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A Preliminary Assembly, Integration, Verification, and Commissioning Plan for ALMA's Wideband Sensitivity Upgrade Project

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1 Extended Abstract

The Atacama Large Millimeter/submillimeter Array (ALMA) is the world's largest ground-based facility for observations at millimeter/submillimeter wavelengths. Inaugurated in March 2013, ALMA has accomplished more than a decade of continued steady-state operations. It consists of 66 antennas located at approximately 5000 metres at the Chajnantor Plateau in the Atacama Desert in Northern Chile.

The Wideband Sensitivity Upgrade (WSU) is the top-priority initiative of the ALMA 2030 Development Roadmap [1]. The WSU will be rolled out in a staged approach, starting towards the end of this decade. It will eventually provide up to 4× increased intermediate frequency bandwidth, and one to two orders of magnitude increase in correlated bandwidth at high spectral resolution (up to ≈ 0.1 km/s) in most receiver bands, which will constitute a significant enhancement on ALMA's capabilities. The WSU will also provide provide improved sensitivity due to lower receiver noise and increased digital efficiency, in both digitization and correlation. For continuum observations, the extended bandwidth will further enhance sensitivity. These upgrades will significantly improve all future ALMA observations and expand the range of scientific programs the community can pursue [2].

With the installation of the Advanced Technology ALMA Correlator (ATAC), a Total Power GPU Spectrometer (TPGS), Wide-band Intermediate Frequency Processors (WIFP), upgraded receivers, 400 GE digital Data Transmission System, a new Fiber Optic System, and a new Correlator Room (OCRO project), ALMA's signal chain will be upgraded, which implies a huge impact both on its processes and the associated computing infrastructure.

To minimize the impact on ALMA's scientific productivity, the Observatory has opted for the so-called Parallel Deployment concept, which will allow to carry out AIVC in parallel, or interleaved in time, with scientific observing. This presents a huge challenge in terms of planning and resource availability, considering the number of hardware, software, and infrastructure impacted, or to be delivered as part of the involved development projects, inter-dependencies, expected timeline to deliver the WSU System, and predicted/unpredicted challenges associated with the hardware and software, integration of the different components, circular dependencies (i.e., retrofitted Array Elements versus ATAC), etc.

This talk presents a preliminary Assembly, Integration, Verification, and Commissioning (AIVC) plan for WSU, based on the analysis performed by different groups across the ALMA-wide partnership, involving engineering, computing, commissioning experts, and science operations astronomers, in coordination with representatives from the different development projects that will provide the hardware components for the WSU signal chain. The plan presents the strategy to follow to incrementally retrofit, integrate, and commission the different elements/subsystems, to deliver a functional WSU-based interferometer towards the end of the decade.

References

[1] J. Carpenter, D. Iono, L. Testi, et al., "The ALMA2030 Development Roadmap" *ALMA Memo Series*, **612**, June 2018, doi:10.48550/arXiv.1902.02856.

[2] J. Carpenter, C. Brogan, D. Iono, and T. Mroczkowski, "The ALMA 2030 Wideband Sensitivity Upgrade" *ALMA Memo Series*, **621**, November 2022, doi:10.48550/arXiv.2211.00195.