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The Spatially Resolved Dust-to-Metals Ratio in M101

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The dust-to-metals ratio provides insights into the life cycle of dust. We measure the dust-to-metals ratio in M101, a nearby galaxy with a radial metallicity gradient spanning ~ 1 dex. We fit the dust spectral energy distribution (SED) from 100 to 500 μm with five variants of the modified blackbody (MBB) dust emission model (free β, fixed β, broken emissivity, warm dust component, and a power-law radiation field distribution). The broken emissivity method performs the best among them, showing small residuals, reasonable $\tilde{\chi}^2$ distribution, a temperature gradient decreasing with radius and no violation of the upper bounds on available metals. We show that the dust-to-metals ratio is not constant in M101, but decreases as a function of radius, leading to a lower fraction of the heavy elements being trapped in dust at low metallicity. We show that the dust-to-gas ratio (DGR) is proportional to $Z^{1.71}$. Alternatively, we could instead explain the DGR gradient as an increase in emissivity as dust grains coagulate. If we assume the Draine et al. 2014 dust-to-metals relation, the opacity constant κ_{160} would increase at most by a factor of two, which is similar to what Planck Collaboration et al. 2014 found.

Consider for a poster?

Yes

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