Exploring the Reionization Epoch with HST and JWST

S. Michael Fall[1], Massimo Stiavelli[1], and Nino Panagia[1,2]

[1] Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
[2] Affiliated with the Space Telescope Division of the European Space Agency, ESTEC, Noordwijk, Netherlands

Abstract. We discuss the detectability of the sources responsible for reionization with existing and planned telescopes. Our approach is based on the number of UV photons required for reionization and depends on relatively few undetermined parameters. We conclude that if the reionization sources are UV-efficient, minimum-luminosity sources, it may be difficult to detect them before the launch of the James Webb Space Telescope. Until then, the best approach may be either to exploit gravitational lensing by clusters of galaxies, or to search for strong Lyα emission by narrow-band imaging or slitless grism spectroscopy.

1 Introduction

Motivated by recent evidence that the epoch of hydrogen reionization may have ended at a redshift as low as $z \approx 6$ [1,2], we have considered the detectability of the sources responsible for this reionization. The main idea is that reionization places limits on the mean surface brightness of the population of reionization sources. We have defined a family of models characterized by two parameters: the fraction f_c of Lyman-continuum photons that escape from the sources and the clumpiness parameter C of the intergalactic medium. The minimum required surface brightness corresponds to a value of unity for both of these parameters. The maximum surface brightness is set by the condition that the reionization sources not produce too many heavy elements. Our general approach is applicable to most types of reionization sources, but in specific numerical examples, we focus on those composed of Population III stars, which have high effective temperatures and therefore produce ionizing photons with high efficiency (e.g. [3]). Our predictions are compared to the parameter space that can be probed by existing and future telescopes, primarily the Hubble and James Webb Space Telescopes (HST and JWST) in order to help plan the most effective searches. A full account of our work has been published recently in the Astrophysical Journal [4].

2 Continuum Searches

In Figure 1, we show the expected mean surface density of the reionization sources as a function of their apparent AB magnitude in the non-ionizing UV

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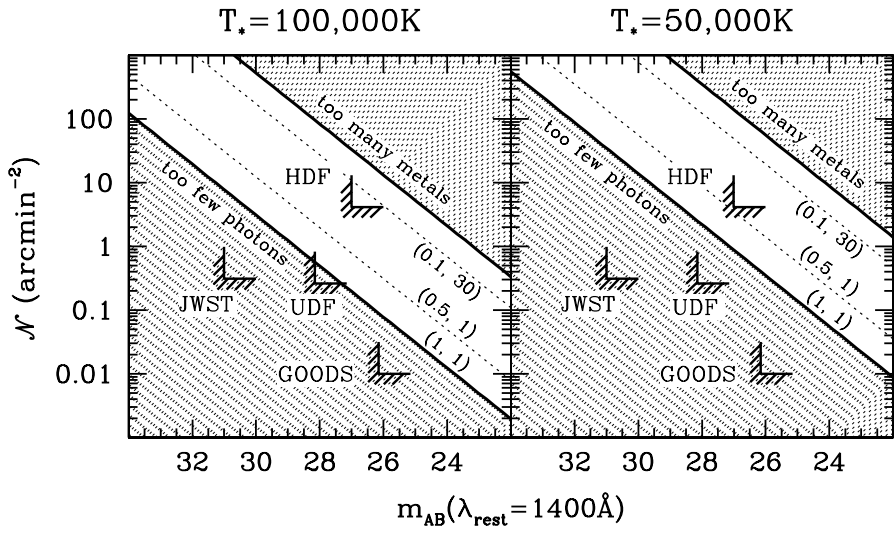

Fig. 1. Surface density vs. apparent magnitude of identical reionization sources composed either of Population III stars (left hand panel) or Population II stars (right hand panel)

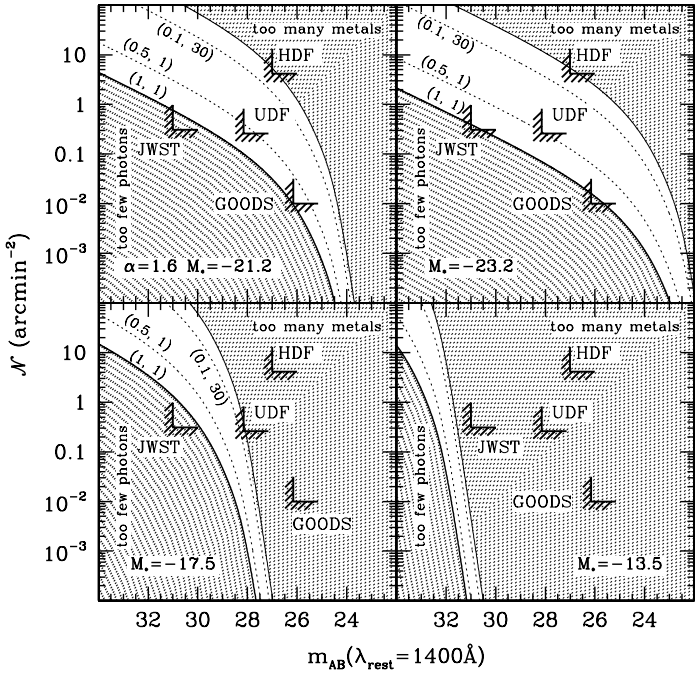

Fig. 2. Cumulative surface density vs. apparent magnitude of non-identical reionization sources with different luminosity functions (different M_* but same α)