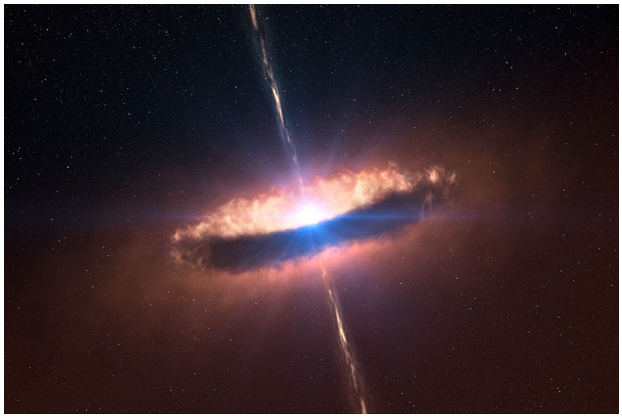


THE PURGING HYPOTHESIS

The new paradigm for solar system formation, solving all SNDM paradoxes while fully integrating solar and planetary formation

ABSTRACT

The Solar Nebular Disk Model (SNDM) is the widely accepted paradigm for solar system formation. However, this modern variant of the almost 300 year-old 'Nebular Hypothesis' is plagued by an unacceptable number of paradoxes and unsolved issues such as the angular momentum paradox, the formation of terrestrial planets and abundant presence of water.

Suspecting SNDM may be fundamentally flawed, a new paradigm was synthesised via 'connective reversed engineering' under the most challenging design parameters possible:

1. *None* of SNDM's paradoxes are allowed to remain
2. All formation aspects must be consistent with the latest footage of Hubble ST, Spitzer ST and ALMA
3. All formation aspects must logically interconnect to provide a solid end-to-end 'story line'.

After nearly 2 years of re-designing efforts, eliminating countless sequence permutations, only one process emerged that can explain solar system formation in the required integrated and paradox free way: The Purging Hypothesis.

Note for the reader:

Due to its very nature, this paper is not written in the usual scientific format of hypothesis - data set – analysis - confirmation cycle. The order is different;

1. *Accumulation and study of all current paradoxes and issues*
2. *Recombination of old and new formation aspects in such a way that all paradoxes are avoided, all aspects are interconnected and all aspects are consistent with latest footage of Hubble ST, Spitzer ST, ALMA.*
3. *All previous (SNDM related) theories on solar system formation are ignored. As a result, only a minimum of references will be made.*
4. *The initial support for the final paradigm is provided by end-to-end connective logic, full compliance with recent footage and targeted absence of any paradoxes. SNDM lacks all of these traits.*
5. *Detailed scientific confirmations will have to be provided in the years ahead, as with any new paradigm.*

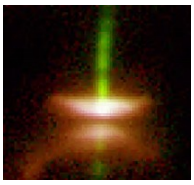
Author: ir. R. Winnubst

Summary

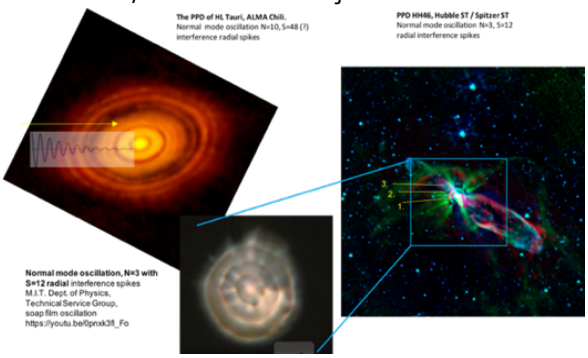
Targeted avoidance of all current paradoxes, leads to the following synthesised –unconfirmed- best fit scenario for solar system formation;

Proto stars

'Halfway' through its contraction process towards fusion, a proto star can no longer accrete new mass due to its high angular momentum. As a result, a disk is formed to store excess in-falling mass and momentum. The core problem of a proto star at this stage, is *not* a lack of mass but its inability to contract any further due to three blockers: Too high angular momentum, a too high *average* temperature and a large core. From now on, the proto star can only contract further, by systematically **purging** excess momentum, heat and core mass. SNDM claims the disk would somehow solve this internally, but this stance raises paradoxes. A physically sounder and *observed* alternative is *periodic* perpendicular purging via jets. Here the disk is merely instrumental to initiate a targeted *series* of short-lived bipolar outflows or 'jets' as the proto star enters a period of 'cyclical compression'. In more detail:



The rotation flattens and compresses the proto star to the extreme, until the star finally *purges* its equatorial mass in a ring shaped purge which centrifugal forces next move outward. In contrast, having lost considerable equatorial momentum, the central flattened proto star will now coil back and **'reflate'** to its former, more voluminous sphere shape. This short *reflation phase* requires extra volume, inducing **incoming** bi-polar vortices of cold molecular gas *(e.g. Hubble ST HH30, left*). This bi-polar influx: 1. cools the star 2. brakes its rotation 3. pushes *out* hot hydrogen, momentum and core fragments back up through the eye of the vortices, forming the bipolar exhaust outflows or 'jets'. *This is how vortices and jets alleviate all three blockers*. Once the star's rotation has slowed down, the vortices and jets will dwindle and vanish. Next, the proto star begins accreting molecular gas anew, picking up rotation, flattening and compressing its interior until the next equatorial purge happens, starting a new 'jets-on' cycle. After each new cycle the proto star will be smaller and denser *leaving behind a set of concentric purge remnants in the accretion disk*, reflecting its shrinking size over time. The concentric purge remnants are clearly visible in the PPD of HL tau (*left*) and HH46 (*right*). This ingenious piston-like compression process will reiterate until fusion conditions are reached.



Gaseous planets

The ring shaped equatorial purges contain swirls which may combine to quickly form high momentum gaseous planets like Saturn and Jupiter. Since they form out of purged *solar* material, the angular momentum paradox is solved. Indeed, recent observations of the disk of HL Tau hint at embryonic gaseous accumulations ***inside*** the dense rings of purged stellar mass, *not* inside the open spacings as initially assumed, effectively falsifying SNDM.

Terrestrial planets

In final stages, the proto star purges hydrogen wrapped core material -Fe, Ni, S, Si, O, N, C- into the jets. These fast spinning supercritical 'knots' or 'Herbig Haro objects' (*HH34, 111, 30, Hubble ST, Spitzer ST*) are the embryonic stages out of which **all terrestrial spheres** form, planets and moons alike. Slowing down their spin, gravity reorganises the elements of these proto spheres into layers pushing the lightest elements -predominantly oxygen- outward. Here the oxygen reacts with the jet's abundant hot diatomic hydrogen to form huge water vapour layers. On the inside the oxygen layer reacts with vertically circulating liquid silicon to form a growing crust and mantle. Heavier terrestrial spheres will leave the jets almost immediately but keep orbiting the rotational axis (*HH34 time laps, HH30 Hubble ST*). They freeze over and gradually fall back to the outer regions of the PPD from where they migrate inwards again with oscillating orbits towards the star, crossing the stationary debris of the PPD. This explains their *self-inflicted* Late Heavy Bombardment. Lighter material is purged too far out and cannot return: it forms the double donut (2 jets) shaped Oort cloud.
Many inward moving terrestrial spheres will be re-absorbed by the star or its large gaseous planets, some are captured as terrestrial moons, while the largest only get gravitational slingshots when passing the gaseous planets, ending up as rogue planets, TNO's or as the inner planets in stable orbits near the Sun. Importantly, terrestrial spheres *do not* form 'in situ' inside the disk.

The purging hypothesis can next elegantly and integrally explain all other details of our solar system such as the combined formation of the Kuiper belt, Uranus, Neptune and Pluto followed by Saturn's rings, asteroid belt, the Earth/Lunar relation and the faint young Sun paradox. Summarised: Solar system formation is fundamentally a dynamic **3D** process, yet for 300 years we have been trying to explain it with the Nebular Hypothesis / SNDM which is an 'in situ **2D** flat-disk-only' model resulting in unsolvable paradoxes. This is not unlike proposing and sticking to a flat Earth concept. The purging hypothesis offers a superior **3D** paradigm solving all paradoxes, fully integrating stellar and planetary formation. One can literally not happen without the other…

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1. Introduction and SNDM

1.1 The origin of the Nebular Hypothesis

The first part of solar system formation is supposed to be well understood: Part of a molecular cloud contracts and collapses into an accretion disk with a proto-star at its centre. This was already broadly described in the 'Nebular hypothesis' published in 1755 by Immanuel Kant based on work of Swedenborg. LaPlace later published an improved model 1796. The hypothesis becomes less usable when trying to answer detailed questions like: How *exactly* do stars reach fusion conditions and how *exactly* do gaseous and terrestrial planets form? To explain such details, a modern version of Laplace's work was introduced around 1970; The 'Solar Nebular Disk Model' SNDM credited to Victor Safranov. Though seen as an improvement, it is not without problems: There is the unexplained and unacceptable skewed distribution of angular momentum between the Sun and gaseous planets associated with the the disk model. In addition, the suggested physics behind the formation of terrestrial planets is highly debated, nor is there a detailed process by which proto stars reach fusion conditions. Worse yet, recent observations of distant solar systems are not consistent with SNDM, requiring ever more complex fixes. In all, this means one of two things:

Either solar system formation is an *extremely* complex process, or the 40 year-old SNDM theory is just fundamentally flawed. To investigate which of the two it is, a 2-year long research project was started with the sole aim of finding an alternative hypothesis that would solve not one but *all* problems that plague SNDM. Before addressing the new paradigm, first a short oversight is provided of the biggest problems of SNDM. It is by no means meant to be complete, but the next six issues provide a stark reminder of just how weak the case for SNDM actually is.

1.2 Issues of SNDM

1. *The process leading to solar fusion*

A contracting proto-star faces inherent physical issues preventing it from reaching fusion conditions: SNDM offers no clear explanation how a star yet reaches fusion conditions, nor does it integrate proto-stellar jets and vortices.

2. *The forming of terrestrial planets*

The current scientific consensus is that inside an accretion disk or 'proto planetary disk' (PPD) small grains grow into rocks and collide into larger rocks and finally into entire terrestrial planets. Yet, it is highly debated whether physics would even allow for clustering of small grains into rocks, certainly without an additional heat source present. Gaseous planets in contrast, could very well accumulate mass inside a PPD. But even there, one should be careful to simply suggest their origin is spontaneous contraction inside the accretion disk.
A good example why caution is needed is the recent famous picture of the PPD of the young star HL Tau by ALMA showing some 10 open and equal distanced circles. It was instantly heralded as 'evidence' for planetary accretion. However, the realisation later sank in that 10 similar planets being born at 10 identical distances is unlikely. Instead it will be argued this is not related to planetary formation at all; It is a concentric *wave pattern* of condensed material from a series of proto stellar equatorial purges, as predicted by the purging hypothesis.

3. *The Angular Momentum Paradox.*

SNDM suggests that our planets formed 'in situ' in the disk, independent of the Sun. If true, then our Sun and planets should contain angular momentum relative to their mass. However, our Sun holds 99,8% of all mass inside the solar system but only 1,75 % of all angular momentum. In contrast, our planets combined have 0,2% of all mass yet hold 98,25% of all momentum. This imbalance is so grotesque that effectively it constitutes a no-go theorem for SNDM. Nevertheless, astronomers did adopt SNDM in the early 70's and ever since generated disk theories trying to account for the angular momentum issue. None however proved substantial enough to solve it. Nevertheless, the paradox is easy solvable, just not under SNDM.

4. *The forming of Earth and Moon*

Next, Earth and Moon formed. Chemical data of retrieved Lunar rocks indicate Earth and Moon have similar isotopic signatures and would be created almost simultaneously out of related material. This provides a problem for SNDM which suggests all terrestrial spheres are individually formed out of rocks inside the PPD. Astronomers had to come up with an ugly solution; a hypothetical collision between a *solid* proto Earth and a *solid* hypothetical 'Theia' planet, which instantly liquefied and merged both planets after which on the backside the Lunar mass popped out, solidifying into our Moon. This somewhat gullible 'Theia theory' basically only looks good in computer generated animations. The purging hypothesis offers an observable and easy solution.

5. *The forming of water on Earth*

As a next stage, scientific consensus has long been that water came to Earth transported by swarms of hypothetical ice-comets. There might have been, but looking at the vast quantities of water on Earth it is highly unlikely so many ice comets would exist and impact Earth only. Earth, which in addition is assumed to be red hot at this stage? And would they next visit Ganymede with its *700 km* (source NASA) thick water ice layer?

It is perhaps the most unrealistic of all explanations ever conceived, yet this consensus idea actually lasted for decades. Recent geologic zirconia findings and deuterium measurements indicated Earth's water is 'home grown' right from its origin, under rather *cool* temperatures. Consequently, scientific consensus shifted 180 degrees now claiming Earth formed out of ice gluing rocks together. But this is also not very credible since an igniting Sun would leave little if any water at such close distances. Again, the purging hypothesis offers an observable and easy explanation.

6. The Late Heavy Bombardment, LHB (4,1-3,8 Billion y.a.)

Next, between 4.1 and 3,8 billion years ago, Earth, Moon and the inner planets have undergone intense bombardment by large meteorites or asteroids. The leading explanation is that Jupiter would have made an orbital side step causing gravitational slingshots to asteroids hurling them towards the inner planets. Again, notice that the *need* for this exotic explanation is caused by the implicit *assumption* that all inner planets are born 'in situ' inside the PPD at their current orbits. Yet, this bombardment can just as well be explained by the inner planets themselves moving through the PPD outside-in with the 'impacting' asteroids being the static objects. We will later argue this is indeed what happened.

Looking objectively at each of the consensus explanations above, the situation is bleak. SNDM cannot convincingly explain *any* major aspect of solar system formation. Worse yet, *none* of the proposed answers are logically connected, failing to produce a coherent end-to-end 'story line' which is the earmark of any valid paradigm.

1.3 The human factor behind the issues

Many more inconsistencies and recent surprises could be mentioned. In fact, they are so plentiful that we have grown accustomed to them, increasingly accepting them as vagaries of Nature. There is however the risk of getting too complacent in this respect when considering the following quote:

'…We tend to think of paradoxes as inherent complexities of nature which we may solve at a time of our liking. However, nature has no paradoxes. Paradoxes are always and without exception symptoms of flawed human thinking…'

In line with this quote, this paper adopts the dogmatic stance that paradoxes are simply unacceptable and must all be removed regardless the consequences for human produced paradigms. As such there are a few things to mention:

a. *An engineering issue.*

Reconstructing solar system formation is not a scientific problem; it is an engineering challenge. Within the scientific community it may be quite acceptable to keep on working on isolated aspects of solar system formation, even in the face of mounting paradoxes and issues 'elsewhere'. From an engineering standpoint this is unacceptable. Since all aspects of solar system formation must eventually interconnect, the first hint of a paradox anywhere in the chain should immediately lead to a design step-back to find common ground from where to rethink and solve the paradox. Failure to immediately address a paradox like the angular momentum paradox, may lead to decades of research on 'shaky' foundations making it politically very hard to 'back-paddle' and correct things afterwards.

b. *Paradigm latency.*

Over the past decades, observational capabilities have leapfrogged. Hubble ST alone led to an unprecedented amount of new insights and footage. We can now observe disk perpendicular phenomena like emerging vortices and powerful jets purging momentum, heat and matter along the proto star's rotational axis. In addition, there is the spherical Oort

cloud with its left-over debris and its inner void suggesting purged mass returning to the disk. All these '3D' phenomena offer a tremendous potential for new and more effective explanations for solar system formation.

Unfortunately, none of this fantastic footage was available at the time of origin of our current solar system formation paradigm. Back in those days, the accretion disk was considered to be the sole and central phenomenon of solar system formation and all key-functionality was attributed to it: The disk would provide mass to the star while at the same time absorb its momentum and after stellar birth it would produce *'in-situ'* condensed revolving planets. Such a 2D 'disk only' model has many, many *inherent* paradoxes, the worst being the angular momentum paradox. Nevertheless, modern astronomy embraced 2D SNDM and next had to develop 'accretion disk theory' in an effort to counter the paradoxes. This complex theory however remains problematic and any 'evidence' seldom exceeds the level of computer generated simulations or animations.

c. *3D solar system formation model*

If on the other hand, we allow ourselves to at least consider the possibility that the accretion disk is not front and centre of everything and that the *observed* '3D' phenomena have a fundamental role to play in solar system formation, than we come to an alternative model that is inherently paradox-free, adheres to basic physics and complies with all recent observations. The price we would have to pay is admitting human fallibility and until now this seems too big a hurdle. Nevertheless, eventually we will realise that sticking to a 2D flat solar system formation model is as good an idea as sticking to a 2D flat Earth model…This paper will next lay out the case for a vastly superior 3D solar system formation model that is engineered to be 'ab initio' free of paradoxes whilst solidly based upon recent observations and basic physics. It will need to be scientifically verified over the coming years…

2. The purging hypothesis and planetary formation

Given the great inconsistencies if not impossibilities of SNDM as described in the previous chapter, a research program was started, seeking an alternative hypothesis, which as a minimum should

1. Solve the Angular Momentum Paradox
2. Support the indigenous forming of water on Earth
3. Be in line with all of the latest footage produced by e.g. Hubble ST, ALMA and Spitzer ST.

General conditions were

- The full acceptance of astrophysics and
- The complete disregard (not falsification per se) of all current planetary forming theories. In Einstein's words: *'…we can't solve our problems with the same kind of thinking we used when we created them…'*

2.1 Research Approach; connective reversed engineering

Constructing a new hypothesis does not require presenting a new set of data or observations. In stead it involves designing a concept that provides better and more coherent explanations than the old hypothesis, preferably without any of its flaws. Since the research premise is that the 40-year old SNDM is fundamentally flawed, there is an inherent problem with all research papers written since its introduction. The scientific tradition requires any new research and researcher to refer to and expand upon earlier peer-reviewed work, ensuring base assumptions -in this case SNDM - permeate through all accepted research work. We thus had to ignore such research on our path to better solutions. With a background as academic engineer the approach thus became clean-sheet 'reversed engineering', studying only the paradoxes and recent footage of solar systems. New and existing parts of formation processes were re-combined with a certain bias for interdependencies and trajectories perpendicular to the accretion disk as this would put planetary formation more in line with the fractal nature of our Universe.

However, we added a crucial extra component; No solution, no matter how plausible, was allowed to be isolated. Like a jig-saw puzzle, it had to logically connect to a solution of a different event preceding it. This is the only way to get a coherent 'story line' which SNDM so desperately lacks. We assumed and were proven correct that a solution that offers good connections to other solutions, also offers the best explanation for the individual issue at hand. If we look at the SNDM solutions of the previous chapter, ***none*** would pass the connectivity criterion. Not surprisingly each individual explanation is also extremely weak. Now compare this to the Purging Hypothesis presented below: Each item connects to a next and appears very intuitive and easy. Nevertheless, it took many failures before each piece of the puzzle was correct. Since the purging hypothesis solves over 20 major problems, only each winning option is presented including its logical connection to other solutions. Special attention is given to the angular momentum paradox and Earth's water formation problem. Both issues *separately* suggested planets must form out of purged solar material. This double indication was the breakthrough leading to all other solutions.

2.2 Step 1; Finding a single point of failure

Taking an engineering approach, the first challenge was to see if there is a 'single point of failure' behind each of the current problems of SNDM. If there is, then all research into individual solutions is useless unless the root cause is first addressed. In the previous chapter a common factor behind all problems appears to be the (implicit) assumption that all planets are independently created 'in situ' inside a PPD. It invokes the angular momentum paradox, it prohibits the large scale water formation on Earth and raises all other issues mentioned. For gaseous planets, the PPD intuitively seems the right place for accumulation but there has to be a solution for the angular momentum paradox. For terrestrial planets the problems are so great and the proposed solutions so bad, that PPD birth seems highly unlikely. In all, we had to assume the core issue of SNDM is an incorrect perceived function of the accretion disk.

2.3 Step 2. Solving the angular momentum paradox

Although there is no universal law on how much skew is allowed between mass and angular momentum within a solar system, it is just not possible for our Sun with 99,8% of all mass to end up with just 1,7% of all angular momentum. Obviously, the simplest solution to the paradox is to redefine planets as 'former solar mass'. This means that planets are not formed directly out of the accretion disk but instead form out of solar mass purged by the Sun during or after its own accretion. By definition, this would make all current mass in our solar system solar mass and all momentum solar momentum, solving the Paradox. Thus, until proven incorrect, our first premise becomes: **(1)*'..our proto-Sun transfers angular momentum onto purged solar mass, some of which eventually accreted into our current planets..'*** In theory, the paradox could also be solved if planets were deep space objects captured by our Sun. But this is unlikely since all planets orbit in the same direction. Moreover, the planets would still need to be created elsewhere.

2.4 Step 3. Solving the water issue

Since large scale water-import by comets is not realistic, the focus has to be on mechanisms and conditions allowing for large scale *indigenous* forming of water on Earth. More over, there is no reason to suggest it is restricted to Earth since the moons of Enceladus, Europe and Ganymede all have formidable layers of –frozen- water of up to 700 km. The most obvious reversed engineering solution for such large-scale water production is mass *chemical* production of water via the simple reaction $2H_2+O_2 \rightarrow 2H_2O$. Such a process would require Earth

1. to have had a giant outer layer of pure unbound oxygen, while;
2. being positioned in a hot and hydrogen-rich environment.

Vast amounts of unbound oxygen could only be found inside the layered core of our proto Sun. Some of it would need to be purged together with other elements that form Earth. If so, Earth would start in the form of a liquid / gaseous sphere and the additional requirement of a hot hydrogen-rich environment would place it

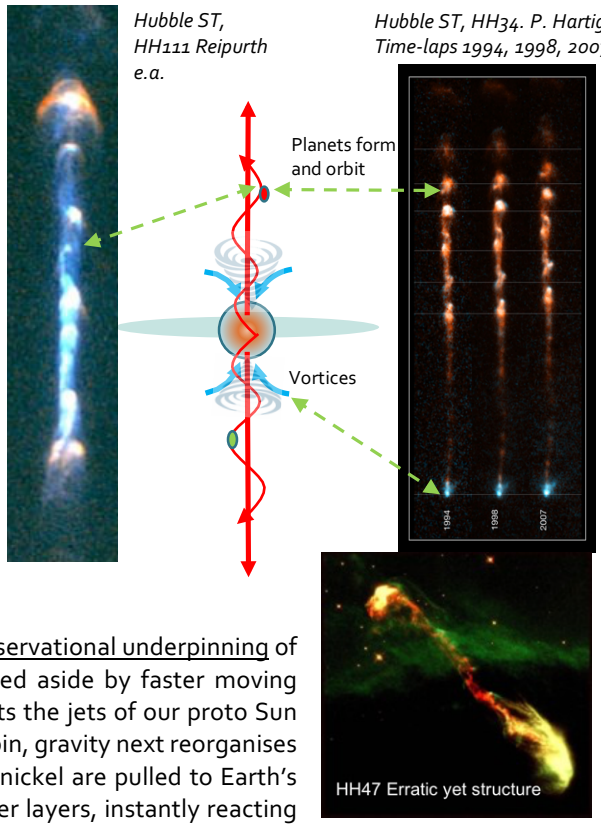
1. Either very close to the proto-Sun's surface, or
2. Inside the hot diatomic hydrogen filled bipolar outflows or 'jets' of a proto-star

A liquid/gaseous Earth orbiting close to the proto Sun would not solidify quickly and would probably not have survived the strong solar winds of an igniting Sun. Also, Spitzer ST has actually observed clouds of purged unbound elements and simple carbon oxides near the jets of HH46. Thus, all points to the second 'jet' option, aligning beautifully with the first purging premise. Thus, until proven incorrect our second premise becomes; **(2) '*...all terrestrial planets are born as super critical liquid/gaseous spheres inside proto-stellar jets out of purged solar core material...*'**

To some extend unbound oxygen could also be produced from in falling debris and dust being superheated inside the collimated jets. We will later explain why we did not prefer this option. In contrast, the big gaseous planets lack the water argument and are far too massive to have formed inside jets. Now, since this is all so different from SNDM, is there any observable confirmation of terrestrial proto-spheres forming inside proto stellar jets?

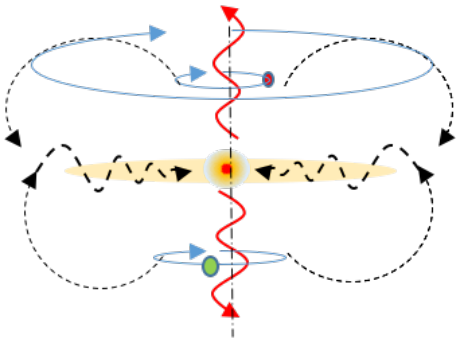
2.5 Solving terrestrial planetary formation

Remarkably, Hubble ST has indeed recorded the above *predicted* planet-like forming process on many occasions in the hot hydrogen jets of proto stars. Such jet structures are referred to as a 'Herbig Haro' (HH) objects, a misnomer for the actual 'knots' inside the jets. In a Hubble time-laps movie study of HH 34 (*right*) one can clearly see 'knots' forming and starting to orbit the rotational axis of a proto Star! In the top right of HH34, even a secondary satellite appears to form inside the same cloud. Earth and Moon may have formed similarly out of identical material. https://youtu.be/ufadgneScAM. The total mass inside most jets is limited and is estimated to contain 1% of non H/He material (Wikipedia). This would suffice for the medium sized terrestrial moons in our solar system. An Earth-sized planet would need more mass and may be relative rare, yet the mechanics of the jets are such that the heaviest material is constantly pushed aside by the faster moving central beam of ionised hydrogen. As such, spheres like Earth would typically leave the jets early. Also, it is possible the 'time window' for return trajectories is limited to periods of erratic jet structure like displayed at HH47 *(below right)*.



In all; unlike SNDM, we now have both theoretical and observational underpinning of a jet-based origin of Earth which would unfold as follows: Pushed aside by faster moving ionised hydrogen, the supercritical liquid/gaseous proto-Earth exits the jets of our proto Sun early, covered in a halo of hot diatomic hydrogen. Decreasing its spin, gravity next reorganises its elements into structured layers: Heavy elements like iron and nickel are pulled to Earth's core, while oxygen and other light elements are pushed to its outer layers, instantly reacting with the abundant and hot diatomic hydrogen to form large amounts of *water* (vapour). Minor quantities of nitrogen and carbon add ammonia, methane and carbon oxides. On the inside the oxygen layer would react with -vertically circulating- silicon, producing a growing mantle of silicon oxide. Earth, orbiting at an ever wider radius would now quickly cool down, solidify and ultimately freeze over outside-in. The logical end-result at 4.4 Ga would be a high spinning silicon oxide sphere, with a giant outer layer of predominantly water ice, looking quite similar to the current -still intact- ice moons of Enceladus, Europe and Ganymede. Although this distant terrestrial planet formation may be emotionally hard to accept, in engineering terms it is *far* more *connective* and thus likely than the *never observed* and *highly controversial* in-situ formation inside an accretion disk. The next paragraphs will further demonstrate this superb connectivity:

2.6 Solving the Oort cloud and the Late Heavy Bombardment



Since Earth is currently orbiting close to our Sun, this means that *if* the purging hypothesis is correct, at least some terrestrial spheres must be able to leave the jets, fall back to the PPD and migrate towards the star. If so, then the Newtonian trajectory would be a long elliptical trajectory, perpendicular to their orbits around the rotational axis. Upon finally reaching the outer PPD at ca. 4.1. billion y.a, they would slightly overshoot the PPD due to their perpendicular momentum and migrate outside-in with oscillating orbits, back towards the star. The central orbital plane is defined by the inline gravity of the Sun, Jupiter and Saturn. We thus get the schematic fall back trajectory on the left for any terrestrial planet. From this we can deduce several new predictions to expand and test the purging hypothesis:

- *The Oort cloud.*

Since the gravitational influence of a proto star is not endless, lighter material and debris that leave the jets too late, will not be able to fall back to the PPD anymore. In stead, they would orbit or hover at stationary distances. Thus the purging hypothesis predicts the presence of a distant cloud of hovering debris just beyond the borders of the trajectories as depicted above. Its inner border would be shaped like a double donut (2 jets) and the space between the inner border of this cloud and the PPD would logically be empty. Is there such a predicted cloud?

Confirmation → General consensus is that the Oort cloud indeed has the shape and size as predicted (*picture right, source Science News*). We now have a coherent explanation where it came from and why it is shaped like it is.

- *The Late Heavy Bombardment.*

As depicted above, the purging hypothesis predicts that all terrestrial inner planets at some point migrate through the PPD. As such they must all undergo a sudden but finite period of *self-inflicted* intense bombardment by debris, e.g. crossing the Kuiper belt and the asteroid belt.

Confirmation→ It is generally accepted that Earth, Moon and all inner planets indeed faced a period of 'Late Heavy Bombardment' at 4.1.-3.8 billion y.a. We now have a solid and simple explanation of what caused it, without the need for a third external body (Jupiter) firing asteroids towards the inner planets.

2.7 Solving the Kuiper Belt, Neptune, Uranus, Pluto.

If the hypothesis is correct, Jupiter and Saturn were already established planets when the terrestrial planets arrived at the PPD. If so, all terrestrial planets must pass Saturn and next Jupiter and run the risk of engulfment or being captured as their moons or slung into deep space. This gives us another prediction:

The only theoretic exception a terrestrial planet would not pass Saturn, is if two such terrestrial planets, e.g. coming from a northern and southern trajectory, would collide in the outer regions of the PPD. This could violently stop their perpendicular and oscillating momentum towards the Sun and Saturn.

Confirmation→ Until now astronomers were at a loss how Uranus and Neptune could form so far out in the solar system and specifically how methane and ammonia could end up there. They might have been gaseous giants evolving like Jupiter and Saturn, but the purging hypothesis now offers a more logic alternative: Neptune and Uranus are early terrestrial planets, born inside the jets, explaining the presence of water, methane and ammonia. Later, *in solid condition*, they collided just beyond Neptune's current orbit resulting in 1) the Kuiper belt 2) ice comets 3) Uranus tilted axis 4) the loss of moons –Pluto- and 5) large-scale sublimation of their ices enabling fast accumulation of the PPD's residue hydrogen en helium, expanding Neptune and Uranus into their current sizes.

2.8 Solving the terrestrial moons of Saturn and Jupiter, Saturn's rings, terraforming

-this paragraph contains the furthest derived logic and thus greatest chance of inaccuracy-

If the purging hypothesis is correct, all terrestrial planets will migrate through the PPD as the in-line gravity of Saturn, Jupiter and the Sun forces them into trajectories that cross the orbits of the big gaseous giants. Being the first gaseous giant on their path, the purging hypothesis predicts that predominantly Saturn, not Jupiter, would be the scene for a 'cosmic pinball game with terrestrial planets'. Many small ice covered terrestrial spheres would be engulfed or captured as moons here, perhaps later colliding with new incoming terrestrial spheres. Heavier spheres would be hurled outwards becoming Trans Neptunian Objects or inwards becoming 'inner' planets or getting re-absorbed by the Sun. Additionally, some incoming terrestrial planets may already have a moon and collide with it at low speed during

the gravitational slingshot of Saturn. In such cases, the smaller moon could be severely damaged e.g. loosing its ice envelope. In all, precisely Saturn should show remnants of many and massive ice-sphere collisions.

Confirmation→ Saturn and *only* Saturn has a massive ring system of 99,8% pure water ice, highly consistent with this prediction. If they ever had outer ice envelopes, our Moon and Mercury are clear candidates for having lost it exactly here.

The ice moons of Enceladus, Europe and Ganymede (with its record 700 km thick water/ice layer, NASA)

The purging hypothesis suggests these spheres represent the archetype for ALL larger sized terrestrial spheres at their birth. This includes Earth, Mars, Venus, Mercury and our own moon. Our moon would have lost its ice shell at a first collision near Saturn approx. 4.1 Billion y.a. as its Aitkin basin region allegedly hit Earth at its current Arctic region (the inversed Clementine alto / pressure maps highly correlate). If correct, some sections of Saturn's outer rings may still contain Lunar ice and regolith. Moving on, the Lunar surface would be exposed to 'Late Heavy Bombardment' impacts while Earth for long kept its protective but melting ice layer. Both spheres gradually moved their collision area's – Aitkin Basin and the Arctic- to a rotational pole as to minimize rotational imbalance.

As a side-remark: There are indications that originally not only Earth-Moon formed a terrestrial binary, but so did Venus-Mercury and Mars with a sizable ex-moon, now forming the asteroid belt. In addition; As such, it might be necessary for a planet to have had a sizable moon to generate an extra 'boomerang' effect when leaving the proto stellar jets, allowing them to follow a return trajectory to the point of origin. Such 'ballistics' would have to be further simulated and researched.

Collisions may be violent and destructive but they are also necessary to make ice covered planets habitable; A planet-moon collision would severely damage Earth's ice layer leading to rotational imbalance. The imbalance leads to conversion of spin energy into surface heat convection allowing Earth's ice layer to melt inside-out in three steps:

1. First melts would create warm dark UV-free caveats in the ices just above the surface, where ammonia, methane, carbon oxide, hydrogen and water vapour could now form first amino acids.
2. Increased ice melting would expose ever more of the Hadean surface, forming large rivers and sediments.
3. Finally, with its base shrinking, the entire ice layer would become unstable, grinding and pulverising the dark warm rocky Hadean surface before rendering it into the highly pressurized bottom of a deep all-encompassing Archean ocean, in which first algae formed around 3.8 Ga.

Earth's upper mantle would have been rebounding ever since, absorbing the water coming in via cracks and later via subduction of water-saturated ocean floor. The storage would take place in various forms; in water pockets/ serpentitite or hydroxide in rocks (ringwoodite) and the highly expansionary formation of SiO_2, all at the decrement of our ocean levels. The above would also explain the 'faint young Sun paradox' coined by the famed Carl Sagan: It was not the faint young Sun that melted and kept first water liquid during the Hadean. Instead it was rotational imbalance causing surface heat convection that provided the necessary Energy. In addition, we now have a solid explanation of how amino acids could form, why there are no Hadean rocks left, and what is powering Earth's continental drift. The realisation that the passage of Saturn and later Jupiter *could* have inner planets collide with their moon at low speed and shallow angle, spawned an additional year long research of maps on geology, vertical crust motion and gravitational anomalies. A separate document was dedicated to it and the results are breath-taking.

2.9 Solving gaseous planets and start of solar fusion

After describing the formation of terrestrial planets in detail, the focus shifts to the gaseous planets. The purging hypothesis predicts they formed out of purged solar mass and earlier we reasoned they are to massive to have formed inside proto stellar jets, leaving only equatorial purges as an option. Our third premise thus becomes: ***(3)'..Gaseous planets accrete out of the remnants of proto stellar equatorial purges..'*** In the next chapter we will show there is ample support for this. Unexpectedly, it provides new insights into the accretion disk and its relation to star birth.

3. The purging hypothesis and proto star formation

3.1 The current explanation of the process towards fusion

Looking at literature, the process of a proto star reaching fusion is often described as a runaway process where mass simply contracts until fusion conditions are reached, although at times there is the more sophisticated notion that linear contraction at some point becomes impossible due to too high angular momentum:

Wikipedia: '….The gas that collapses toward the centre of the dense core first builds up a low-mass proto star, and then a proto-planetary disk orbiting the object. As the collapse continues, an increasing amount of gas impacts the disk rather than the star, a consequence of angular momentum conservation. Exactly how material in the disk spirals inward onto the proto star is not yet understood, despite a great deal of theoretical effort. This problem is illustrative of the larger issue of accretion disk theory, which plays a role in much of astrophysics. Regardless of the details…' etc., etc.

The above description is a fair approximation of the general scientific consensus of this crucial stage in the live of a proto star. Remarkably, even after 300 years, the process is really only known with certainty up to the point where the proto star can no longer take on more mass because of its growing angular momentum (spin) and starts to grow an 'accretion disk' or rather 'flywheel', storing excess mass and angular momentum. This is a physically sound process and has been observed countless times. But…now look carefully at the underlined follow-up process Wikipedia suggests above. With a very subtle choice of words Wikipedia suggests we would know *for sure* that mass next reverses from the disk onto the proto star (..!), adding that this process is just 'not yet understood' (..!) after which it concludes it is a mere 'detail' anyway (..!). Fact is we don't know this to be true at all. We *do* know however that *if* it were true,

1. it would be a most remarkable process seemingly defying logic and Newtonian physics.
2. it gives rise to the angular momentum paradox
3. it cannot not explain the occurrence of vortices and jets, which by now *we know* play an important role.

The alternative process is quite straightforward: The flywheel disk will just accrete ever more mass and momentum, flattening the proto star to the extreme until the inevitable will happen: The thinning equatorial disk will develop a fissure and its outer part will split off from the star. This process has the advantage of explaining the formation of high momentum gaseous planets and offers a direct link to the formation of jets. So why would SNDM seek such an impossible process in stead? The answer is that 40 years ago SNDM wrongfully focussed on the mass issue and refused to integrate vortices and jets. The disk just had to do it all; provide star mass, absorb star momentum, grow planets.

3.2 The proto star problem.

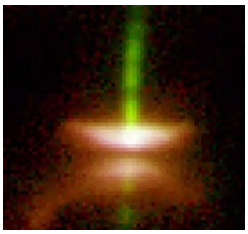
At this important stage, the problem a proto star faces is **NOT** a lack of mass. The problem is that the already accreted mass cannot perform its function of compressing the lowest hydrogen levels to fusion conditions. No amount of extra mass can solve this. There are *three* issues:

1. *Too high angular momentum*. Obviously, high angular momentum counteracts the gravitational force that the accumulated gas exerts on the surface of the core. As a result, the hydrogen pressure right above the core remains far from fusion levels. Any follow-up process should target this excess angular momentum.
2. *Too high average temperature.* The temperature just above the core must be high to reach fusion conditions. But in contrast, the average star temperature should be LOW. Cool gas is denser and allows for greater pressure on the core and a smaller core in itself. Though a lot of heat is generated and radiated outwards, it would help if the follow-up process would 'artificially' expedite this cooling process.
3. *Too big core size.* This is an overlooked issue. As the molecular cloud contracts, the heaviest elements spiral to the centre of the future proto star and logically *remain there* in ever more separated and compressed form. Obviously a large core is a negative as achievable pressure is inversely related to the size of the helium surface the hydrogen mass rests upon. Any follow-up process should therefor also 'artificially' hurl parts of the core away. As addressed later, bringing down the core size may very well be the single most important aspect.

In order to yet reach fusion conditions, the proto star must next **PURGE** momentum, heat and core material. Looking at the scale of a black hole or a hurricane on Earth, it seems nature by default purges perpendicular to the disk itself. As such, the overwhelming number of observations of vortices and jets around young stars suggests that these perpendicular phenomena, although transitory, *fundamentally* belong to this purging process and we need to integrate them into SNDM even if SNDM itself would change beyond recognition. As such we get a clear distinction

between the first phase in the life of a proto star where gravitational collapse of the molecular cloud was enough to contract the star ('passive linear accretion', PLA) and a second phase where additional gravitational collapse leads to disk, vortices and jets that do the actual work ('active cyclical compression', ACC). They form an *observable* piston-like compression process based on very straightforward and basic Newtonian physics.

3.3 The solution: Periodic vortices & jets



To complete the correct 3D process, we must

1. start at the moment the star gets flattened by the disk
2. end with a compressed star with fusion conditions.
3. fundamentally integrate the infamous and impressive proto stellar vortices and jets, observed at evolved stages of proto stellar formation (*HH 30 NASA/ESA right*).

Stage 1: Compression phase and equatorial purge

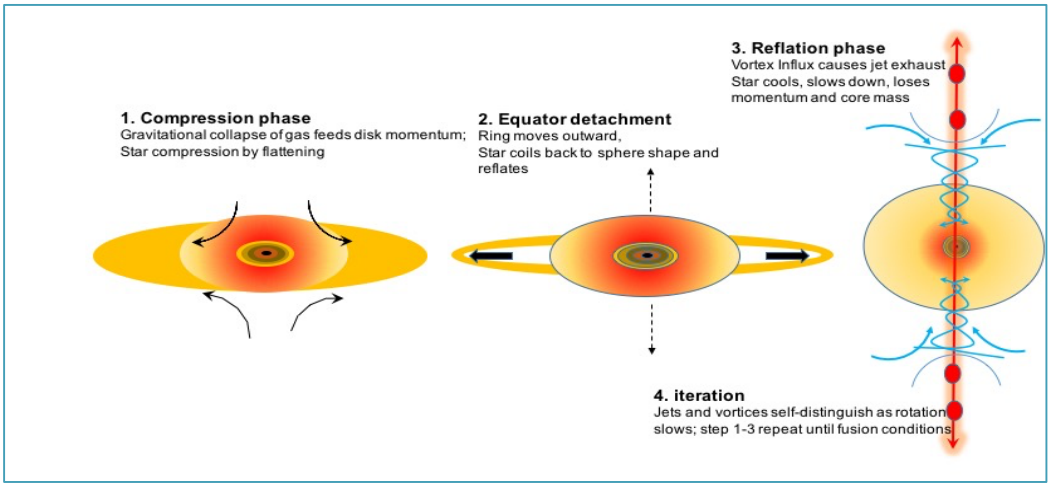
The ever increasing momentum and mass of the disk (or 'elongated equator') flattens the star, compressing it as such. Since there is no logical stop to this process, at some point the thinning disk will reach a limit and a notch or 'fissure' will occur in the disk, separating the outer elongated equatorial mass from the central mass. The star 'gives up' and purges this large chunk of equatorial mass in the form a massive ring. Subject to centrifugal forces it will move outward in a widening toroid. Its radial speed combined with its outward movement will produce violent internal turbulences which may combine to quickly form the large gaseous planets (Saturn, Jupiter). Since they thus form out of ex-solar material the angular momentum paradox is solved.

Stage 2 Reflation phase; forming of vortices and jets

Thanks to its equatorial purge the proto star has lost substantial momentum, allowing it to coil back and 'reflate' towards its former, **more voluminous sphere shape**. This relative quick elastic 'reflation' requires extra volume and will thus logically cause a pressure low at the star's rotational poles, leading to a sustained influx of cold and dense gas from the molecular cloud, forming the vortices. This bi-polar influx: 1. brakes the rotation 2. cools the interior of the proto star 3. pushes out hot hydrogen, angular momentum and core mass back up through the eye of the vortices, forming the bipolar exhaust outflows or 'jets'. Much like a soap bubble, the star will likely next overshoot its sphere shape and enter a longer period of dampened oscillation as the vortices and jets keep slowing down its rotation. The oscillation may explain the ca. 10-year period with which material 'puffs' or 'knots' appear inside the jets of e.g. HH34 (Hubble ST). Our Sun's current 11-year sunspot cycle my also reflect this natural oscillation.

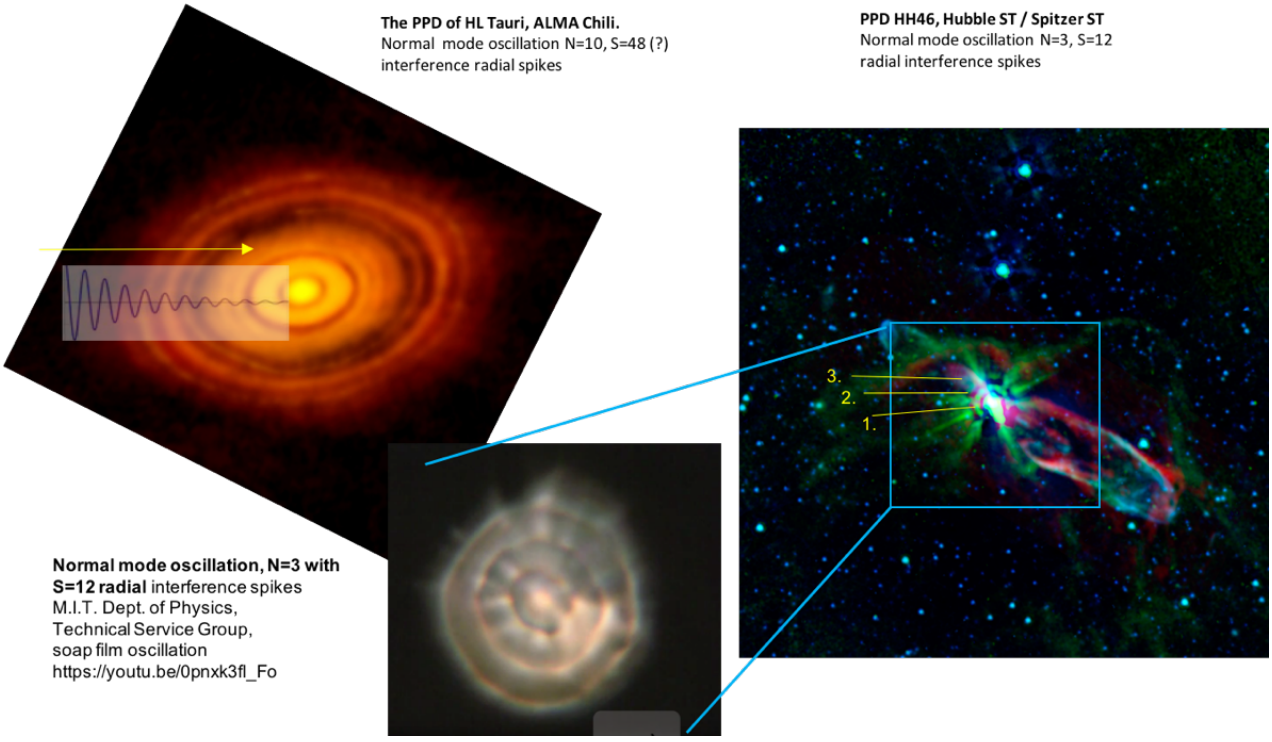
Stage 3. Iteration

Ultimately, the vortices and jets are self-distinguishing features; Once the star slows down enough they will dwindle and disappear. Next, the proto star will start accreting new mass again from the molecular cloud, perhaps even reclaiming parts of the earlier purged equatorial mass. Consequently, the rotation increases, the star flattens and compresses until the next equatorial purge happens, starting the next 'jets on' cycle. Provided enough fuel in the form of collapsing molecular cloud gas is available, this repetitive process will ultimately lead to fusion conditions since after each cycle, the proto star is more condensed and has a smaller core. This also means the series of equatorial purges ***must logically leave behind a pattern of ever smaller concentric circles in the 'accretion' disk,*** reflecting the shrinking size of the proto star over time. The entire process is a very ingenious 'piston-like' compression process:



3.4 The disk wave patterns of HL Tau and HH46

The described process elegantly solves all SNDM paradoxes and integrates planetary formation with stellar birth as one can literally not happen without the other! But as fantastic and all-explaining as this process may be, we want to see definitive proof in the form of PPD's showing the predicted wave-like pattern of concentric equal-distanced circles. The famous picture of the accretion disk of HL TAU by ALMA (*below left*) shows many open spaced rings, and was initially heralded as evidence for planets forming. It is tempting to jump to the conclusion of some 10 planets forming, causing empty spacings. However, no further credible indications for planets were found *inside the open spacings*. Moreover, 10 planets forming at 10 identical distances from each other does not lead to a logical orbital resonance for planets. To this day astronomers struggle with the phenomenon which is not compatible with SNDM. In contrast, the picture is *precisely* what the purging hypothesis predicts: **A series of ever smaller circles of purged equatorial stellar mass**, reflecting its shrinking size over time. The near perfect *wave pattern* becomes apparent by the superimposed sinus wave below. In addition, the situation of e.g. HH46 also resembles a normal oscillation mode *wave pattern*:

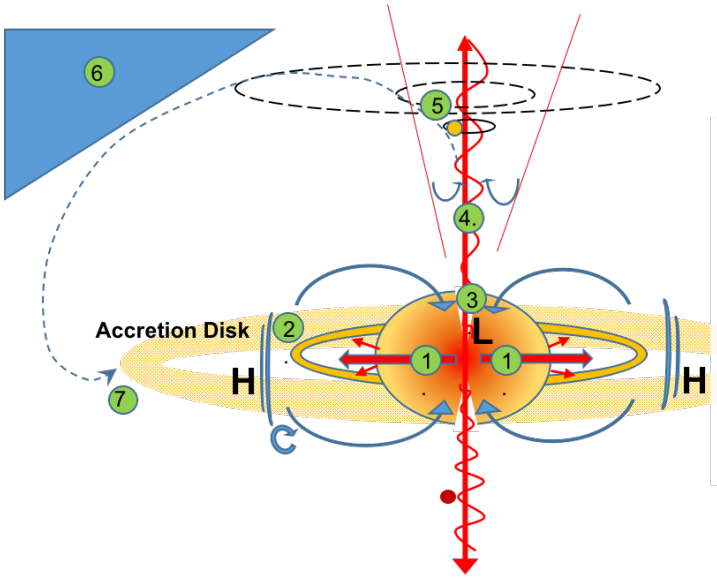


As if any further proof was needed, recent observations indeed suggests embryonic stages of gaseous accumulations are present in the *condensed* rings, *not inside the open spacings*, exactly as predicted by the purging hypothesis. In all, overlooking all that is discussed and presented, we should acknowledge that the purging hypothesis:

1. (Unlike SNDM) Is rooted in solid Newtonian physics
2. (Unlike SNDM) Has solid supporting observational evidence in countless HH images and the above disk images
3. Solves the angular momentum paradox and all other open issues of solar system formation
4. (Unlike SNDM) Does not need any auxiliary hypothetical process, circumstance, object or simulation. All of its individual formation aspects are functionally linked.
5. Has no paradoxes of itself.
6. Fully integrates stellar birth with planetary formation in a solid end-to-end process.

As such, the superiority of the 3D purging hypothesis over the old 2D 'in situ, flat-disk-only' model is obvious and of historic proportions. At this point only academic inertia can postpone the overhaul of our 300-year old and ailing nebular hypothesis / SNDM.

Schematically, we can summarize the purging hypothesis as below



Equatorial purge

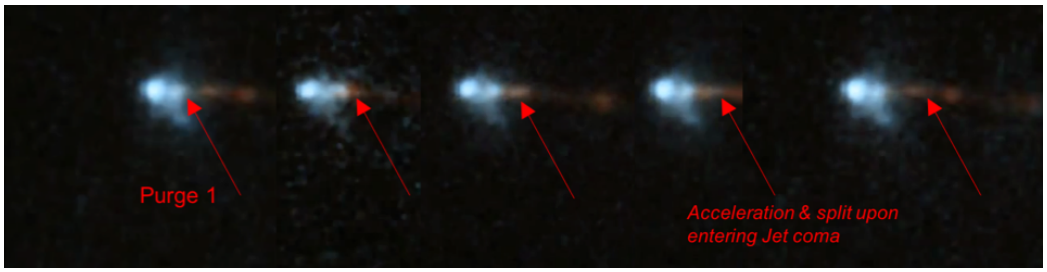
1. Fast rotation causes extreme equatorial flattening, blocking further accretion. Most likely outer core separates, spiraling outward; The proto star purges its equatorial ring,
2. Purge causes bow shocks and pressure high in PPD. Out of the condensed ring, gaseous planets (Jupiter and Saturn) form.
3. Purge, fast rotation and recoil back cause pressure low at rotational poles of proto star inducing incoming vortices of cold hydrogen via poles

Bipolar purge

4. Polar influx increases density and pushes out hot hydrogen and helium, angular momentum and core material via eye of vortices. Bipolar outflows (Jets) form. Rotation slows down
5. Terrestrial planets spin into existence as described. Some falling back
6. Oort cloud marks the distance area where fall back is no longer possible
7. Planets face their individual 'late heavy bombardment' moving through PPD

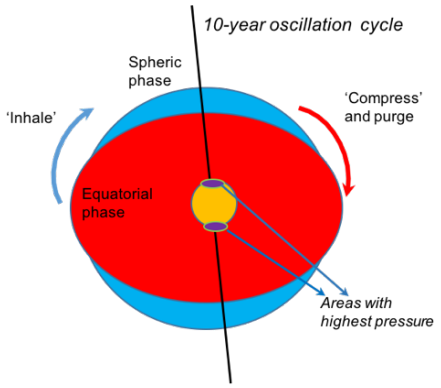
3.5 Herbig Haro knots and T-Tauri phase

Given the importance of Earth's formation it is fitting to speculate on the origin of the periodically purged knots inside the jets (Hubble ST HH34 and HH111). At these scales there is very little detailed footage available, the best arguably being the stellar surface of HH34 as recorded by Hubble ST in a time laps video below; Looking closely at this fantastic footage, it would appear the knots actually do come from the interior and there are various supporting arguments:



1. In the various recordings of HH objects one can notice that knots form *incrementally* and follow a *frequency* producing a string of periodic purges. If the knots were formed out of in-falling cloud material, one would expect to see a more continuous flow of material and a less strict frequency, if any.
2. The Hubble HH34 time laps study shows the base of the vortex is seriously disrupted anytime a knot is 'fired' outward from the star's surface. Exterior originating knots would not cause such an influx distortion. Also there seems to be a slight delay between the primary distortion of the stellar surface and the actual appearance of the resulting knot, hinting at an interior travelling time.
3. There is a 'motive'. Core purges would not just shed momentum and heat, but also produce a *smaller core* which means greater pressure on the remaining core expediting fusion in a self-enforcing manner.

Referring to the above, the purges appear to happen every 10 years or so (Hubble ST time-laps HH34). The proto star is simply the only object around that could produce such a steady frequency e.g. by oscillating between sphere-shape and equatorial bulge-shape, much like a large soap bubble does. Such an oscillation would be the logical aftermath of a big equatorial purge. Next, the specific mechanics by which the core material is periodically purged could be

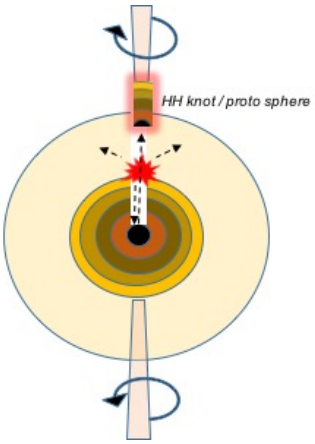


1. Suction, by the vortices
2. Cold hydrogen injected into the core by the vortices. Heating up, it expands and pushes layers up like a 'java lamp'
3. First hydrogen fusion explosions near the rotational axis (area with highest core pressure), partly deflecting off the iron core, blasting back up <u>*an entire cross section*</u> of the core through the jets back up and out.

Any and all could occur but 'suction' would be the most likely method during first 'jets-on' periods. The third option of deflected first hydrogen fusion blasts would then come into play only during final 'jets-on' periods: Getting close to fusion conditions, a star's first infant fusion reaction would happen near the rotational axis during a solar compression phase. Part of this first fusion blast would deflect 180 degrees off the iron core, blasting up-and-out an entire cross section of all layered elements via the jet (Fe, Ni, S, Si, O, N, C etc.). The core would re-organise its layers on a slightly smaller scale and with a slightly higher pressure on it. Each 10 years a new burst would now happen, gradually increasing the pressure on the remaining core. At some point during its final 'jets-on' phase the general pressure on the core becomes so close to fusion conditions that blasts start to happen during much of the 10-year period. The core is now exponentially slashed in a run away process at an ever increasing rate, expanding the area with fusion conditions towards the equator. The very moment the entire lower hydrogen layer exceeds the limit, a short outburst to upward layers would officially ignite the star, seeking hydrostatic equilibrium. Below an illustration is provided of the suggested purging of core fragments during first nuclear blasts:

First fusion blasts; HH objects

- First fusion blasts happen at the point of greatest pressure which is at lowest hydrogen layer at rotational axis
- Part of blast wave deflects off iron core causing an entire core cross section purge back up into jets;
- These form the embryonic stages of all terrestrial spheres
- Core is now incrementally slashed, automatically increasing pressure on its remainder;
- This results in a run-away process towards fusion as eventually jets are no longer needed



Zooming out a bit, the purging process would also bring symmetry in the life of a star, making star birth the exact inverse of star death:

Star Death	***Star Birth***
Inflation in several steps	Contraction in several steps
Creating elements between helium and iron	*Purging* elements between helium and iron
Final expansion and next contraction towards death	Final contraction and next expansion towards birth

3.6 Dark objects and 'Fremdkörper'

Fast moving and spinning bipolar purged mass that enters interstellar space may over time trigger a gravitational collapse of nearby molecular clouds. If so, these would collapse around a smaller and more 'polluted' area compared to supernova pressure-wave induced gravitational collapses. Unfortunately, less mass wrapping around a relative large core, significantly reduces the chance of successful star birth because:

1. A relative large core is obviously negative for achievable core pressure
2. Limited mass in itself is negative, since pressure is cubic star mass divided by the squared surface of the non hydrogen core.

As time goes by this would lead to a chain of ever more failed star births, which in turn may contribute to the gradual dominance of dark objects in general. This might contribute to the explanation of why at the outer arms of galaxies there appears to be much more mass than we can see.

Taking a more philosophical approach, hydrogen may be seen as the simplest and therefor highest achievable state of mass, just short of pure Energy itself. As such, the purging hypothesis in turn may be seen as an inherent attempt of the universe to clean it self from all non-hydrogen 'pollution' or 'Fremdkörper'. From this perspective, collapsing molecular clouds are all about isolating, compressing and ultimately purging all non-hydrogen 'metallics' allowing fusion to start. As such, Earth and the other terrestrial planets are the 'cosmic hairballs' of solar systems.