

24 Fundamental Principles that Reflect Our Current Understanding of the Physical World

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in collaboration with Allen Mincer, Professor of Physics, New York University

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"I contacted Professor Allen Mincer, knowing his work questioned our sky, the stars, the galaxies, our universe and infinity. I asked him to choose 24 principles he considered enabled his research today.

Desire and disaster have the same etymological origin, "the star": waiting for, missing, being frightened by, the star. Hence, the lace-like structure inside the "principles" is a close-up of "the other's" hair and skin." **ICW**

"After much work by numerous persons over many generations, we have managed to learn much about the natural world around and inside us. Our world is complicated, and it is difficult to condense our understanding into simple phrases.(...) Finally, science is an ongoing process of progress in our understanding. The ethereal portrayal of these ideas may also hint at the possible ephemeral nature of some of them. Yet each represents what for us was a necessary step in the process and they will perhaps therefore not be diminished, even if superseded." **AM**

A BODY SUBMERGED IN A FLUID IS BUOYED UPWARD BY A FORCE THAT IS EQUAL TO THE WEIGHT OF THE DISPLACED FLUID. Archimedes' principle. ● WHEN LIGHT TRAVELS FROM A LESS DENSE TO A MORE DENSE OPTICAL MATERIAL, THE RAYS ARE BENT TOWARD THE NORMAL. Snell's law. ● THE ORBIT OF EACH PLANET IS AN ELLIPSE WITH THE SUN AT ONE FOCUS. Kepler's first law. ● EVERY BODY PERSEVERES IN ITS STATE OF REST, OR OF UNIFORM MOTION IN A RIGHT LINE, UNLESS COMPELLED TO CHANGE THAT STATE BY FORCES IMPRESSED THEREON. Isaac Newton's first law. ● THE RATE OF CHANGE OF MOMENTUM WITH TIME IS PROPORTIONAL TO THE IMPRESSED FORCE AND IS IN THE SAME DIRECTION. Newton's second law. ● MUTUAL ACTIONS OF TWO BODIES UPON EACH OTHER ARE ALWAYS EQUAL, AND DIRECTED TO CONTRARY PARTS. Newton's third law ● THE TOTAL AMOUNT OF ELECTRIC CHARGE IN THE UNIVERSE REMAINS CONSTANT. Based on the work and observations of many. ● THE NET FLOW OF ENERGY ACROSS THE BOUNDARY OF A SYSTEM IS EQUAL TO THE CHANGE IN ENERGY OF THE SYSTEM. Based on the work of many, such as Joule. ● THE NET ELECTRIC FLUX THROUGH A CLOSED SURFACE IS DIRECTLY PROPORTIONAL TO THE NET ELECTRIC CHARGE ENCLOSED WITHIN THE SURFACE. Gauss's law. ● IF TWO SYSTEMS ARE IN THERMAL EQUILIBRIUM WITH A THIRD SYSTEM, THEN THEY MUST BE IN THERMAL EQUILIBRIUM WITH EACH OTHER. The "zeroth law" of thermodynamics. ● IN ANY PROCESS THE ENTROPY OF THE UNIVERSE INCREASES OR REMAINS CONSTANT. The second law of thermodynamics, based on the work of many persons. ● THE INDUCED EMF IN A CIRCUIT IS PROPORTIONAL TO THE NEGATIVE RATE OF CHANGE OF THE MAGNETIC FLUX THROUGH THE CIRCUIT. Farady and Lenz. ● THE NET MAGNETIC FLUX THROUGH ANY CLOSED SURFACE IS ZERO. Based on the lack of observation of magnetic monopoles. ● A CHANGING ELECTRIC FIELD INDUCES A MAGNETIC FIELD. Maxwell's displacement current. ● IF RELATIVE TO K, K' IS A UNIFORMLY MOVING CO-ORDINATE SYSTEM DEVOID OF ROTATION, THEN NATURAL PHENOMENA RUN THEIR COURSE WITH RESPECT TO K' ACCORDING TO EXACTLY THE SAME GENERAL LAWS AS WITH RESPECT TO K. THIS STATEMENT IS CALLED THE PRINCIPLE OF RELATIVITY. Albert Einstein's definition of relativity. ● THE INERTIAL MASS OF A BODY IS NOT CONSTANT BUT VARIES ACCORDING TO THE CHANGE IN THE ENERGY OF THE BODY. Based on Einstein's relativity. ● THE SPEED OF LIGHT IS INDEPENDENT OF THE MOTION OF ITS SOURCE. Based on Einstein's relativity. ● AT EVERY SPACE-TIME POINT IN AN ARBITRARY GRAVITATIONAL FIELD IT IS POSSIBLE TO CHOOSE A « LOCALLY INERTIAL COORDINATE SYSTEM » SUCH THAT, WITHIN A SUFFICIENTLY SMALL REGION OF THE POINT IN QUESTION, THE LAWS OF NATURE TAKE THE SAME FORM AS IN UNACCELERATED CARTESIAN COORDINATE SYSTEMS IN THE ABSENCE OF GRAVITATION. Steven Weinberg's statement of the strong principle of equivalence, based on Einstein's theory of General Relativity. ● IT IS NOT POSSIBLE TO MAKE A SIMULTANEOUS DETERMINATION OF THE POSITION AND THE MOMENTUM OF A PARTICLE WITH UNLIMITED PRECISION. Werner Heisenberg's uncertainty principle. ● THE PROBABILITY OF AN EVENT IS GIVEN BY THE SQUARE OF THE ABSOLUTE VALUE OF THE PROBABILITY AMPLITUDE. Basic principle of quantum mechanics. Schroedinger ● WAVE AND PARTICLE NATURE ARE COMPLEMENTARY ASPECTS OF MATTER. A result of quantum mechanics. Perhaps first phrased this way by Neils Bohr. ● THE SUCCESSFUL DESCRIPTION OF THE ELECTRIC, WEAK, AND STRONG FORCES ARE BASED ON QUANTUM GAUGE THEORIES. Based on the work of many in relativistic quantum mechanics. ● OUR WORLD AND A TIME-REVERSED PARITY-REFLECTED ANTIWORLD MUST BEHAVE IDENTICALLY. A statement of the results of relativistic quantum field theory. Worked on by many. Perhaps first codified in a book by Streater and Wightman. ● NO LOCAL HIDDEN-VARIABLES THEORY CAN REPRODUCE ALL OF THE PREDICTIONS OF QUANTUM MECHANICS. Bell's theorem ●

