ABSTRACT

HEDLA from 1996 to 2012#

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Laboratory astrophysics at high energy density dates from work by Hideaki Takabe and Bruce Remington in 1993. Soon thereafter Bruce drew me in, and by 1995 he decided we had to have a Workshop. This led him to pretty much single-handedly put together the Workshop on Laboratory Astrophysics with Intense Lasers, in early 1996 in Pleasanton CA. In this and the first few early meetings we spent a good bit of time listening to input from those astrophysicists who we could get to come, regarding what laboratory work would be useful to astrophysics. Notable contributors in this way were Dave Arnett of Arizona, Dick McCray of Colorado, and Jim Stone of Princeton. Some of their suggestions led to long-term research efforts. Others did not make much sense. I will discuss some examples.

A key contribution in the 1998 workshop, at U. Arizona in Tucson, was the discussion of scaling relations by Dmitri Ryutov, leading to the 1999 paper that has so influenced the field. Also notable were opacity measurements discussed by Paul Springer. By the end of the 1998 Workshop it was clear that its name was too narrow – the potential of pulsed-power machines was evident. So after the usual thrashing about to find a name the first HEDLA as HEDLA was in 2000, at Rice. We then met at Michigan in 2002, again at Arizona in 2004, again at Rice in 2006, in St. Louis with an APS meeting and the first ICHED in 2008, and at Cal Tech in 2010.

One of the counter-intuitive things that have become clear over the years is that astrophysics is a very fast-moving field. Some new observation, often isolated, or new theoretical idea, leads large numbers of scientists to scurry after it. They produce bunches of papers in a short time, consensus is often reached, and then everyone scurries off after the next big thing. In contrast, developing a novel experiment to address some issue and generating solid result takes a decade, more or less. So if one sets out to address a very specific question, by the time one has an answer the astrophysicists can no longer remember the question (well, at least they are no longer very interested in it). It turns out that the more powerful approach is to seek to address fundamental issues as opposed to specific cases, and this has been a trend in the field.

We have now been at this long enough to see the emergence and fading of some technical themes. I will trace some of these, emphasizing experimental work (the scope of astrophysical contributions has been and remains broad). Enduring themes

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have included equation of state work relevant to planets and simulations of relativistic systems including collisionless shocks. Jim Bailey has been a continuing leader in both opacity measurements relevant to stars and in work on photoionized plasmas. In the early years, there was a lot of work on hydrodynamic systems. Experiments on these were the most natural extension of pre-existing experiments and the easiest experiments to scale. While hydrodynamic work continues, it is no longer dominant within the meeting. We have seen continuing work in radiation hydrodynamic systems. There was a substantial outbreak of work on piston-driven radiative shocks beginning at the 1998 meeting; this reached peak luminosity in about 2006 but has since faded. What we now see in radiation hydrodynamics experiments is mainly work on flow-driven reverse shocks. About half of the 2000, 2002, 2004 and 2006 meetings, for example, were devoted to hydrodynamics and radiation hydrodynamics. By 2006 jets, both magnetized and not, had become an important topic and they were the most prominent topic in 2008. Strong leadership on this topic came from Sergey Lebedev, Patrick Hartigan, and Adam Frank.

A significant disappointment has been in the area of ultrafast lasers. We worked hard to draw in that community, but mostly heard talks about research that is not connected to astrophysics. Perhaps we were just too early in the evolution of these experimental systems. Edison Liang and others have discussed some fascinating theoretical possibilities, but the experiments have not managed to deliver very much. The 2012 program has zero talks on experimental work with ultrafast lasers. This reflects the reality of their use for HEDLA purposes as I understand it.

The 2010 and 2012 programs show a much broader and deeper field than what we started with. One can see the emergence of experimental work on collisionless shocks, led by several colleagues from Japan, to complement the long-term theoretical contributions. We also see one of the first presentations related to the potential for experiments on dust. One also sees work on warm dense matter (we used to call this equation of state), opacities and photoionized plasmas, jets, hydrodynamics, radiation transport, radiation hydrodynamics, and magnetized plasmas. No one area seems as dominant as did hydrodynamics and later jets. The current breadth has driven the growth of HEDLA from a short Workshop to a weeklong Conference and provides a lot of excitement for the attendees.

Key contributors not mentioned above have included Serge Bouquet, Tomek Plewa, Roberto Mancini, Marc Pound, Paul Bellan, and whoever I am forgetting.

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