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Probing dark matter properties through the morphology of the intergalactic medium in emission

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The properties of dark matter affect its distribution in the universe. In particular, the mass of dark matter defines a characteristic free streaming length under which structure formation is suppressed. While this length is negligible for standard cold dark matter, it can be of the order of galactic sizes for warm dark matter with mass ˜ 1keV, and thus have observational effects. Current constraints from astrophysical probes set a lower limit around 2-6 keV, but they depend on assumptions about the thermal history of the universe or galaxy formation. In this talk I will present a promising new probe to constrain dark matter properties: fluorescent emission from the intergalactic medium (IGM) around bright quasars in the young universe (z˜3), in particular at the Lyman-alpha (Lya) wavelength. This emission is produced by the cold (T<10ˆ5K) diffuse gas in the IGM, which represents the fraction of cosmic gas that has been minimally impacted by galactic processes, making it an optimal tracer of the underlying dark matter. It is however very faint, and observations only revealed it very recently on intergalactic scales. Before being able to exploit these, it is necessary to study similar structures in numerical simulations with different dark matter implementations. I will present our new suite of high resolution zoom-in hydrodynamical simulations. We use these to create mock observations of the Lya surface brightness in cold and warm dark matter scenarios. Using topological tools, I will then show that the nature of dark matter impacts the morphology of the intergalactic Lya emission, making it more clumpy in the cold dark matter case. These results constitute the first steps towards new constraints on the nature of dark matter complementary to, and competitive with existing ones.

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