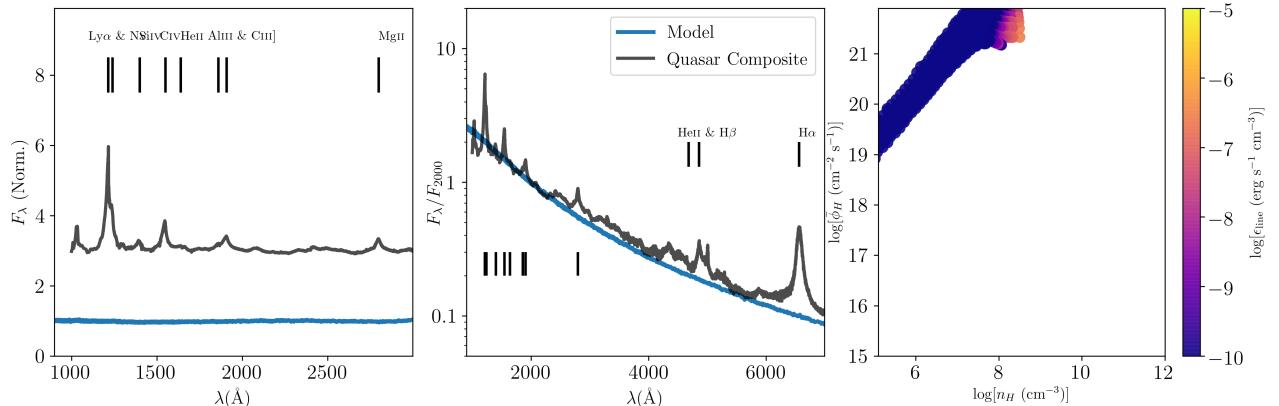


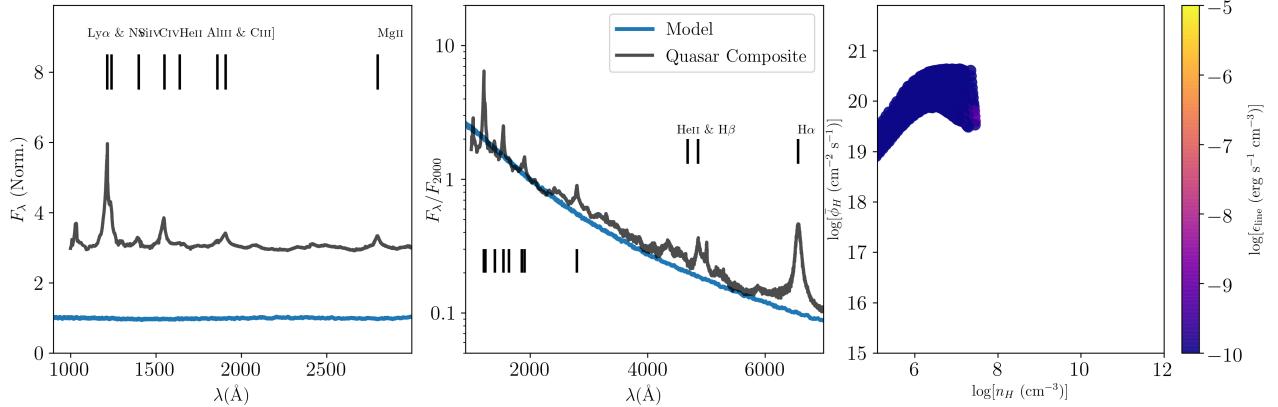
## Supplementary Material

9 January 2020

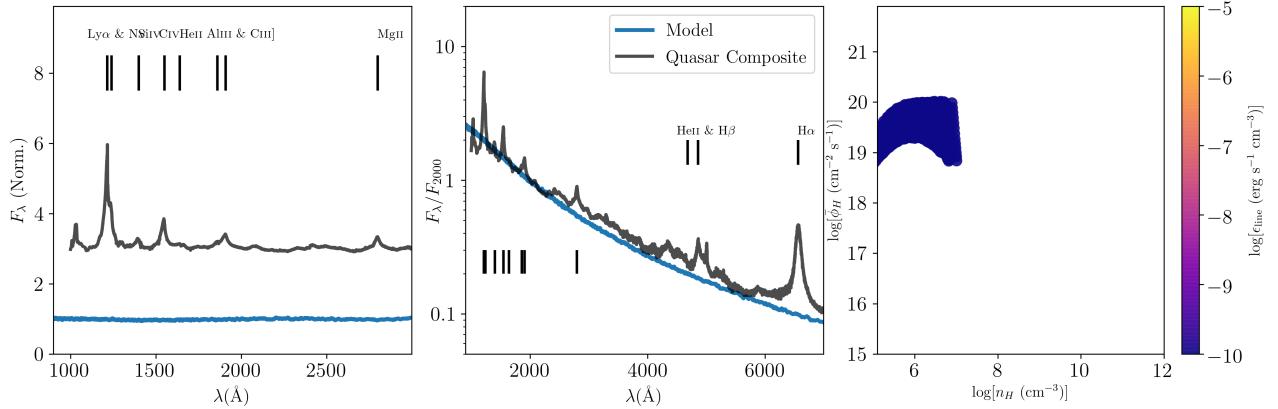
This file contains some supplementary material for the paper entitled ‘Stratified disc wind models for the AGN broad-line region: ultraviolet, optical and X-ray properties’. The figures here show a series of plots of spectra from the model grid. For each model, we show analogues to figures from the paper. The left-hand and central panels show a comparison between spectra between the model spectra (blue) and the XShooter quasar composite spectrum (black). The left shows just an ultraviolet comparison, where the spectra are normalised to the continuum. An offset of +2 is applied to the composite spectrum for clarity. Strong permitted UV transitions are labeled. The central panel shows a comparison across a wider wavelength range and without continuum normalisation – instead the flux is scaled to that at 2000Å and shown on a logarithmic scale. Strong permitted UV transitions are marked with lines and the H $\beta$ , H $\alpha$  and He II 4686Å optical emission lines are labeled. The right-hand panel shows the  $\phi_H - n_H$  plane. The points show the location in the  $\phi_H - n_H$  plane in the disc wind model, with the points colour-coded according to the logarithm of the emissivity of the Ly  $\alpha$  line. The colour scale is the same as for Model A in the main paper, but the limits of the plot are adjusted to allow every model to be shown with a reasonable range. Each caption gives the run number and the model parameters, as well as the convergence fractions  $f_c$  and  $f_w$ , defined by equations 13 and 14 in the paper. There are 54 models in total, and Models A and B have run numbers 52 and 9, respectively.



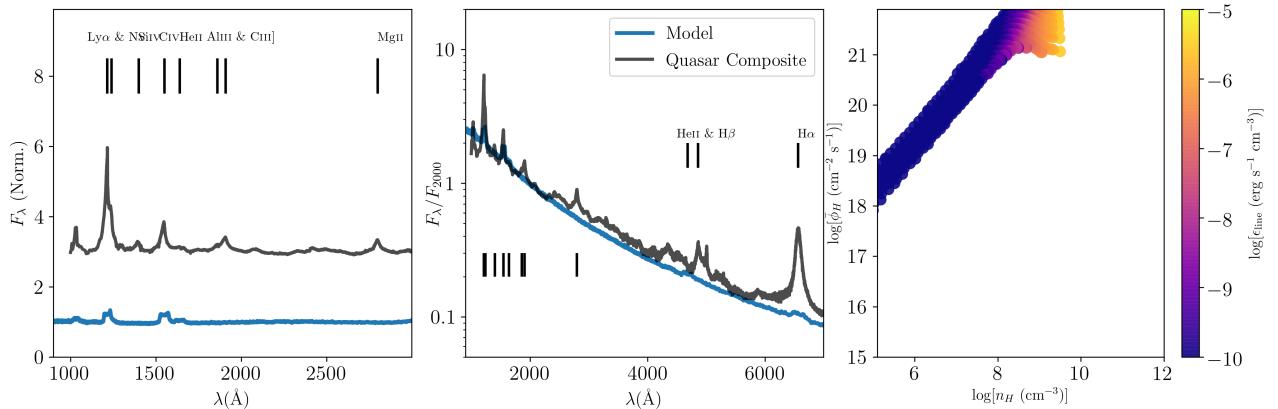
**Figure S1.** Run 1,  $f_c = 89.2\%$ ,  $f_w = 84.9\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 450.00r_g$



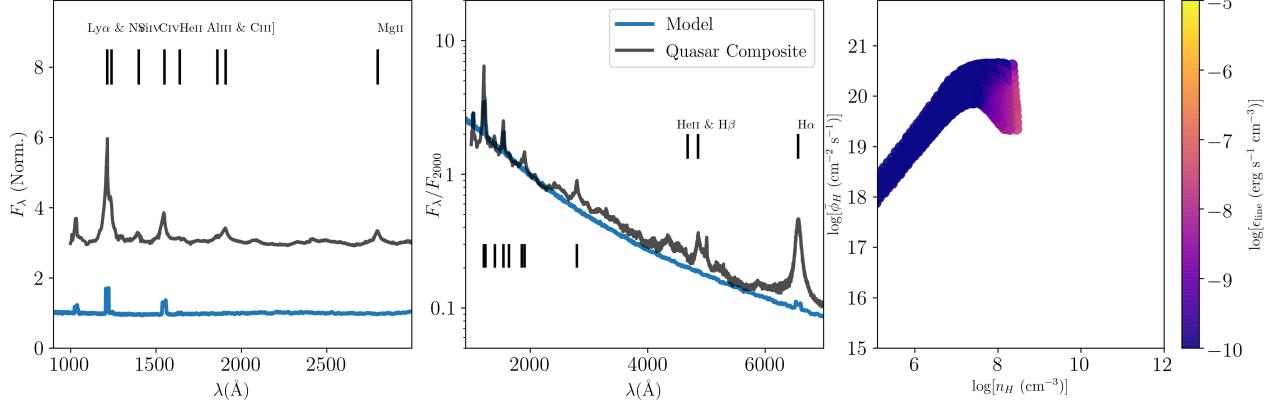
**Figure S2.** Run 2,  $f_c = 93.8\%$ ,  $f_w = 94.3\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 2250.00r_g$



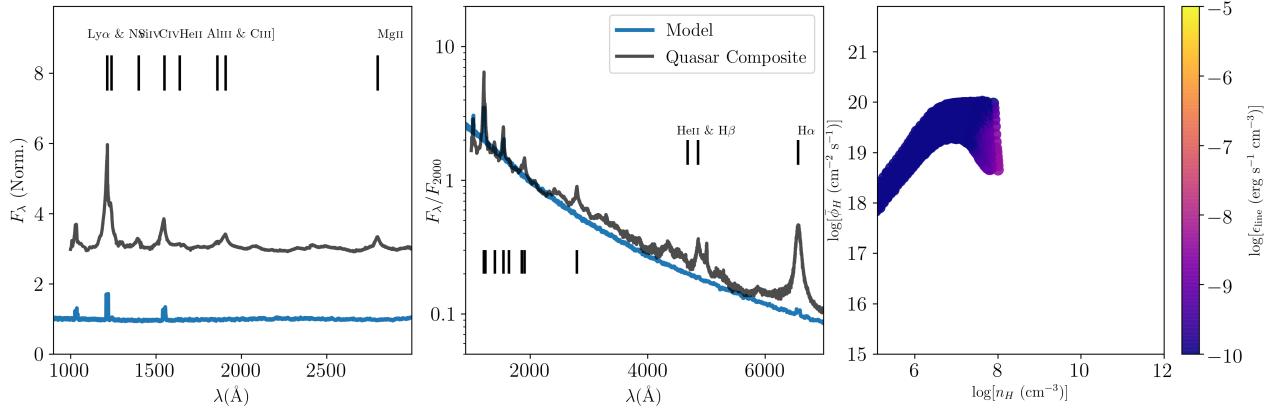
**Figure S3.** Run 3,  $f_c = 98.3\%$ ,  $f_w = 96.4\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 4500.00r_g$



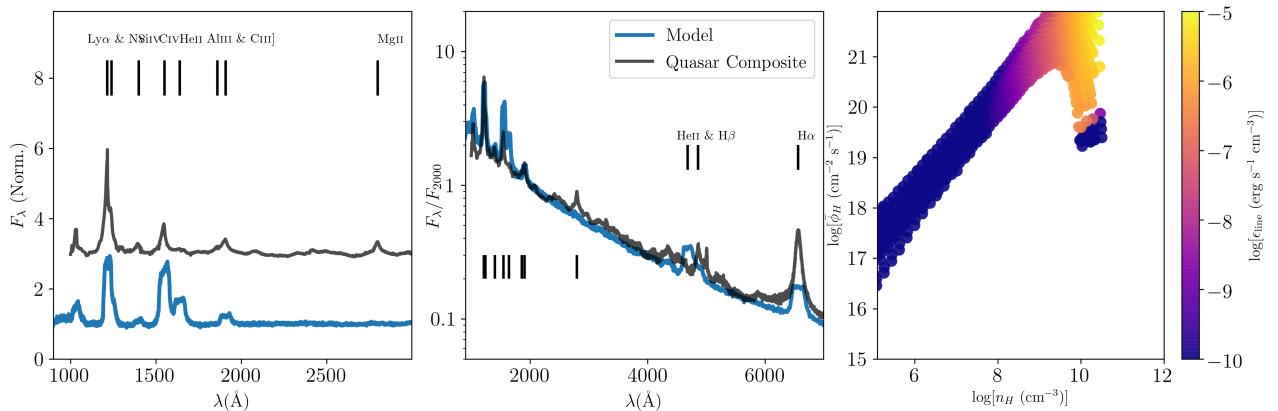
**Figure S4.** Run 4,  $f_c = 77.5\%$ ,  $f_w = 74.4\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 450.00r_g$



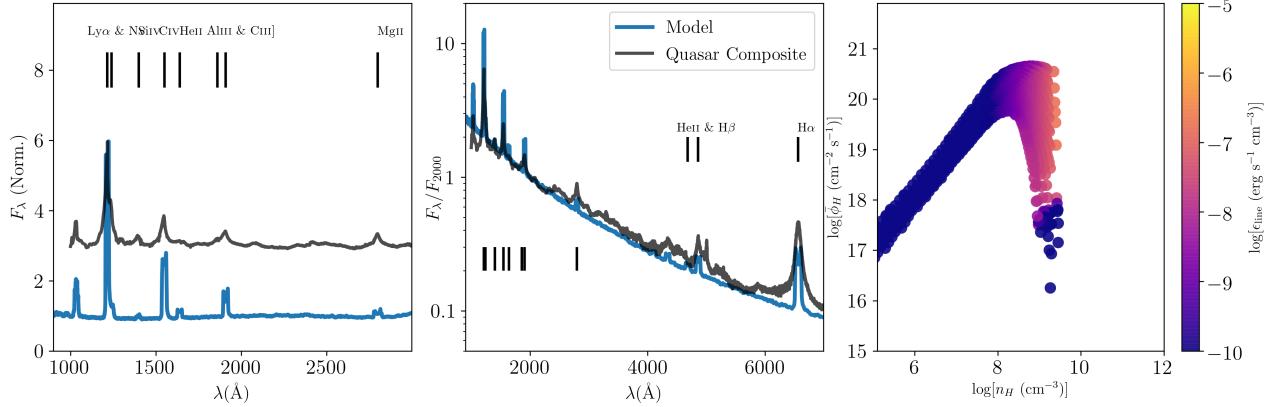
**Figure S5.** Run 5,  $f_c = 89.9\%$ ,  $f_w = 91.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 2250.00r_g$



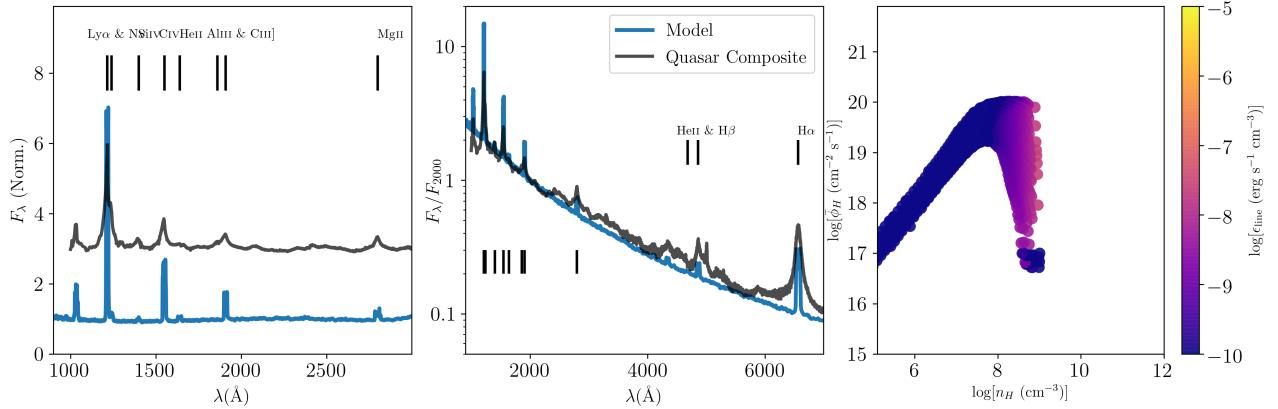
**Figure S6.** Run 6,  $f_c = 92.3\%$ ,  $f_w = 96.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 4500.00r_g$



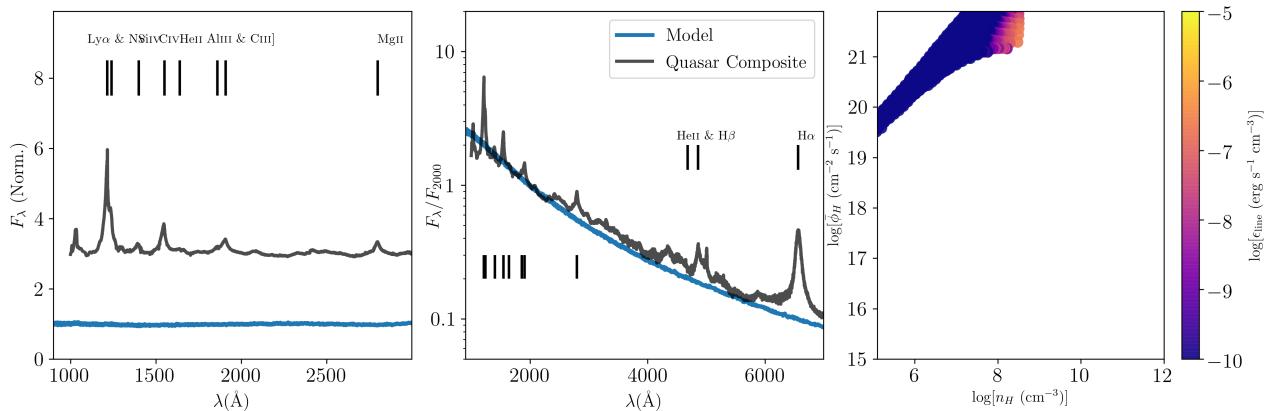
**Figure S7.** Run 7,  $f_c = 95.7\%$ ,  $f_w = 95.4\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 450.00r_g$



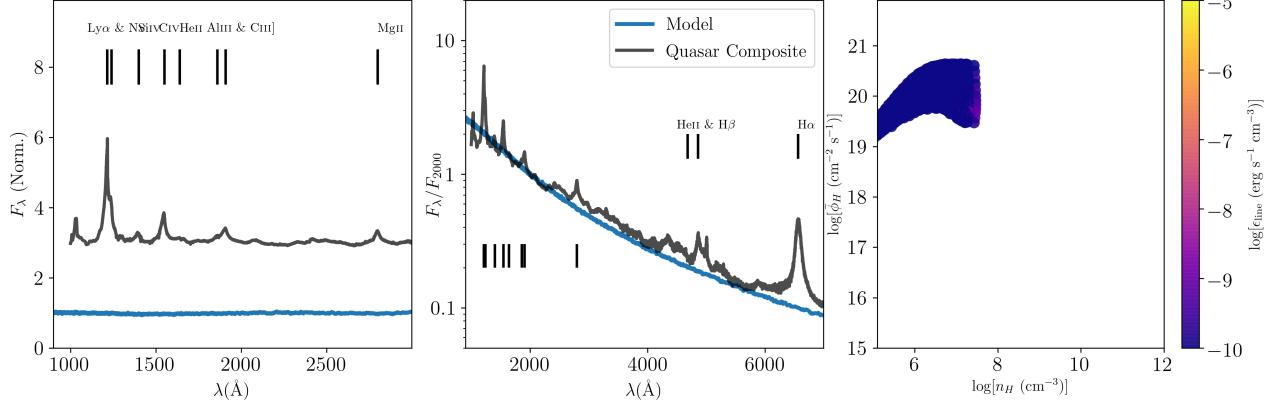
**Figure S8.** Run 8,  $f_c = 94.8\%$ ,  $f_w = 96.2\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 2250.00r_g$



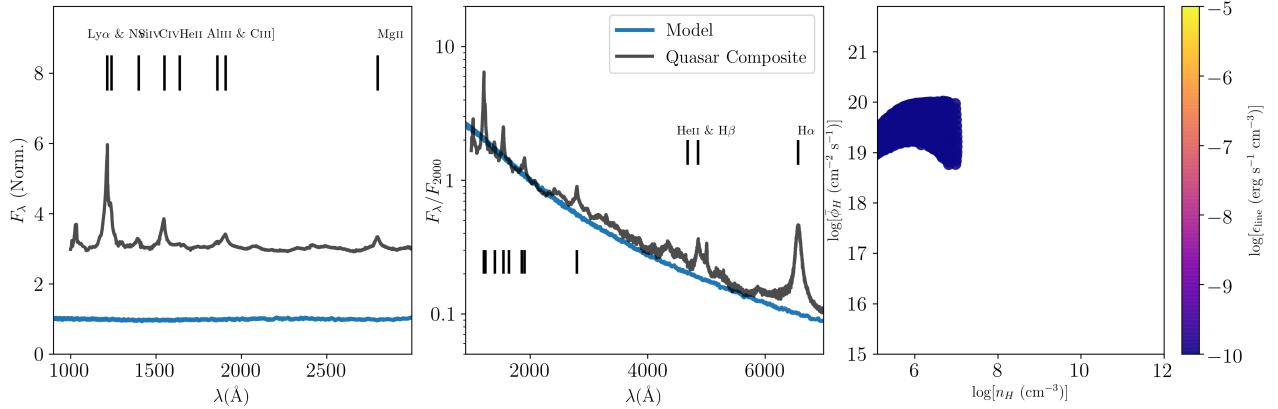
**Figure S9.** Run 9,  $f_c = 96.8\%$ ,  $f_w = 98.2\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 35$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 4500.00r_g$



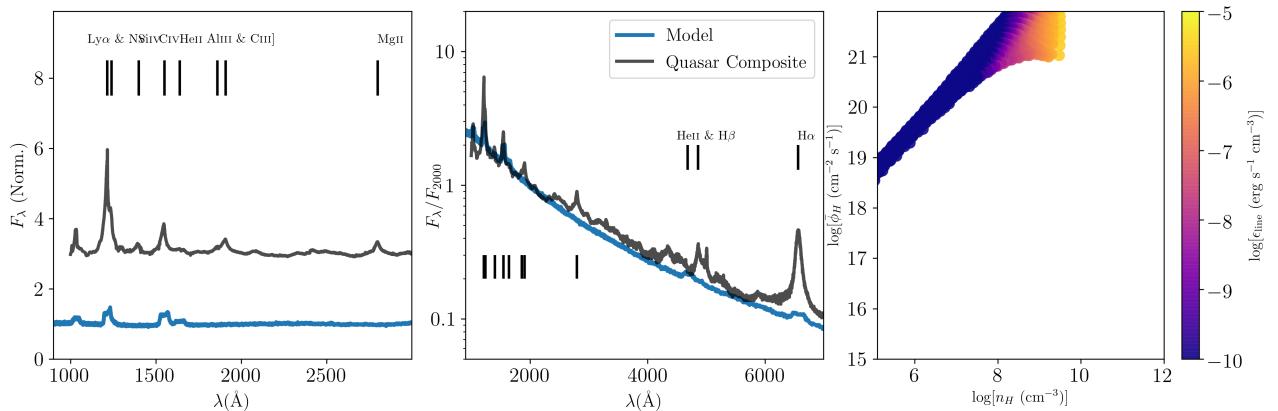
**Figure S10.** Run 10,  $f_c = 92.5\%$ ,  $f_w = 91.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 450.00r_g$



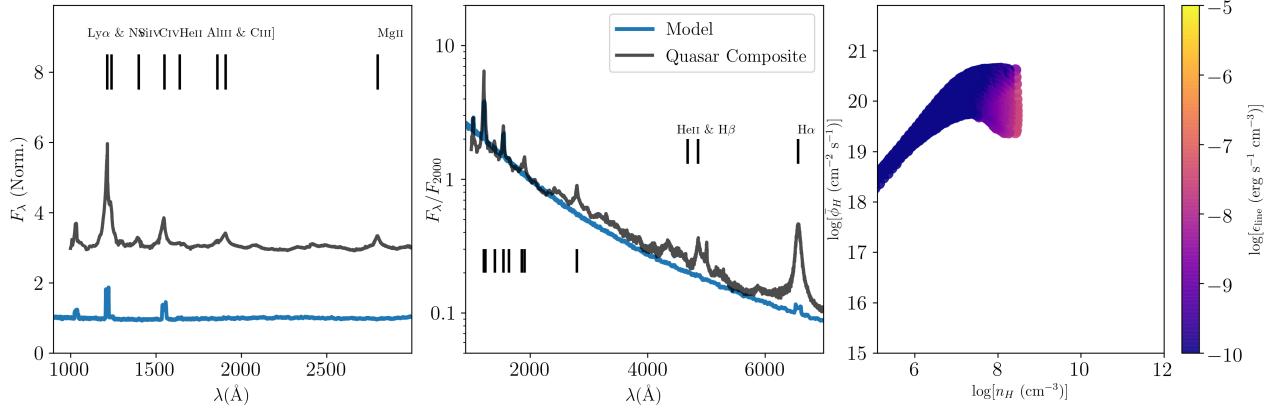
**Figure S11.** Run 11,  $f_c = 94.8\%$ ,  $f_w = 95.4\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 2250.00r_g$



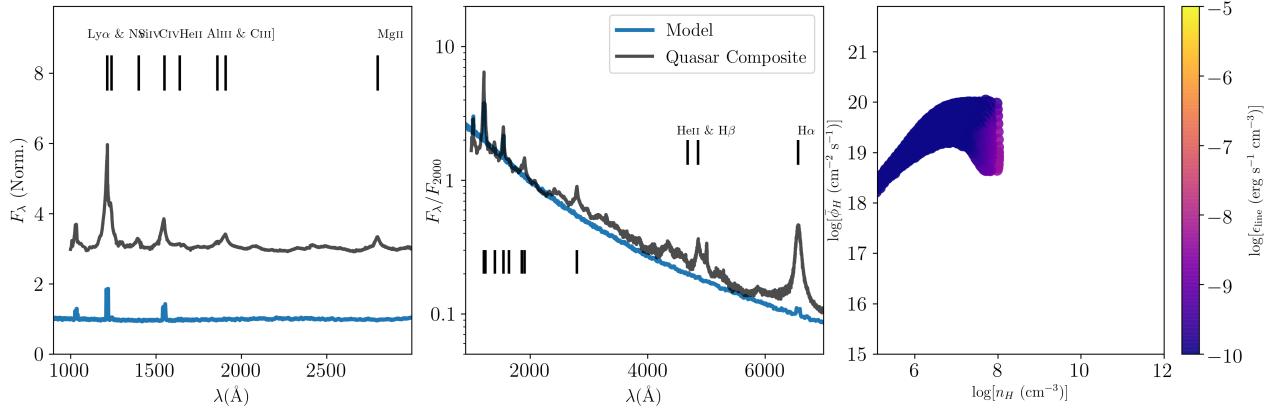
**Figure S12.** Run 12,  $f_c = 98.8\%$ ,  $f_w = 99.1\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 4500.00r_g$



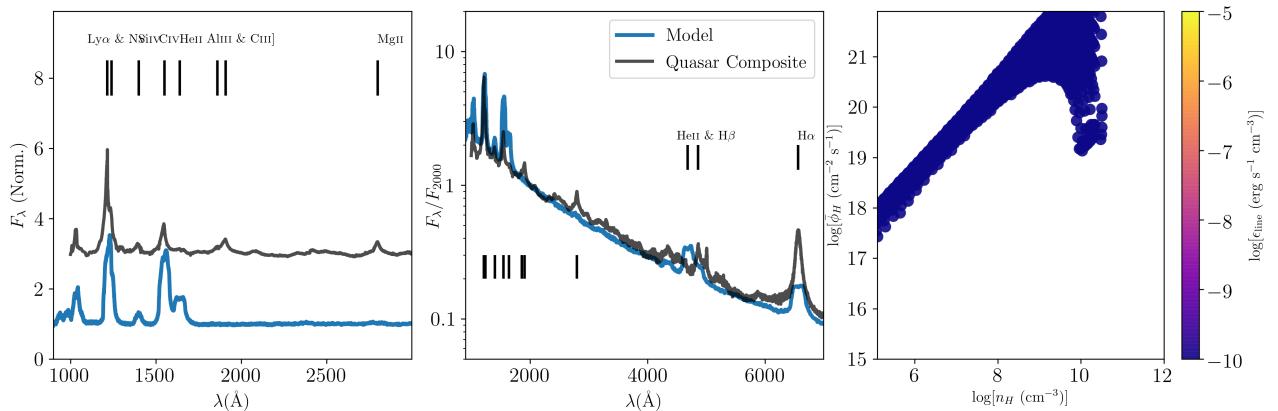
**Figure S13.** Run 13,  $f_c = 84.3\%$ ,  $f_w = 84.2\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 450.00r_g$



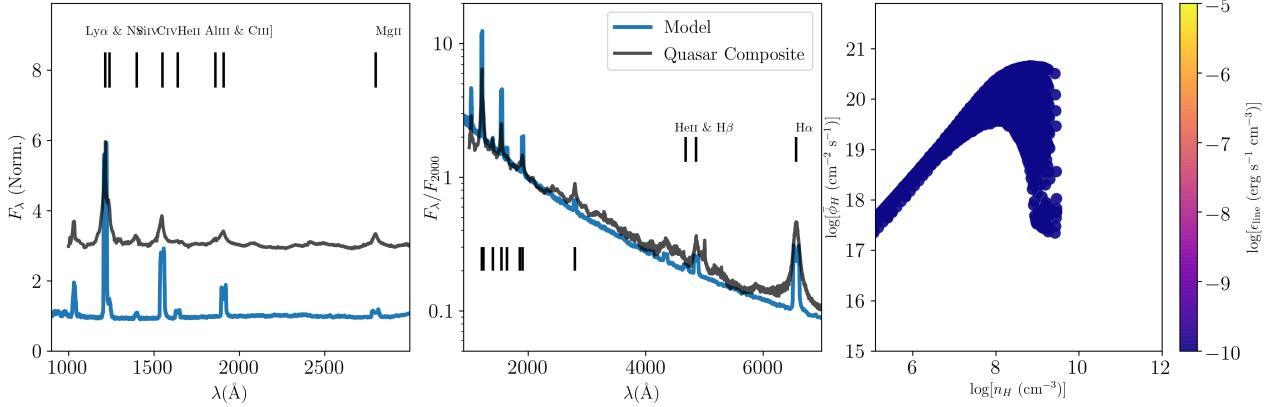
**Figure S14.** Run 14,  $f_c = 91.6\%$ ,  $f_w = 93.1\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 2250.00r_g$



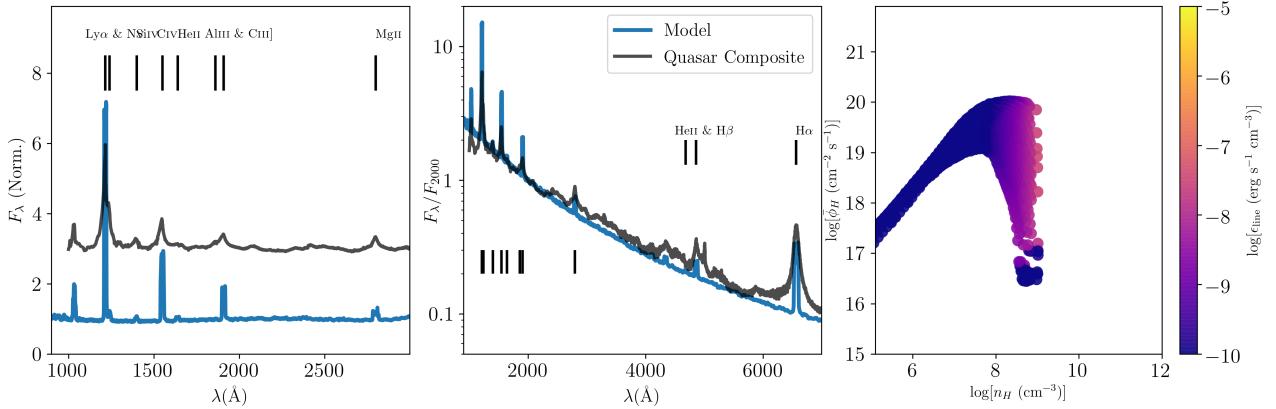
**Figure S15.** Run 15,  $f_c = 93.6\%$ ,  $f_w = 97.1\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 4500.00r_g$



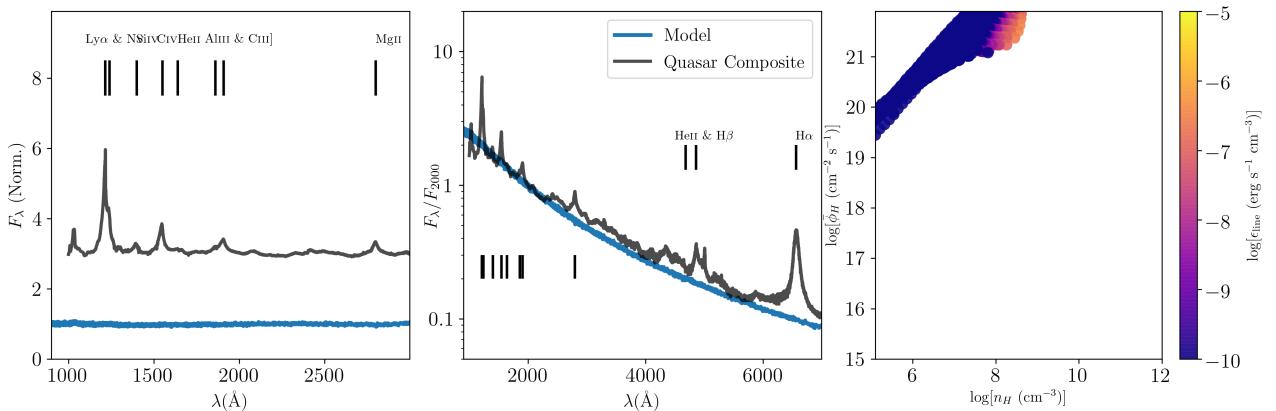
**Figure S16.** Run 16,  $f_c = 82.5\%$ ,  $f_w = 77.9\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 450.00r_g$



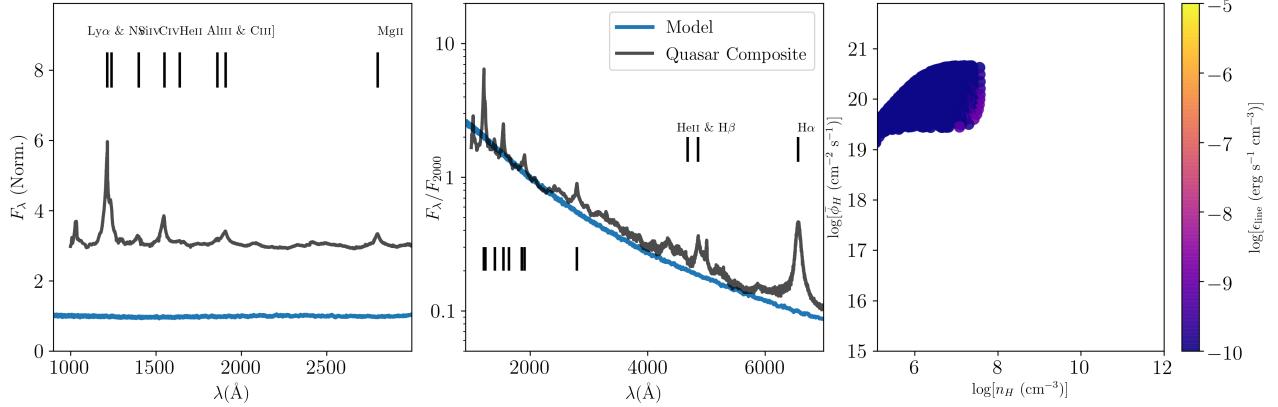
**Figure S17.** Run 17,  $f_c = 89.5\%$ ,  $f_w = 89.2\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 2250.00r_g$



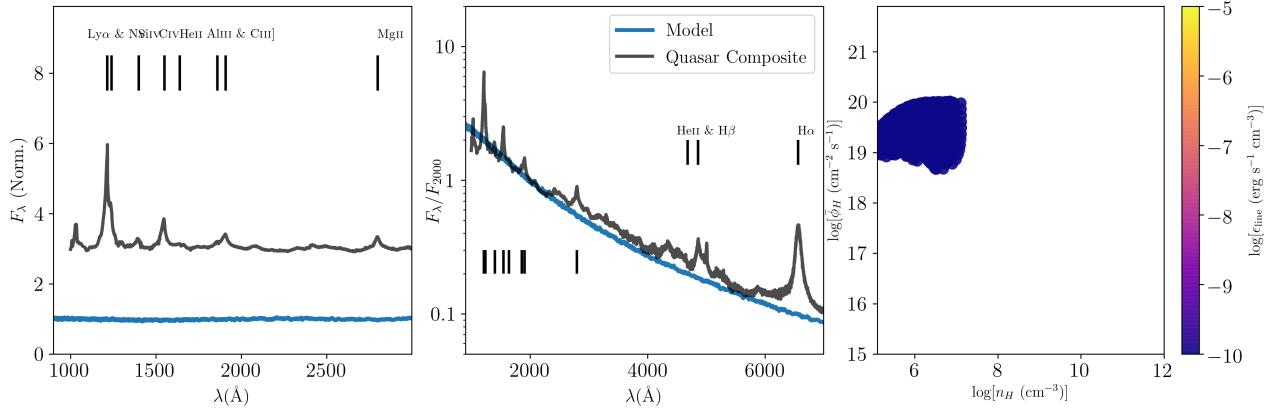
**Figure S18.** Run 18,  $f_c = 96.6\%$ ,  $f_w = 97.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 60$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 4500.00r_g$



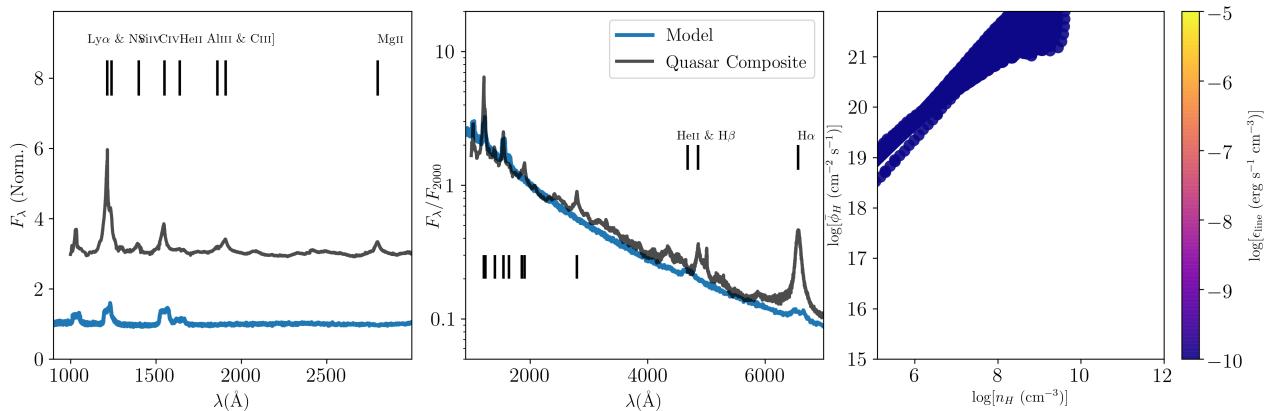
**Figure S19.** Run 19,  $f_c = 95.0\%$ ,  $f_w = 93.8\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 450.00r_g$



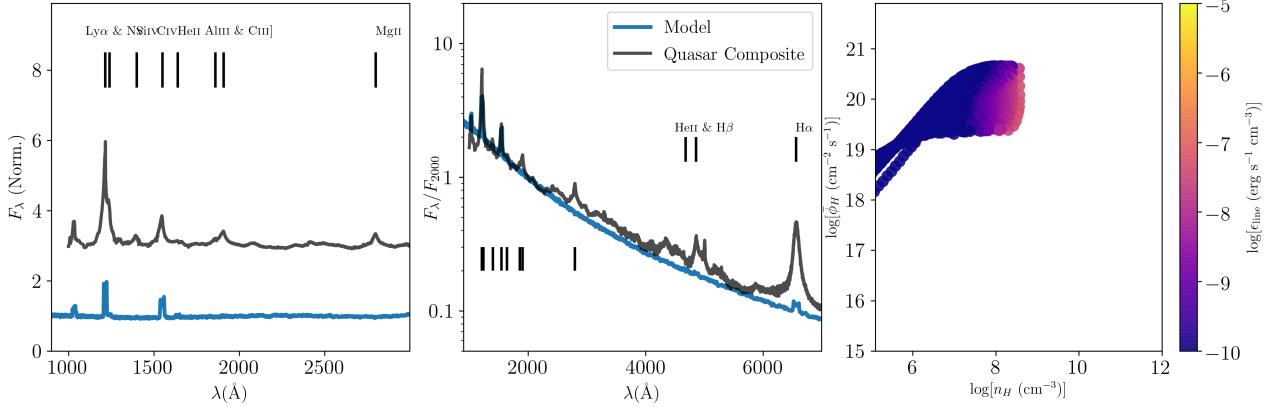
**Figure S20.** Run 20,  $f_c = 96.3\%$ ,  $f_w = 96.3\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 2250.00r_g$



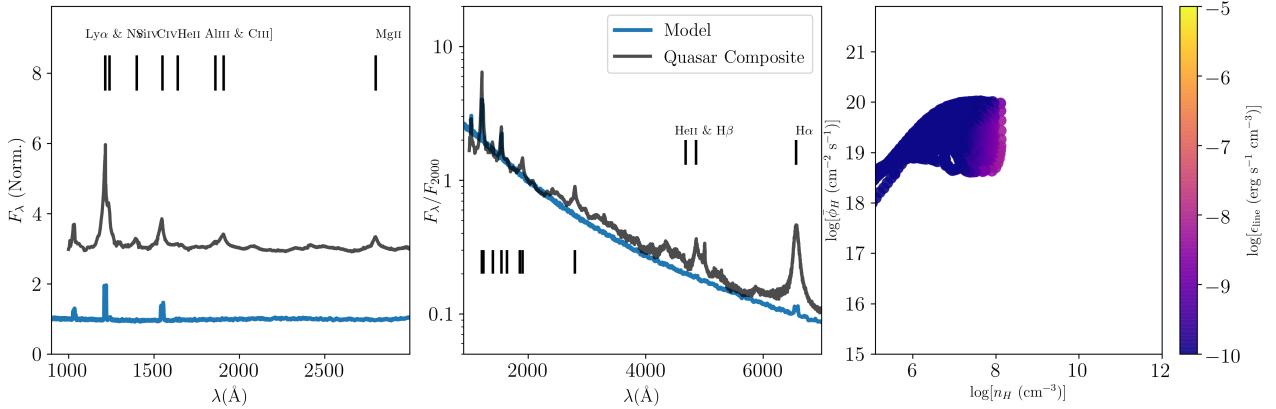
**Figure S21.** Run 21,  $f_c = 98.6\%$ ,  $f_w = 99.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 4500.00r_g$



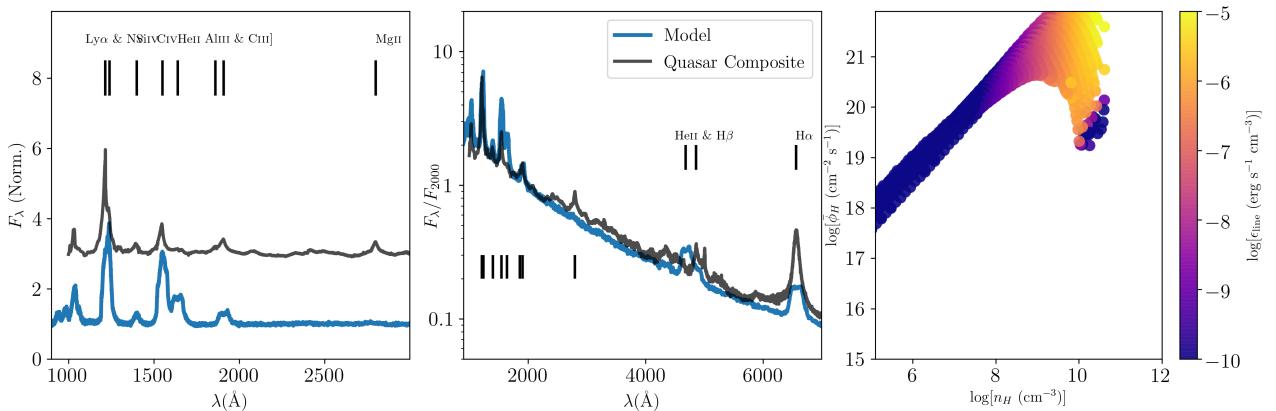
**Figure S22.** Run 22,  $f_c = 84.9\%$ ,  $f_w = 87.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 450.00r_g$



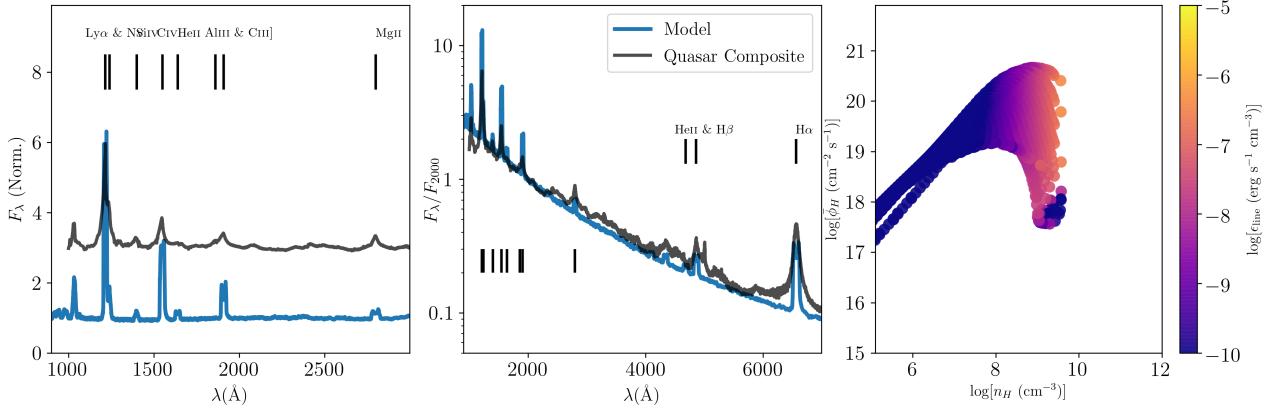
**Figure S23.** Run 23,  $f_c = 92.1\%$ ,  $f_w = 94.3\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 2250.00r_g$



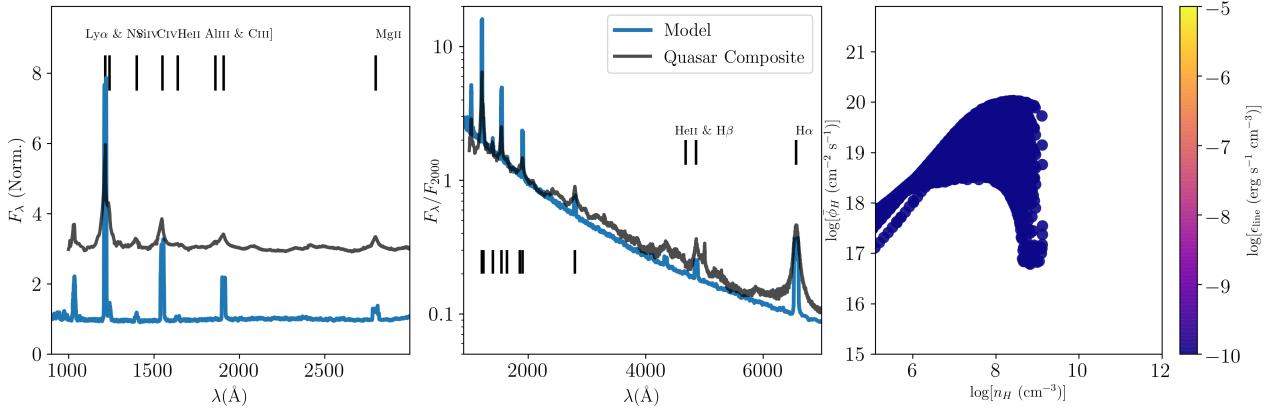
**Figure S24.** Run 24,  $f_c = 94.6\%$ ,  $f_w = 96.5\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 4500.00r_g$



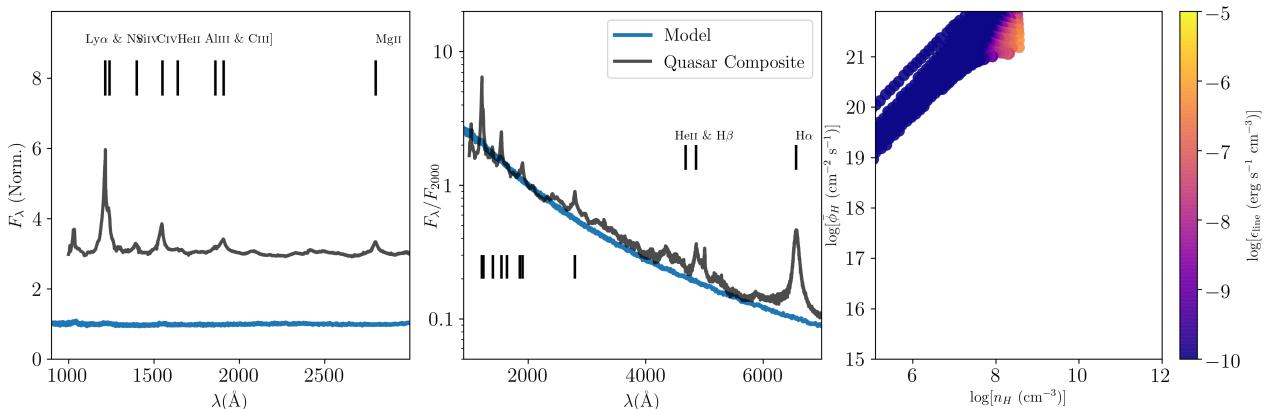
**Figure S25.** Run 25,  $f_c = 81.4\%$ ,  $f_w = 80.7\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 450.00r_g$



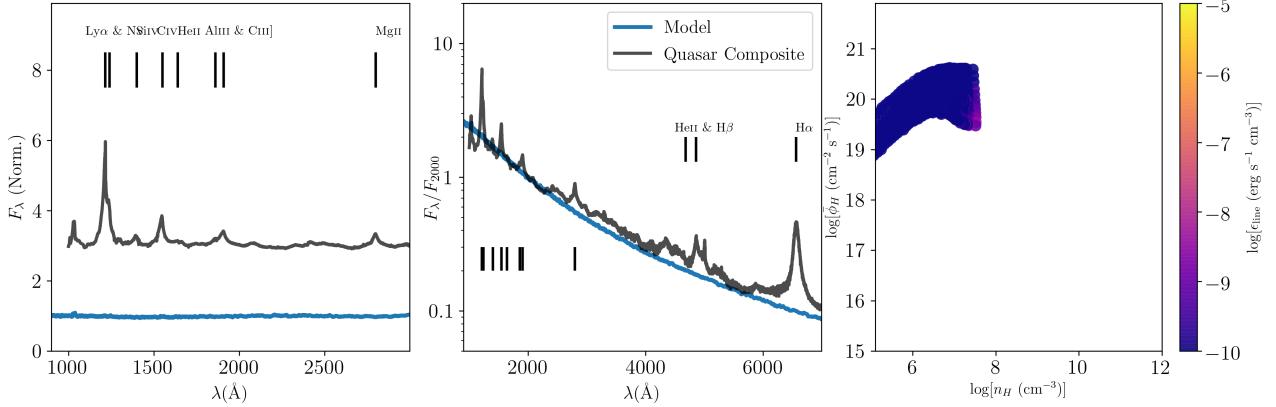
**Figure S26.** Run 26,  $f_c = 86.2\%$ ,  $f_w = 88.7\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 2250.00r_g$



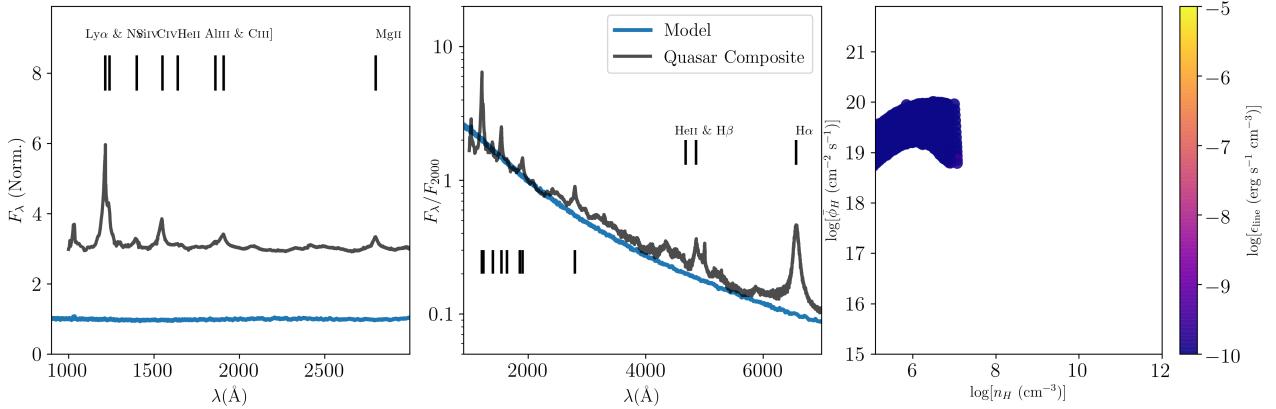
**Figure S27.** Run 27,  $f_c = 90.8\%$ ,  $f_w = 94.9\%$ ,  $\theta_1 = 20$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 4500.00r_g$



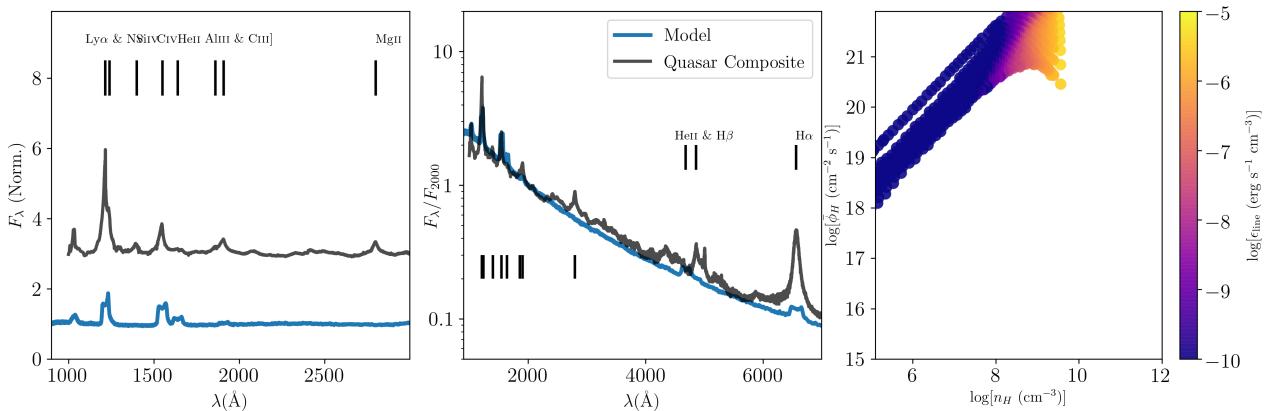
**Figure S28.** Run 28,  $f_c = 85.0\%$ ,  $f_w = 87.3\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 450.00r_g$



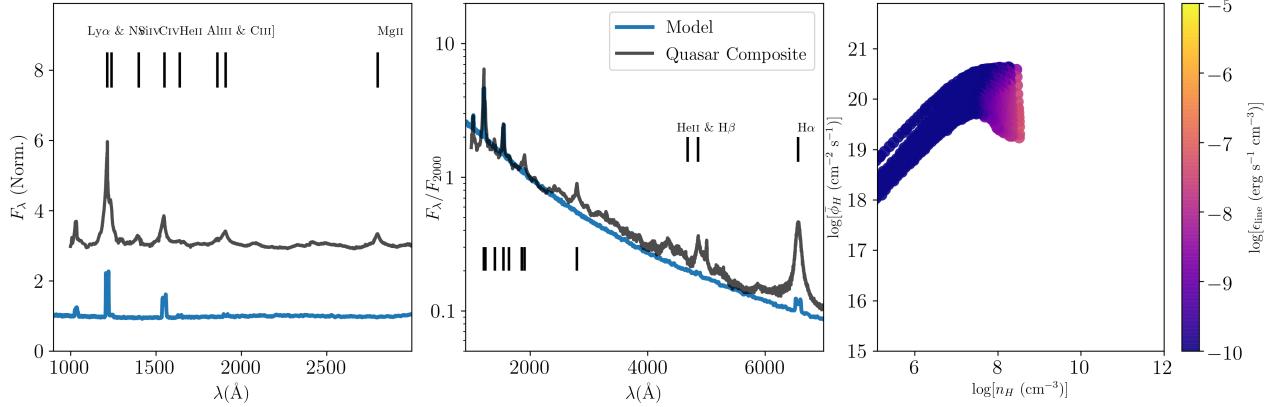
**Figure S29.** Run 29,  $f_c = 86.9\%$ ,  $f_w = 89.5\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 2250.00r_g$



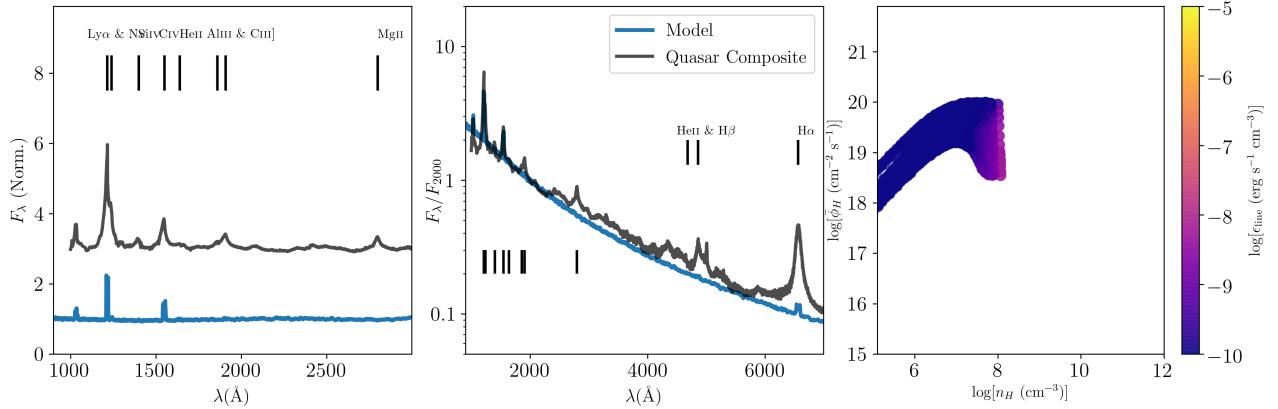
**Figure S30.** Run 30,  $f_c = 94.9\%$ ,  $f_w = 97.2\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 4500.00r_g$



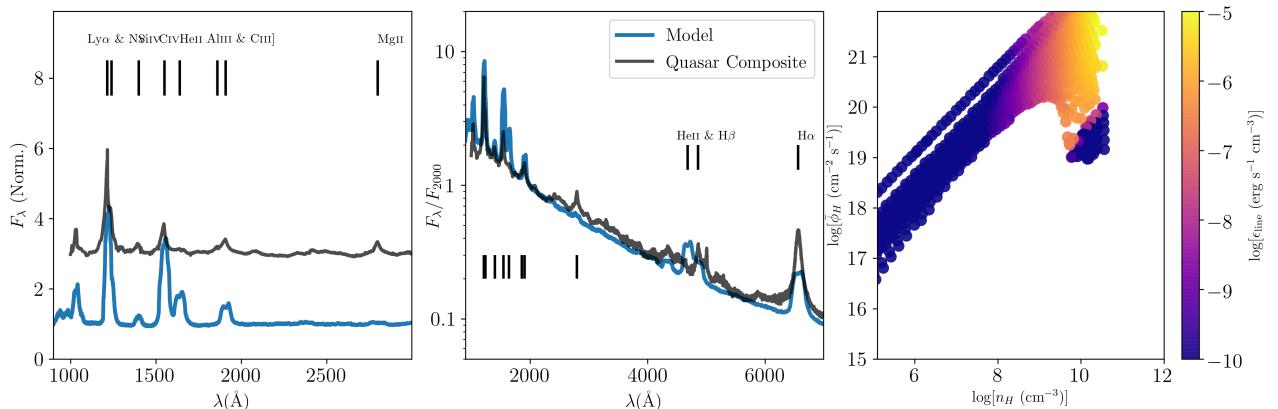
**Figure S31.** Run 31,  $f_c = 81.6\%$ ,  $f_w = 84.3\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 450.00r_g$



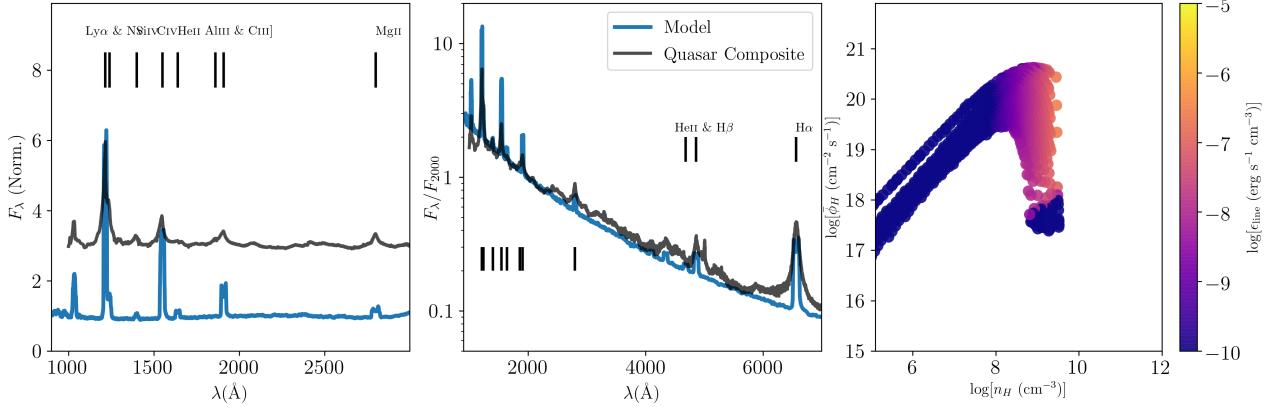
**Figure S32.** Run 32,  $f_c = 88.2\%$ ,  $f_w = 89.7\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 2250.00r_g$



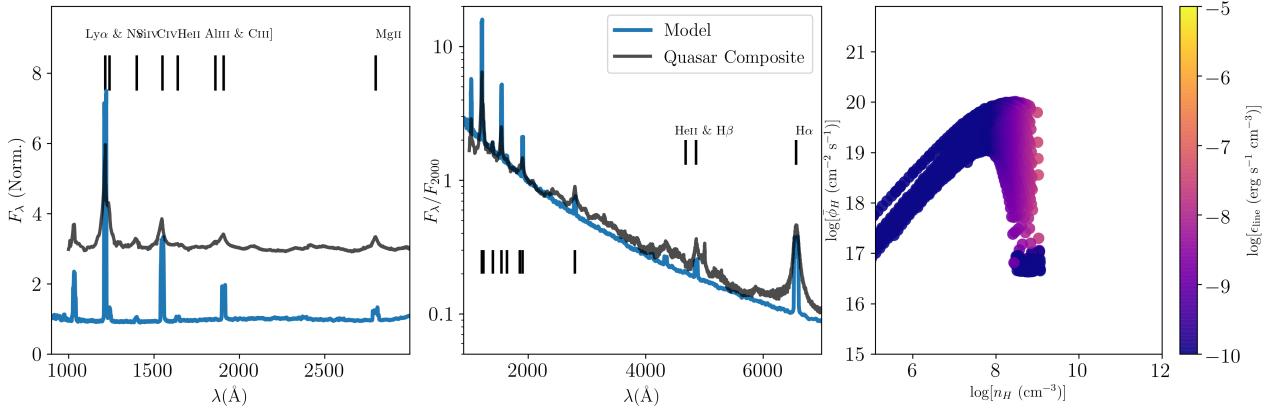
**Figure S33.** Run 33,  $f_c = 90.4\%$ ,  $f_w = 94.5\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 4500.00r_g$



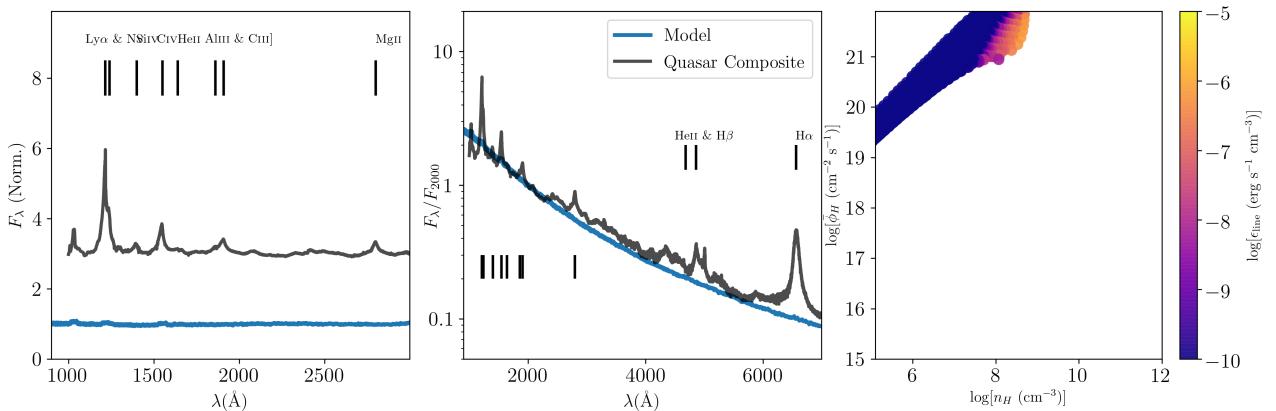
**Figure S34.** Run 34,  $f_c = 98.9\%$ ,  $f_w = 99.7\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 450.00r_g$



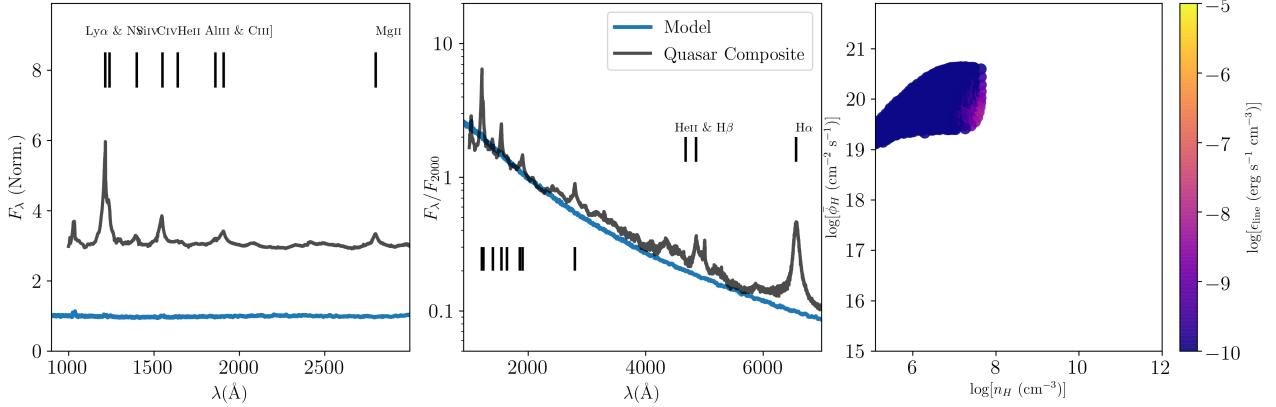
**Figure S35.** Run 35,  $f_c = 95.2\%$ ,  $f_w = 97.7\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 2250.00r_g$



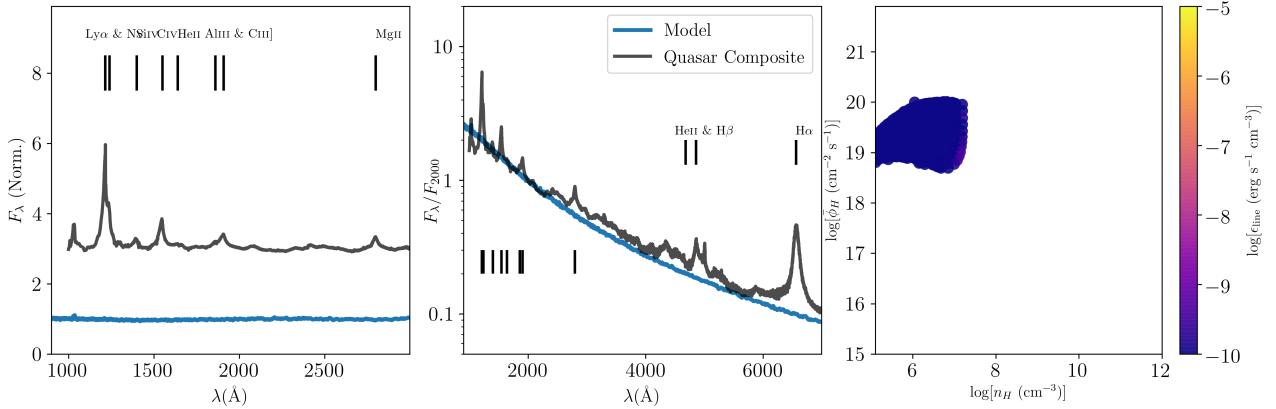
**Figure S36.** Run 36,  $f_c = 96.9\%$ ,  $f_w = 98.8\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 60$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 4500.00r_g$



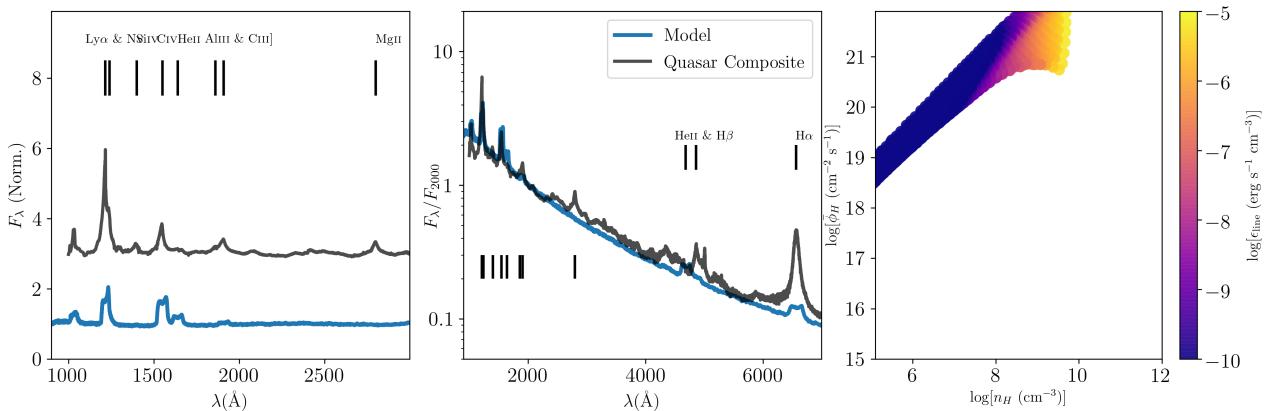
**Figure S37.** Run 37,  $f_c = 90.9\%$ ,  $f_w = 88.7\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 450.00r_g$



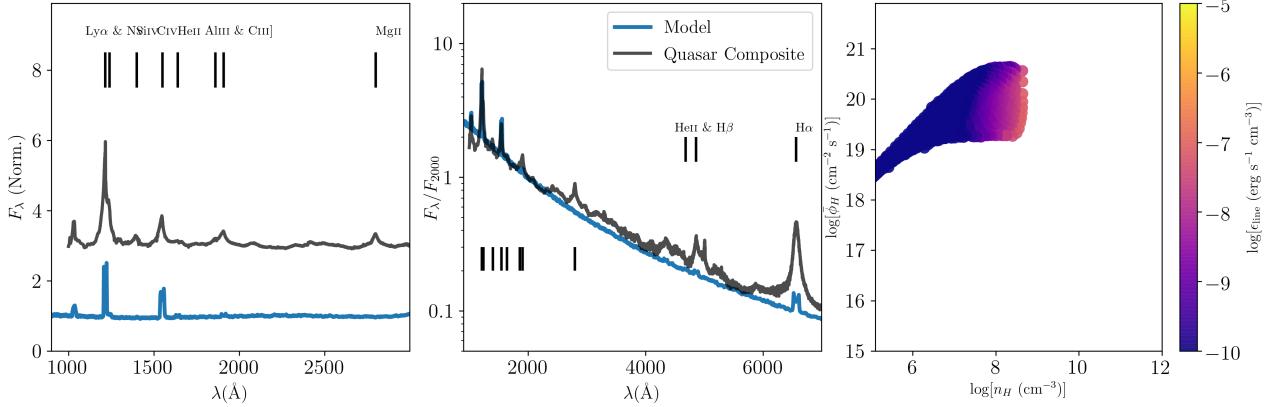
**Figure S38.** Run 38,  $f_c = 92.0\%$ ,  $f_w = 92.5\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 2250.00r_g$



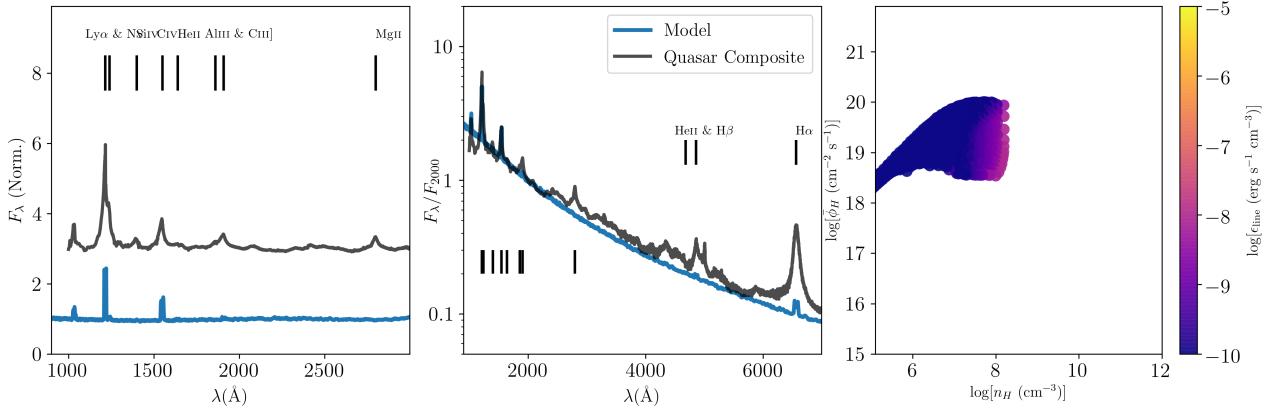
**Figure S39.** Run 39,  $f_c = 95.1\%$ ,  $f_w = 95.7\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 4500.00r_g$



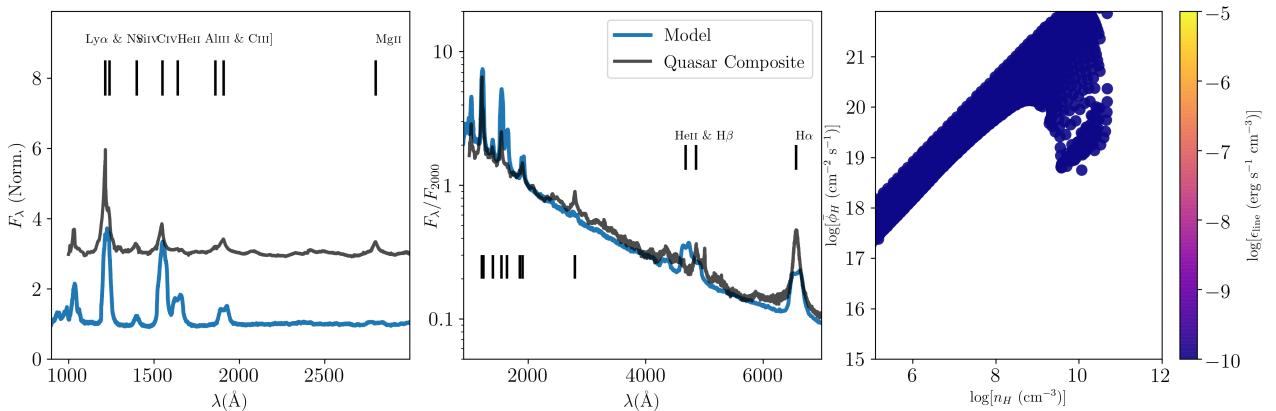
**Figure S40.** Run 40,  $f_c = 82.8\%$ ,  $f_w = 84.6\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 450.00r_g$



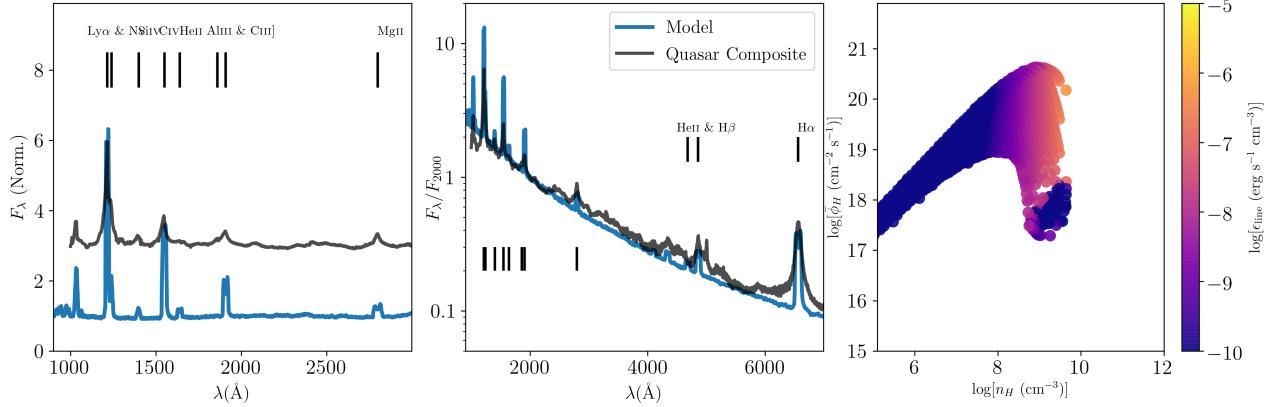
**Figure S41.** Run 41,  $f_c = 88.9\%$ ,  $f_w = 90.8\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 2250.00r_g$



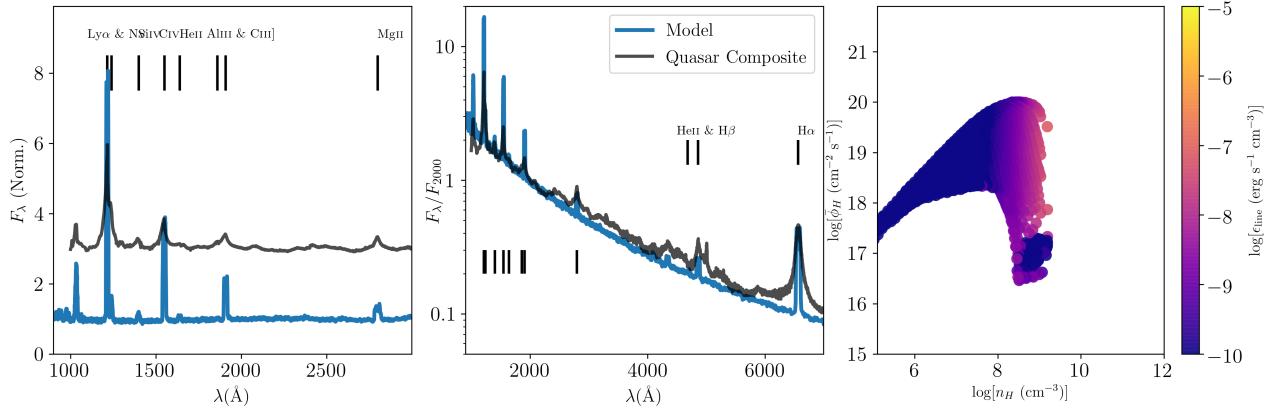
**Figure S42.** Run 42,  $f_c = 92.4\%$ ,  $f_w = 94.2\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 4500.00r_g$



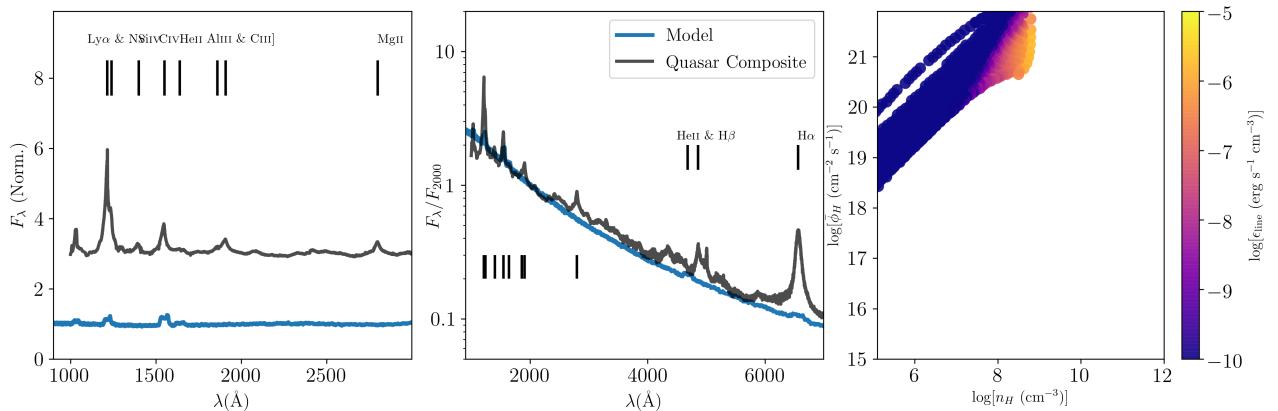
**Figure S43.** Run 43,  $f_c = 95.9\%$ ,  $f_w = 97.2\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 450.00r_g$



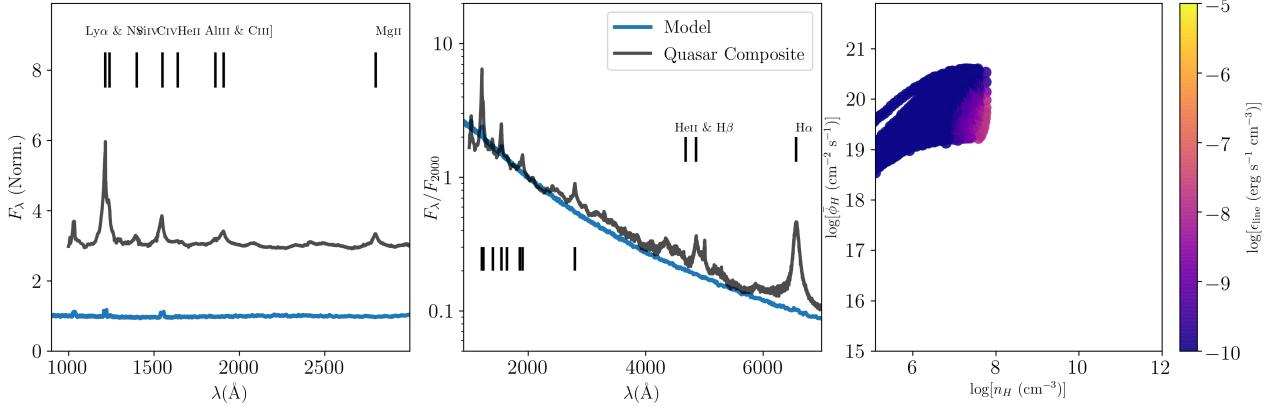
**Figure S44.** Run 44,  $f_c = 93.8\%$ ,  $f_w = 94.1\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 2250.00r_g$



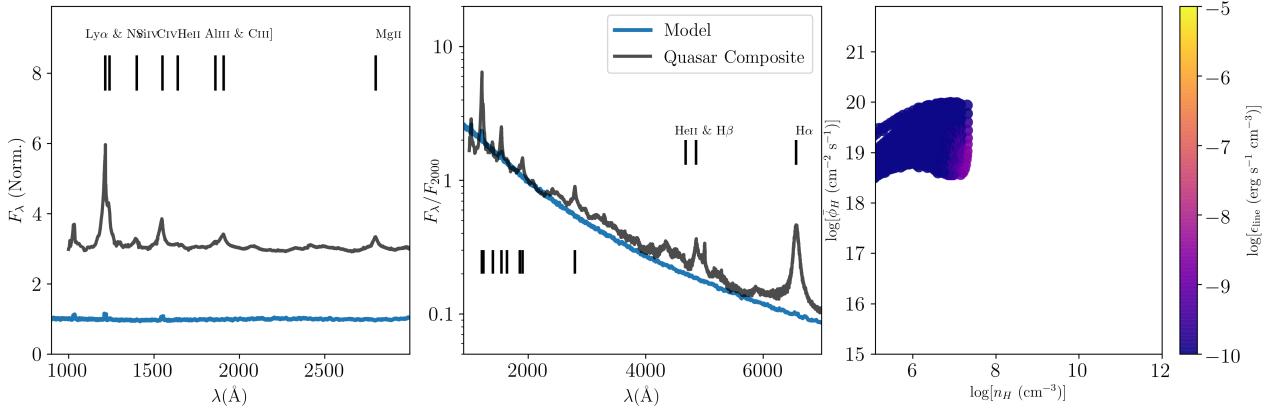
**Figure S45.** Run 45,  $f_c = 95.3\%$ ,  $f_w = 96.5\%$ ,  $\theta_1 = 45$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 4500.00r_g$



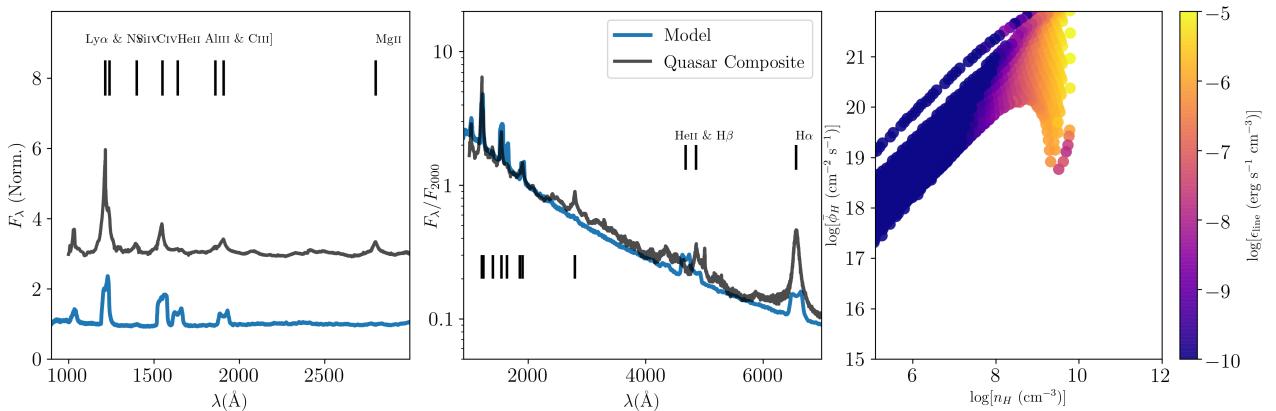
**Figure S46.** Run 46,  $f_c = 83.7\%$ ,  $f_w = 82.7\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 450.00r_g$



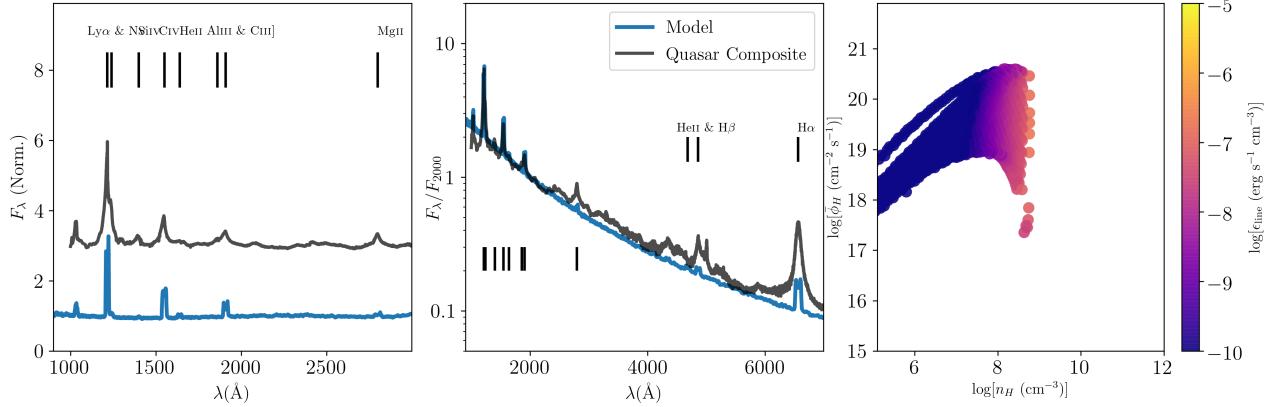
**Figure S47.** Run 47,  $f_c = 85.6\%$ ,  $f_w = 84.5\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 2250.00r_g$



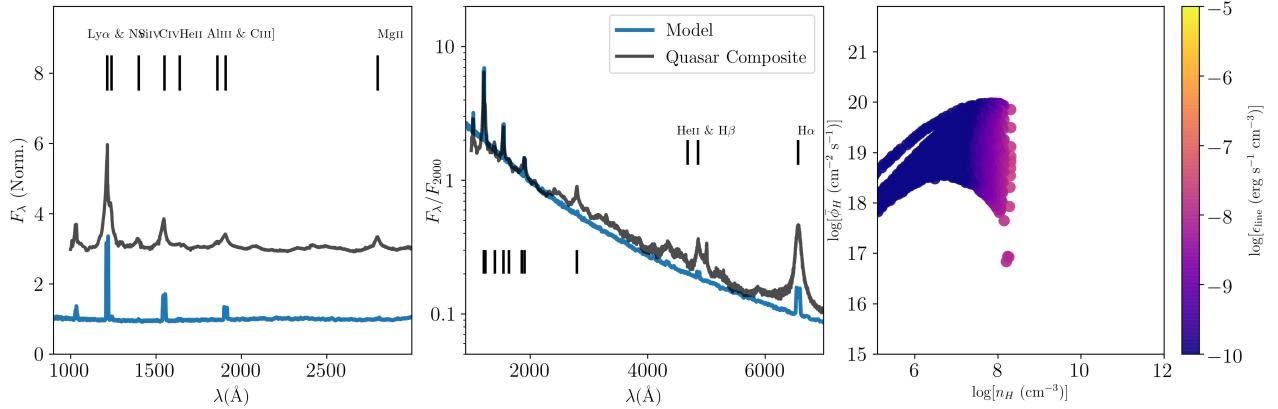
**Figure S48.** Run 48,  $f_c = 86.9\%$ ,  $f_w = 87.5\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 1.00$ ,  $R_{\text{launch}} = 4500.00r_g$



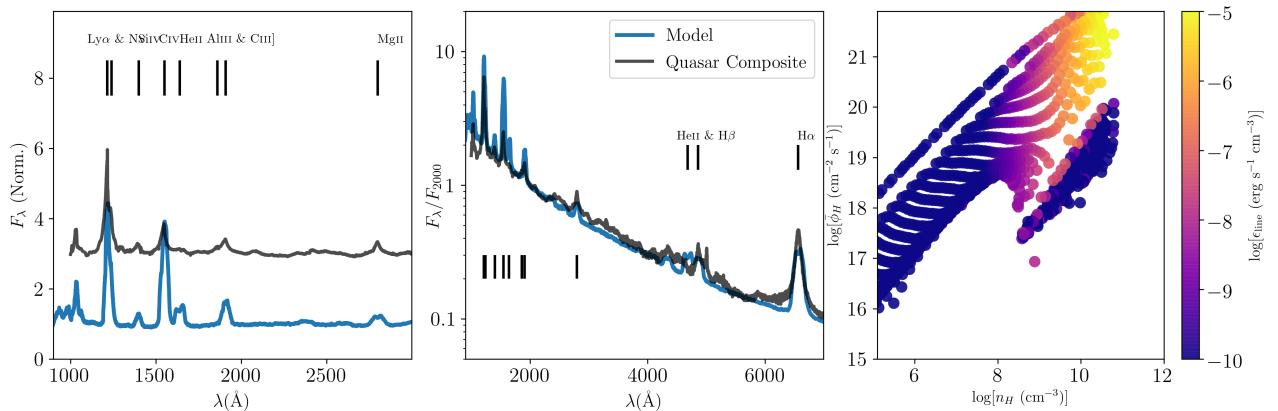
**Figure S49.** Run 49,  $f_c = 86.7\%$ ,  $f_w = 86.3\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 450.00r_g$



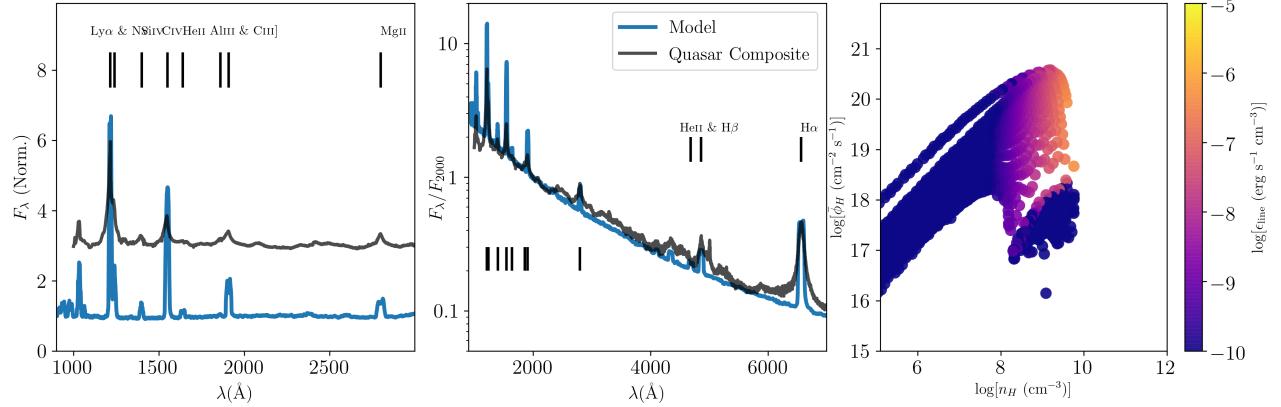
**Figure S50.** Run 50,  $f_c = 87.3\%$ ,  $f_w = 86.9\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 2250.00r_g$



**Figure S51.** Run 51,  $f_c = 89.8\%$ ,  $f_w = 87.8\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 0.10$ ,  $R_{\text{launch}} = 4500.00r_g$



**Figure S52.** Run 52,  $f_c = 87.6\%$ ,  $f_w = 82.7\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 450.00r_g$



**Figure S53.** Run 53,  $f_c = 92.7\%$ ,  $f_w = 89.3\%$ ,  $\theta_1 = 70$ ,  $\theta_2 = 85$ ,  $f_V = 0.01$ ,  $R_{\text{launch}} = 2250.00r_g$