

## ASTRONOMY AND THE LAWS OF PHYSICS

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The metaphor of physical law - a range of orderly behavior within certain authoritative constraints - has not escaped the historians of ideas. That scheme, in all its forms, east and west, gained its earliest strength from astronomy itself. The search for measured order in heaven is old and widespread; two instances from ancient China and pre-Columbian Mexico will make the point.

For our modern science, two universals rule: that of particulate matter - from neutrons to  $C_2H_5OH$  - and the only unsaturable force, long-range gravitation. The<sup>2</sup> phenomena of astronomical scale are mainly examples of kinetic motion resisting for a time that untiring attraction, under the virial theorem. Matter is everywhere familiar, apart from the deep and puzzling question of what seems to be the large-scale failure of matter-antimatter symmetry.

We encounter the analogues of waterfalls and of spinning tops especially at short time scales: dwarf novae to x-ray bursters, to pulsars. Whole stars also act as molecules of a very dilute and generally non-thermal gas. This strange tidal, frictional, and accelerational effects are expressions of Newton alone: extraordinary only because they arise in unadjusted many-body systems, quite unlike our quiet disc of planets. Here may lie as well the roots of the grand events of the galactic nuclei, perhaps.

We know we must go beyond Newton to general relativity; the small effects are present beyond doubt. But at extreme redshifts, realized in the universe, and predicted locally in "black holes", even consistency remains on trial. And it is left to us to ask two harder questions still: whence the laws themselves, and are we the only IAU-UAI among many suns to ask the question?