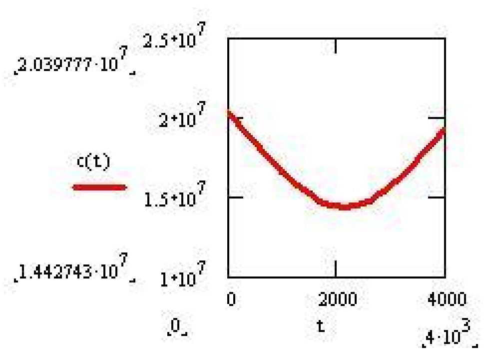
A simplistic look at the best EM technologies (MIRIAH & SIM) for Lay level understanding (backed by scientific principles)

In this brief review, we will look at the two leading contenders for Electro-Magnetic (EM) imaging from satellites, which are NASA's "**S**pace **I**nterferometry **M**ission" (**SIM**) which images deep ***space***, and our "**M**icrowave **I**nterferometry **R**adiating **I**ncrementally **A**ccumulating **H**olography" (**MIRIAH**), which images the ***earth***. And we want to make this simple to understand for the general public's Lay mindset, while also satisfying the most discriminating scientist's mindset. So we ask our "Lay" readers to please bear with a modicum of mathematics herein, since our scientist readers are understandably insistent on this. Furthermore, throughout this web site, we have made every effort to include a lay level description of all of the concepts you will find therein.

Now, it's generally accepted that "*a picture is worth a thousand words*", and with that in mind, and given the following well known EM relationship:

$$G_{VLA}(t) := \frac{4 \cdot \pi \cdot A_{VLA}(t) \cdot \eta}{\lambda^2}$$

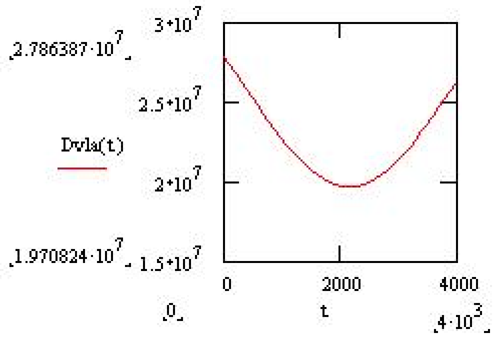
(as shown on the 9th page of the Math Model), we have this "XY" plot of MIRIAH's VLBI (Very Long Baseline Interferometers), wherein ***triads*** of rotating VLBI with lengths c(t), ***coherently*** cover triangular *areas, which circumscribe the earth (each of these several triads are known as MIRIAH*3)*:

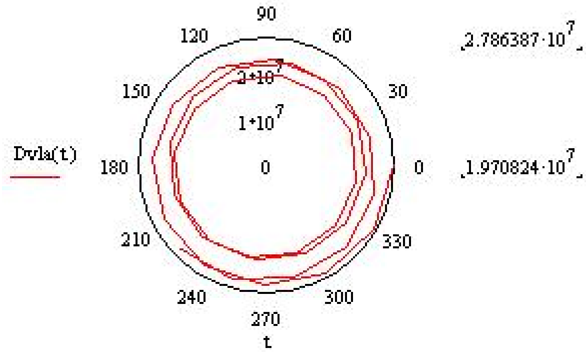


MIRIAH*3 is comprised of *one* triad of these VLBI, and is the "unit" of MIRIAH's Rotational Synthesis Imaging, or "RSI" process. These triads must both rotate and cycle in size in order to facilitate the RSI process, so we compute the length of c(t), which we designate as the length of the Interferometers, which form ***triads*** (of three in an equilateral triangle like this: Δ) as a "sparse VLA" (sparsely sampled Very Large Array), whose diameter is D_{VLA}, and area is A_{VLA} (Note that these sparse VLA will be "fully filled" with imagery data ***in time***, since satellites have a lot of time, but not much power).

The area A_{VLA} of the " Δ " synthesis aperture $A_{VLA} = \pi(D_{VLA})^2/4$, wherein

D_{VLA} is $Dvla(t) := \left(\sin\left(\frac{\pi}{6}\right) + \cos\left(\frac{\pi}{6}\right)\right) \cdot c(t)$ with DVLA's XY and Polar plots below



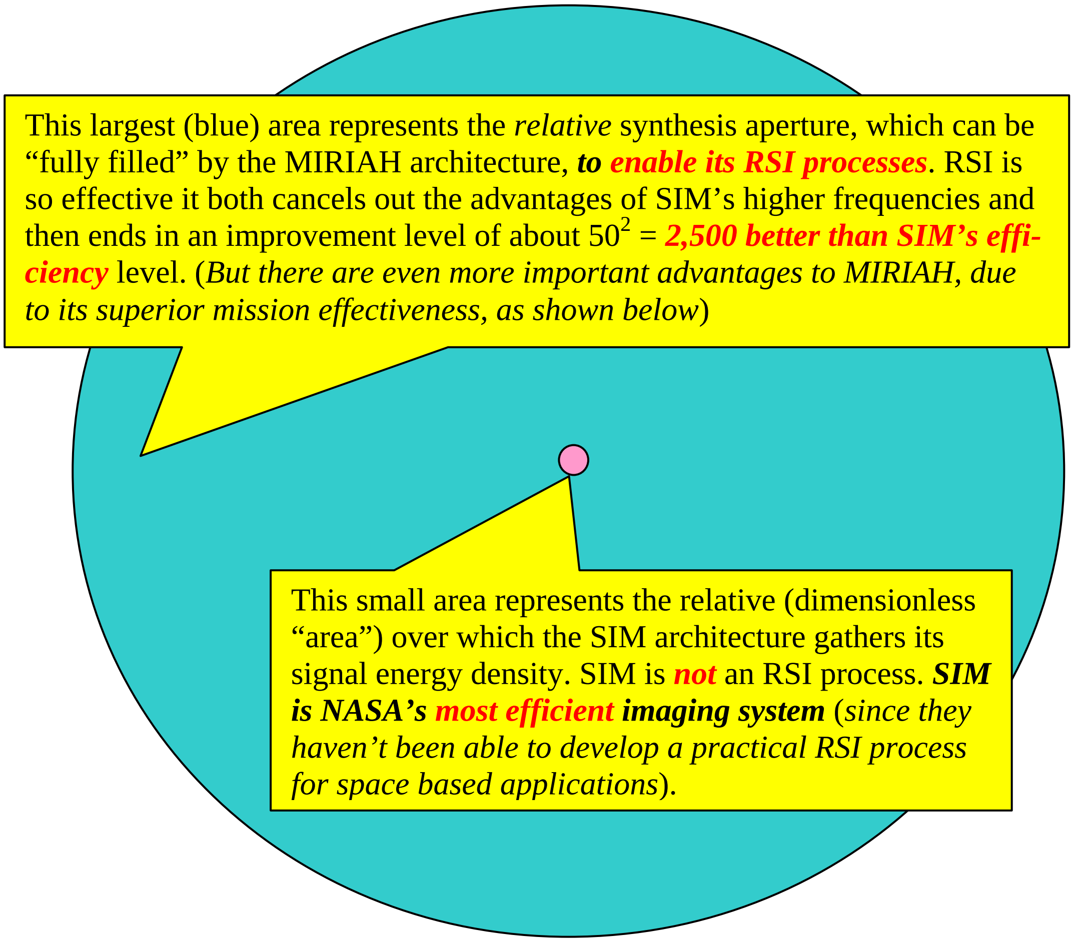


So an average value of MIRIAH's average RSI aperture diameter, D_{VLA}, would be about 24 ***million*** meters (which is 88% larger than the diameter of the earth)!

Comparing this to **SIM** (i.e., NASA's best) Interferometer imaging system, we will have to "normalize" parameters as a function of wavelength (λ), in order to get a rational way of comparing the performance as a function of *coherency*, rather than just a function of frequency or wavelength. These different methods of imaging (**MIRIAH** vs. **SIM**) strongly influence efficiency, so while **MIRIAH's** wavelengths are about a million times longer than **SIM's** (which highly favors **SIM**), yet **MIRIAH** has the capacity to "fully fill" the phase information in its synthesis aperture, while **SIM** can't do this with its present architecture. Yet, per Information Theory, *coherency is a far more powerful efficiency factor* than is just frequency or wavelength (NASA admits this here at this website).

Since at **MIRIAH's** "best" wavelength (L Band), the optimum resolution, λ = 0.24 meters (a minimum microwave wavelength, which can "fully fill" a maximum synthesis aperture), then its $D_{VLA}/\lambda = 10^8$ (a dimensionless number). For SIM, which unlike MIRIAH is not an RSI process, D_{SIM} = 8 m, λ_{SIM} = 0.4 - 1.0 µm, so then $D_{SIM}/\lambda_{SIM} = 20 – 8 \times 10^6$, for an average of 1.4×10^7 (also dimensionless).

In both of these cases (**MIRIAH** and **SIM**), the aperture area ***circumscribes*** the ***rotating*** triads, which is why it plots as a circle (below), whose diameter is D_{VLA}. Since the efficiency of each of these two different architectures depends on the Gain, which depends on the aperture area, which varies with D^2/λ^2, then **MIRIAH** improves over **SIM** by the ratio of these, which is $10^{16}/(2 \times 10^{14})$, or about 50 to 1. So the "picture" below is one, which is both scientifically accurate and yet is easily understood. For, the larger the coherent area, the greater is the synthetic aperture, or coherent "lens". And, as with telescopes, etc., larger "lenses" improve both resolution and contrast (or energy density). And, at the same time, since it also improves Gain, then it lowers cost, i.e., this greatly increases cost effectiveness (***and yes - $Profit*** – keeping in mind that MIRIAH is a commercial enterprise first, and a governmental service second).



Mission first, efficiency second.

In addition we need *to consider the* ***mission***. For, at MIRIAH's wavelengths, it can "see" both the earth surface, and under the surface, day or night, in all weather. And, with MIRIAH's ***two*** Power-Apertures, it also has ***hyper-spectral*** capabilities, of ***extremely finely discriminated*** frequency increments, while SIM ***doesn't*** have these additional (***vitally needed***) mission capabilities. These new capabilities will enable us to view new sources of energy deep underground consistent with environmental concerns. And to do so using new techniques which take advantage of its hyper-spectral, very fine spectral definition too (as you just read in the first paragraph of Section 1 of "The Introduction to MIRIAH").

In times like these, when our economy comes first, we expect to see NASA's and DoD's missions giving way to this urgency. And as the above figure shows, MIRIAH should be pursued as a "Dual-Use" project of huge importance to our nation and to the world. Rightly, it puts $Profit first (i.e., commercialism first), and governmental service second, yet even in the case of government, MIRIAH is far more effective than anything they now have in their entire inventory. If some object to MIRIAH's long coherence time, which doubt is barely credible at L Band in light of SIM's long coherence times, then since we intend to start at much ***lower*** frequencies for this and startup mission reasons, this objection is no longer moot.