Getting the Science from Next-Generation Deep Surveys

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Abstract

Deep surveys have two distinct roles: (a) to answer specific science questions, (b) to make unexpected discoveries. While (a) is common to all well-designed projects, (b) is rapidly changing.

Over half the astronomical discoveries in recent years have been unexpected. For example, only 10% of the discoveries from Hubble were listed in its science goals, so that answering the specific science questions would have missed 90% of Hubble's science output. The only Nobel prize resulting from Hubble (Dark Energy) was completely unexpected. But, ironically, our ability to capture unexpected science from next-generation surveys may be diminished by the same technology that enables the deep surveys. While many astronomical discoveries in the past resulted from observing the Universe in a new way, they also relied on human ability to distinguish discoveries from artefacts. Next generation surveys are certainly taking us into new areas of observational phase space, but the instruments are so complex that no individual will truly understand them, and the petabyte databases will prevent any user from sifting through the data. So it will be difficult to discover the unexpected with next generation telescopes. Or can we design algorithms to search for the "unknown unknowns"?