What is meant by spectral dynamic range?

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Spectral dynamic range is the ratio of the brightnesses of the strongest and weakest detectable features in one channel of a spectrum in a spectral line image with obvious generalizations to smoothed or integrated data. Since the weakest detectable feature is some multiple of the single-channel rms, the spectral dynamic range is often quoted as the ratio of the strongest signal to the channel-channel rms, much like the continuum case. In some cases the brightest signals will actually be continuum and the presence of very strong continuum emission limits the detectability of weak line signals for the same reasons that are discussed in the case of the imaging dynamic range. The spectral dynamic range is ultimately limited by the quality of the bandpass calibration, whose own fractional noise (rms/continuum) is added in quadrature with that of the imaging data. Most spectral line emission experiments have low S/N (5:1) and the spectral dynamic range is not limited by the bandpass calibration but when the continuum is strong the fractional noise in the bandpass calibrator can produce noise in a spectrum that overwhelms weak line signals. To reduce the fractional noise of the bandpass calibration it is often possible to smooth the bandpass calibrator spectrum.

From Section A.9.3 of the ALMA Proposer's Guide: "Spectral dynamic range (i.e. the desired signal-to-noise ratio per spectral resolution element) of 1000 has been demonstrated for Bands 3, 4, and 6, and a spectral dynamic range of 400, 250, 170, and 150 has been demonstrated for Bands 7, 8, 9, and 10, respectively. Proposals that request higher accuracies may be rejected on technical grounds. For Band 5, a spectral dynamic range limit similar to Band 6 may be assumed, except for setups at 183 GHz, but users should note that this has not yet been verified."

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