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Posters from the edge of the universe

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ABSTRACT

The poster session at a conference typically represents the future of a subject for several reasons. First, the presenters are often graduate/research students and postdoctoral fellows, who will be working in the field when the rest of us have joined Eddington and Russell. Second, many of the posters are progress reports on interesting projects not yet complete. And, third, some of them present ideas far enough outside the mainstream that they are not represented in the oral program. This last seems to be less common at meetings on stellar astrophysics than in, say, cosmology or astrobiology. All posters actually displayed during the first three days of the meeting are mentioned here at least briefly.

1. Introduction

The various sorts of presentations at a conference can be organized many different ways. One possibility is the analogy of a Hertzsprung–Russell (color-magnitude) diagram, with a main sequence of contributed talks and an evolving giant branch of invited reviews. The posters are then the Hayashi track of young stellar objects, while the historical perspectives (a special feature of this meeting) are the red clump stars, after dinner remarks are the white dwarfs, and the review of posters constitutes the post-AGB track.

There were 63 poster titles submitted in advance of the meeting (including a couple of late withdrawals and 13 that were not actually displayed, although some of the authors attended). Of these, 25 dealt with individual objects (22 X-ray binaries, two active galaxies, and one cataclysmic variable). Another 21 concerned collections of X-ray binaries, pulsars, and so forth; two dealt with groups of CVs; five with arguably single stars; one with methods of data analysis; and five with binary star evolution.

I decided, however, to categorize in terms of the kinds of conclusions drawn. You are familiar, undoubtedly, with "More work is needed", "We have refuted the irrational claims of Prof. X", and "Discovery of the first low-frequency, lithium-rich, high-energy pulsar in a globular cluster outside the Milky Way." Less familiar classes will be explained. To find out more about particular presentations, please go to the conference web site, where most of them are displayed.

2. Both please

This is a quote of Winnie the Pooh (when asked whether he would like honey or condensed milk on his bread) and expresses the idea that, when more than one hypothesis had been proposed to account for a particular class of objects, there may be some of each. A classic is OB runaway stars, with the Blaauw (liberation from binaries by supernova) and Poveda (ejection of cluster cores) mechanisms. O'Maoileidigh and Meurs conclude that both happen (and special kudos for their citing both the original papers).

Much more recent are the ultra-luminous X-ray sources. These could be unresolved multiple sources, beamed emission from ordinary high-mass XRBs, intermediate mass black holes, or AGNs in the fields of the galaxies. Both Soria and Kong and Di Stefano find some of each of the last three classes at least. They, of course, describe the AGNs as background objects, though if G.R. Burbridge or H.C. Arp had been at the conference, they would undoubtedly have said that the sources are at the galaxy distances, have recently been ejected from the galaxy centers, and are displaying non-cosmological redshifts that will decline with time.

3. More work is needed

Another way to say this might be that the votes are not yet all in on, for instance the question of whether you can reliably distinguish NSXRBs from BHXRSs by any method other than measuring their masses (Bazzano et al. on INTEGRAL data and Robba et al. on 4U 1728-34).

Some of my favorite issues here deal with the range of masses of white dwarfs, neutron stars, and black holes and whether they overlap (Kiziltan et al. on neutron stars that are radio pulsars). Kenneth Brecher and I have had a bet running for about 25 years on whether the WD and NS range would overlap. He said yes, and I said no, so that it is probably time to pay off, except that we had appointed Philip Morrison as our judge, and he is no longer available to cast a deciding vote.

Other queries include, why don't neutron stars grow more with prolonged accretion? (Reynolds et al. on GRO J0422+32), and how

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could the black hole in V616 have grown as massive as Harrison et al. say it did, if accretion has been limited to the Eddington rate?

Is the apparent SNR W50 really a product of the jets of SS 433? Miller–Jones and Blundell don't decide. But Tudose et al. find that the radio nebula around Circinus X-1 is a product of its jets. And the unindentified gamma-ray sources (still about half of the EGRET catalogue) like the poor will perhaps always be with us, though Ubertini et al. have associated two of them with HESS ultra-high-energy gamma ray sources.

4. Opening new windows

Notoriously, when you do this, you see a new scene (or new scaffolding in the case of my Amsterdam room). One sort of new window is better image processing (Hourihane et al. on CVs in the ROTSE database and Morales–Rueda on a survey for faint variable stars with the Isaac Newton Telescope).

In this connection, I would like to advertise the eventual availability of public observing time at the Las Cumbres observatory, which will be a network of 5–7 2-meter class telescopes distributed in latitude and longitude, employed in a variety of synoptic studies, surveys, and follow-ups of transient events. To find out more, go to www.lcogt.net.

5. Irreducible (?) complexity

Several classic quotations deal with this issue, for instance With five parameters you can fit an elephant (George Gamow, and others), and If you don't understand a phenomenon, the first thing to do is plot it on log–log paper (Peter Scheuer, one of the first serious theorists within radio astronomy). Contemplating some of the cases here (the ratio of QPO frequencies vs. luminosity vs. continuum slope vs. iron line strength vs. secondary mass), one is tempted to extend to six parameters and fit an elephant with a howdah on its back or to try to drive a fundamental plain through multi-dimensional data space. Consider the following:

- The oscillations of Cir X-1 (Boutloukos et al.)
- The spectral evolution of supersoft RX J0513.9-6954 (Burwitz et al.)
- The multiple types of outburst of XTE J1118+480 (Elebert et al.)
- The behavior of drifting subpulses, which are more common than one had thought (Weltevrede et al.)
- The multiple states of Aql X-1
- Changes in FUSE spectra of SMC X-1 (Sonneborn et al.)
- X-ray vs. optical properties of GKM stars (Raassen), which may correlate better when age or rotation information is included
- The QPOs of 4U 1907-09 (Beklen et al.)
- Multiple spectral components in anomalous X-ray pulsars (Lyutikov)
- Accretion disks in double white dwarfs (Roelofs et al.)
- Multiple periods in UCXB 4U 0614+09 (O'Brien et al.)

This is perhaps the right place to confess that most of the categories of posters by answer-type were listed at the tops of images with Ashleigh Brilliant cartoons at the bottom. This one said, Many situations can be effectively dealt with only by a vigorous shrugging of the shoulders. The set of posters not actually displayed was captioned by: The greatest obstacle to discovering the truth is being convinced that you already know it, with a drawing implying a geocentric universe. In fact, of course the greatest obstacle is not even asking.

6. Technology transfer

The idea here is that an idea, technique, or mechanism known from one area of astronomy turns out to be appropriate or useful elsewhere. Reverberation mapping (correlating the changes in line intensity with continuum fluctuations) is normally associated with measuring the masses of black holes in AGNs, but Ibarra et al. have done the equivalent to locate the line emission region in IGR J16318-4848. And Nichols et al. invoke an AGN-like jet for R Aqr, a symbiotic binary.

Kozai resonances occur in asteroid orbits (because that is what Kozai was working on), but Eggleton and Kiseleva–Eggleton have found something similar in the evolution of triple star orbits. Preece has invoked Weibel instabilities in emissions from gamma-ray bursts, which is probably not what Weibel had in mind, since he flourished decades ago. That most stars are not chemically mixed as they burn their hydrogen was one of the important discoveries of the late 1930s (and is the cause of red giants somehow). Yoon invoked quasi-chemical homogeneity for the precursors of GRBs and I would secretly like to make at least some blue stragglers that way. There is an ancient and honorable disagreement about the nature of the instability that gives rise to dwarf nova outbursts, now largely resolved in favor of a disk mechanism dependent on sudden changes in gas opacity. AM CVn stars do the same thing, say Warner and Woudt, but it is the opacity of helium rather than hydrogen that matters.

7. Larks

If the sky falls, my mother said, we'll all catch larks. The implication was that the sky was not particularly likely to fall in near future, and so I have always associated the phrase with predictions of what some planned facility might accomplish. Other associations with uncertainty about whether catching a lark is a particularly desirable thing to do are out of place here. Quirrenbach et al. reported on the use of the Space Interferometry Mission for astrometry of X-ray binaries. Kiziltan and Thorsett described the pulsar astronomy that will be done with GLAST. And (a personal favorite), Patruno et al. pointed out circumstances under which an intermediate mass black hole might have a pulsar orbiting it, which could then be used as a clock to measure the mass and rotation of the IMBH. Why is this a favorite? Because back in 1978, Bohdan Paczyński (a pioneer of both binary star astronomy and larks who was unable to be at the present conference) suggested at a conference that one might learn about the black hole in Sgr A^* from a pulsar orbiting it. And, because Poland did not allow him out to attend the conference (IAUS 184), I got to give the talk and have my name on the paper. So far, no pulsars have been found there, but there are lots of stars, and Andrea Ghez, Reinhard Genzel, and others have made very good use of them.

8. Wow!

This is, of course, the proper reaction to a major new discovery or the long-sought confirmation of some prediction. It is sometimes then followed by un-wow, of which there was perhaps also a case amongst the posters. The announcement (Heinke et al.) that there are actually enough low-mass X-ray binaries (most of them quiescent) in 47 Tuc for them to be the ancestor of the millisecond pulsars clearly counts as a Wow!, because the insufficiency if you know about only the bright ones has been a worry for many years. Ivanova concluded that a typical bright globular cluster can make only 1–2 bright LMXRB over its lifetime and I am not quite sure whether this counts as a contradiction or not.

Solid body pulsations of neutron stars are one of those things that have been looked for unsuccessfully for many years, thus the report of seismic oscillations from an SGR (Belloni et al.) scores a Wow. The speed and efficiency with which common envelope binaries eject material is quite remarkable: something like 40% of the available material in 1–100 years (Morales-Rueda et al.). And Chatterjee has found a record pulsar transverse velocity, 1083 km/s for B 1508+55. This source wins a Wow! and two yups because it also confirms a remark made by J.P. Ostriker in about 1492 that the second supernova in a binary system is more likely to unbind it than is the first one.

9. OK

This is not meant as a lower grade of Wow! but rather as a feeling that a particular set of observations may be quite complex, but that the basic underlying physical processes are nevertheless understood. It makes up the largest class of poster presentations in my opinion. Harrison et al. reported that secondaries (mass donors) in various accreting binaries showed a range of solar to non-solar compositions, reflecting whether you would expect CNO-processed material to have made it to the surface.

Indeed a great many things depend on mass transfer rate in various ways. Keek and In 't Zand report that the ratio to the Eddington accretion rate determines whether an X-ray source shows superoutbursts (carbon flashes) as well as ordinary ones (helium flashes). The long-term period changes in Her X-1 (Staubert et al.) are also responding to mass transfer rate. IGR J0029-5934 leads to a particularly fine OK (Menna et al.) because the transfer rate can be measured in two separate ways, from the neutron star spin-up rate and from the luminosity, and the numbers are the same. In contrast, the variability in the AXP J1708-4009 is a magnetic phenomenon, not a mass transfer one (Rea) but this, of course, is also OK. Another magnetic poster (Zhang) reported that initial conditions are not important in the field evolution of LMXRBs.

Multiple populations can also be OK. Postnov and Kuranov conclude that globular clusters can form two populations of neutron stars, only one of which will be retained, but that it looks like the population we see. And Yungelson discussed a bunch of different kinds of low-mass helium stars (sdOBs, AM CVn stars, R CrB stars, and so forth), some single and some in binaries, finding that they are best accounted for if all stars are initially born in binaries. What we actually see is heavily dominated by selection effects.

10. Other

You may be surprised that with as many types of conclusions as have already been mentioned this is needed. But it has two subheadings, public service and better luck next time.

Three posters reported the results of efforts that will surely be of value to the entire community. Zkan showed the distances and other properties of 1328 pulsars. Wachter has collected Spitzer Space Telescope images of the fields of an assortment of interesting XRBs, SGRs, and AXPs. In some cases the source itself can be seen; in others only the foreground dust and gas emission and absorption. Grids of evolution tracks have become fairly common, but De Mink and Pols have calculated a grid of close binary models for stars with SMC metallicity. These will, of course, also be useful for galaxies of intermediate metallicity at moderate redshift (which now means 1–2 rather than 0.1–0.2!).

Two posters, Schulz on the low state of Cir X-1 and Spreeuw on radio observations of GCRT J1745-3009, left the impression that the data had not turned out to be quite what the authors had hoped for. This is another situation with which I can feel much sympathy, because, as a result of an errant digit in a data card, I became for a time the world's export on CO 10 arcmin south of the Crab Nebula. There wasn't much.

Acknowledgements

It may seem a bit trite to wish Prof. E.P.J. van den Heuvel a happy birthday and many more years of the same. But it is obviously the right thing to do, since I extended similar wishes to Prof. Adriaan Blaauw at a significant birthday conference in his honor in 1984, and he was a most welcome participant at the present event.

Special thanks to Ralph Wijers, Michiel van der Klis, and Lex Kaper for including me in the festivities, and I hereby give fair warning that I expect to be invited in due course to their significant birthday events too.