

The 1.11 Million Year Cycle in Earth's Magnetic Field Polarity

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Abstract

Geomagnetic polarity reversals are widely held to occur at random, with no periodicity to their timing — a position well supported by over 50 years of statistical analysis. This paper shows that the same reversal record, examined not as a sequence of reversal timings but as the prevailing polarity condition through time, displays a clear periodicity near 1.11 million years. Using the standard 0-30 Ma geomagnetic polarity timescale sampled on a 1000-year grid, a continuous-frequency spectrum reveals twelve dominant cycles between 0.2 and 6 Ma, refined here to five significant figures. Two of the next-strongest peaks relate to the dominant 1.1101 Ma cycle by simple, clean ratios — 0.74026 Ma ($2/3$) and 3.3335 Ma ($3\times$) — each within a tenth of a percent of an exact fit. The 1.1101 Ma periodicity is confirmed visually by folding the full 30 Ma record at this period. The origin of these harmonic relationships, and their connection to solar system cycles of very similar period, is left for future papers.

Introduction: The Standard Position, and Why It Is Only Half the Story

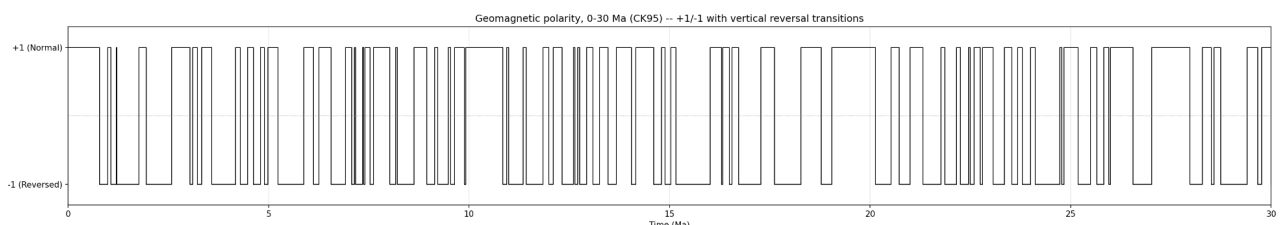
The mainstream position on geomagnetic polarity reversals is stated plainly and consistently across the literature: reversals occur at random, with no periodicity to their timing. The U.S. Geological Survey states it in the most direct terms available to the public:

"These reversals are random with no apparent periodicity to their occurrence." [7]

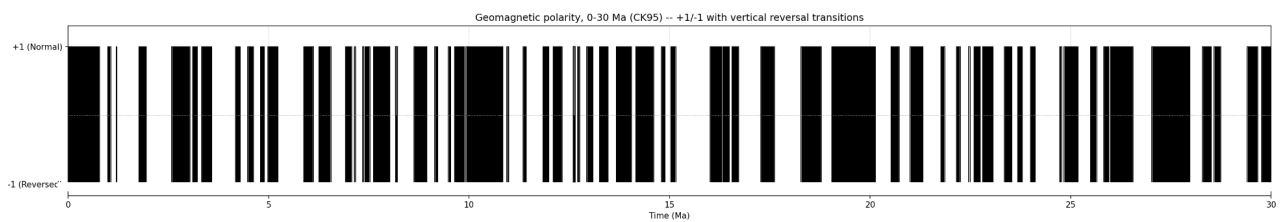
The British Geological Survey concurs:

"Reversals are not predictable and are certainly not periodic in nature. Hence we can only speak about the average reversal interval." [8]

This position is not merely a popular simplification — it has a solid academic pedigree going back to Allan Cox's foundational 1968 analysis, which modeled the lengths of geomagnetic polarity intervals as arising from a Poisson (memoryless, random) process [1]. Subsequent work refined the statistical model — noting the true distribution has somewhat fewer very-short intervals than a pure Poisson process would predict, and is better described by a gamma renewal process [2] — but the underlying conclusion has held for over half a century: whatever governs *when* the field flips, it does not do so on a fixed clock. Constable [4] and McElhinny & McFadden [5] are standard references for the modern form of this statistical treatment.



This is correct. If the question asked of the data is "when does the next reversal happen, given the last one," the honest answer from over 50 years of analysis is: not periodically.



But this is not the only question worth asking of the same data. The standard position concerns the timing of *events* — the discrete moments the field flips. It says nothing about the *prevailing polarity condition* — which state, normal or reversed, dominates at any given moment, integrated over the unequal and highly variable lengths of the intervals between flips. This is precisely what we find in the geomagnetic reversal record: no periodicity in reversal timing, but a clear and repeatable periodicity in the resulting polarity condition, near 1.11 million years, with a family of harmonically related periods around it.

Some hint that reversal *rate* itself is not purely featureless is not without precedent in the mainstream literature either — Lowrie [2] notes "the rate of reversals since the Late Cretaceous shows a steady increase on which a cyclical variation appears to be superposed," and an earlier review by the same author [3] identifies this more specifically as a roughly 30-million-year cyclicity with a more distinctive 15-million-year harmonic in reversal rate, distinct from the "random timing" conclusion drawn about intervals themselves. The present paper follows this same distinction — periodicity is present, but only visible once the data is framed as the prevailing *polarity* to be tracked through time, not merely a sequence of instantaneous events.

This is not a new observation on our part. It appears, in graphical form, in Ray Tomes' 2025 book *Wobbly Universe* [6], where a chart of the magnetic reversal record shows the 1.11 million year cycle clearly, along with a hint of an accompanying ~ 9 million year cycle. The present paper sets out to establish that observation on a fully quantitative footing.

Analysis Method and Results

Data and setup

The reversal record used here is the standard 0–30 Ma geomagnetic polarity timescale (CK95), giving 122 reversal boundaries. From this, a polarity series was built as a simple ± 1 signal — +1 for normal polarity, –1 for reversed — sampled on a regular 1000-year (1 ka) grid across the full 30 million years, giving 30,000 evenly spaced samples.

The spectrum was computed at continuously variable frequency, not via FFT binning: a Lomb-Scargle periodogram evaluated across a fine, continuous grid of candidate periods. The results below focus on the 0.2 to 6 Ma range, where the twelve dominant peaks of interest are found.

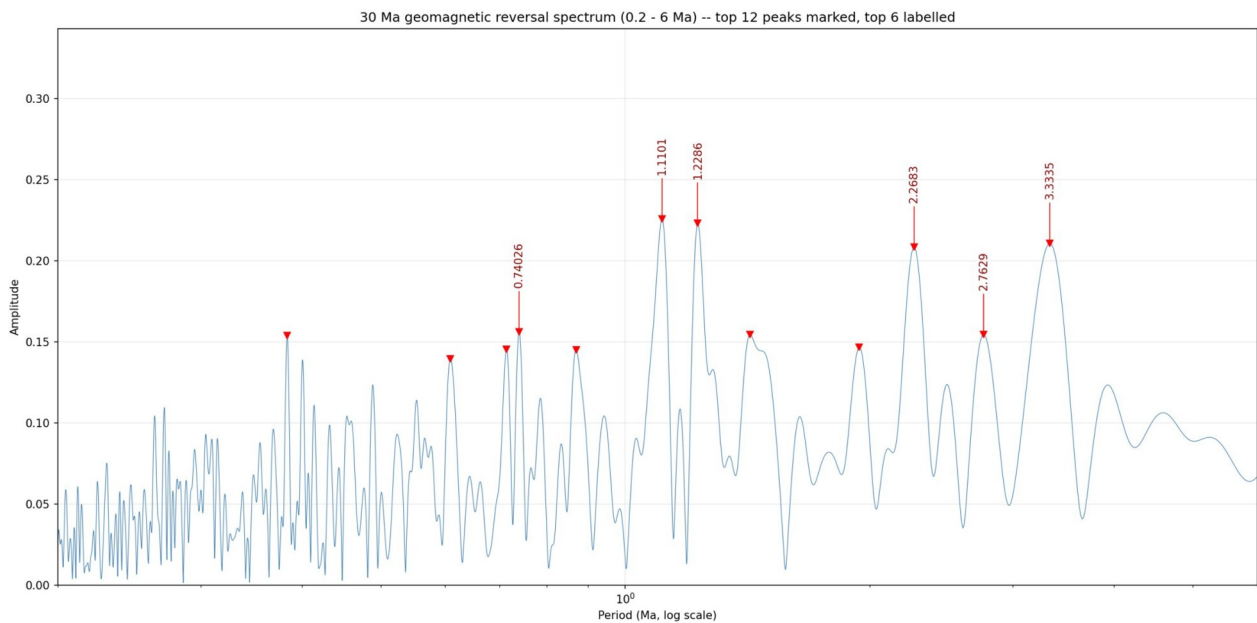
Peak selection

Peaks were selected directly by amplitude — the twelve tallest features in the spectrum within the 0.2 to 6 Ma range.

The selected cycles

The twelve tallest peaks in the spectrum, by raw amplitude, in order of period (5 significant figures):

0.38356, 0.60934, 0.71432, 0.74026, 0.86999, 1.1101, 1.2286, 1.4251, 1.9425, 2.2683, 2.7629, 3.3335 (all in Ma)

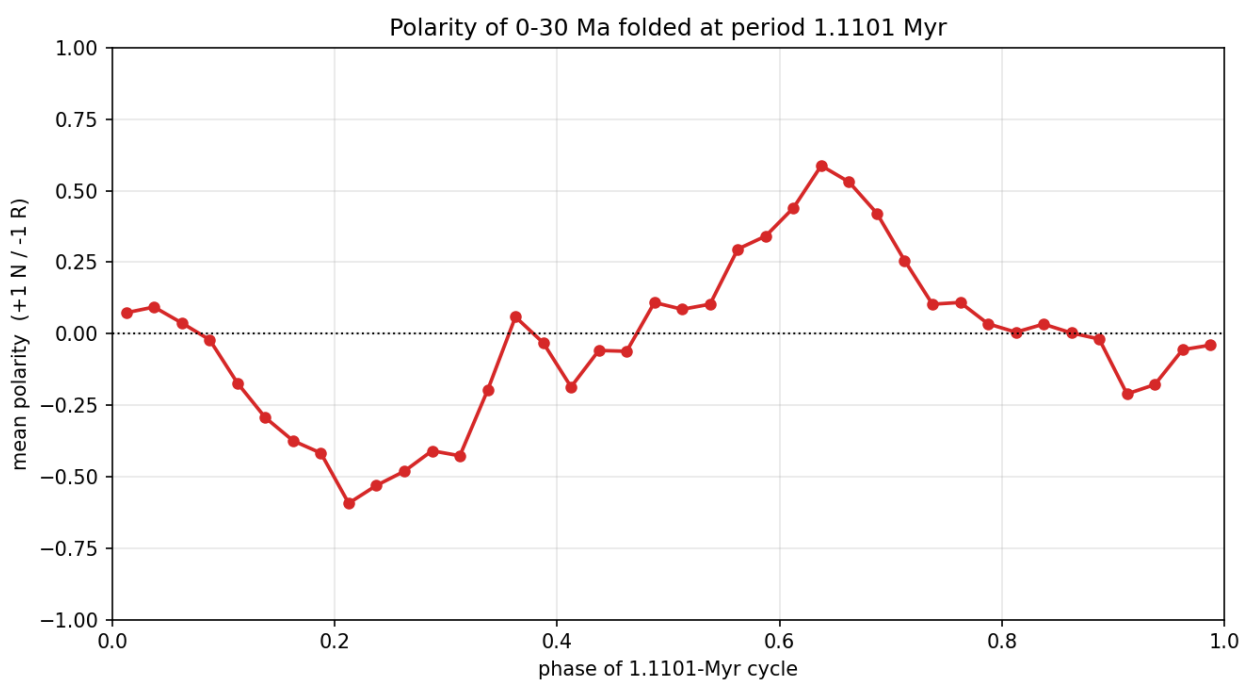


Labelled spectrum, amplitude vs. period on a log scale, restricted to the 0.2-6 Ma range; all 12 peaks marked, the top 6 by amplitude labelled — 1.1101, 1.2286, 3.3335, 2.2683, 0.74026, 2.7629.

The 1.11 Ma peak, precisely determined

Refining the dominant peak in the 30 Ma spectrum to five significant figures gives:

1.1101 Ma



The periodicity is not only visible as a spectral peak — folding the entire 30 Ma polarity record on top of itself at this exact period, and averaging, gives a strikingly clear result:

Polarity of 0-30 Ma folded at period 1.1101 Myr — a smooth, single-humped wave swinging from roughly -0.6 to +0.6 across the cycle, rather than the flat noise a non-existent period would produce. At the highest peak and lowest trough, more than 80% of the 27 cycles (22/27) are in the expected direction of polarity. This is highly significant with a chi-squared test.

Two clear relationships within the 1.11 Ma family

Two of these largest six peaks relate to the dominant 1.1101 Ma peak by simple, clean ratios:

Period (Ma)	Ratio to 1.1101 Ma	Deviation
0.74026	2/3	+0.03%
3.3335	3	+0.10%

Conclusion

The geomagnetic reversal record, when examined as a prevailing polarity rather than as a sequence of reversal timings, shows a highly significant 1.1101 Ma cycle and a clear harmonic relationships centred on 1.1101 Ma — most notably its 2/3 and 3× multiples at 0.74026 and 3.3335 Ma. The reason for these relationships is left for a future paper, together with the solar system cycles of very similar period to 1.11 Ma.

References

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<https://doi.org/10.1111/j.1365-3121.1990.tb00100.x>
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