From Stardust to Planets

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Planets, such as the one we live on, are formed from interstellar dust. Their birthplaces are the gas+dust disks surrounding newly formed stars. This much is known for sure. However, in spite of half a century of research, the mechanism by which Nature agglomerates ~ 10^40 sub-micro size dust particles into a single rocky planet such as Earth is still largely unknown. It is fascinating to realize that even very basic questions, such as whether it was a gradual bottom-up coagulation process involving objects of ever increasing mass, or a violent top-down process driven by gravitational instabilities, are still unanswered. The reason for this is the overwhelming complexity of the processes involved. There is no way by which any computer model can follow the motions of 10^40 particles. Statistical methods are often used, but complex interplays between the dust and the turbulent gas in the disk occur often on spatial scales that cannot be resolved with current-day computer technology. Progress has been made in recent years because of a combination of vastly increased computer speed, powerful new algorithms and laboratory experiments. In addition to this, observations of protoplanetary disks in the infrared and millimeter wavelength range have drastically improved our understanding of the environments in which planets are formed, and are even giving hints about the planet formation process itself. In this talk I will give an overview of these new developments and the activities of my group along these lines.