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High-Entropy Polar Regions Around the First Protostars

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(Submitted on 28 Oct 2010)

We report on simulations of the formation of the first stars in the Universe, where we identify regions of hot atomic gas (fH2 < 10-6) at densities above 10-14 g/cc, heated to temperatures ranging between 3000 and 8000 K. Within this temperature range atomic hydrogen is unable to cool effectively. We describe the kinetic and thermal characteristics of these regions and investigate their origin. We find that these regions, while small in total mass fraction of the cloud, may be dynamically important over the accretion timescale for the central clump in the cloud, particularly as a chemical, rather than radiative, mechanism for clearing the polar regions of the accretion disk of material and terminating accretion along these directions. These inherently three-dimensional effects stress the need for multi-dimensional calculations of protostellar accretion for reliable predictions of the masses of the very first stars.

Comments:	12 pages, 2 figures; accepted for publication in The Astrophysical Journal Letters
Subjects:	**Cosmology and Extragalactic Astrophysics (astro-ph.CO)**
Cite as:	**arXiv:1010.6076v1 [astro-ph.CO]**

Submission history

From: Matthew Turk [view email]
[v1] Thu, 28 Oct 2010 20:01:45 GMT (1379kb)

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