The ALMA Wideband Sensitivity Upgrade

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The Wideband Sensitivity Upgrade (WSU) is the top priority initiative for the ALMA2030 Development Roadmap. The WSU will initially double, and eventually quadruple, ALMA’s system bandwidth and deliver improved sensitivity by upgrading the receivers, digital electronics, and correlator. The WSU will afford significant improvements for every future ALMA observation, whether it is focused on continuum or spectral line science. The continuum imaging speed will increase by at least a factor of 3 for the 2× bandwidth upgrade, plus any speed gains from improved receiver temperatures. The spectral line imaging speed is expected to improve by a factor of 2–3 depending on the receiver band. The improvements provided by the WSU will be most dramatic for high spectral resolution observations, where the instantaneous bandwidth correlated at ∼ 0.1 km s⁻¹ resolution will increase by 1–2 orders of magnitude in most receiver bands (see Figure 1). The improved sensitivity and spectral tuning grasp will open new avenues of exploration, increase sample sizes, and enable more efficient observations (see [1] for a detailed science case for the WSU).

The first elements of the WSU are under development and will be available to the user community later this decade, including a wideband Band 2 receiver, a wideband upgrade to Band 6, new digitizers and digital transmission system, and a new correlator. Upgrades to other instruments and receiver bands are under study, including the newly developed ACA spectrometer and 2SB upgrades of Band 9 and 10 receivers for better rejection of atmospheric noise. The substantial gains in the observing efficiency enabled by the WSU will further enhance ALMA as the world leading facility for millimeter/submillimeter astronomy.

Figure 1. Factor by which the correlated bandwidth will increase with the 2× bandwidth WSU relative to the current system for each band, in two spectral resolution regimes: “Low Spectral Resolution” (blue), which is defined by the best spectral resolution that the current correlator can achieve at full correlated bandwidth (7.5 GHz per polarization), and “High Spectral Resolution” (orange), which is defined by the WSU goal of reaching ∼ 0.1 km s⁻¹ in every ALMA band at the maximum correlated bandwidth (16 GHz per polarization).

References


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