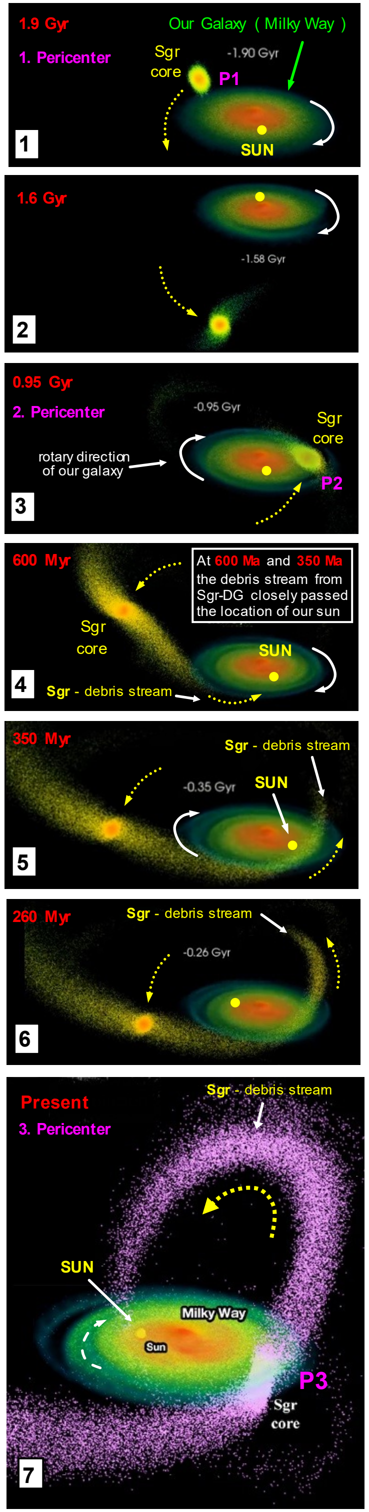
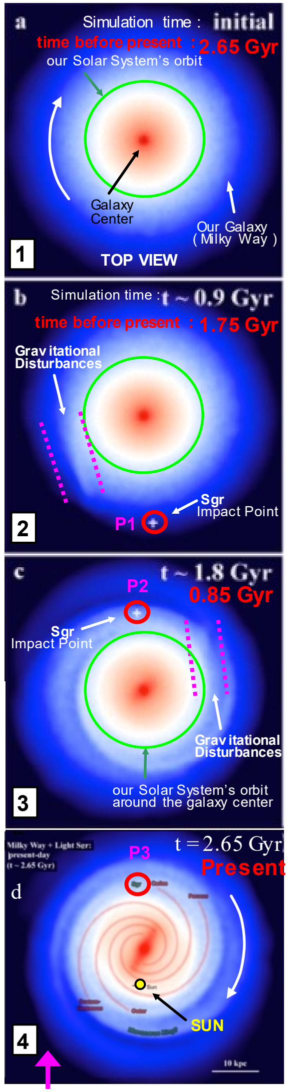


Introduction – Evidence for a fundamental cause of Global Impact Events and "Super-Continent Break-Ups"

There is strong indication that the **Sagittarius Dwarf Galaxy (Sgr-DG)**, a companion of our own galaxy (Milky Way), is responsible for "periods of global impact events" in our solar system, and in million other solar systems as well ! This means that around each **pericenter event** of the **Sgr-DG** with our own Galaxy (→ pericenter event = closest approach between the mass centers (or the collision) of both galaxies), millions of planets in our galaxy were hit by large impactors (large debris) caused by the collision of the two galaxies.

During Earth's history there were at least three (maybe even 4 or 5) of the mentioned pericenter events. The image sequence on the left shows the last three pericenter events in quick-motion (images 1 to 7 & 1 to 4). The images are extracted from a super-computer simulation of the dynamic behaviour of the two galaxies over the last 2,65 Gyr's (1 Gyr=1 billion years). The key events are the three pericenter (P)-events (collisions, or closest approaches of the two galaxies). They took place at : **P1=1,9 Gyr**, **P2=0,9 Gyr** and **P3= 0 Gyr** (now !)

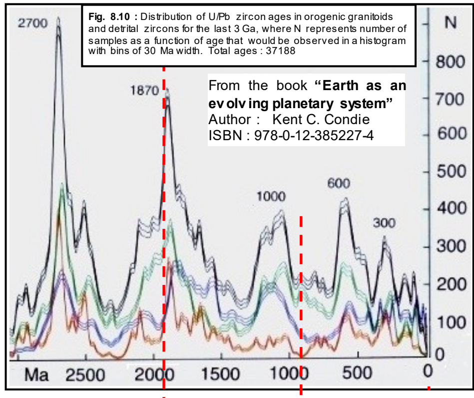


Here the weblink of the movie which shows the Dynamical Analysis of the galaxy collisions:

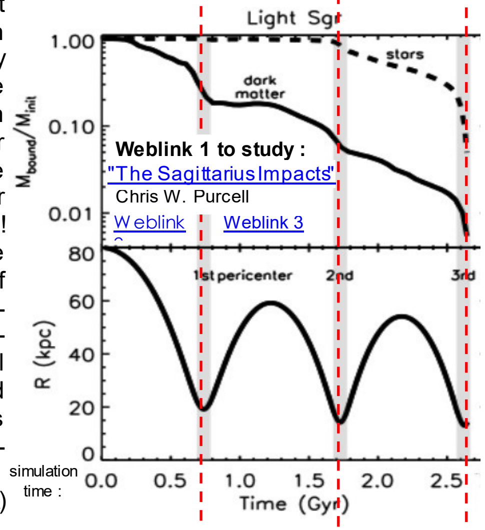
→ Movie_Dynamic_Analysis

The dynamical analysis of the three collisions (pericenters 1 to 3) of the Sagittarius Dwarf Galaxy with our own galaxy shows, that gravitational disturbances, which are caused on our galaxy disk at each collision, shear into trailing arms, which are then enhanced, strengthening the transient spiral modes of our galaxy. In other words this means that collisions of this Dwarf Galaxy with our own galaxy cause & intensify the spiral arms and spiral structure of our own galaxy. As everyone can imagine this has consequences for all solar systems located in the new created spiral arms caused (or later intensified) by these collisions ! The spiral arms created by the collisions are actually vortices of stars in which billions of solar-systems rotate around the bow-shaped center-lines of these spiral arms. And on each rotation around the center-lines of the spiral-arms the solar-systems cross the center-plane of the galaxy disk two times. (up- & down oscillation through disk)

Figure 2 - **Face-on surface density visualizations of the Milky Way at four important moments during the *Light Sgr* simulation**. **a**, Initial model. **b**, Immediately following first pericenter, where the white cross marks the Sgr impact point. **c**, Shortly after second pericentric disk crossing. **d**, At the present-day (corresponding to elapsed simulation time 2.65 Gyr), overlaid by a four-armed symmetric-spiral fit to the observed arms of the Milky Way as revealed by mapping neutral hydrogen[23]. The traditional view of the Milky Way as a secularly-evolving system has encouraged theoretical descriptions of quasi-stationary density-wave spirality, although the large peculiar motions of young stars in spiral arms support a more transient picture[24] (numerical evidence exists for both short-lived configurations[25] as well as more stable forms of spirality, varying with the strength of the tidal induction[26]). Dynamical analysis of each impacted Milky Way model reveals the importance of the swing amplification mechanism, in which gravitational disturbances in the stellar disk at each pericentric approach shear into trailing arms that are subsequently enhanced on small scales (even in a globally stable system), strengthening transient spiral modes.

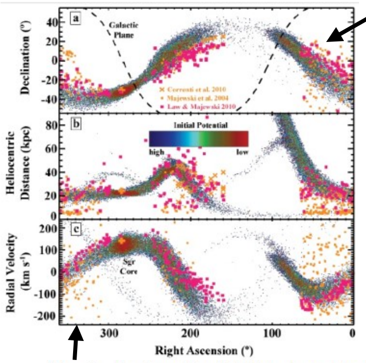


The diagrams on the left show that there is a distinct correlation between the U/Pb **Zircon** age peaks in orogenic granitoids (& detrital zircons) on Earth and the ages / times when the Sagittarius Dwarf Galaxy (S-DG) impacted on our own galaxy (→ pericenter events **P1** & **P2**). And because there is also a correlation between the Zircon age peaks and the break-up & formation of super-continents, it can be concluded that each pericenter event with the Sagittarius Dwarf Galaxy resulted in a super-continent "break-up" & "formation" cycle (or in a shattered crust) on Earth ! These "supercontinent cycles" must be the result of strong variation of "debris-flow" in our own Galaxy, caused by the collisions (pericenters) with the S-DG, which led to times with many global impact events on the planets of our solar system, when the debris flow was high, or they led to quiet periods with low debris flow → which then allowed planets to heal fractures in their crust caused by the global impact events. In the last 600 Ma (**P3**) more global impact events occured, because there was a constant debris flow of stellar material from S-DG through our Galaxy.



time before Present : 1.9 Gyr 0.9 Gyr 0 Gyr

Figure S2 - The time evolution of bound mass and orbital radius in each simulated Sgr infall. Most mass loss occurs near the pericentric passages, marked by shaded bands. The dark halos in these satellite models both follow NFW density profiles with a scale length of 4.9 kpc for *Light Sgr*. We account for the mass loss that would have occurred between virial-radius infall and our initial Galactocentric radius of 80 kpc by truncating the Sgr progenitor mass at the instantaneous Jacobi tidal radius at that position, *i.e.* $r_t = 23.2$ kpc for the *Light Sgr* model The total mass enclosed within this radius is $M_{Sgr} = 1.37 \times 10^{10} M_\odot$ for the *Light* model These masses agree well with the pre-disruption mass estimates based on the stellar kinematics of the observed Sgr core and debris stream[6]. Implicit in our model is that the infall into the halo was recent enough that the first pericenter crossing modeled here was indeed the first close passage experienced by this satellite.



The S-DG debris stream :
→ comparison of the real and simulated debris stream

Our Galaxy's (Milky Way) data :
disk (galaxy) diameter: 120000 LY
disk height : 3000 - 16000 LY*
number of stars : 100 - 300 billion
orbit period of our solar system around the galaxy center : **230 Ma**
age of our galaxy : 13.6 Ga

Sagittarius Dwarf Galaxy :
disk diameter (core) : 10000 LY
number of stars : around 1 billion
age of galaxy : approx. 13 Ga
Orbital velocity : 140 – 170 km/s

LY* = Light Year

Figure 3 – **The observed Sgr tidal debris stream and remnant core in comparison to our *Light Sgr* simulation, in equatorial coordinates**. a, Declination versus right ascension. b, Heliocentric distance versus right ascension. c, Radial velocity versus right ascension. Simulated particles are colored according to their initial potential energy, and the orange points are data from 2MASS M-giant stars[27] and SDSS red-clump stars[28] (marked by squares and crosses respectively; thick crosses denote canonical values for the remnant core[2,12]). The pink points are 2MASS M-giants identified as likely stream members[5]. The present-day location of the simulated remnant and tidal arms are similar to those observed Combining this with observational constraints on the dispersion ($\sigma \sim 10 - 15$ km s^{-1}), breadth (8 – 10 kpc)[27] , and length of the observed debris stream provides some legitimacy for our model.