Effect of Stoichiometry on the Two-Dimensional Electron Gas at the LaAlO$_3$/SrTiO$_3$ Interface Grown by MBE. MAITRI WARUSAWITHANA, CHARLES BROOKS, DARRELL SCHLOM, Cornell University, STEFAN THIEL, JOCHEN MANNHART, University of Augsburg, NICOLAS REYREN, ANDREA CAVIGLIA, STEFANO GARIGLIO, JEAN-MARC TRISCONE, University of Geneva — The discovery of a quasi 2-dimensional electron gas (q2-DEG) at the interface between SrTiO$_3$ and LaAlO$_3$ has enabled a number of exciting developments. So far this q2-DEG has been observed only in films grown by pulsed-laser deposition, which raised a question as to whether this manifestation has a connection with defects that result from the dynamics of the growth scheme employed. We find that a q2-DEG can also be obtained using the more gentle growth technique, molecular-beam epitaxy, and that control of the stoichiometry of the LaAlO$_3$ layer is key to its existence. Small changes in the composition of the LaAlO$_3$ layer affect the conductivity at the heterointerface. With appropriate stoichiometry the electron gas transitions into a superconducting state below $\sim 200$ mK. Interesting possibilities that stem from these findings of composition control on conductivity and the ability to obtain this q2-DEG under the framework of molecular-beam epitaxy will be discussed.