Though set in stanzas making the 'abab' rhyming scheme and the (mostly) iambic pentameter obvious, if formatted differently it would sound almost like normal prose — no mean feat! As such, this is a unique book, at least in modern times; I certainly haven't come across anything similar. At times, the style reminded me of Pope, Ginsberg, Whitman, Wordsworth, Blake, or Carroll (Lewis, not Sean). It is not clear to me who the target readership is: the union of those interested in poetry and physics? The intersection? Those who want to try everything? A nice gift for the person who has everything else? I'm not sure, but I think that many will get something out of this book. — Phillip Helbig.

References

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Cosmic Masers: Proper Motion toward the Next-Generation Large Projects, edited by Tomoya Hirota, Hiroshi Imai, Karl Menten & Yiva Pihlström (Cambridge University Press), 2024. Pp. 514, 25·5 × 18 cm. Price £120/$155 (hardbound; ISBN 978 0 009 39892 3).

The purpose of this review of IAUS 380 is presumably to give those who did not attend an impression and overview of the current state of the field. For this your reviewer is familiar enough with maser astronomy but has been away from the centre of action for some time. He therefore apologises for any misapprehensions in what follows. The overall personal impression is that work on, and using, celestial masers is very much in line with the astonishing change and progress in physics and astrophysics over the last half-century.

The structure of the volume reporting on IAUS 380 is that it comes in seven chapters relating to separate topics plus Chapter 8, 'Concluding Remarks'. Each chapter opens with a longer review paper and for the most part the succeeding papers report more individual work mentioned in the review. The work described in all of the chapters except Chapter 6 is concerned with the use of celestial masers as astrophysical probes rather than with the masers themselves. I attempt to make some comments about each chapter.

Chapter 1: 'Cosmic Distance Scale and the Hubble Constant'. There are just three papers in this chapter. The chief result is that megamasers may be used to measure the distance to some edge-on galaxies directly without using standard candles or distance ladders. H_0 for the late Universe is given as 73·9 km/s/Mpc with 4% precision. We are told that 1% precision is in prospect. This is important for work to resolve the so-called "Hubble Tension".

Chapter 2: 'Black-Hole Masses and the M-Sigma relationship'. The key point here is that super-massive black holes appear to be a feature of most, if not all, galaxies. Interesting relationships are discussed between these black holes, AGN, and rapid star formation in starbursts, which may co-evolve. Very high luminosities are made possible by the high energy-generation efficiency of mass accretion, tens of percent compared with 0·7% for nuclear fusion. However, all this is a bit obscure — literally. The surrounding medium is often optically thick to visible and IR radiation and the properties of the SMBH must be inferred from observations at sub-millimetre and longer wavelengths. Fortunately there

are megamasers of water at 22 GHz, 183 GHz, and 321 GHz, which turn out to be useful. The M-Sigma relation is not much discussed.

Chapter 3: 'Structure of the Milky Way'. This opens with a masterful and full review by K. Rygl. The following papers are concerned with astrometry and measurements of distances to objects within the Galaxy. Both of these aspects are obviously crucial to understanding its structure, dynamics, and evolution. Currently we are short of data about the 1st and 4th quadrants of the Galaxy, *i.e.*, those that lie largely on the far side, beyond the Galactic Centre. The paper by Mark Reid is therefore of interest, 'Mapping the Far Side of the Milky Way'. The novel method uses "3-D kinematic distance estimates" requiring "only Doppler velocities and proper motions".

Chapter 4: 'Dynamics of Formation of Massive Stars'. The opening review paper by J. S. Urquhart highlights the importance of understanding high-mass, and therefore bright, stars because their properties are likely to dominate our observations of other galaxies and therefore on cosmological models that may depend on those observations. Unfortunately it is not so easy from our point of view, as there are few high-mass stars close by, and anyway they tend to form in clusters. Good progress has therefore depended on various Galactic Plane surveys and a useful table of 22 of those is presented. There follow more than 30 papers presenting various observations and aspects of this important topic.

Chapter 5: 'Pulsation and Outflows in Evolved Stars'. This section consists of some two dozen varied and interesting papers beautifully introduced by the review of L. D. Matthews, 'Mass Loss in Evolved Stars'. Although the basic framework for understanding mass loss from AGB stars is now half a century old, challenges remain. Winds are believed to be driven by radiation pressure on opaque dust grains formed in the cool outer atmospheres of such stars. Whilst this model works well enough for carbon stars as the carbonaceous grains have high opacity, this is not true for the majority of AGB stars that have oxygen chemistries. It is not clear what determines whether the C/O is greater or less than unity in the first place. Furthermore, the outward flow is not uniform but is subject to turbulent variations. It may be not possible to model this in detail but only in terms of scales in time and space. Nevertheless the overall process has regularities as shown by the famous movie of TX Cam by Gionidakis *et al.* of SiO maser emission over 78 epochs. Indeed, studies of both maser emission and thermal radio-line and continuum radiation are needed to observe these winds. Winds from AGB stars are believed to be a major mechanism by which the ISM becomes enriched with all elements up to iron. It is perhaps good to note that our own existence therefore depends on such processes in the past.

Chapter 6: 'Maser Theory'. This section has six interesting talks on the physics of masers rather than how they might help in understanding celestial objects. The opening talk revisits Dicke's super-radiance theory and discusses its complementarity with maser emission. This work is reflected in modelling maser flares in real sources: S255IR-NIRS3 with results shown and G9·62+0·2E with work in progress. The other papers discuss maser effects in recombination lines, the pumping of flaring masers, and two papers on polarization of maser emission, modelling and simulation.

Chapter 7: 'New Projects and Future Telescopes'. The opening paper discusses the valuable work of the Maser Monitoring Organization (M2O), set up around the time of the previous IAUS devoted to masers. As discussed in Chapter 6, flaring is a notable feature of celestial maser emission. By its very nature, it is easy to miss them unless they are watched for. The M2O has found an average of 1 to 2 per year. The new facilities and upgrades to present ones

discussed in the following papers are a sign of a lively research community and interesting results to be expected in the future.

Chapter 8: 'Concluding Remarks'. In some ways, this section does the work of a reviewer for them. Two quotations may suffice: (*i*) "Seven major topics on maser sciences were presented and discussed: theory, cosmology, galaxies, Milky Way, star-formation, evolved stars and future prospects. Just as in previous meetings, the details of high-mass star formation continue to stimulate extensive research through primarily methanol and water maser studies. …"; and (*ii*) "In recent years, accurate Galactic astrometry has been done and the Milky Way rotation curve has been verified (*e.g.*, Rygl, Honma, Reid, Ellingsen). It is clear that we can now study the 'unreachable' — *e.g.*, the Bulge (Sjouwerman, Lewis), the Long Bar (Kumar), the Galactic Centre (Paine, Sakai) and we can learn about kinematics in extremely obscured Luminous Infra-Red Galaxies (*e.g.*, Aalto)."

The book itself is nicely produced by CUP, but there are serious downsides when it comes to the reproduction of the figures which are so important to the text. A large fraction of them are quite complex and authors have used colour to simplify matters. Having them reproduced in black and white makes them much less than easy to interpret. Also in some cases the figures are made too small making it hard to read text on them, although this may be due to how the authors presented their papers for publication. In all cases the figures are at least as important as the text and they deserve to be shown in the same clear style as the text. — M. R. W. Masheder.

Before the Big Bang: Our Origins in the Multiverse, by Laura Mersini-Houghton (Vintage), 2023 (first published 2022). Pp. 248, 19·7 × 13 cm. Price £10·99 (paperback; ISBN978 1 784 70934 1).

Laura Mersini-Houghton's doubled-barrelled surname reflects her Albanian origin and her British husband. That would normally not be worth mentioning in a book review, but in this case the book is not only a popular-science book with an emphasis on the author's own work, but also something of a personal memoir, recounting her life in Albania (where she received her BS degree), the USA (MSc and PhD), and Italy (postdoc) before moving up the ranks from non-tenured assistant to tenured full professor at the University of North Carolina at Chapel Hill. The book starts out asking whether our Universe is special, particularly with respect to the low entropy at the beginning. Following that is a standard discussion of inflation and the early Universe and then an overview of quantum mechanics. The next three chapters discuss fine-tuning, the many-worlds interpretation of quantum mechanics, and the string-theory landscape. Those first six chapters (of eleven altogether) are necessary background for the introduction of her own idea: "quantum mechanics on the landscape of string theory".

She arrives at the conclusion that our Universe is, in contrast to the famous objection by Penrose[1], not unlikely despite its low entropy at the beginning, the difference due essentially to taking quantum de-coherence into account. I don't know whether her book will convince anyone that her reasoning is correct, but I, despite familiarity with concepts such as cosmology in general, the Multiverse, fine-tuning, the Anthropic Principle, and so on[2], found her argument hard to follow. Of course, her technical papers should be the deciding factor, but in a popular book it should be possible at least to make the case so convincingly that readers with the necessary background are moved to explore it in more detail (whether or not they are still convinced after such an exploration). Neither is it