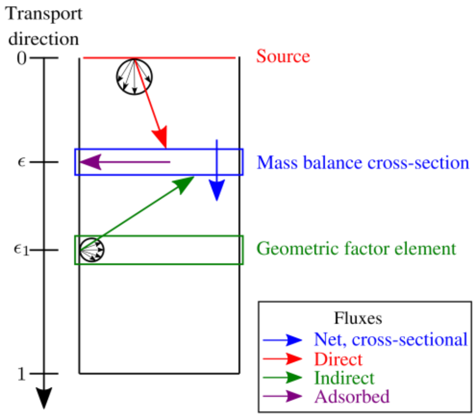

*Fig.1: Schematic representation of our extended Knudsen diffusion model. The goal is to obtain the net, cross-sectional flux through the mass balance volume (blue) by balancing the direct (red), adsorbed (purple), and indirect (green) fluxes. The complete indirect flux contribution is obtained by integrating over all* $\epsilon_1$ *(green elements).*

$$\tilde{j}(\epsilon) = \overbrace{F_D(\epsilon) + g(\epsilon) \times \overbrace{\tilde{D}_{Kn} \times \frac{d\psi}{d\epsilon}}^{\text{Standard Knudsen diffusion}}}^{\text{Extended Knudsen diffusion}}$$

$$\frac{d\tilde{j}}{d\epsilon} = k \times \psi(\epsilon)$$

$\tilde{j}$ : Normalized, net, cross-sectional flux
$\psi$ : Normalized concentration
$\epsilon$ : Normalized axial distance
$F_D$ : Direct flux
$g$ : Geometric factor
$\tilde{D}_{Kn}$ : Normalized Knudsen diffusivity
$k$ : Surface adsorption rate

*Fig.2: Schematic representation of the system of ordinary differential equations modeling neutral transport. The colors relate to Fig.1. We note the differences between our model and the standard Knudsen diffusion approach: The presence of direct flux and the geometric factor. The adsorbed flux is modeled by a volumetric sink term.*

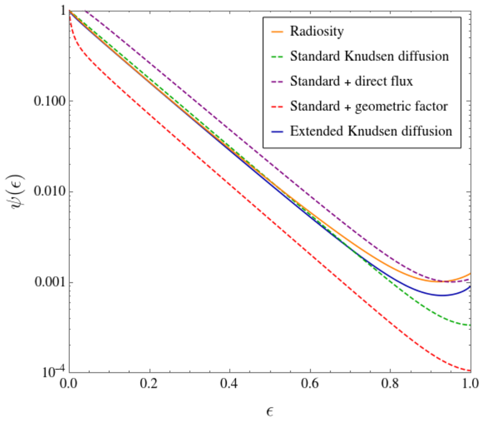

*Fig.3: Comparison of the local concentration between different approaches for a cylinder of aspect ratio 50 and sticking 1%. We note that the full extended Knudsen diffusion approach is required for more accurately matching radiosity over most of the feature.*

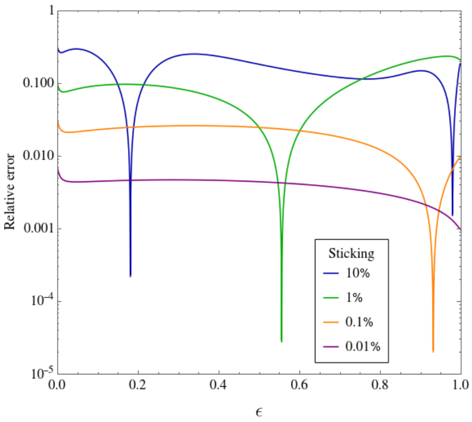

*Fig.4: Local relative error, defined as the relative difference between the extended Knudsen diffusion and radiosity results, for a cylinder of aspect ratio 50 and varying sticking. Here, we showcase how our model produces adequate results even in high sticking regimes.*

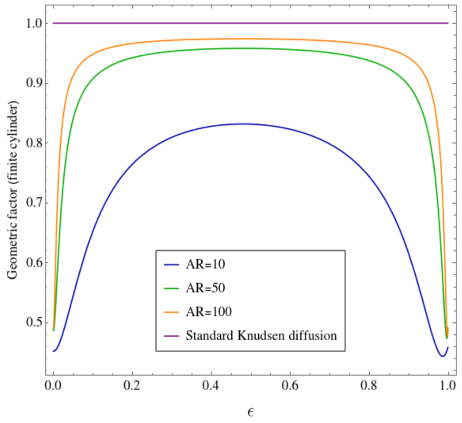

*Fig.5: Geometric factor as a function of axial distance* $\epsilon$ *for a finite cylinder of sticking 1% and varying aspect ratios. Our model highlights significant discrepancies in the standard approach for the extremities of the cylinder even for high aspect ratios.*