Astronomy has always been a science of catalogs: catalogs of stars, galaxies, quasars, and planets. While most of the light in the Universe comes from these dense objects in the darkness, the contents of the universe are largely diffuse. Even setting aside dark energy and dark matter, plasma and gas make up the vast majority of the mass of the Universe and cannot be easily cataloged. If we want to understand how the objects in the universe came to be, we must understand the state the largely invisible diffuse phase that forms them.

I will argue in this talk that tomography, the process by which we take catalog data (quasars, galaxies, and stars) and reconstruct the intervening gas (intergalactic, circumgalactic, and interstellar medium), is poised on the edge of a revolution. I will describe advances of the last decade, powered by the industrial photometric precision of SDSS, and how much we have learned about the diffuse phase of the universe, especially in astrophysical dust. I will also give an introduction to a whole new subfield we are developing, Kinetic Tomography, which attempts to reconstruct not the 3D gas and dust distribution, but the 4D distribution, including velocity. With this 4D data we can crack longstanding problems in the formation and destruction processes that govern spiral arms, molecular clouds, and galaxies as whole.