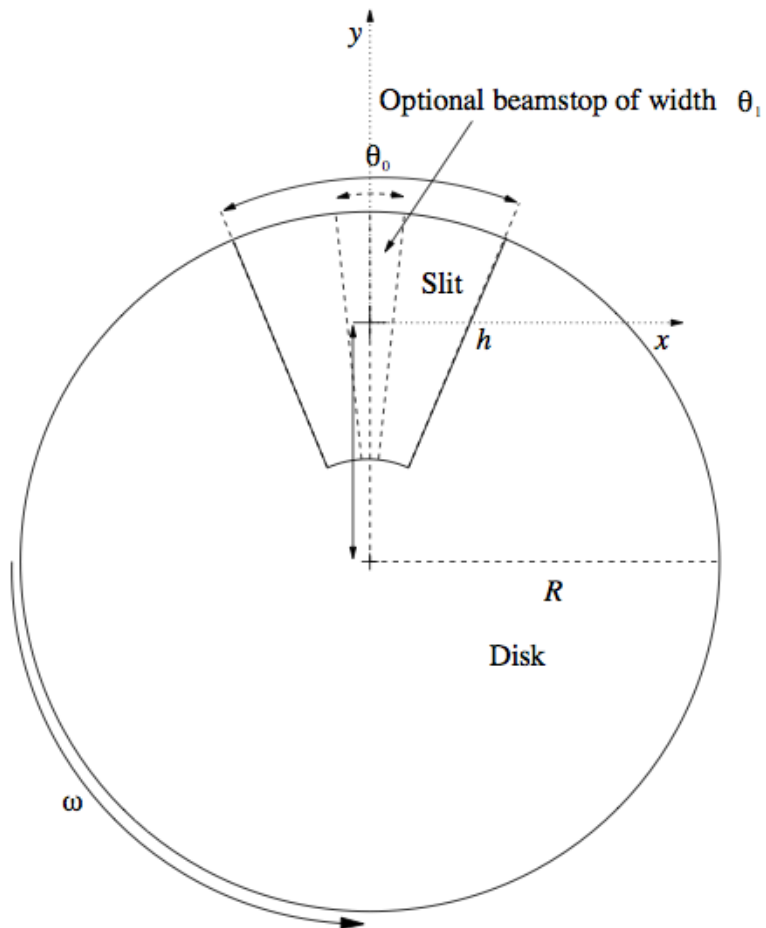
## Input parameters

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

Name	Unit	Description	Default
phase	deg	chopper phase at t=0	0
radius	m	chopper cylinder radius	0.04
nu	Hz	chopper frequency. $\Omega=2*\pi*\nu$ in rad/s, $\nu*60$ in rpm. Positive value corresponds to a clockwise rotation from X towards Z from above ( $y>0$ ).	100
w	m	width of one chopper slit	0.00022475
nslit	1	number of chopper slits	200
R0	1	low-angle reflectivity	0.0
Qc	AA-1	critical scattering vector	0.02176
alpha	AA	slope of reflectivity	2.33
m	1	m-value of material. Zero means completely absorbing.	0.0
W	AA-1	width of supermirror cut-off	2e-3
length	m	channel length of the Fermi chopper	0.012
eff	1	efficiency = transmission x fraction of transparent material	0.95
zero_time	1	set time to zero: 0=no, 1=once per half cycle, 2=auto adjust phase	0
xwidth	m	optional total width of slit package	0
verbose	1	set to 1,2 or 3 gives debugging information	0
yheight	m	height of slit package	0.08
curvature	m-1	Curvature of slits (1/radius of curvature).	0
delay	s	sets phase so that transmission is centered on 'delay'	0



## Disk Chopper



- If  $h$  not explicitly specified,  $h=R$
- Auto-centering the beam axis 'z' at  $R-h$  (half-height of slit)

## Disk Chopper

# Input parameters

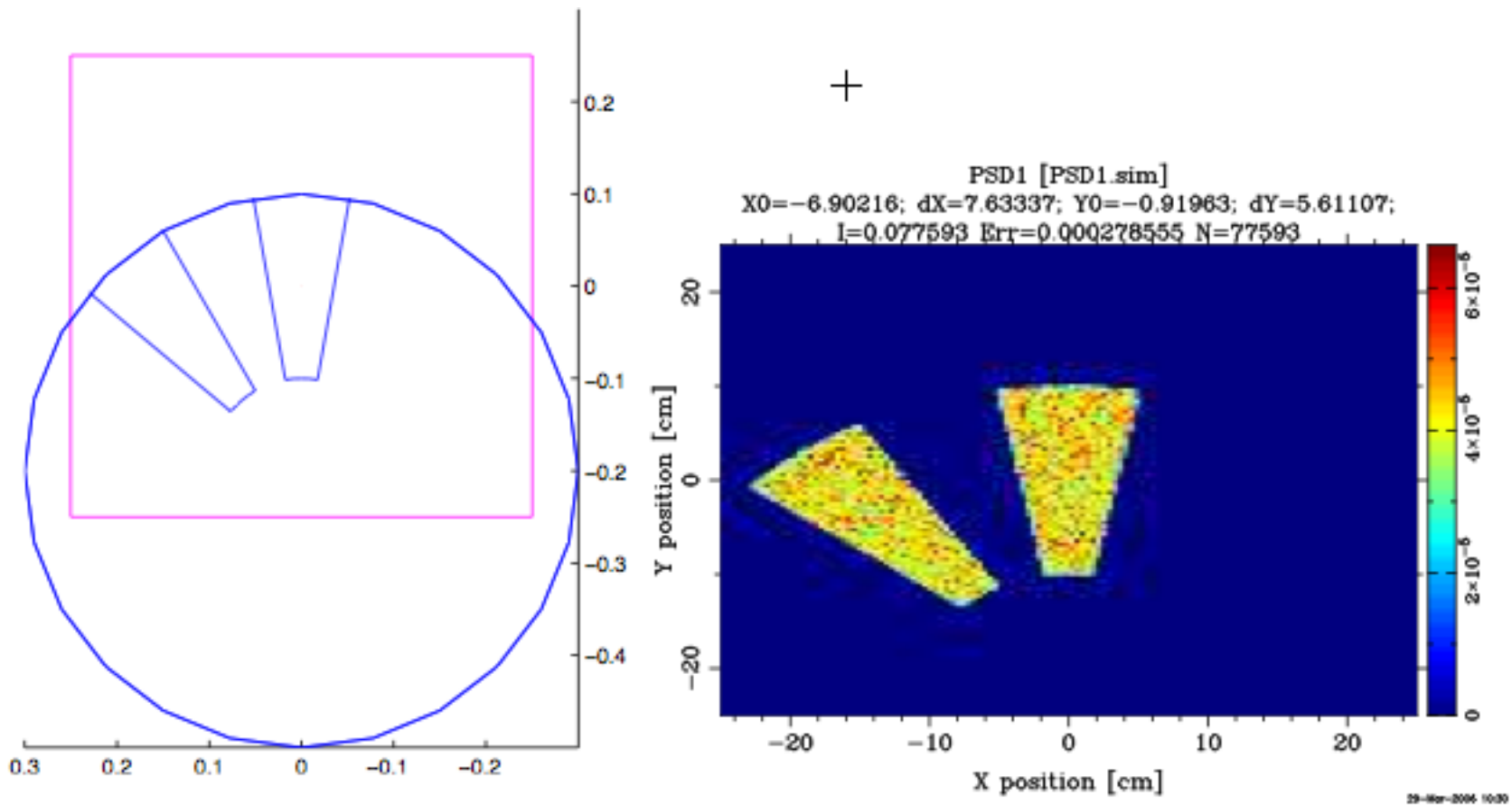
Parameters in **boldface** are required; the others are optional.

<b>Name</b>	<b>Unit</b>	<b>Description</b>	<b>Default</b>
theta_0	deg	Angular width of the slits.	0
radius	m	Radius of the disc	0.5
<b>yheight</b>	m	Slit height (if = 0, equal to radius). Auto centering of beam at half height.	
<b>nu</b>	Hz	Frequency of the Chopper, $\omega=2*\text{PI}*\nu$ (algebraic sign defines the direction of rotation)	
nslit	1	Number of slits, regularly arranged around the disk	3
jitter	s	Jitter in the time phase	0
delay	s	Time 'delay'.	0
isfirst	0/1	Set it to 1 for the first chopper position in a cw source (it then spreads the neutron time distribution)	0
n_pulse	1	Number of pulses (Only if isfirst)	1
abs_out	0/1	Absorb neutrons hitting outside of chopper radius?	1
phase	deg	Angular 'delay' (overrides delay)	0
xwidth	m	Horizontal slit width opening at beam center	0
verbose	1	Set to 1 to display Disk chopper configuration	0

*nslit placed equidistantly around the disk....*

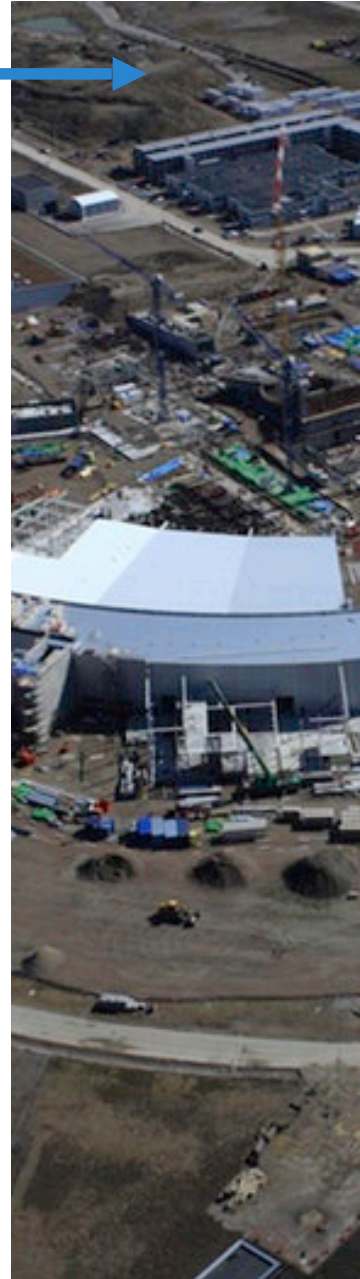
## Disk Chopper

*Non-equidistant configurations should be realized via the GROUP keyword.... (illustrated below, nu=0)*



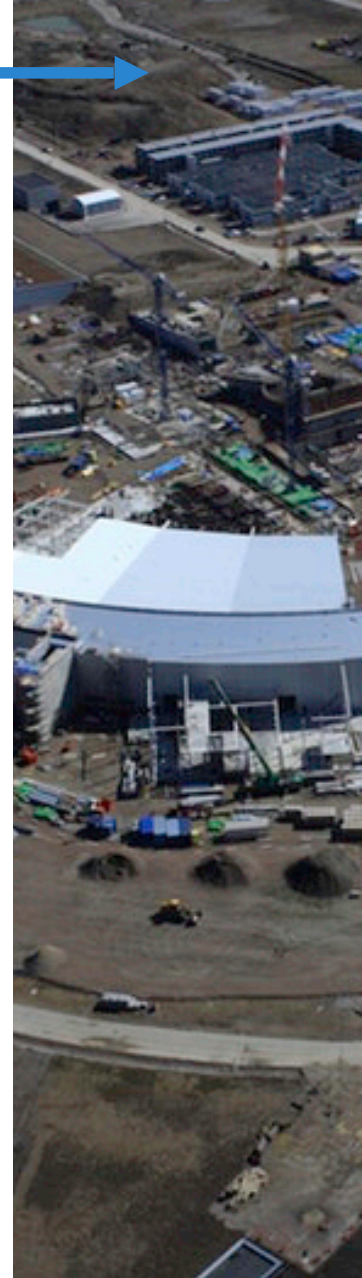
## Exercise 4.2

- Open the *Ex\_4\_2\_chopper.instr* instrument
- Notice use of the *EXTEND* `%{ %}` section, defining a time structure (1 second, flat distribution)
- Notice use of *Monitor\_nD*, our “Swiss army knife” monitor
  - `options="t auto bins=200"`
  - `options="t auto bins=200 x auto bins=200"`



## Exercise 4.2 cont'd:

- *Insert a disk chopper 0.5 mm after guide exit*
- *Chopper Component Parameters:*
  - *radius of disk-chopper (we use 0.5 m)*
  - *n, number of openings (we use 2)*
  - *Phase (angular phase at  $t=0$ , in degrees, we use 90 deg)*
- *Instrument input parameters:*
  - f (Hz) - chopper frequency*
  - Theta0 (degrees) - opening width of slits*



## Exercise 4.2 Cont'd

- *Make a TRACE to get an overview of the instrument*
- *SIMULATE  $1e7$  neutrons at the default of  $f=5\text{Hz}$  and  $\text{Theta}0=10$  degrees. While simulation is ongoing, estimate the number of pulses per second?*
- *Try another  $1e7$  at  $f=1$  hz. Notice space-time correlation in the third TOF panel*
- *At a given frequency, try changing the  $\text{Theta}0$  chopper opening to higher and lower value. Comment on the results.*

