

The SummaTime Scale

A Non-technical Introduction

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This paper aims to ease the reader into a somewhat technical – albeit relatively straight-forward construction – the SummaTime Scale. If you are already comfortable with exponents and powers of ten, you may want to skip directly to section II.

I – Cycles and Rhythms

The Many Kinds of Rhythms

We're used to thinking of some things as happening fast and other things happening slowly.

In the course of our lives we get to experience many kinds of regular timings – the passing of decades, presidential elections every four years, yearly holiday celebrations, weekly routines, daily rhythms, breath cycles, heartbeats, etc...

Most of us recall vividly passing into a new millennium – marking 1000 years since the last such event – and marking the passage of two such cycles since the life of Jesus the Christ.

Longer cycles still are creeping into our awareness as science reveals climate cycles lasting tens of thousands of years and astronomical cycles that are even longer – for example, it takes our Sun 240 million years to complete one cycle around our Milky Way galaxy.

Meanwhile, with electronics creeping into every corner of our lives, we are regularly exposed to computer and internet terminology and technologies of mega and giga hertz rhythms beating millions or billions of times per second.

The Two Ways of Describing a Rhythm

We can describe any rhythm in two ways – we sometimes pick one over the other as a matter of convenience.

For example, we can describe a rhythm in terms of how many cycles there are per some unit of time.

Our hearts beat around sixty times per minute (roughly one beat per second).

This is the “heart rate” or “pulse rate” that the nurse measures when you go see the doctor.

Another way to describe the same rhythm, is in terms of how long each heart beat lasts – for our hearts it is about one second per heartbeat.

Scientists use both of these two ways of describing rhythmic events: they call the first one “frequency” – given in terms of cycles per unit time; they refer to the second as “duration” – given as elapsed time per cycle.

Mathematically the two kinds of descriptions are considered “equivalent” – the one is the “inverse” of the other (I wont try to explain that here).

For the heart, the frequency is approximately one beat per second, and the duration is one second per beat – a particularly easy example.

Scientific Standards for Describing Rhythms

The internationally agreed upon unit of time in science is the second.

Thus, rhythmic events can be described in scientific terminology in two ways as we’ve seen above: as cycle frequency in terms of cycles per second – known as “Hertz” (abbreviated Hz); or as cycle duration in terms of seconds per cycle.

(Scientists sometime use a third kind of description in terms of “wavelength,” but we will not consider that approach here.)

Which way of describing a cycle is used in practice is generally a matter of convenience or convention – in electromagnetism (dealing with light and radio waves), for example, it is common to use frequency, measured in Hertz – the number of cycles per second.

In the figure here, notice that frequency is given in Hertz (Hz) with prefixes (see Table of POT Prefixes in Docs section of this website) for a bit more detail on these and how they are named and the next section for what these mean).



Fig 1. The Electromagnetic Spectrum (from the wikipedia article). Class designations are abbreviations for Extremely Low Frequency, Very Low Frequency, etc... Extreme High Frequency, Far Infra-Red, Near Ultra-Violet, X ray, and at the top of the scale, gamma rays. Notice that narrow band between NUV and NIR – this is the visible light band.

Scientific Notation

Another key tool that scientists use every day is “scientific notation.”

This refers to a standard way of dealing with potentially cumbersome large or small numbers in terms of “powers of ten” (or POTs).

For example, say we want to express the duration of a year in terms of seconds – we know that there are 60 seconds in every minute, 60 minutes in every hour, 24 hours in every day, and 365 days in a year (approximately).

Multiplying all that out – $60 \times 60 \times 24 \times 365$ gives 31,536,000 seconds per year.

In scientific notation, this becomes roughly 31.5×10^6 seconds where 10 to the 6th power refers to the number of zeros, or “powers of ten.”

So, just keep this rule in mind when dealing with “Powers of Ten:” the small number above and to the right of the 10 refers to the number of zeros.

If the number is positive, it means that many zeros to the left of the decimal place – i.e., times ten that many times.

If the number is negative, it means that many zeros to the right of the decimal place – i.e., divided by ten that many times.

So, for example, if we take the Planck Time which appears at the top the SummaTime Scale as 53.9×10^{-45} seconds, that means that we have to divide the 53.9 by 10 forty five times – or, move the decimal place to the left by adding 45 zeros to the right of the decimal place.

(This may be confusing more than clarifying – if anybody knows how to make this stuff simpler, please let me know.)

Scientists have also agreed upon names for powers of ten in steps of 1000 – the “SI Prefixes” or “metric prefixes” (described in the wikipedia article “SI Prefix”).

Some of these prefixes have become familiar to us: kilo, mega, giga, and milli, micro, nano.

Others are less familiar: tera, peta, exa, and pico, femto, atto, zepto, yocto.

Each refers to a power of ten 1000 times larger or smaller than the next.

Scientists make frequent use of these prefixes in dealing with very large and very small numbers – as we see in Figure 1 where some of these are abbreviated as E, P, T, etc...

II – Inspirations for the SummaTime Scale

Charles and Ray Eame’s Powers of Ten

I grew up fascinated with all kinds of science – had my first microscope at 11 – my first telescope at 13.

Among my favorite places as a boy growing up in the Washington DC area was the Smithsonian National Aeronautics and Space Museum.

There in the late ‘60s I first saw the award winning science short film by industrial designers Charles and Ray Eames.

Powers of Ten (the movie) takes us on a marvelous journey from a lazy outdoor picnic by continuous zoom out into the deep Cosmos, and then zooms back to the picnic, then zooms deep into the center of a carbon atom – picturing our best scientific knowledge of each level of zoom view.

This film made a lasting impression on my imagination – it expanded what I was already familiar with from endless hours spent playing with microscope and telescope, very small and very large, into a sort of “zoom consciousness” where moving up and down the scale of size gradually became almost second nature.

It also demonstrated how useful it is to think in terms of powers of ten – basic scientific notation.

When I began my study of Yoga and was introduced to the Patanjali Sutras, I was delighted to find there reference to something similar in the Vibhuti Pada.

I’ve come to think of this as Yogic Zoom Consciousness.

Psychophysiology and Biofeedback

Some of the first reports of scientific studies on Yogis in the Himalayas were done while I was in college.

There was a great deal of excitement about these studies since they seemed to show that these Yogis were doing extraordinary things with their physiology.

Most of these early studies were done “in the field” using portable electrical devices to measure respiration, heart rate, and brain waves rather than more “invasive” tests like blood tests or biopsies, or more cumbersome devices like X-ray machines.

The field of “psychophysiology” really caught on and developed into an active area of research when it was realized that these same electrical devices might be used to help train ordinary people to perform some of the same tricks as the Yogis were doing – and thus was born the field of “biofeedback.”

The take home message from all of this for me was simply – there are all kinds of electrical rhythms that can be observed in the human body.

Irving Dardik’s “Waves Waving”

As a young biologist, I became interested in all these “biorhythms” and made a special study of “chronobiology” and how life’s many kinds of cycles are nested, one within the other.

And, as a student of Yoga, I came to appreciate that roughly ten heart beats per breath was often a particularly calming combination.

Later I came to discover that ten brain-wave cycles per heart beat was another well-known and presumed-to-be-beneficial nesting pattern – the famous “alpha rhythm.”

As my study of chronobiology deepened along with my practice of Yoga, I began to think in terms of a whole series of different types of cycles, each nested within the other.

This idea was reinforced by my discovery in the mid 1980s of the work of Irving Dardik MD, a pioneer in medical biorhythms and their role in health.

Dardik tried to extend his medical discoveries into the deeper realms of physics and quantum mechanics.

He came to see everything as “waves waving” and to this day is working to apply this basic idea to various practical problems facing humankind.

Adi Da’s “Nothing Already Arisen”

My focus on “time ago” derives from an early talk given by my second spiritual teacher, Adi Da, where he declared “it is not true that anything has already arisen.”

This paradoxical statement was a kind of koan for me for many years given my interest in chronobiology and my practice of medicine.

Eventually I decided to see if I could develop a scientific scale of total time ago with the idea of mapping all possible levels of zoom.

My intuition was that this might serve some useful purpose – but the activity itself was really more playful – and I’ve had fun with this now for years since.

I wanted to see how far I could extend a time scale in both directions – inwardly to shorter and shorter times ago, even “shortest possible” time ago, and outwardly to longer and longer times ago, even “longest possible” time ago.

I use the prefix Summa – meaning largest, or highest – to indicate a total scale – one that aims to encompass all possible times ago.

For the purpose of the SummaTime Scale, I choose the inverse way of describing cycles - - the number of seconds per cycle since I was interested specifically in “how long ago” any particular kind of event took place.

(I’ve recounted some of the story of how I came up with this in “Tale of the Scale” -- interested readers are referred to that piece for more background details.)

Ken Wilber's Holarchy

I picked up Ken's [Sex, Ecology, and Spirituality](#) in 1995 when it was first published. The first half of the book gives a wonderful overview of how natural systems are organized into nested holarchies.

Following Arthur Koestler's original 1967 use of the term, a holarchy is composed of holons where each holon is a whole/part – each whole is itself composed of parts which are themselves wholes et... “all the way up, and all the way down.”

Countless examples exist in nature, and as Nature.

If we assume that every phenomenon – including every holon – has a “characteristic time” or “life cycle,” then, natural rhythms are likewise nested into a holarchy.

III – The SummaTime Scale (STS)

Tucson-II and the First STS

The original STS was presented at the 2nd Tucson Conference on the Science of Consciousness in April of 1996 ([link to abstract](#)).

This version of the Time Scale stopped at the level of 10^{-24} seconds, because that is where the SI Prefixes stop.

Only recently did I decide to play with extending the TimeScale all the way down to the Planck time at 53.9×10^{-45} seconds (see wikipedia article on “non-SI units”).

I have found this second version of the STS particularly provocative as it relates to the Yoga Science since it suggests so clearly a three-fold division of phenomena that might line up with traditional descriptions in Yoga of Gross, Subtle, and Causal.

Last month I wrote a draft scientific paper exploring this matter in terms that may be of particular interest to Yogi physicists, mathematicians, philosophers, and other students of the “Science of Consciousness” – “The Subjectoscope” ([link](#)).

Here, I'll try to take you on an overview tour of this expanded second version of the STS:

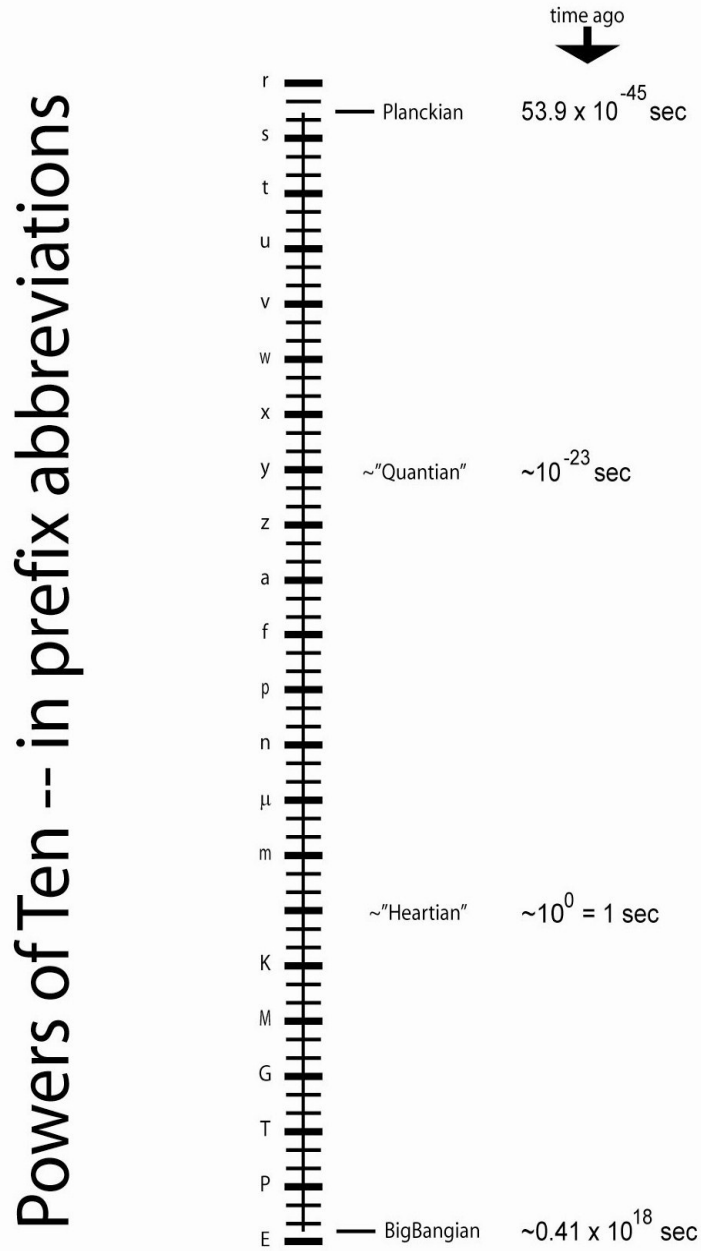


Fig. 2 – the SummaTime Scale

Overview of the SummaTime Scale

Notice first the backbone of the scale – the central vertical line that extends from the Big Bang at the bottom to the Planckian at the top.

Many people have heard of the Big Bang – it is currently thought to be, in effect, the moment of creation of the Universe.

Yogis know that they themselves are whole and non-separate from the whole of the world – inside and out – even as they live what may seem to others to be ordinary lives.

We can think of this as “a nondual singleness” that embraces both subject and all possible objects.

A Singleness in Two

One of the most striking features of the SummaTime Scale is that visible light, that mysterious electromagnetic quantum stuff that allows us to see and envision so many wonderfully detailed and brilliant things, is smack dab in the middle of the STS:

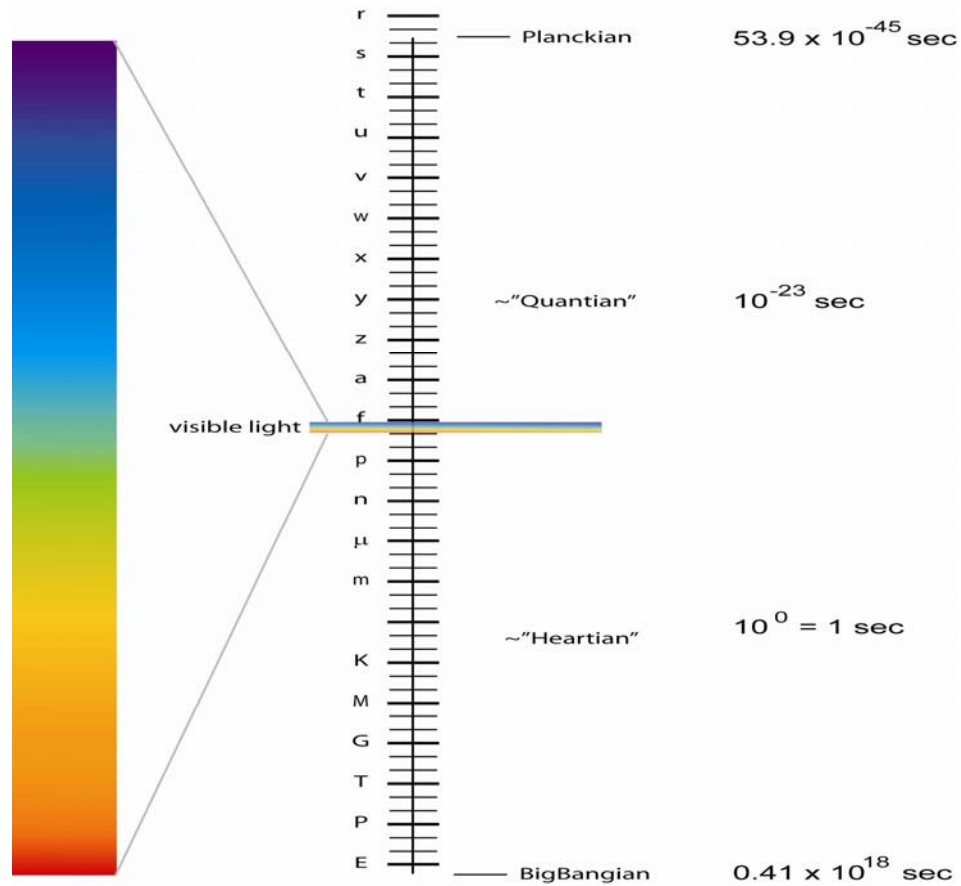


Fig. 3 – STS with visible light spectrum

Adjacent to the femto region, visible light plays a predominant role in our experience – more of the cortex of the brain is devoted to vision than to all other senses combined.

Perhaps the “central” role that visible light plays in our lives is mirrored by its central position on the STS.

Typically our eyes are turned to the world outside the body where vision acts to guide our actions, delight and inform our minds, and give us early warning of potential threats.

The SummaTime Scale suggests, however, in keeping with the experience of Yogis, that there is an inner world that we cannot see, and that that inner world might be every bit as vast as the outer cosmos that science tells us extends all the way out and back ago to the Big Bang.

A Singleness in Three

Another striking feature of the SummaTime Scale (one that I discuss in technical detail in “The Subjectoscope” paper) concerns the central position of the electromagnetic spectrum as a whole that divides the scale into three ranges.

The lower range extends from the Big Bang up to the region I call the Heartian – around the range of the human heart beat.

This is the range of all outer phenomena – the “outside the skin” zone, as Elmer Green calls it.

The middle range spans the entire range of what is usually considered as the electromagnetic spectrum.

You’ll notice that Fig. 1 fits neatly in between the Heartian and the Quantian of Fig. 3.

It extends roughly from the Heartian with its extremely low energy super long-wave radio waves up to what I call the Quantian with its extremely high energy super short-wave gamma rays.

Beyond that then lies another large region from the Quantian to the Planckian that I think will reveal many secrets in time to come.

The SummaTime Scale Zipper

Based on this quick tour, you may get a sense of how we might be able to zip together the fabrics of Yoga and Science along the STS.

At each level of the STS we can find phenomena on the subjective side via ordinary experience or with the help of Yoga that “line up” with phenomena on the objective side discovered by Science.

The hope is that this zipper will help bring together these two sides of our experience and lead us toward a life that is enriched by the cross-fertilization that is the promise of the Yoga Science.