why does mercury spins as it does?

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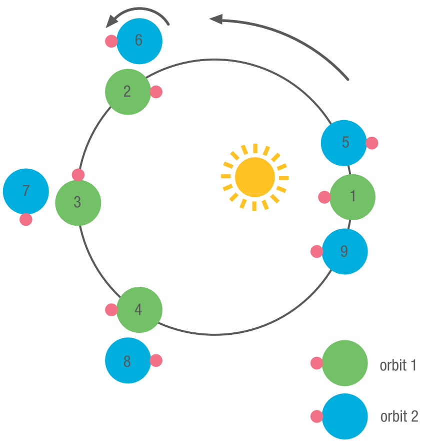
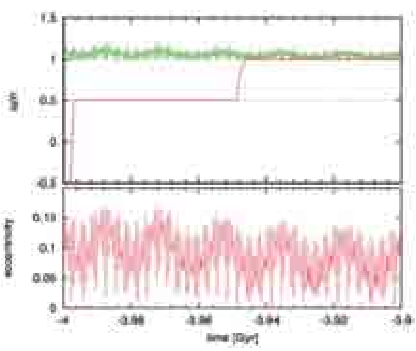
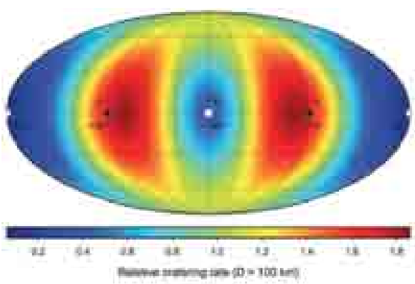
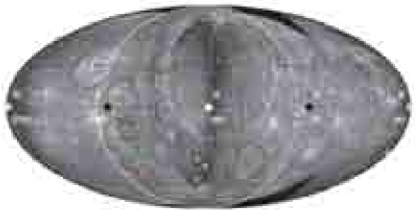


The rotation of Mercury is presently trapped in a 3/2 spin-orbit resonance. This means that the planet rotates three times about its spin axis for every two orbits about the Sun. However, recent observations with the Messenger spacecraft have shown that it was not always so. An international team of astronomers, including Alexandre Correia from the Physics Department, University of Aveiro, found strong evidence that the planet once rotated synchronously with the Sun (as the Moon does with the Earth).
The team also explained how the present 3/2 configuration could be obtained due to impacts with large asteroids, starting from a retrograde rotation.
Using computer models that simulate the long-term evolution of Mercury's rotation, the team started the simulations by assuming that Mercury initially had a retrogade rotation (east-to-west) in the past instead of a prograde one (west-to-east). Current planet formation models suggest that the initial spin of terrestrial planets in the Solar System could have been either prograde or retrograde – with equal probability – so making such an assumption is not outlandish. In this situation, it was shown that Mercury evolves to the synchronous resonance naturally.
Moreover, in contrast to previous studies, the new model can make real predictions about the density and distribution of impact craters on the surface of Mercury. For a synchronous orbit, for example, the model implies that there should be more craters on the dark side of Mercury - that is, the side that does not face the Sun. This is exactly what astronomers observe today when they analyze Mercury's craters data from Messenger.
The calculations also suggest that a large asteroid impact may have disrupted this initial synchronous rotation. A giant impact like the one that formed the Caloris Basin unlocks the spin from the synchronous resonance and the planet subsequently evolves into the present 3/2 observed state. Researchers will now look for other evidence of the initial synchronous rotation, such as different thicknesses in the lithosphere (the rigid, outermost shell of a rocky planet) on the light and dark sides of Mercury. The Messenger probe, currently in Mercury's orbit, will hopefully provide further insights.







absent words in genomic sequences

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Genomes can be abstracted as a sequence of four letters representing the nucleotides. The convenience of this simplification goes beyond representation, to exploring properties of finite-sized strings over finite alphabets in genome analysis. One such property is the existence of a set of absent words.
Absent words in genomic sequences are surprising because of the typically large size of the sequence (approximately 6 billion letters in the haploid human genome), the small alphabet size (4 letters), and the small size of the shortest absent words (11 letters in the reference human genome). The set of all words not present in a genome is of limited biological interest. Hence, we have introduced a new class of absent words designated minimal absent words. By definition, minimal absent words have at least three letters and the removal of their left- or rightmost character uncovers a word that is present in the sequence. For illustration, consider sequence ACGGCGGCTTC.
Its set of minimal absent words is {ACT, CGC,CTC,GGG,TCG,TCT,TTT,ACGGC T,GCGGCG}. Consider word ACT from this set. This word does not occur in the sequence. However, words AC and CT do occur. Hence, ACT is a minimal absent word of the sequence above. The core of a minimal absent word, that is, the word that remains after removing the left- and rightmost characters (for example, CGGC in the minimal absent word ACGGCT), is