A Conductor Model for Coated Materials: Supplemental Material

This document serves as supplemental material for 'A Fresnel Model For Coated Materials' and presents visual results, plots, and quantitative error analyses of our model. It also contains plots of the reflectance curves where our model is compared to ground truth reflectance curves calculated from spectral data sets. Additionally, this document highlights the visual impact of representing our coefficients in 16 bits versus 32 bits, specifically focusing on the largest errors observed using the FLIP metric amplified by a factor of 10 (Fig. 1). Table 1 shows the quantitative results of our model, representing the average of 10,000 evenly distributed samples across all incident angles and IOR values, compared to the ground truth Fresnel curves. Color value differences are expressed using the ΔE2000 metric.

Conductor	Δ E-Ours	Δ Schlick
Ag	0.05	0.78
Al	0.09	0.62
Au	0.15	3.36
Be	0.42	1.72
Co	0.21	1.81
Cr	0.31	1.73
Cu	0.10	2.32
CuZn	0.13	4.0
Fe	0.44	2.01
Hg	0.13	1.37
Ir	0.25	1.68
K	0.04	1.24
Mn	0.31	1.92
Mo	0.06	0.36
Na	0.03	0.76
Nb	0.41	1.81
Ni	0.26	2.46
Pb	0.10	0.65
Pd	0.14	1.7
Rh	0.14	1.2
Ta	0.47	3.54
W	0.53	1.91

Table 1. The average ΔE2000 error value for various conductors.

Fig. 1. The visual difference between 32 bit and 16 bit coefficients for Be. The FLIP difference image is amplified by a factor of 10.

VISUAL RESULTS

Our method's visual results, rendered in our in-house RGB-based path tracer, are compared to the accumulated renders from Pbrt-v4, a spectral path-tracer. We demonstrate that our results closely align with the ground truth for various conductors at η_i values of 1.5 and 2.5, using the FLIP method for comparison. All visual results are presented in the ACEScg color space and are split vertically: the left side displays our approximation, while the right side shows Schlick's approximation. This incorporates Lazányi and Szirmay-Kalos's error compensation term in Hoffman's notation, along with the accurate external media adjustment mentioned by Hoffman. Above these visual comparisons, plots of reference Fresnel curves are compared to the plots from our model, where the dotted lines represent our approximation and the straight lines represent the ground truth. These plots show the angle in degrees on the X-axis and the reflectance values in the ACEScg color space on the Y-axis.

Ag

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

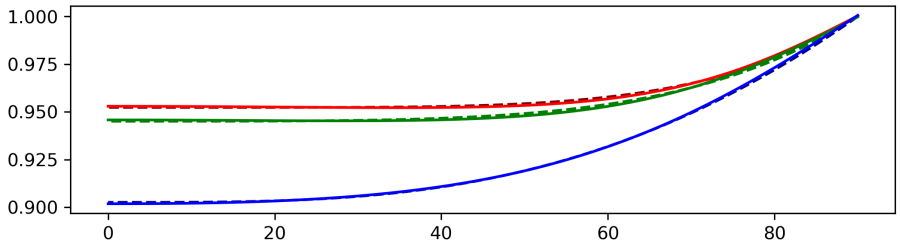


Fig. 2. Graph showing Ag η_i 1.5. The x-axis represents the angle measured in degrees.

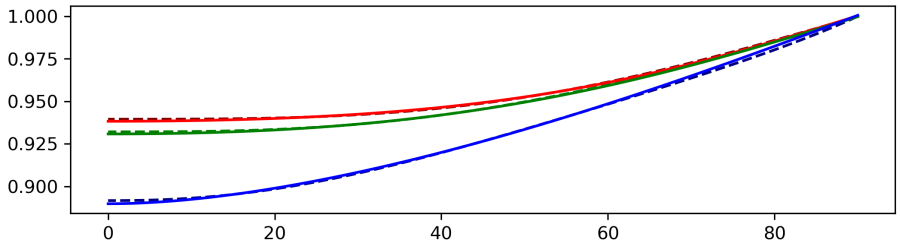
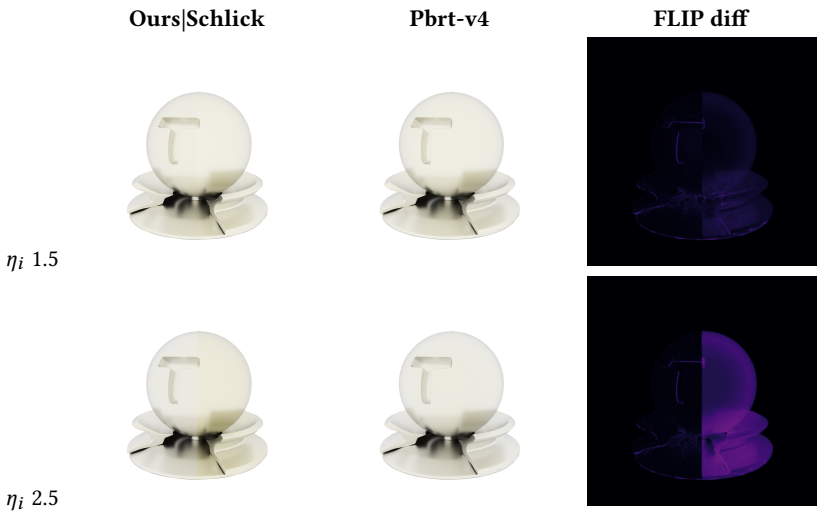


Fig. 3. Graph showing Ag η_i 2.5. The x-axis represents the angle measured in degrees.



Al

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

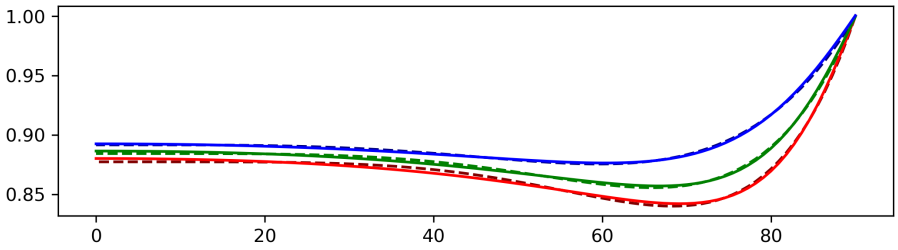


Fig. 4. Al η_i 1.5

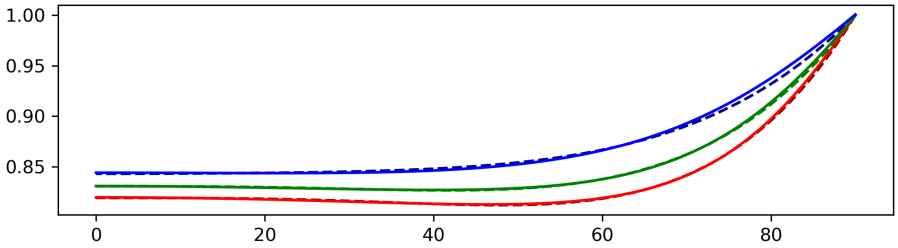
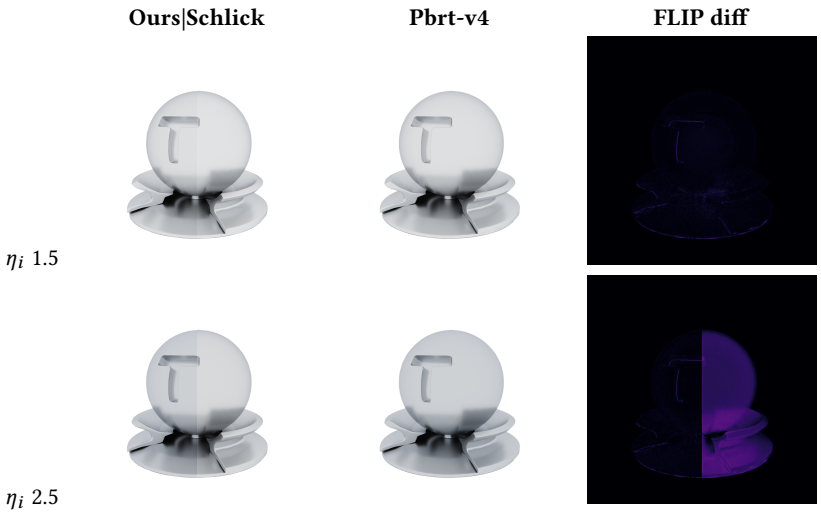


Fig. 5. Al η_i 2.5



Au

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

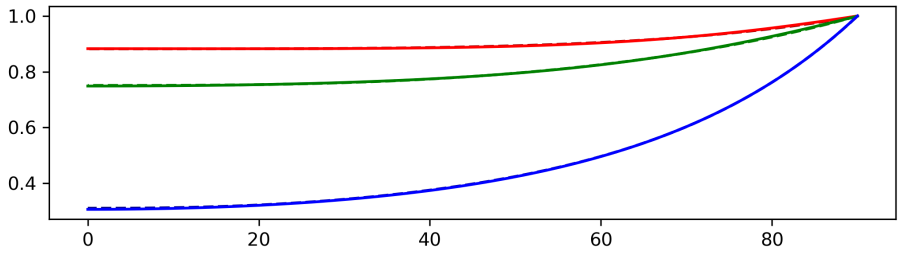


Fig. 6. Au η_i 1.5

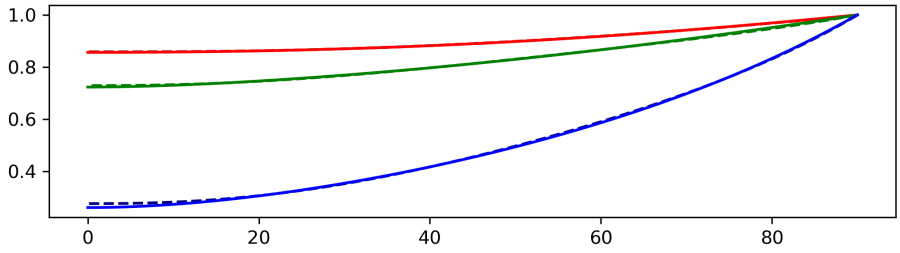
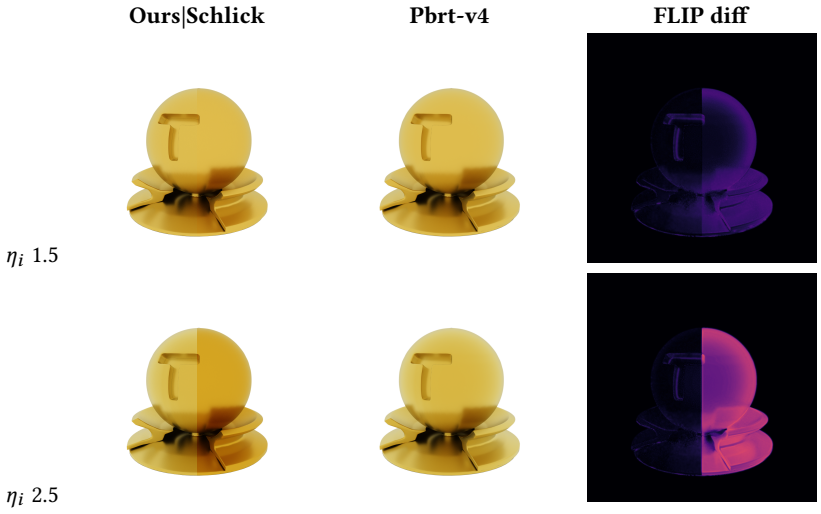


Fig. 7. Au η_i 2.5



Be

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

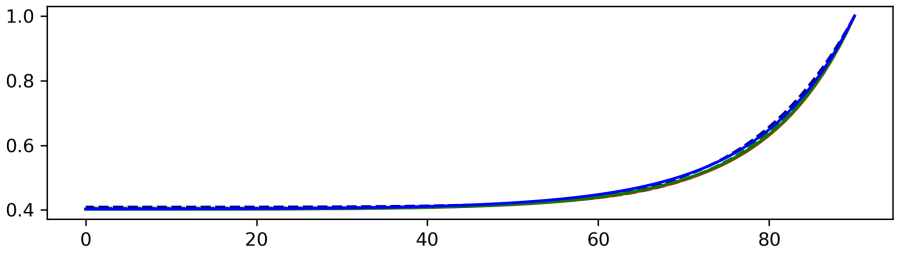


Fig. 8. Be η_i 1.5

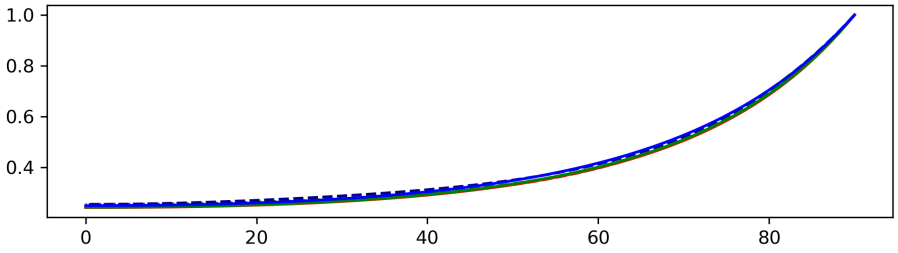
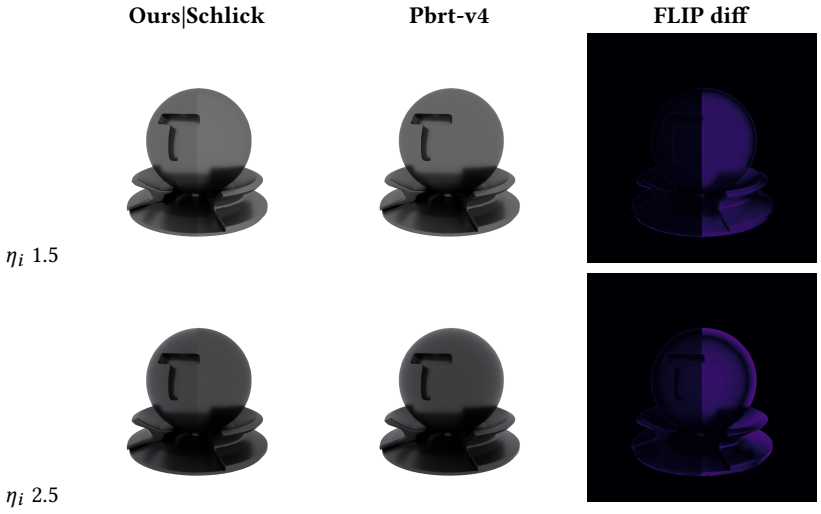


Fig. 9. Be η_i 2.5



Co

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

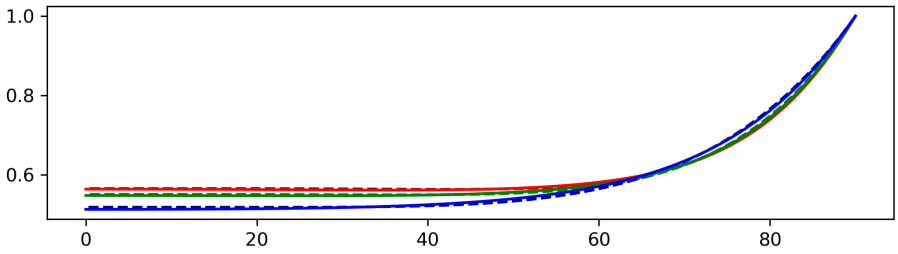


Fig. 10. Co η_i 1.5

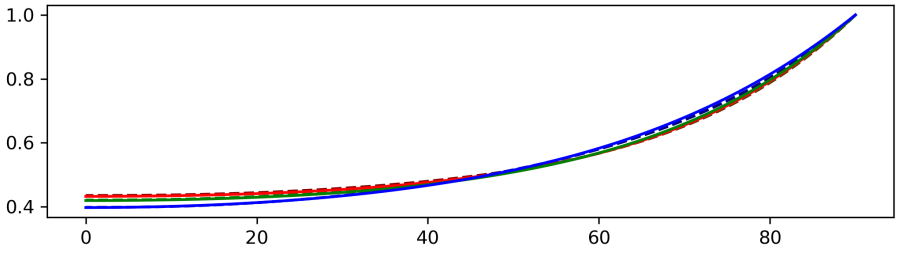
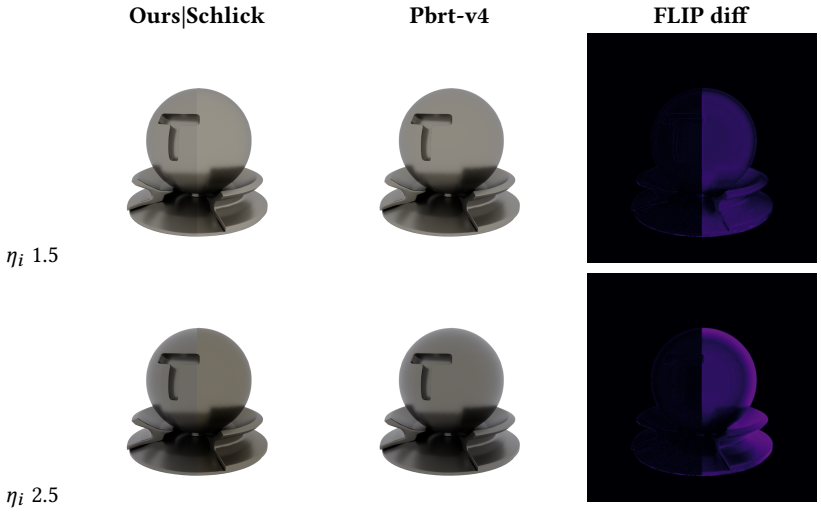


Fig. 11. Co η_i 2.5



Cr

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

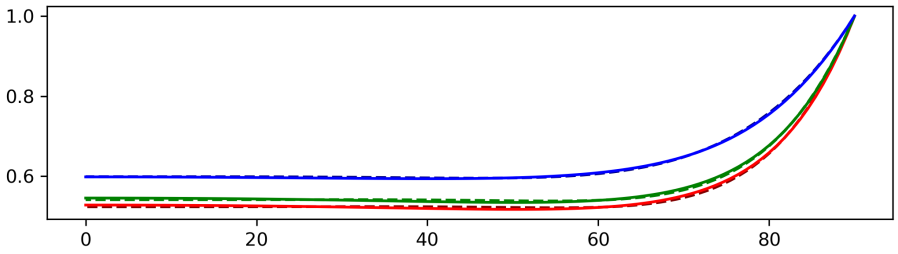


Fig. 12. Cr η_i 1.5

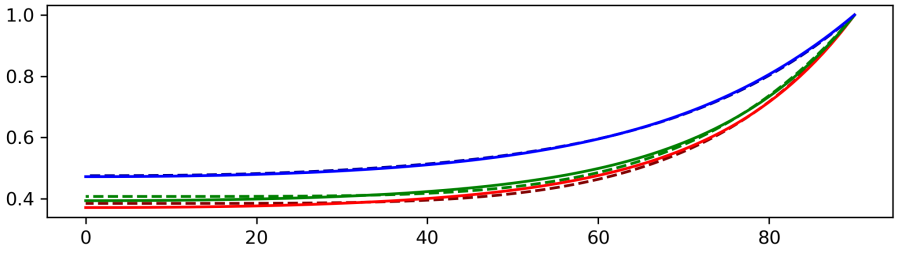
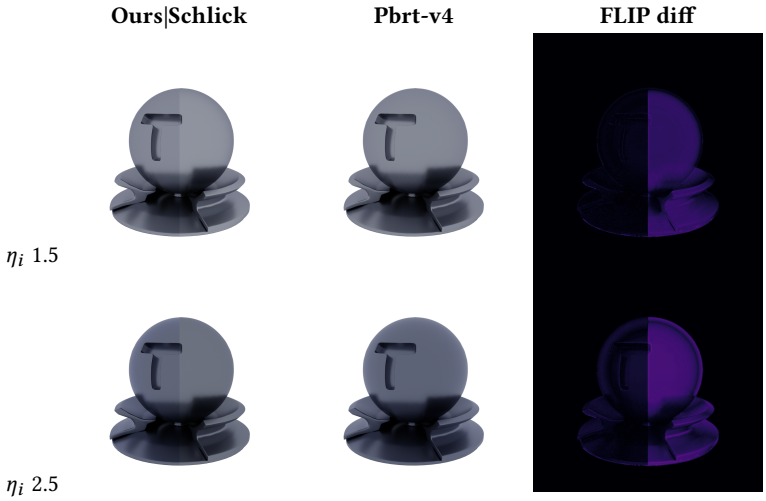


Fig. 13. Cr η_i 2.5



Cu

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

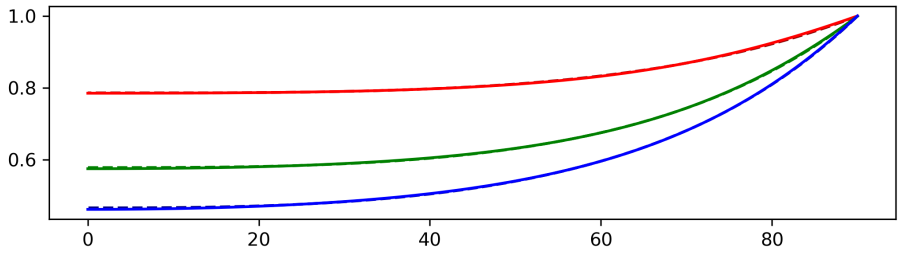


Fig. 14. Cu η_i 1.5

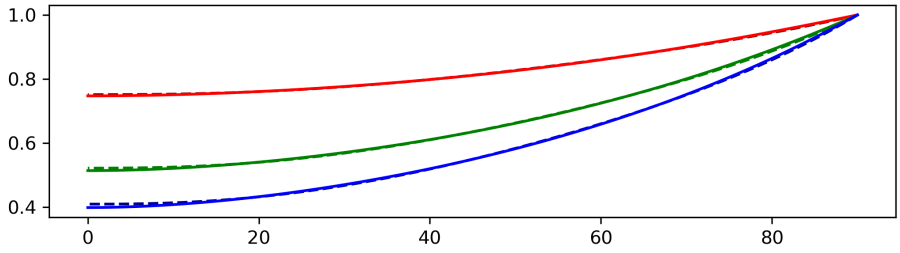
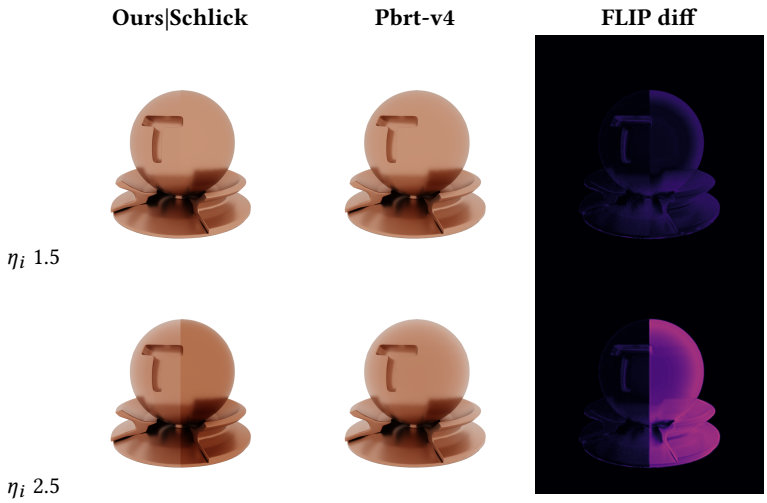


Fig. 15. Cu η_i 2.5



CuZn

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

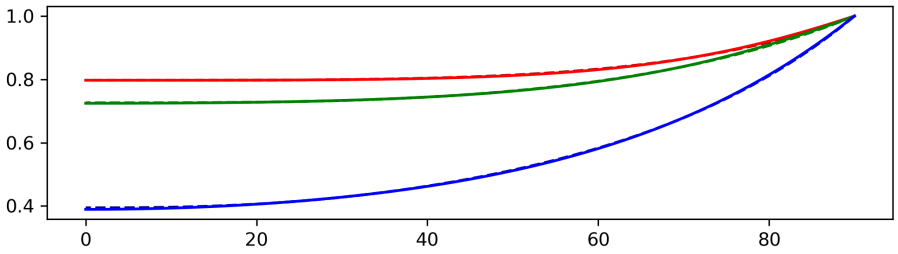


Fig. 16. CuZn η_i 1.5

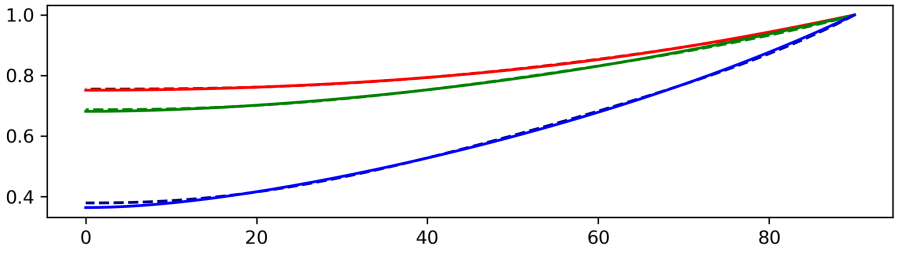
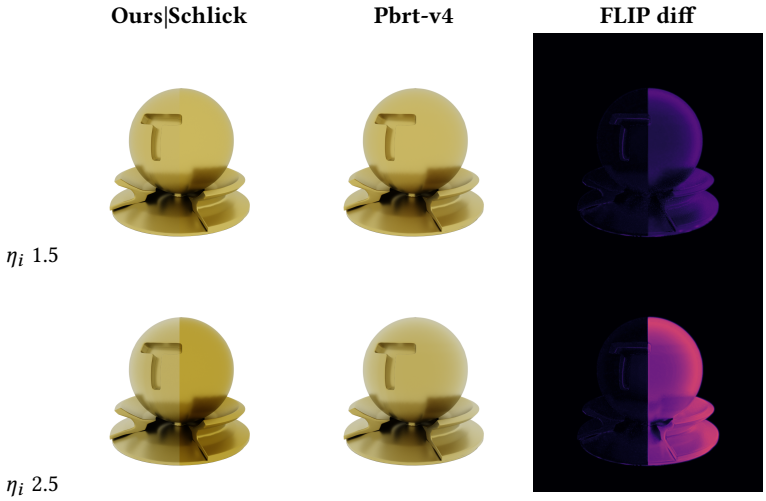


Fig. 17. CuZn η_i 2.5



Fe

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

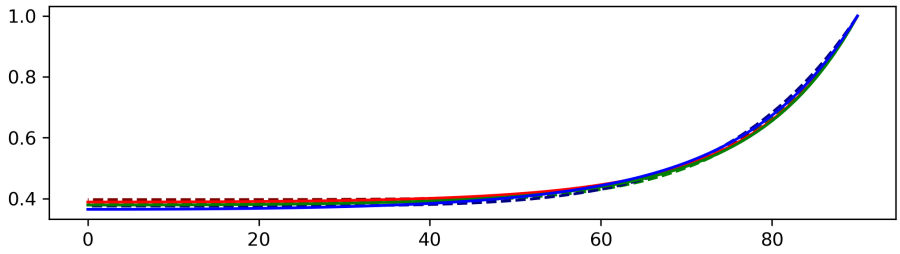


Fig. 18. Fe η_i 1.5

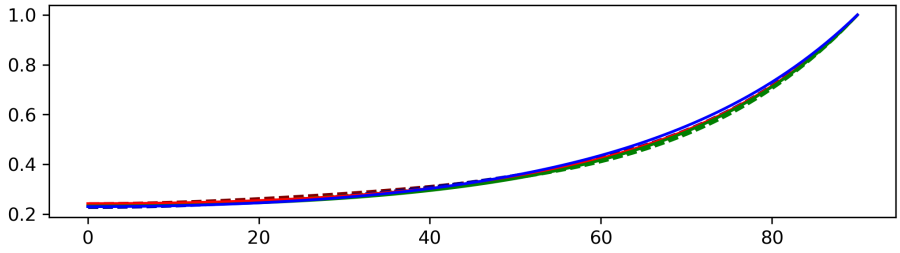
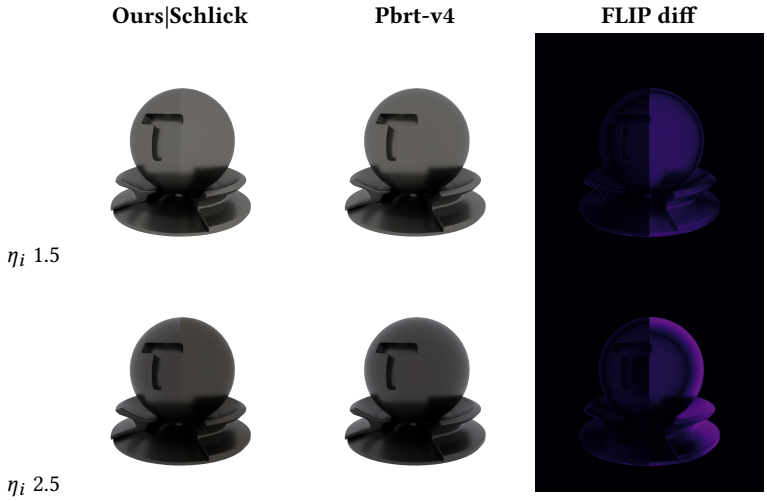


Fig. 19. Fe η_i 2.5



Hg

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

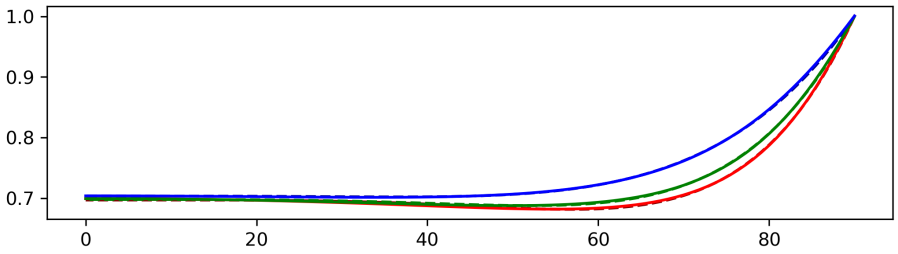


Fig. 20. Hg η_i 1.5

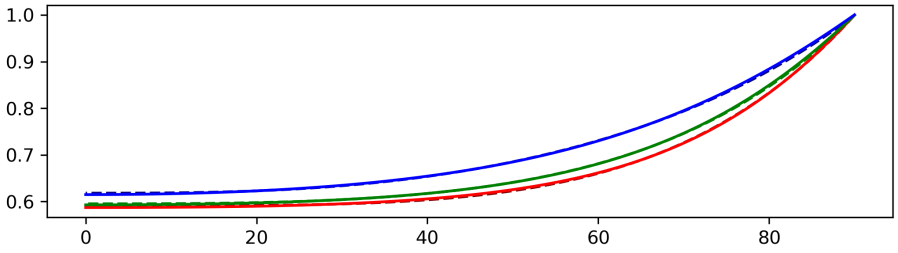
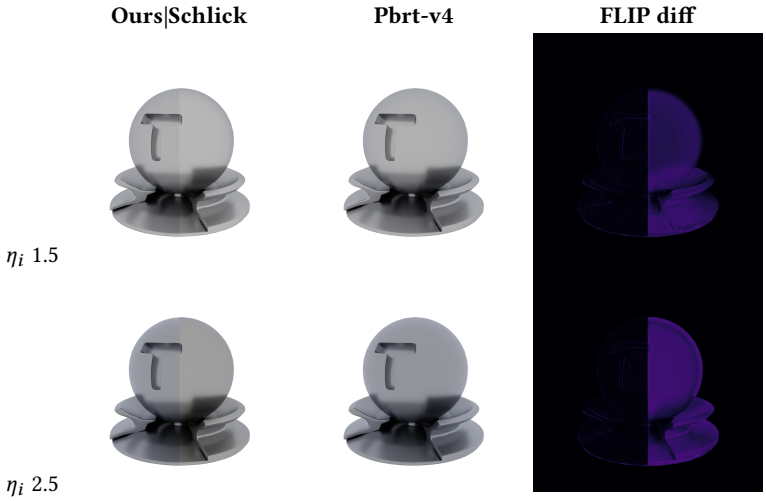


Fig. 21. Hg η_i 2.5



Ir

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

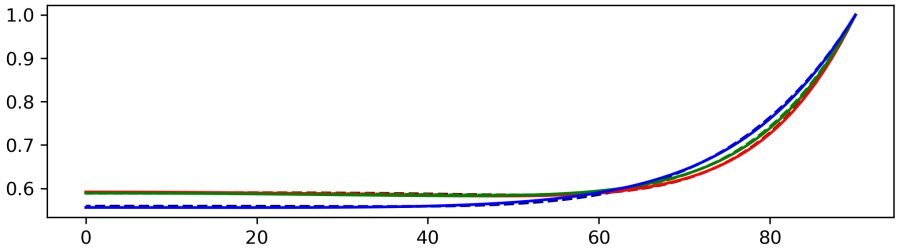


Fig. 22. Ir η_i 1.5

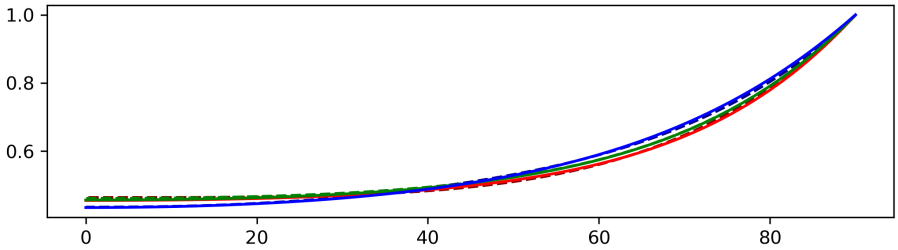
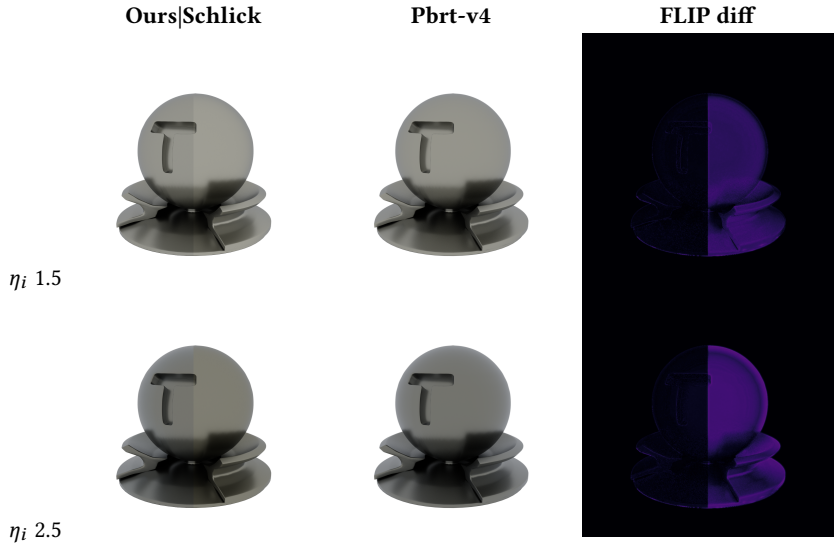


Fig. 23. Ir η_i 2.5



K

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

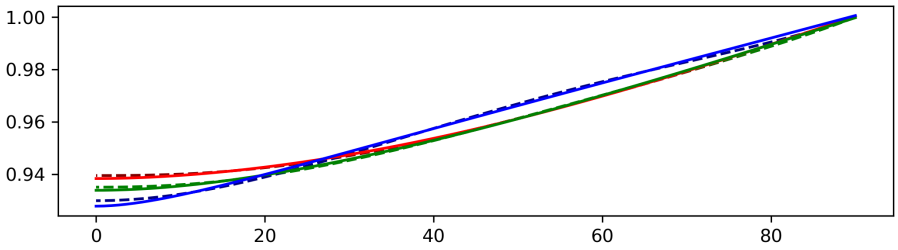


Fig. 24. K η_i 1.5

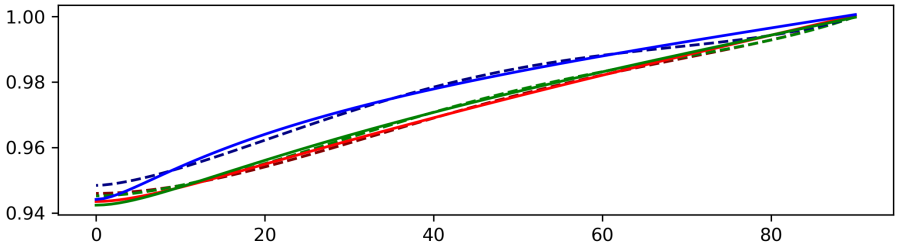
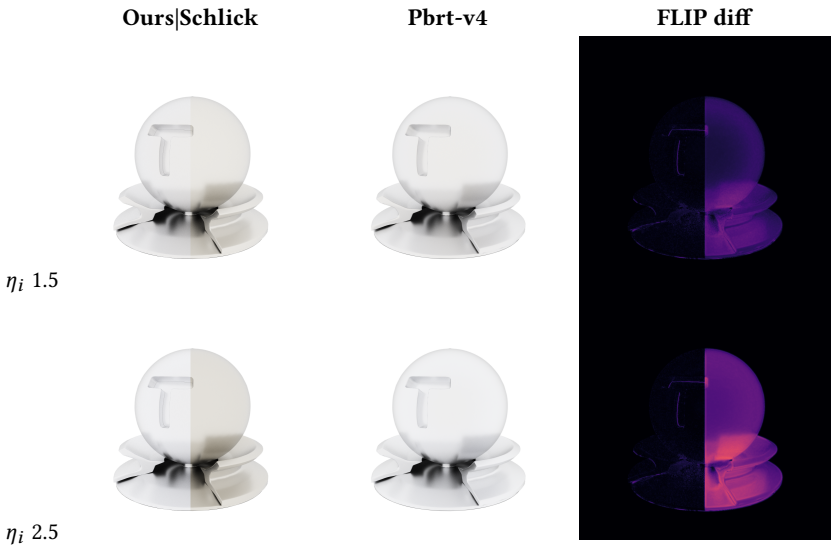


Fig. 25. K η_i 2.5



Mn

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

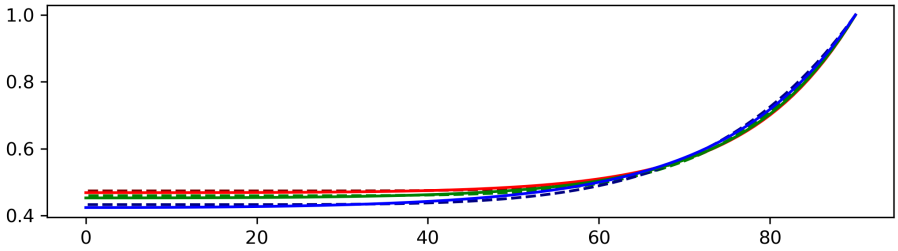


Fig. 26. Mn η_i 1.5

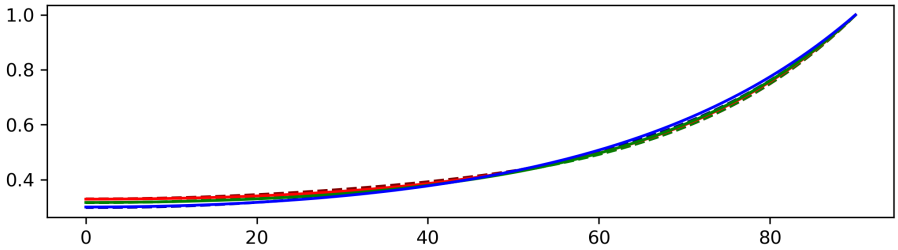
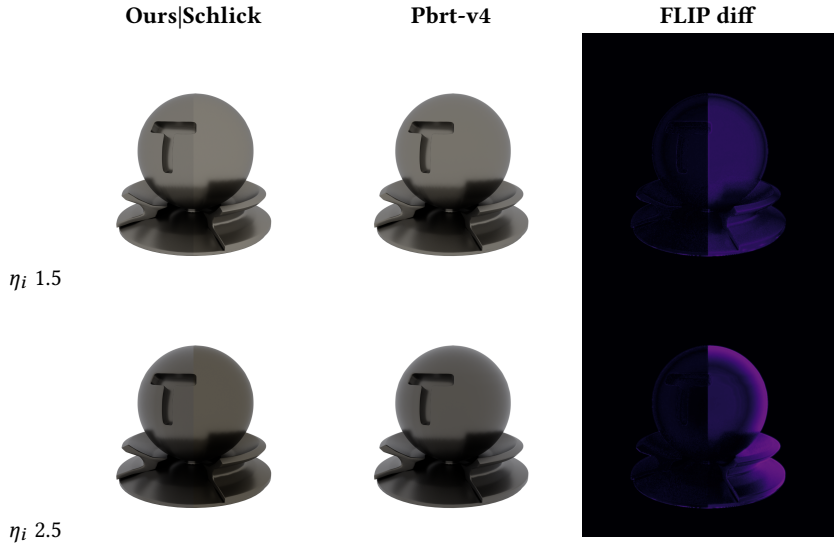


Fig. 27. Mn η_i 2.5



Mo

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

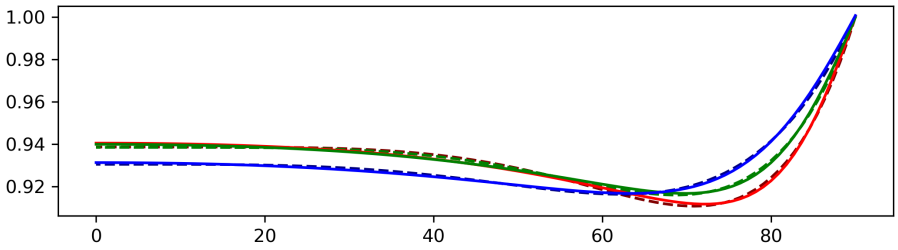


Fig. 28. Mo η_i 1.5

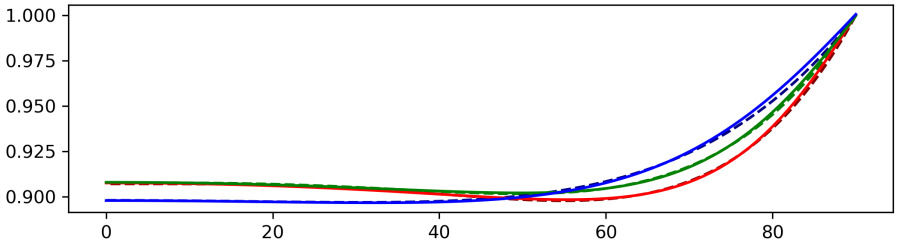
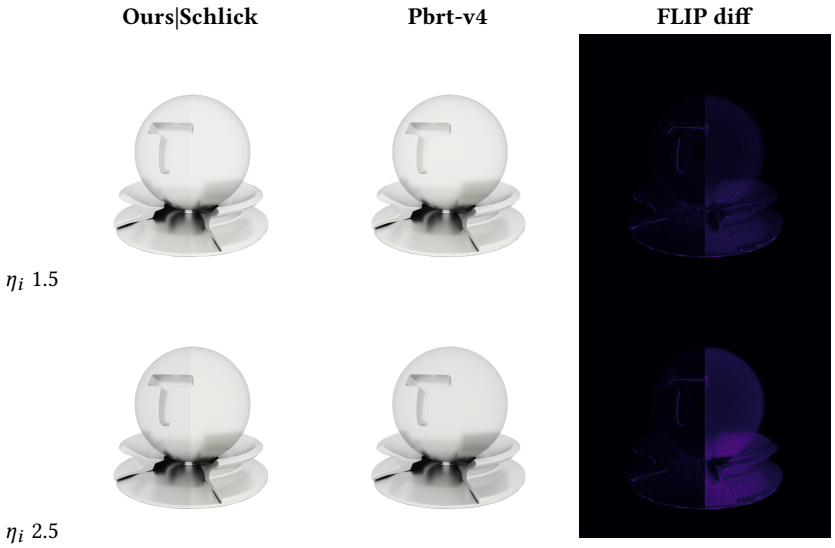


Fig. 29. Mo η_i 2.5



Na

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

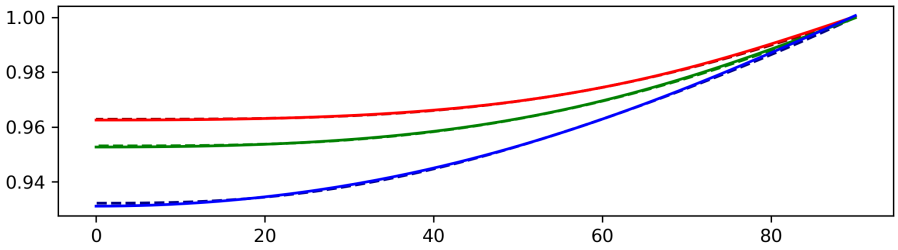


Fig. 30. Na η_i 1.5

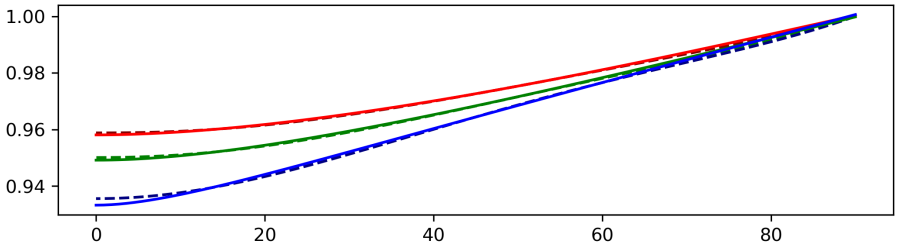
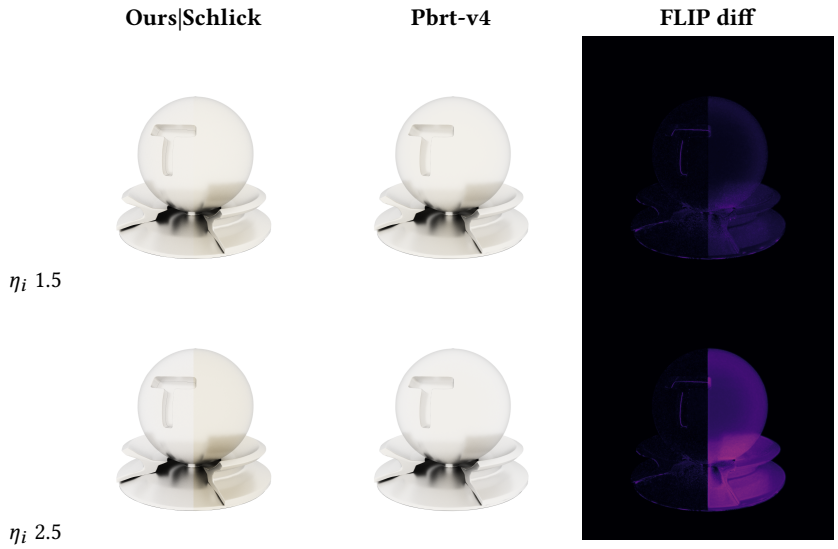


Fig. 31. Na η_i 2.5



Nb

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

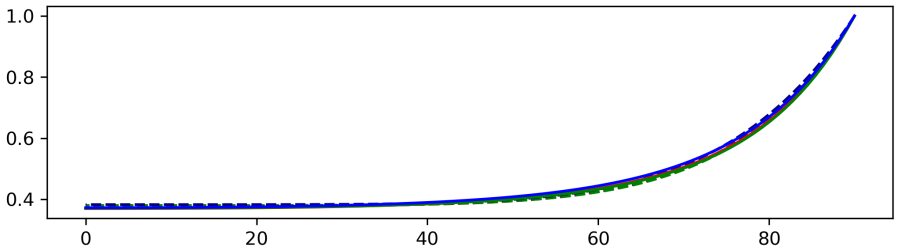


Fig. 32. Nb η_i 1.5

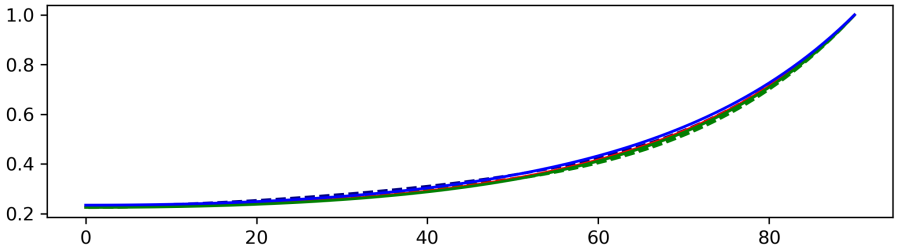
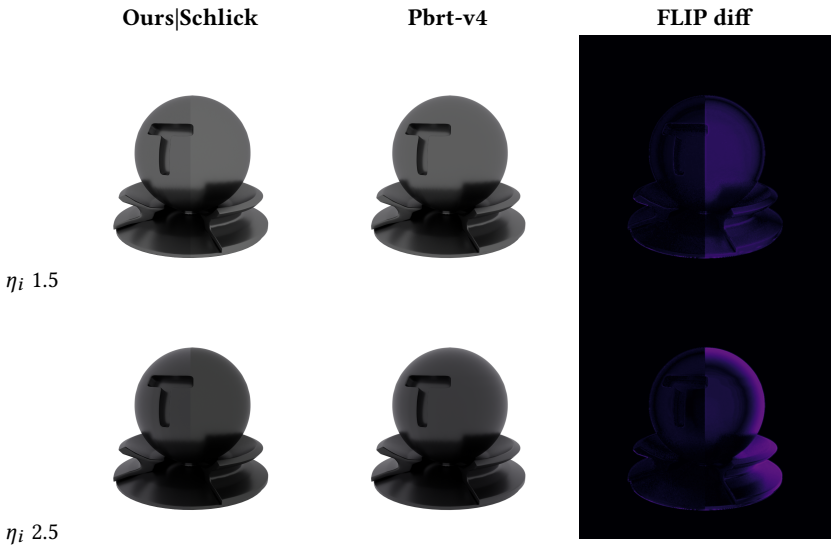


Fig. 33. Nb η_i 2.5



Ni

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

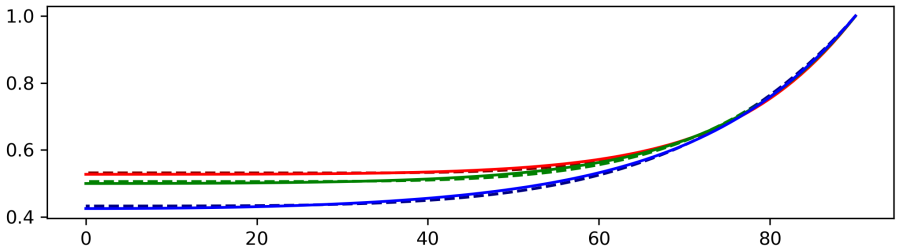


Fig. 34. Ni η_i 1.5

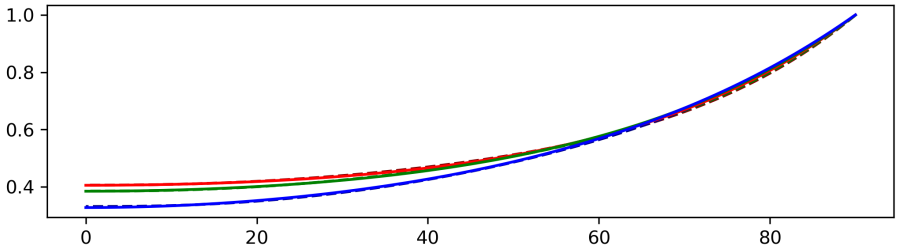
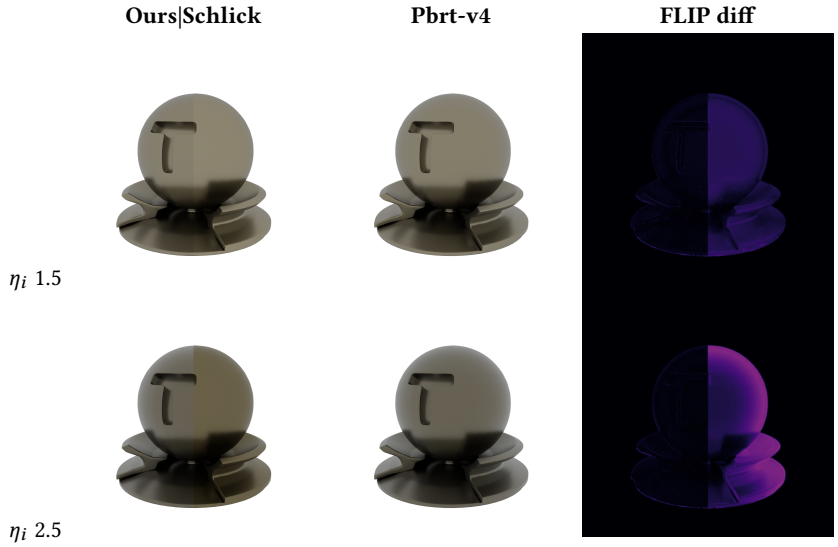


Fig. 35. Ni η_i 2.5



Pb

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

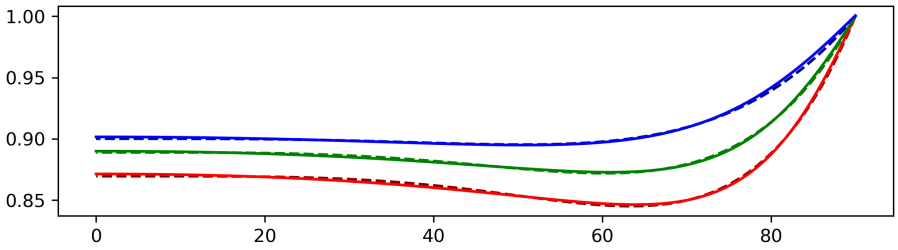


Fig. 36. Pb η_i 1.5

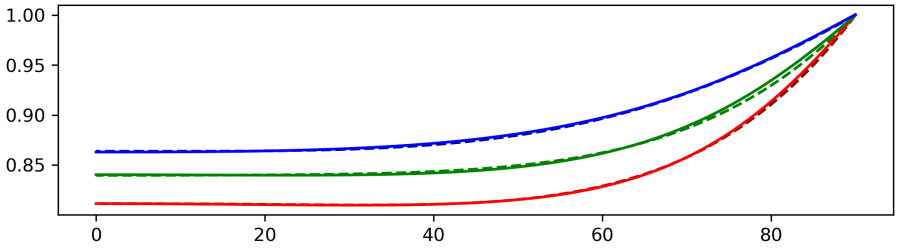
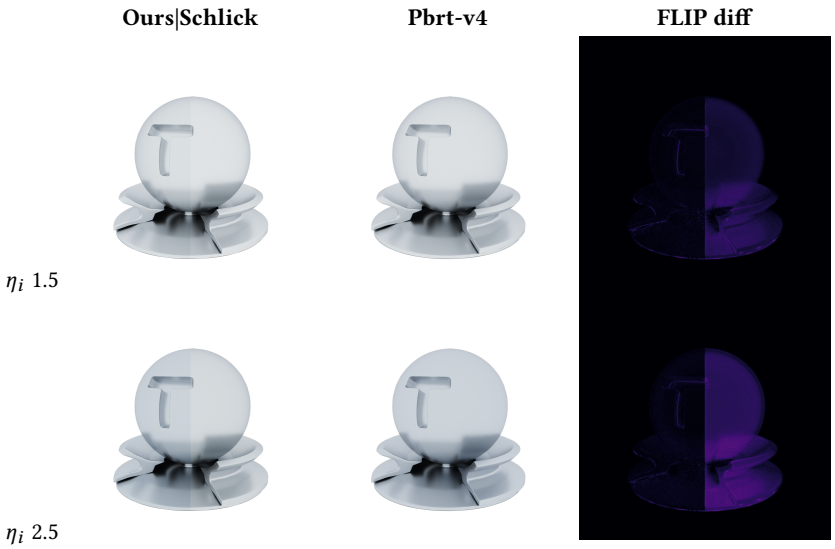


Fig. 37. Pb η_i 2.5



Pd

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

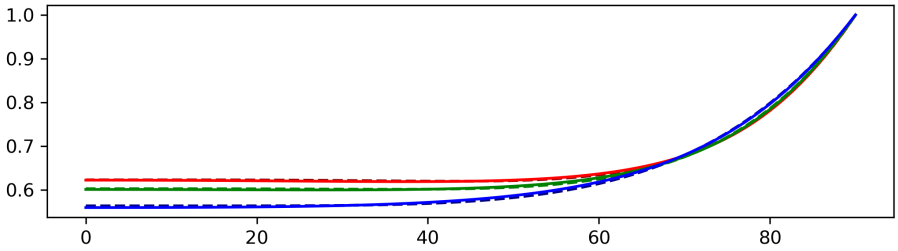


Fig. 38. Pd η_i 1.5

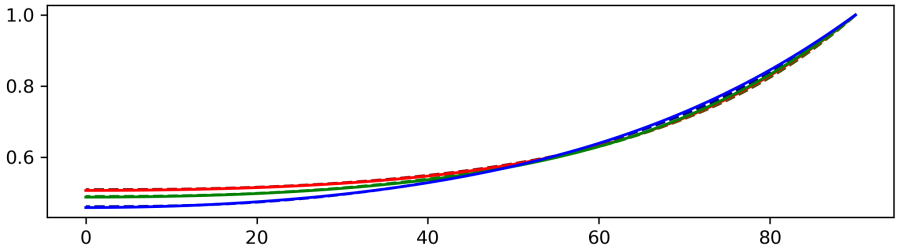
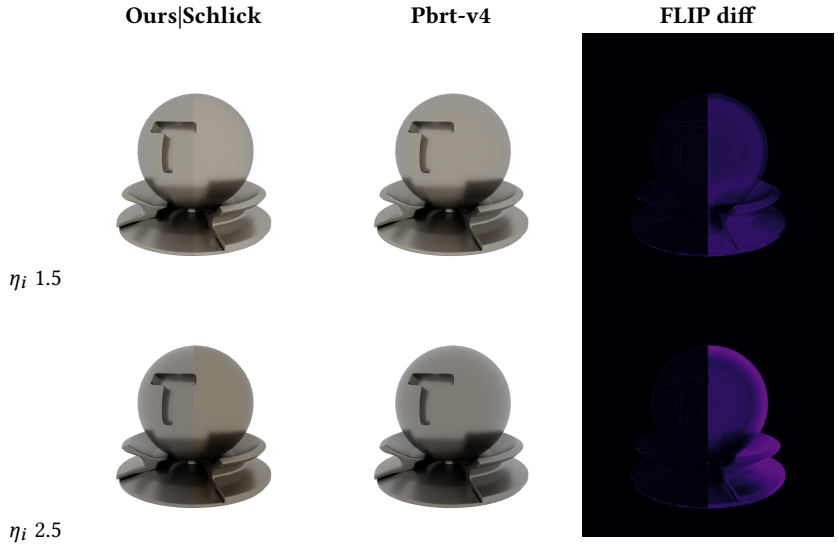


Fig. 39. Pd η_i 2.5



Rh

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

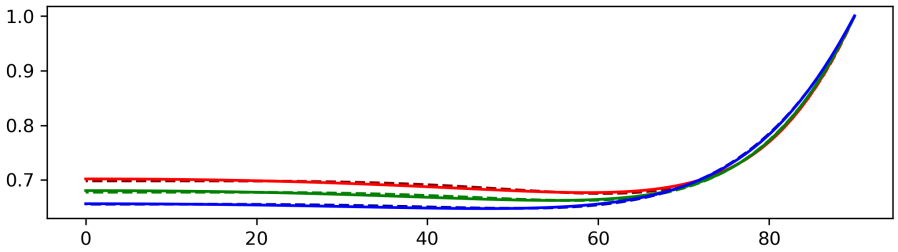


Fig. 40. Rh η_i 1.5

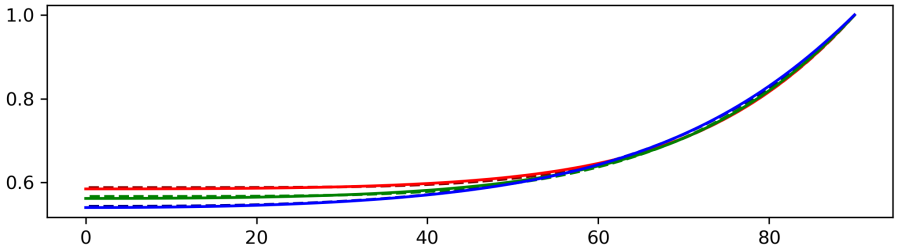
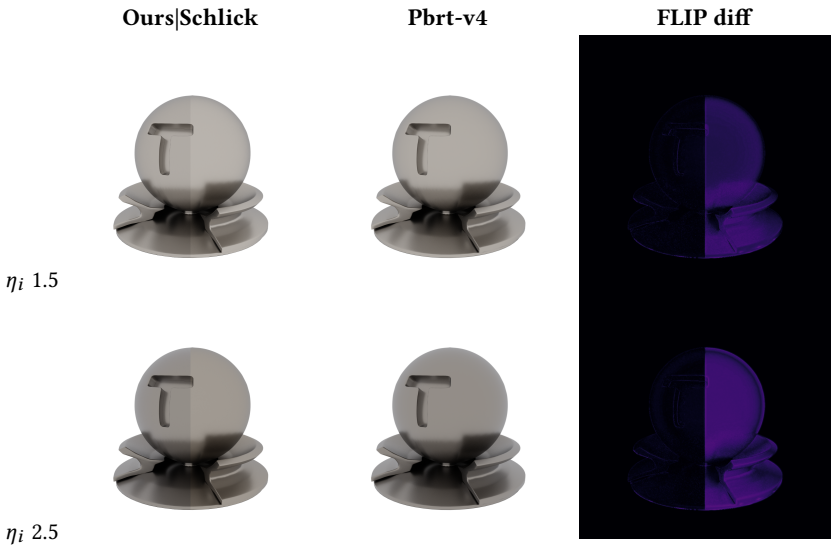


Fig. 41. Rh η_i 2.5



Ta

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

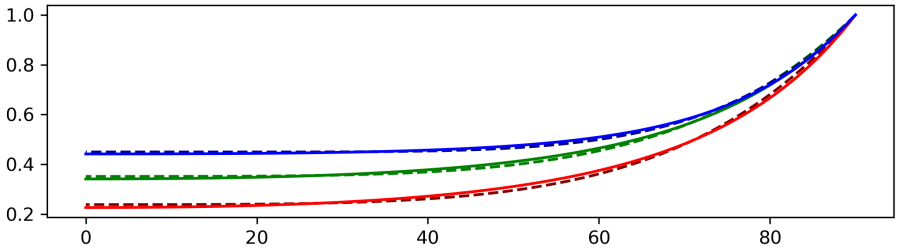


Fig. 42. Ta η_i 1.5

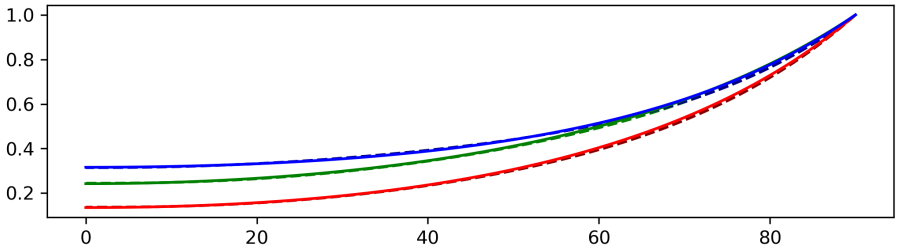
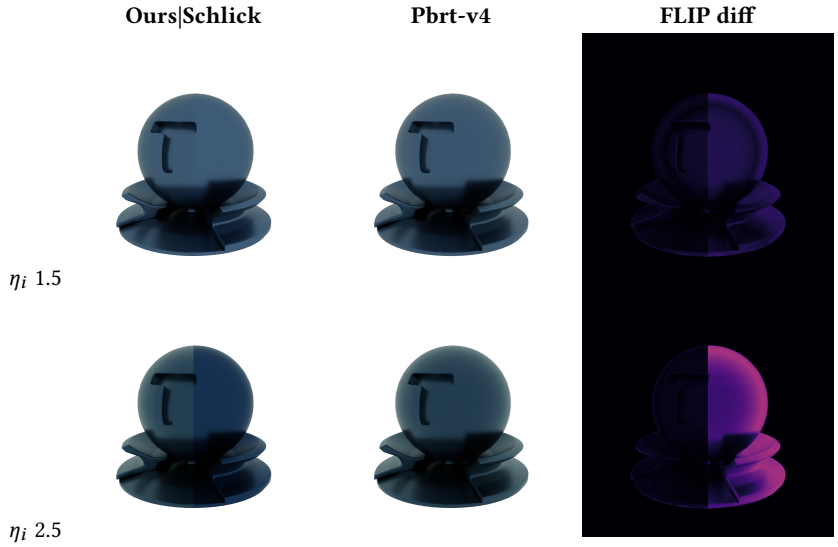


Fig. 43. Ta η_i 2.5



W

In the graphs below, the y-axis displays color values within the ACEScg color space, while the x-axis represents the angle in degrees. Our method is depicted with dotted lines, distinguished by the ground truth Fresnel curves, which are shown as straight lines.

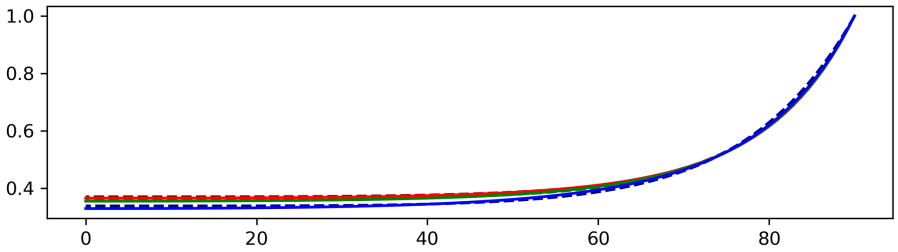


Fig. 44. W η_i 1.5

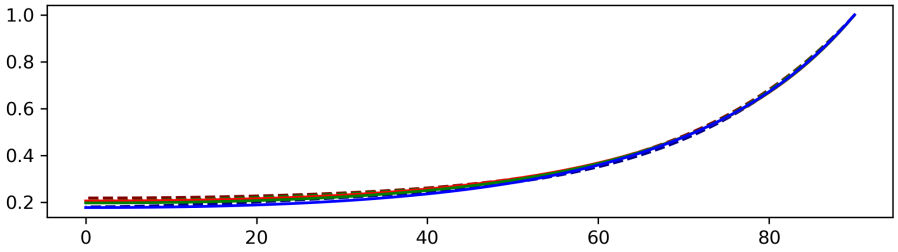


Fig. 45. W η_i 2.5