November 30, 2012

Dear Colleagues:

I am writing to recommend **Shibi Rajagopalan** for a post-doctoral research position in your group.

Shibi has worked with me as a graduate student at University of Oklahoma (OU) during 2008-2010 and at Florida State University (FSU) for a couple years before that, in the area of high energy physics phenomenology. Early on, he was with the FSU math department, but was interested in gravitation and general relativity. He elected to work with me since I was the closest thing to gravity in our department at that time.

Early on, Shibi and I did some work exploring models of inflationary cosmology with an inflaton given by combinations of MSSM fields. While nothing was published, it was a good learning experience for Shibi.

Then, Shibi and I joined Radovan Dermisek to explore the phenomenological consequences of a model he developed called "hypercharged anomaly-mediation", or HCAMSB. Shibi and I were able to add this new model into the Isajet spectra and event generator, and then look into many of the consequences for LHC. It turns out that while the gaugino sector looks like usual AMSB, the scalar sector is left-right split, due to the influence of the large $U(1)_Y$ gaugino mass. Shibi mapped out the relevant spectra and parameter space, and then computed all the multi-lepton LHC signatures along with Standard Model background rates. The model turns out to be distinguishable from usual AMSB due to the presence of real Z bosons in LHC events, arising from an altered gaugino mass hierarchy. Shibi played the leading role in getting this paper out.

Later, Shibi and I joined with Shanta de Alwis at Colorado to investigate collider phenomenology of type-IIB string models with flux campactifications. In this case, gauginos get AMSB masses, but scalar masses and A-terms are suppressed. The model leads to a distinctive mass spectra and collider events. On the surface, it looks like usual AMSB, except that a double bump opposite-sign dilepton mass distribution should emerge1 This serves to distinguish gaugino AMSB from minimal and hypercharged AMSB. Again, Shibi worked out essentially all the calculations, and gave good input on how the project should proceed.

As a third project, Shibi investigated many aspects of dark matter AMSB models. In the standard cosmology, AMSB models with a wino-like LSP yield typically not enough cold dark matter. We explored several modifications, each of them very plausible: 1. extra wino production from moduli decay, ala Moroi-Randall, 2. extra wino production from thermal or non-thermal gravitino production and decay, 3. extra wino production from heavy axino production and decay (in which case the dark matter is mixed axion/WIMPs), and 4. the case of an exino LSP where the bulk of dark matter is composed of axions. Shibi computed the direct and indirect WIMP detection rates for the case of wino-like neutralino dark matter. Unlike SUGRA models, AMSB gives a lower bound to direct detection cross sections, so that these models are in theory excludable by negative search results from direct detection.

Shibi, I and others posted a fourth paper on what Tevatron can do in gaugino AMSB models; in this case, with a spectrum of light sleptons and quasi-stable charginos, the signatures give Tevatron some sensitivity to slepton pair production.

Shibi also joined in with my group here at Oklahoma to work on a very interesting sce-

nario involving mixed axion-neutralino dark matter. This work, now published in JCAP, presents the correct analytic formlae needed for understanding rates of dark matter production in the early universe when there are two DM particles: axion and neutralino.

Shibi wrote up his thesis during summer 2010 and successfully defended it. After residing in Grenoble, France for a year, working with Sabine Kraml's group, he is now a postdoc in Torino Italy, with Fornengo's group.

Shibi has a pleasant, outgoing personality. His knowledge of collider phenomenology is very good, and he also knows many of the basics of particle physics model building. He also has a solid knowledge of particle physics and cosmology. He has matured nicely during his last year at OU to the point where I think he can be an asset to any group working on collider physics and dark matter cosmology.

Sincerely yours,

Howard Baer
Homer L. Dodge Professor
of High Energy Physics
University of Oklahoma