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Measuring the Evolution of Reionization with Big-Glass Observations of Lyman-Alpha (Steve Finkelstein) (I)

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The epoch of reionization ($6 < z < 10$) marks the period in our universe when the first large galaxies grew to fruition, and began to affect the universe around them by burning off the haze of neutral gas that had filled the intergalactic medium (IGM) since recombination. The evolution of this process constrains key properties of these earliest luminous sources, thus observationally constraining reionization is a key science goal for the next decade. The measurement of Lyman-alpha emission from photometrically-identified galaxies is a constraining probe of reionization as a neutral IGM will resonantly scatter these photons, reducing detectability. I will describe our groups recent efforts to do this with 10m-class telescopes, showing that ultra-deep observations can routinely detect Lyman-alpha at $z > 7$. However, these observations require extremely large telescopes (ELTs) –the flux limits available from today's 10m class telescopes are sufficient for only the brightest galaxies ($m < 26.5$). Ultra-deep surveys with the Giant Magellan Telescope (GMT) and Thirty Meter Telescope (TMT) will be capable of detecting Lyα emission from galaxies 2-3 magnitudes fainter than today's deepest surveys. Wide-field fiber spectroscopy on the GMT combined with narrow-field AO-assisted slit spectroscopy on the TMT will be able to probe the expected size of ionized bubbles throughout the epoch of reionization, following up ~degree scale deep imaging surveys with the Wide Field Infrared Space Telescope. These data will provide the first resolved Lyα-based maps of the ionized intergalactic medium throughout the epoch of reionization, constraining models of both the temporal and spatial evolution of this phase change.