PROCEEDINGS OF SCIENCE

Concluding Remarks

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What follows is an entirely personal perspective on our meeting, meant to highlight certain elements of our discussion that struck me as interesting scientifically. Some are things I simply liked. It is not a "best of the meeting" kind of essay. Thus, I apologize for those I have omitted. I affirm explicitly that everyone has contributed wonderfully to the quality of the scientific discussions here. I also want to thank colleagues here, friends of many decades, who have helped in this progress. Throughout the tribulations of a variegated political landscape, we have worked over our own horizons to a better understanding not only of the physics of the sky, but of the nature of our selves.

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1. Concluding Remarks

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I cannot help noting that since the beginnings of these workshops (first at Vulcano and now here at Mondello) there has been a substantial evolution in our understanding of the observations, theoretical interpretations, and modelling techniques of astrophysical systems.

I recall vividly the early modelling of the variability of astrophysical sources, and our early discussions in these workshops of the necessity of going beyond physical assumptions like spherical symmetry. Most recently, we have even begun to believe that thermal equilibrium is an unrealistic hypothesis!

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And occasionally, some of the results are simply stunning.

2. An Incomplete Appreciation

The Star of Bethlehem: Bernd Ashenbach’s discussion of the possible timing of the Puppis A supernova is an example of this. To imagine that we know the association of an historical event like the birth of Jesus with something astronomical is truly impressive. But it does give us pause, too. What worlds, even lifeless ones, were given to the fire to “mark" a point in our history? Perhaps someday we may see directly as opposed to looking through a glass darkly.

Direct Detection of Gravity Waves: Dorota Rosinska’s and Luiga Stella’s talks on gravity waves are interesting because each (albeit in a different way) poses the question of the real detection of gravity waves. It’s interesting that we are still trying to find a direct detection of such radiation. Charles Misner once told me that he thought such a detection was terribly important, since it provides an independent test of “field theory." Apparently, for such a test, an indirect measurement like pulsar orbit spin-down rates is not sufficient.

Gravity Waves, Magnetars, and Hunters Bullets: This underscores the need for some sort of direct detection. Most instantiations of such a method require large pieces of equipment like interferometers that operate on scales of kilometers or larger. Dorota Ronsinska’s talk demonstrated the hazards of such structures (or perhaps I should say the hazards to such structures): from hunters’ bullets to a run-away pickup truck. Still, the work goes on, both in terms of theoretical inferences of observations, and attempts at direct observations.

The Large Magellanic Cloud and the Effects of Metallicity: Sometimes, however, the advances come from straightforward astronomical research. Guido De Marchi’s talk on the effects of Metallicity in star formation is such an example. He makes the simple, yet fundamental point that star-formation rates could proceed at radically different rates in different environments: for example, the Large Magellanic Clouds or the very early environment in the Universe as it manifests itself in observations at very high Z’s.

Transient Processes: Discussions of transient processes also play a key role in the discussions here. Peter Meintjes's work on transient processes on high energy cosmic sources is of such a nature, and seems to me quite fundamental, since we need to understand how astrophysical jets form accretion disks and how those jets are "launched" from physical processes in the disk. The likely mechanism is the "winding up" (via Keplerian orbits) of magnetic fields generated by turbulent disk motion. This causes magnetic fields entrained in the disk gas to recombine and generate extremely large electric fields. These in turn accelerate the particles. Of course the details are both complex and poorly understood.

Magnetospheres of Accreting Neutron Stars and Cyclotron Lines: Intense magnetic fields also play an important part in the explanation of the emission of hard X-rays from neutron stars via polar cap accretion, as Joern Wilms notes. Gabriele Schoenherr's talk is of interest here. The cyclotron lines generated by intense magnetic fields can actually be used to infer the strength of magnetic field lines.

Accretion Modelling: Of course, accretion modeling generally is of critical importance in our understanding both the structure of disks and their evolution. Dimitri Bisikalo's paper on the development of turbulence in non-magnetic accretion disks is a fine case study on how turbulence can evolve interesting features. While that paper modelled non-magnetic systems, the work clearly shows the potential for a full-scale, turbulent accretion disk model as a possible source for interesting processes.

Launching Jets: Gennady Bisnovatyi-Kogan's interesting talk underscores the difference between 2D and 3D numerical simulations of core-collapse supernovae shows that we are coming to an age where high-resolution 3D simulations are both more available and more necessary.

Hadronic Jets: Andrzej Zdiarski's interesting talk on possible hadronic jets in blazars. He makes the important point that even leptonic jets will have hadrons. It is likely, of course, that the jets will produce cascades, so that the originals of the jet acceleration will be altered by the cascade process.

Long-lived Spacecraft and Scientific Data Centers: Pietro Ubertini's talk on the importance of maintaining scientific analysis capabilities for long-lived spacecraft is one of the most important things to note. This has been called the "Golden Age of Astronomy" for a reason: it is the golden age of multifrequency observations! But those observations are meaningless unless they are subjected to cogent analysis and their archives be made available for future researchers.

Scenario Engines for SN Ia Progenitors: Vladimir Lipunov's talk on the way stellar populations evolve to produce Type Ia supernovae is also worthy of note. That work underscores the importance of our ability to model the evolution of stellar populations.

Multifrequency Observations of Blazars: Rozenn Boissay's talk on the way general relativistic effects change the multifrequency observations of blazars is also noteworthy, and is a good extension of much work on blazar spectra.

This can be coupled with Luis Carrasco's talk on multifrequency observations of blazars, which shows the importance of the efforts of many colleagues over several decades in their efforts to characterize the jet-ambient medium interaction.

Centaurus A: In this regard, it is remarkable that Cornelia Mueller has given us the Centaurus A radio jet in the 8.4 GHz band at milli-arcsecond scales. The observation of his "Tuning Fork" structure is fascinating. Such observations can allow more detailed modeling of jet structures and

also allow us to better understand the interaction of the jets with the ambient medium for our nearest-neighbor quasar.

Mathematical Techniques: We have also had fine examples of numerical or machine learning in Martin Topinka's talk.

X-ray Spectral Curvatures in HBLS at different Zs: Another remarkable result is the indication of different x-ray spectral curvatures in HBLs at different Z's, which can lead to a better understanding of the evolution of these sources.

Color Indices of Optical Afterglows for Long GRBs: And Vojtech Simon's talk on the color indices of optical afterglows for long GRBs in the SWIFT data is also quite interesting.

AGN Outflows: Keigo Fukumura's work on MHD-Driven Disk-Wind models is also interesting, and provides what must be an element to consider in the development of a complete model of jet evolution.

Supersoft X-ray Sources: The adoption of a model for a belt-shaped annulus extending around a WD equator in (CAL 83) is quite interesting. Apparently, in this model, the belt rotates slower than the Keplerian period because of coupling with the WD magnetosphere.

New Capabilities: Rene' Hudec and Vladimir Tichy's Lobster-Eye detector and Bronislaw Rudak's Cherenkov telescope also show promise for simple and effective new detection technologies.

New Possibilities: Pier Luigi Luisi's discussion of the nature of life provides us with a worthy occasion for reflection on the nature of chance and necessity. And calls us again to wonder about what worlds were given to the fire that we might see a star in the sky such a long time ago.

Again, these are concluding praises, but only about some of the interesting talks. Thanks to all for a most interesting meeting!