Ideas for SRW<->SHADOW SWITCHES

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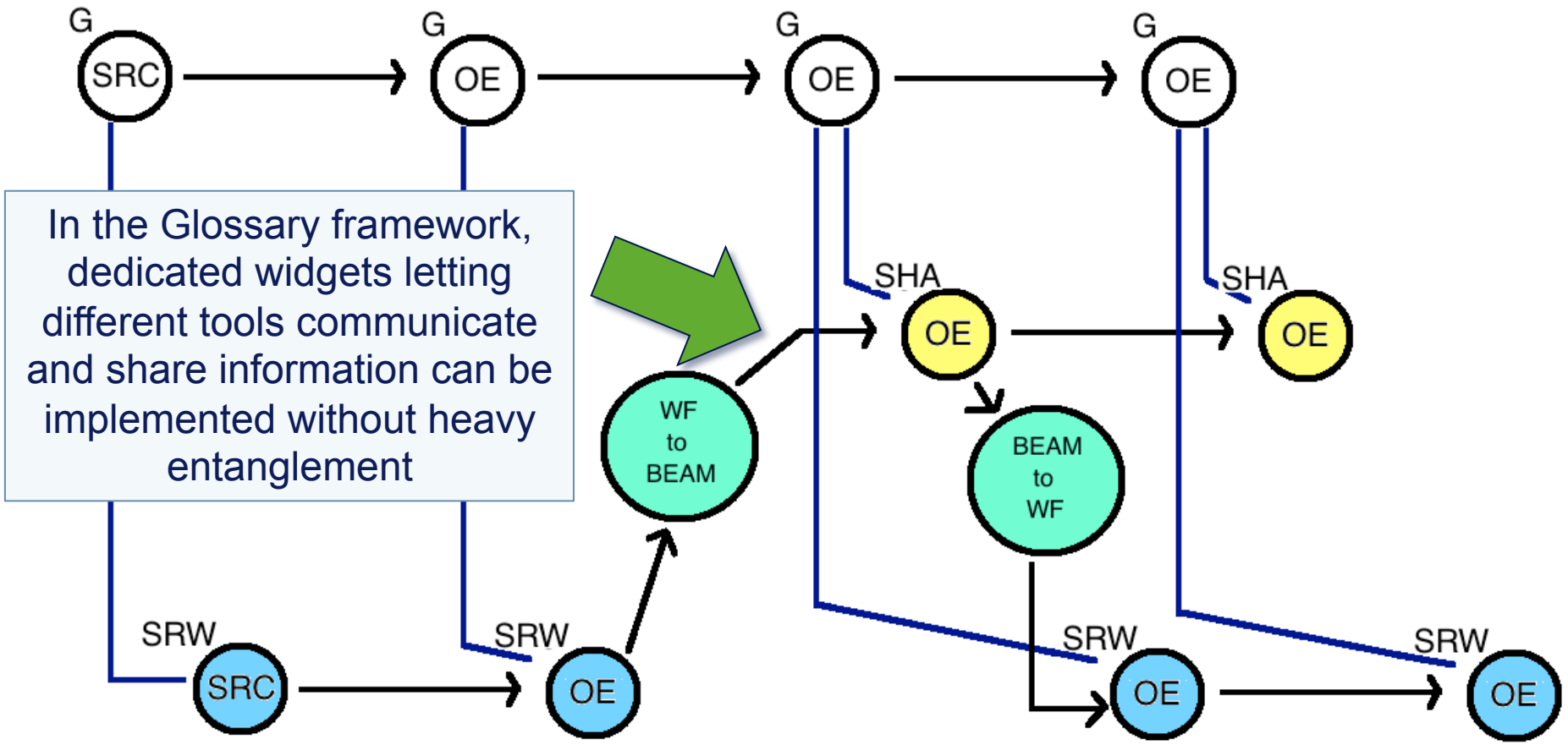
STEP 2: SRW-SHADOW SWITCHES



THEORY MODEL

MAXWELL → WAVE → HELMHOLTZ

WAVE OPTICS

FRESNEL-KIRCHHOFF
…
FOURIER OPTICS

GEOMETRICAL OPTICS
λ->0

$$\vec{E} = \vec{e}\, e^{ik_0 S(r)}$$

$$\vec{H} = \vec{h}\, e^{ik_0 S(r)}$$

$$(\nabla S)^2 = n^2$$

$$\nabla S = n\,\vec{s}$$

$$\frac{d}{ds}\left(n\frac{d\vec{r}}{ds}\right) = \nabla n$$

$$\nabla n = 0 \Rightarrow \frac{d\vec{r}}{ds} = 0 \Rightarrow \vec{r} = s\vec{a} + \vec{b}$$

- Same physical quantity
- Why not changing model from one oe to the next one?
- Problem: different ways to store it and different sampling

$$\vec{E}$$

DIFFERENCES

SRW

- Wavefront sampled in a homogeneous and regular grid
- Each pixel contains the electric field (complex) [and cte curvature R?]
- The curvature of the wavefront is encoded in the phase
- Amplitude and phase are continuous (and smooth?)

SHADOW

- Rays are sampled in a random way
- Ray contains electric field (vector) positions, and directions
- One ray = one wavefront of a tiny (spatial) plane wave
- Several rays do not belong necessarily to the same wavefront, but
- A wavefront could be sampled in several rays (take care with phase!!), but in SHADOW, although possible, we never pay attention to the phases. We always add intensities.

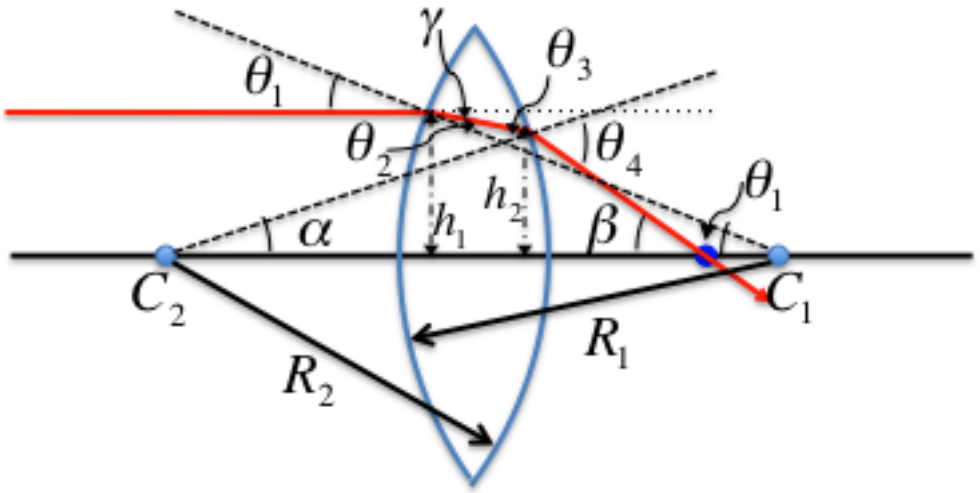
EXAMPLE: THE CASE OF A LENS

If the beam is a ray:

•Change of direction

Law of Refraction (Snell's Law)

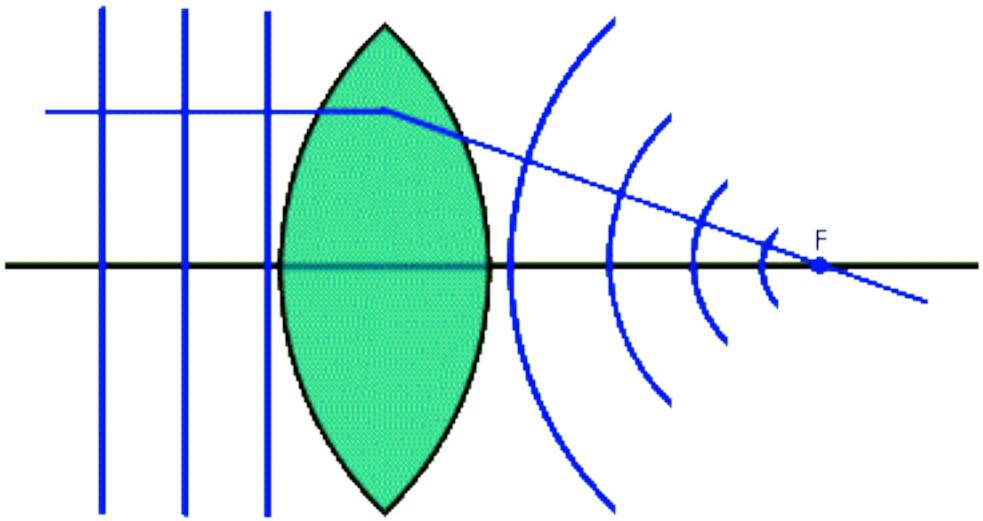
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$



If the beam is a wave:

•Change of phase

$$E = E_0 \exp\left(+j\frac{kr^2}{2f}\right)$$



GOAL: PASS FROM RAYS TO WAVES AND VICEVERSA

FROM PHASES TO DIRECTIONS (FROM SRW TO SHADOW)

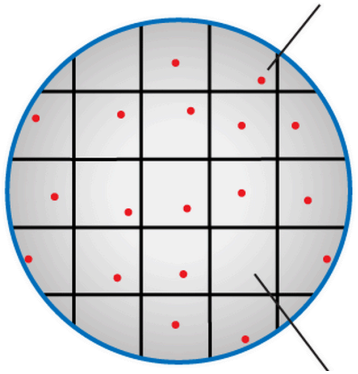
$$\vec{E} = \vec{e}\, e^{ik_0\Phi(r)}$$

$$\vec{H} = \vec{h}\, e^{ik_0\Phi(r)}$$

$$\nabla\Phi = \vec{v}$$

$$v_x = \frac{\partial\Phi}{\partial x}; \quad v_y = \frac{\partial\Phi}{\partial y}; \quad v_z = \sqrt{1 - v_x^2 - v_y^2}$$

1) Each pixel to a ray
2) Each group or pixels to a ray (binning)
3) Sample rays using intensity and apply this phase

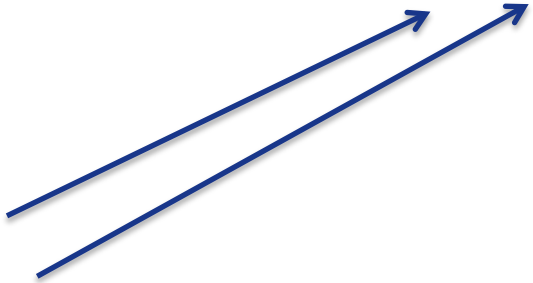


FROM DIRECTIONS TO PHASES (FROM SHADOW TO SRW)

$$v_x = \frac{\partial \Phi}{\partial x}; \quad v_y = \frac{\partial \Phi}{\partial y}$$

$$\Phi(x_i, y_i) = \int v_x(x, y_i)\, dx + \int v_y(x_i, y)\, dy$$

$$\Phi(x_i, y_i) = \sum v_x w() + \sum v_y w()$$



1) Which rays?
2) Which weights?

A good sampling is essential and will not always be available
⇒ Define system/source in an *intelligent* way…

⇒ Let's try!!