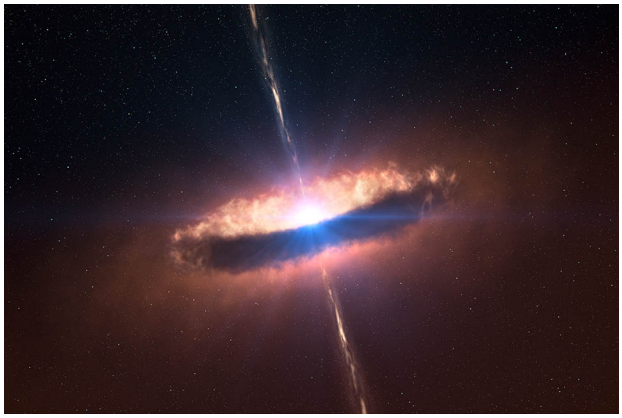

THE PURGING HYPOTHESIS

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 (SSF). 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 'Paradox Based 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 all observations, especially 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. *All previous (SNDM related) theories on SSF are ignored. As a result, only a minimum of references will be made.*
3. *Application of Paradox Based connective Reversed Engineering; This involves sequencing of old and new individual formation aspects in such a way that all paradoxes are avoided, all aspects are interconnected and consistent with latest footage. Computer generated simulations are explicitly not considered as valid input.*

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Summary

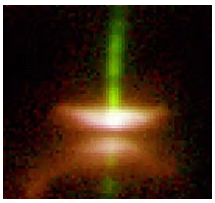
Paradox Based Reversed Engineering (PBRE), leads to the following synthesised paradox-free, best fit scenario for solar system formation;

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, the star's equator flattens into an elongated disk shape, storing excess in-falling mass and momentum. At this stage, unlike consensus thinking, the problem of a proto star is ***not*** a supposed lack of mass. The problem is that its acquired mass can not exert enough *pressure* on the core due to three blockers:

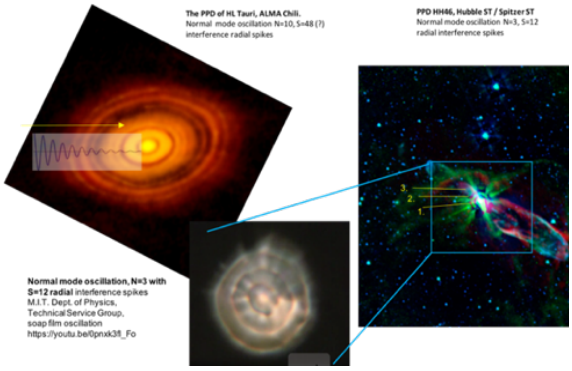
1. Too high angular momentum, counteracting the gravitational force the hydrogen exerts on the core
2. Too high *average* temperature, resulting in low density gas
3. A too large core, limiting the pressure the hydrogen can exert on the helium layer surface. A 90% smaller core surface would mean 10x greater pressure.

To further increase pressure, the star must now 'change tactics' and focus on ***purging*** momentum, heat and -above all- *core mass*. As with any high angular momentum disk object -from galaxy to tornado- such purging typically happens *via perpendicular jets*. Unlike consensus believe, this is ***also*** the case with proto stars. It is the growing momentum of the disk that jumpstarts a series of cyclical recurring proto stellar jets until the goal of reaching fusion conditions is achieved. In more detail:



The growing and ever faster spinning disk flattens the proto star to the extreme, until the star *inevitably* 'gives up' and mechanically *purges* its equatorial mass in a widening ring outward. The central proto star, having lost considerable equatorial momentum, will now elastically coil back and ***reflate*** to its former, more voluminous sphere shape. This 'instant' reflation induces ***incoming*** bi-polar vortices of cool disk halo gas *(Hubble ST HH30, left*). This bi-polar influx: 1. cools the star 2. brakes its rotation 3. ***pushes out*** hot hydrogen, momentum and core material through the eye of the vortices, forming the bipolar exhaust jets. This is how the star alleviates all three blockers.

Once they have slowed down the star's rotation, the short-lived (10k-100k years) vortices and jets will dwindle and vanish. Next, the star begins accreting mass anew, picking up rotation, flattening its interior until the next equatorial purge happens, starting a new 'jets-on' period. After each 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. ***This*** is what's behind the concentric wave pattern in the PPD of HL tau (ALMA, *right*) and HH46 (Spitzer, *far right*). As such, the open spacings are *unrelated* to planetary formation. Provided there is enough fuel in the form of in-falling molecular cloud gas, this cyclical process will automatically repeat until fusion conditions are reached. In short: proto star formation is ***not*** about linear mass contraction but all about cyclical mass purging. Given its tremendous importance, the entire process is once more schematically displayed on the next page. As a result, a direct link is now established between proto star formation and planetary formation:



Gaseous planets

Parts of the ring shaped high-momentum equatorial purges may condense to form high momentum gaseous planets like Saturn and Jupiter. Since these thus 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 their *open spacings* as long assumed by the scientific community.

Terrestrial planets

At the base of the jets, in-falling non-hydrogen gas, dust and silicate debris are 'sucked into' the jets. Here the jet's phenomenal heat (8.000-12.000K) melts it into magmatic material and next catapults it upwards during the star's periodic H/He purges. This H/He engulfed material next spins into liquid 'knots' or 'Herbig Haro objects' (*Hubble HH 111, right*) forming the embryonic stages of **all terrestrial spheres**, planets and moons alike. Slowing down their spin, gravity reorganises the elements of these proto spheres into layers. Iron and nickel sink to the core, pushing the lightest elements -predominantly oxygen- outward. The oxygen reacts with the jet's abundant hot diatomic hydrogen to form water vapour. On the inside of the oxygen layer reacts with vertically circulating liquid silicon forming a first primordial mantle. Additionally, as observed at L1448-MM, the proto star itself may typically eject massive amounts of water and other volatiles into the jets ending up as outer ice layers on the spheres. Arriving at the outer part of the jets, the jet's central beam of ionised hydrogen typically changes from collimated to helix shape, inducing a bar-magnet shaped magnetic field. This pushes out all magnetised material -including metal core terrestrial spheres- and curves their trajectory straight back towards the star (*Hubble ST HH30*)! Lighter non-magnetic material is purged too far out and cannot return, arguably forming the double donut (2 jets) shaped Oort cloud. Covered in a halo of hot hydrogen and orbiting the rotational axis, the jet-ousted proto-spheres gradually cool down, freeze over and eventually reach the outer regions of the former PPD. Due to their circular disk perpendicular momentum they will now all migrate inwards towards the star with oscillating orbits, crossing the Kuiper belt and some even the asteroid belt. This explains their *self-inflicted* Late Heavy Bombardment. Many terrestrial spheres will be re-absorbed by the star or its large gaseous planets, some will collide or be captured as terrestrial moons, while the largest only get gravitational slingshots upon passing the gaseous planets, ending up as rogue planets, TNO's or as the inner planets near the Sun. Importantly, terrestrial spheres *cannot* and *do not* form 'in situ' inside the disk.

*The purging hypothesis can next elegantly (and paradox free!) 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 combined Earth/Lunar origin 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 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 while fully integrating stellar and planetary formation. One can **literally** not happen without the other…*

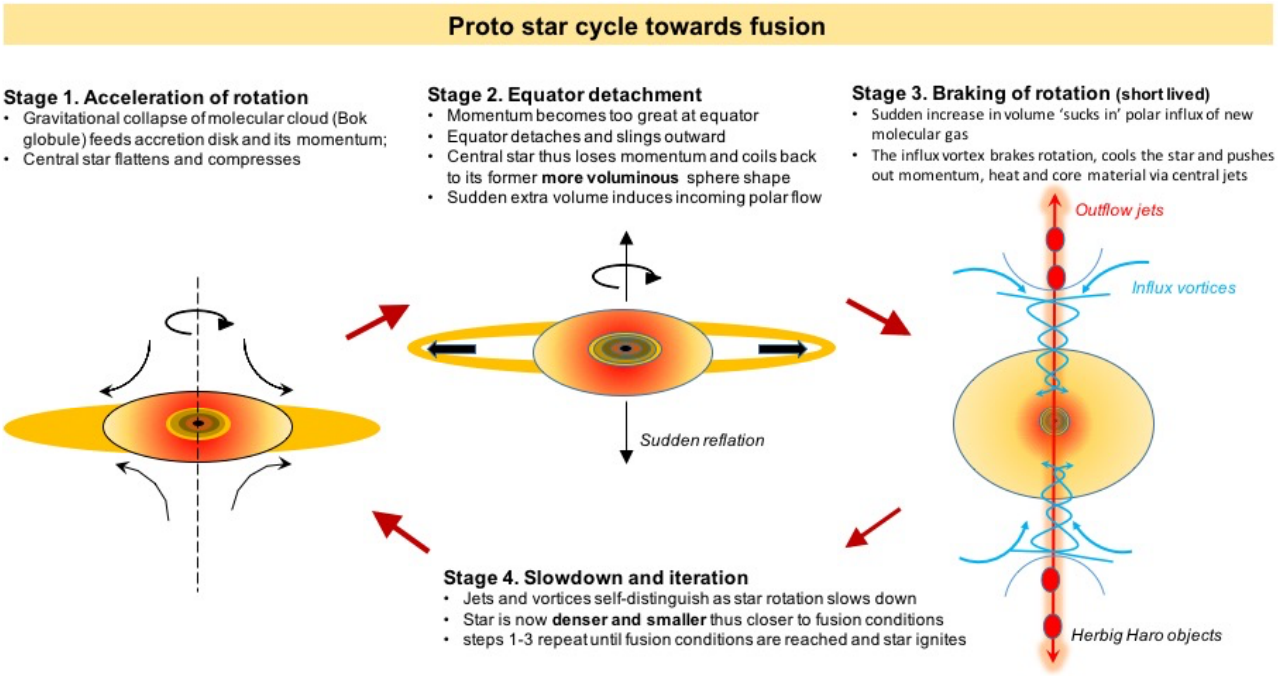


Table of Contents

1. Introduction and SNDM

1.1 The origin of the Nebular Hypothesis

The first part of solar system formation (SSF) 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 this 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 proved 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 of our current paradoxes. 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 ('the 1-meter problem'), certainly without an additional heat source present. Gaseous planets in contrast, could very well accumulate mass inside a PPD, but also this process is not well understood and we need to be cautious drawing quick conclusions from recent footage.
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 complex hypothetical disk-internal processes trying to somehow account for the angular momentum issue. None however proved substantial enough to solve the problem. 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 came up with an ugly and isolated 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. Recently more sophisticated ideas involve shared 'magma oceans', yet they all remain ad-hoc and simulated proposals. The purging hypothesis offers an observable and connected solution.

5. *The forming of water on Earth*

As a next stage, scientific consensus for decades was 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 just highly unlikely. And would they also have visited Ganymede with its *700 km* (source NASA) thick water ice layer? Recent geologic zirconia findings and deuterium measurements disproved the idea and next prompted other theories from asteroids to dehydration of indigenous rocks. However, all these ideas suffer from the absence of a clear overall SSF model they can connect to. Moreover, they all run into trouble due to their shared -but unfounded- human premise of Earth having formed 'in situ' close to the (igniting) Sun. In contrast, the purging hypothesis again offers an *observable* and very easy explanation for Earth's water.

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

Although recently somewhat disputed, the consensus thought is that between 4.1 and 3,8 billion years ago, all inner planets would have undergone intense bombardment by large 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 Jovian explanation is caused by the implicit *assumption* that all inner planets are born 'in situ' inside the PPD and the asteroids thus had to be dislocated. Yet, this bombardment –if it happened- can just as well be explained by the inner planets themselves migrating outside-in while crossing the orbits of the steadily orbiting asteroids. We will later argue this is exactly 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, accepting them as 'given vagaries' of Nature which we may come to understand at a later time. This complacent 'paradigm forgiving' posture is somewhat misplaced when reflecting on 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, the sheer number of paradoxes, issues, observational inconsistencies and the lack of coherent solutions actually make a very compelling case for reconsidering 40 years of SNDM based theories entirely, even if intellectually, politically or financially inconvenient.

Underlying the current troublesome scientific progress is a growing disconnect between our leapfrogging observational capabilities (Hubble ST, Spitzer ST, ALMA) and our sluggish pace or even blatant refusal to adjust our ancient theories that originate from an era when this material was not known or even dreamt of.

Front and centre of our ancient theories is the 'accretion disk' to which all key functionality is attributed: Stopping just short of claiming the disk produced our proto Sun in stead of the other way around (!!), the disk would provide mass to the star in a hitherto unknown linear way, while somehow taking away its momentum and next grow 'in situ' planets prompting the angular momentum paradox. Physically, this concept is beyond 'ugly' and 'accretion disk theory' had to be invented to counter the inherent paradoxes that come with this awkward 'disk only' 2D vision.

Fast forward to today, the latest observations reveal it is not the disk, but rather the spectacular perpendicular proto stellar vortices and jets that form the young protostar. This would include the theorised 3D Oort cloud as the logical structure for non returning jet-debris. If we allow ourselves to at least consider that these impressive perpendicular phenomena have a transient but fundamental role to play in solar system formation, we can synthesise a '3D' paradigm which is paradox free and perfectly in line with physics and observations. This paper next lays out the case for this superior 3D model making it unequivocally clear that sticking to our current 'disk-only' solar system formation model is as good an idea as sticking to a flat Earth model…

2. The purging hypothesis and planetary formation

Given the great inconsistencies if not impossibilities of SNDM as mentioned in the previous chapter, a research program was started, aimed at seeking an alternative, paradox-free hypothesis, solidly based upon the latest footage.

2.1 Research Approach; Paradox Based Reversed Engineering (PBRE)

Taking the stance that our current SSF paradigm is flawed, leads to limitations on what material and method to use:

Step 1: Ignoring existing studies
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 to a large extend 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 principal grounds.

Step 2: Ignoring the dysfunctional scientific method
The normal 'scientific cycle' of hypothesis, data collection, analysis and verification only works when incrementally 'forward designing', largely assuming correctness of earlier work. However, it becomes dysfunctional if we are to *challenge* all earlier work and need to come with an entirely new vision. One cannot develop such a complex end-to-end new concept with this method. It requires a reversed engineering approach as discussed shortly.

Step 3: Allowing rough-cut observational data.
Our main input source will be the latest footage of Hubble ST, Spitzer ST and ALMA. Interpretations of the community may be correct yet are not allowed as valid input data, neither are computer generated simulations.

Step 4: Introducing PBRE (Paradox Based Reversed Engineering) as the main method
Since we do not know for sure which main aspects of our current SSF paradigm are ***correct***, we do not have a starting point there. However, using the new method of 'Paradox Based connected Reversed Engineering (PBRE) we can now derive with reasonable certainty which aspects of our current SSF paradigm must be ***incorrect***. Navigating around these human errors, provides a novel but solid base for designing the new paradigm, this time free from human error and based upon the latest observations. As such, our biggest problems turn into our greatest assets. We can summarise the PBRE 'dogmatic' approach as follows:

1. Nature has NO paradoxes. It is working just fine
2. Paradoxes are virtual contradictions caused by flawed human thinking only. Consequently:
3. Paradoxes can not be solved by looking for a 'hidden solution' in nature
4. Paradoxes can only be 'voided' or 'nullified' by systematically identifying and correcting their underlying flawed human assumptions by using PBRE. In more detail:
5. The method of PBRE involves
   a) Targeted voiding of each individual paradox by identifying their PFA (Paradigm Falsifying Argument)
   b) Correcting the PFA via a 'best fit' PFAAH (Paradigm Falsifying Argument Alternative Hypothesis)
   c) The 'best fit' PFAAH is the option that scores best on 4 aspects:
   - It should be ***logically linked*** to solutions of the other PFA's (+ score)
   - It should be linked to an actual observation (+ score)
   - It should not be isolated (e.g. the Theia hypothesis) (-/- score)
   - It should not be the product of computer simulations (-/- score)
6. The logic end result will be an observation based, connected and paradox free - thus likely correct- SSF paradigm

Step 5: Explaining the detailed working of PBRE:
This requires some elaboration and illustration. As an example we will use the 'faint young Sun paradox':

'...If our Sun's output was only at 70% during early Hadean ('x')...,
.....then how could Earth sustain liquid water ('y') ?..'

A paradox is always formulated as a logic operator: If 'x' then why 'y'? Over the past 50 years since Carl Sagan coined the 'faint young Sun paradox', we have tried to solve 'y' countless times, mostly suggesting super-greenhouse effects or internal radiation. At some point our relentless but fruitless efforts start to resemble Einstein's witty definition of

insanity: '…Doing the same thing over and over again and expecting a different result…' Ergo, at some point we need to change tactics to tackle the paradox: If after decades or even centuries we cannot solve the paradox by answering 'y' than something must be wrong with 'x' in stead. This is a non-intuitive and difficult step to make, since 'x' and 'y' above are both correct. However, there is a hidden unproven ***human*** assumption in 'x' above, namely that our Sun plays a role in sustaining liquid water in the first place! From a purely logical standpoint, attacking this implicit second assumption is the *only way* to radically falsify 'x' and eradicate this tenacious paradox. Thus, the faint young Sun paradox produces the following derived 'Paradox Falsifying Argument (PFA)':

'*…The energy to sustain liquid water on Earth did **NOT** come from our faint young Sun…'*

Given our shared education, this feels like going against an 'incontrovertible truth'. But let's consider the following: Our ice moons of Europe, Enceladus and Ganymede all have vast liquid primordial oceans under their water ice layers and the faint Sun for sure plays ***no role at all*** here. Admittedly, In the case of these ice moons, it is the gravitational influence of a close-by giant planet that constantly jolts the rotational axis of the ice moons, generating the needed heat convection to melt and sustain liquid water above the rocky core. However, it does not require a nearby giant planet per se. A continuous jolted rotational axis can also be the result of rotational imbalance, e.g. in case of a damaged outer ice layer following a collision.

So following up on this PFA of the angular momentum paradox, we can now sketch an alternative hypothesis (FPAAH) of a Hadean Earth migrating inward, carrying a liquid ocean underneath its ice layer. This in contrast to our current consensus vision of our Hadean Earth having formed 'in situ' near our Sun, which 1) is never observed 2) is highly debated whether even possible 3) involves a Sun too weak to support its liquid surface water 4) lacks a decent explanation of how water got there in the first place. So, as much as we emotionally dislike to consider any alternative to our ailing consensus vision of Hadean Earth, we need to stay rational: What superior argument is there against the alternative of an ice covered inward migrating Hadean Earth since this FPAAH option:

1. Solves the 'faint young Sun paradox' (!!!!)
2. Has observational support from our three ice moons and all 7 TRAPPIST-1 terrestrial planets
3. Provides excellent connectivity to the other successful solutions (as we will show later)

We should also notice that the 'faint young Sun paradox' contained an implicit opinionated human assumption, but the resulting PFA is **NOT** an opinionated human assumption. It is the *logic consequence* of not finding a solution to 'y'. This distinction is important as it drives out human opinion, which is what makes the PFA such a powerful instrument; Precisely our extensive failures to solve 'y' increased the likelihood that the PFA is correct.

In the same way, for each of the 20 main paradoxes a PFA was derived -occasionally two-, resulting in a very detailed set of paradox-derived design parameters from which to built the new paradigm in a connected way.
As mentioned before, the most important criterion was connectivity; No solution, regardless how plausible, was allowed to be isolated. Like a jig-saw puzzle, it had to logically connect to a solution of a different event (PFA) preceding or following it. This is the only way to get the coherent 'story line' that SNDM so desperately lacks. We assumed and are arguably 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 our consensus solutions of the previous chapter, ***none*** would pass the connectivity criterion and all are very weak. Since the purging hypothesis solves over 20 paradoxes, the number of PFAAH trial & error permutations was staggering. As such, only each ***winning*** PFAAH is presented below. Special attention is given to the angular momentum paradox and Earth's water formation problem. Both issues *separately* suggested planets form out of purged solar material. This double indication was the breakthrough leading to all other solutions, which gradually all fell in place: a clear sign of a correct SSF paradigm:

2.3 Solving the angular momentum paradox

The 'angular momentum paradox' is generally recognised as the most severe paradox of all. Although there is no universal law on how much skew is allowed between mass and angular momentum within a solar system, it would appear nearly impossible for a disk to form on the one hand our Sun with 99,8% holding 1,7% of all angular momentum and on the other our planets with 0,2% of all mass and 98,3% of all momentum. Obviously, the simplest PFAAH solution to the paradox is to redefine planets as 'former solar mass'. This in turn means that the accretion disk out of which they formed must be seen as high momentum 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 Solving the water issue

Since large scale water-import 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 best fit reversed engineering solution for such large-scale water production of potentially up to 20% of radius 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 an outer layer of unbound oxygen, while;
2. being positioned in a hot and hydrogen-rich environment.

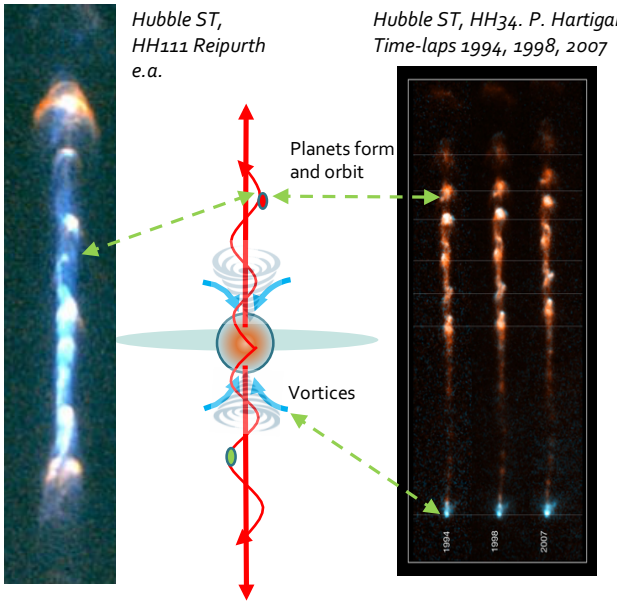
Unbound oxygen would not be easy to come by. There may be some stored inside the layered core of our proto Sun although H, He and Li dominate its interior. More likely, the needed unbound oxygen would be produced by proto-stellar jets superheating in-falling molecular cloud debris and dust that enters at the jet base. In addition, Spitzer ST has actually observed clouds of purged unbound elements and simple carbon oxides near the jets of HH46.
Next, the additional requirement of a hot hydrogen-rich environment would place Earth

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

Combining the requirements above suggests Earth's origin would indeed be jet-based. It also avoids the complication of a close-by igniting Sun blowing away volatiles. Therefor, until proven incorrect our second premise becomes;
(2) '*…all terrestrial spheres are born as magmatic spheres inside proto-stellar jets out of molten space debris…*'
In contrast, the big gaseous planets lack the water argument and are far too massive to have formed inside jets. Given its quite radical break from SNDM, is there observable evidence for terrestrial spheres forming inside jets?

2.5 Solving terrestrial planetary formation

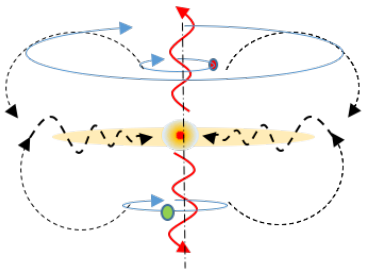
Remarkably, Hubble ST has indeed recorded the above *predicted* planet-like forming process on ***many*** occasions inside the hot hydrogen jets of proto stars. Such jet structures are referred to as a 'Herbig Haro' (HH) objects, a misnomer for the actual 'knots' inside the jets. In a Hubble time-laps 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 binary appears to form. Earth and Moon may have formed similarly out of identical material. https://youtu.be/ufadgneScAM. The total mass inside jets is limited, but the mechanics of the jets are such that the heaviest material is constantly pushed aside by the faster moving central beam of ionised hydrogen. The return trajectory is most likely initiated and curved by a ***change in the jet's magnetic structure at the outer end of the jets*** where the central beam of ionised hydrogen can be seen to form a helix. This crucial aspect is explained in annex 1.



The detailed formation for proto Earth would unfold as follows; The molten material spins into a sphere. Next, decreasing its spin, gravity reorganises its elements into structured layers: Heavy elements like iron and nickel sink to proto Earth's core, while oxygen and other lighter elements are pushed to its outer layers, reacting with the jet's abundant hot diatomic hydrogen to form large amounts of *water* (vapour). Minor quantities of nitrogen and carbon add ammonia, methane and carbon oxides. Additionally, as observed at L1448-MM, the proto star itself may purge massive amounts of water and other volatiles into the jets, ending up as outer ice layers on the spheres. On the inside the oxygen layer would react with -vertically circulating- silicon, producing a primordial mantle of silicon oxide. At some point Earth will be pushed out of the central jet. Covered in a halo of hot hydrogen, Earth will next orbit at an ever wider radius, gradually falling back. It will cool down, solidify and freeze over outside-in, going into 'hibernation' as a fast 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. Its fast spin and thick outer ice layer will protect it against any future collisions and it provides the materials *and energy* needed to later deploy oceans and atmosphere.

Although such distant and dynamic 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 further demonstrate this superb forward connectivity:

2.6 Solving the Oort cloud and the Late Heavy Bombardment



The return trajectory from the distant jet-ends would logically be an elliptical trajectory, perpendicular to their orbits around the rotational axis. Upon finally arriving at the outer PPD at ca. 4.1. billion y.a, the spheres would slightly overshoot the PPD due to their perpendicular momentum and migrate outside-in with oscillating orbits, back towards the star. One may again compare this with the earlier discussed situation of the seven terrestrial water planets of TRAPPIST-1.
In Earth's case, the central orbital plane is clearly defined by the inline gravity of the Sun, Jupiter and Saturn. In all, we thus get the schematic fall back trajectory on the right for terrestrial planets. From this we can deduce several new predictions to expand and test the purging hypothesis:

- *The Oort cloud.*

Since the gravitational and magnetic 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 and connected explanation where it came from and why it is shaped like it arguably is.

- *The Late Heavy Bombardment.*

As depicted above, the purging hypothesis *predicts* that all terrestrial inner planets at some point migrate through the remnants of 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 indeed Earth, Moon and all inner planets faced a period of 'Late Heavy Bombardment' at 4.1.-3.8 billion y.a. We now have a solid, simple and connected 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 purging hypothesis is correct, Jupiter and Saturn were already established planets before the terrestrial planets returned to 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 quickly at the outer end of our 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

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 and minor quantities of *regolith* (!!), 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. Notice how our human 'in situ' thinking emotionally objects to this. However, physically and logically there is nothing 'outlandish' at all about this explanation.

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.

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. Of course this would also explain the 'faint young Sun paradox' and our missing Hadean rocks.

The realisation that inner planets could have migrated passed Saturn and later Jupiter also lead to the realisation that the resulting gravitational slingshot could have them collide with their moon at low speed and shallow angle. It 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.

As a side note; in line with the purging hypothesis our Moon would have had an outer water ice layer prior to its Aitkin basin impact. This is consistent with the fact that this low speed, wide-body impact (with Earth?) at Aitkin Basin (4.1Ga) was its greatest ever impact, yet left no visual damage, while each and every minor impact afterwards did visually damage its surface (a minor paradox).

2.9 Solving gaseous planets

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 too 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 (forming the accretion disk).'*** 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 jets and 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 simply 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 'linear' 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 reason why mainstream science proposes this awkward process, is because they erroneously believe proto star formation is all about accreting as much mass as possible, just like a singularity. That is nonsense; Gathering mass is just a means, not an end. The physical goal of the star is to ***increase pressure, not acquiring more mass per se***. The moment the accretion disk forms, marks the infliction point where taking on more mass no longer 'works'. But nature is more sophisticated than we think: It now uses the growing amount of momentum stored in the accretion disk as a 'flywheel' to initiate another process aimed at further increasing the pressure at its core. To understand this, we need to spent a bit more time on the actual problem:

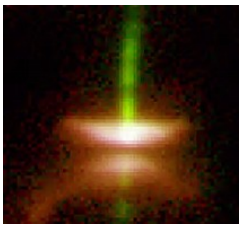
3.2 The proto star problem.

At this important stage, the main problem a proto star faces is **NOT** a lack of mass as suggested by SNDM; 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 ***big*** 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 'artificially' hurl most helium 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 disk-jet constellations at other scales (galaxies, whirlpools, tornados), nature by default purges momentum 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.

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 en 2 : Acceleration, compression and equatorial purge

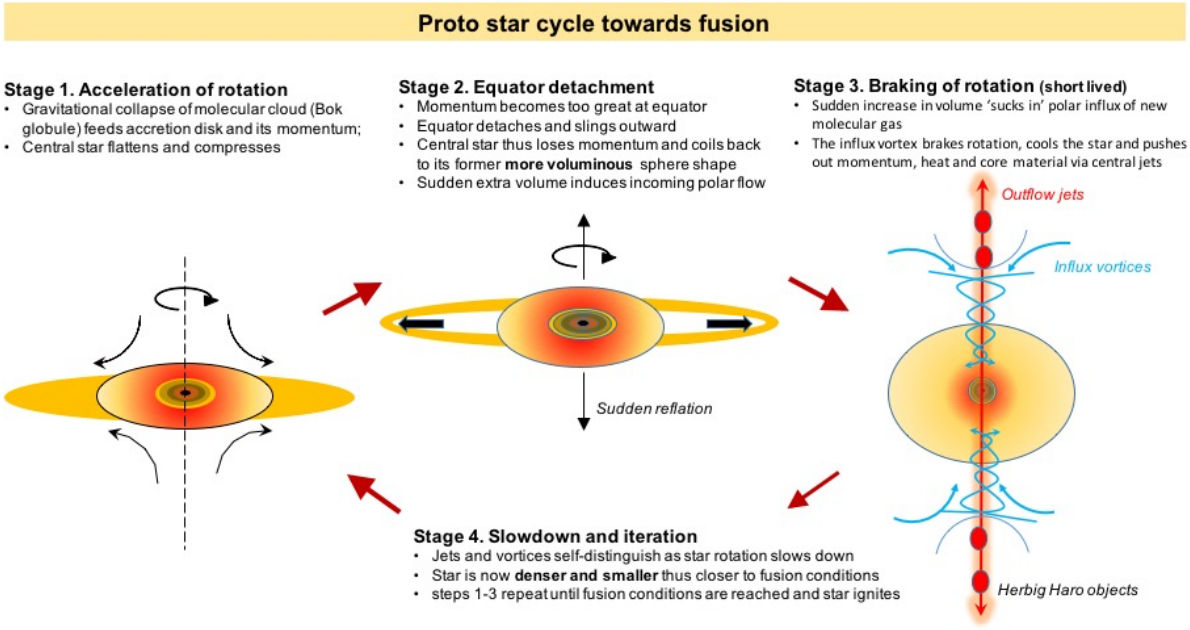
The ever increasing momentum and mass of the disk ('elongated equator') flattens the star to the extreme. Since there is **no logical stop** to this process, the outcome is inevitable: At some point the connection between disk and star reaches a limit and a 'fissure' will occur in the disk, separating the outer elongated equatorial mass from the central mass. The star purges its 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 may produce internal turbulences which may combine to form the large gaseous planets (Saturn, Jupiter). Since these thus form out of ex-solar material the angular momentum paradox is solved.

Stage 3 Braking phase: forming of vortices and jets

Thanks to its equatorial purge the proto star has lost substantial momentum, allowing it to elastically coil back, 'reflating' towards its former, **more voluminous sphere shape**. This quick 'reflation' requires extra volume, causing a pressure low at the star's rotational poles, leading to a sustained influx of cold and dense gas from the molecular cloud forming 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'. Notice that polar influx gas, passes the jet outflow it produces through its centre. Both flows are vertically opposed *and* rotate in the opposite direction. As such, a substantial part of the heavier components of the incoming molecular gas (He, Li, silicate dust and debris) will swirl and get 'sucked in' by the jet's base not entering the star at all. As such, the H/He ratio of the polar influx is substantially higher than the jet-outflow which has a H/He ratio of 3:1. Therefor, each jet period improves the star's interior H/He ratio, bringing it closer to fusion conditions.

Stage 4. Iteration

Ultimately, the vortices and jets are self-distinguishing features; Once the star slows down enough they will dwindle and disappear. Now, the cycle will repeat: The proto star starts accreting mass again from the molecular cloud, perhaps even reclaiming parts of the earlier purged equatorial mass. Its rotation increases, the star flattens and compresses until the next equatorial purge happens, starting a next 'jets on' period. 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, has a better H/He ratio and a smaller core:

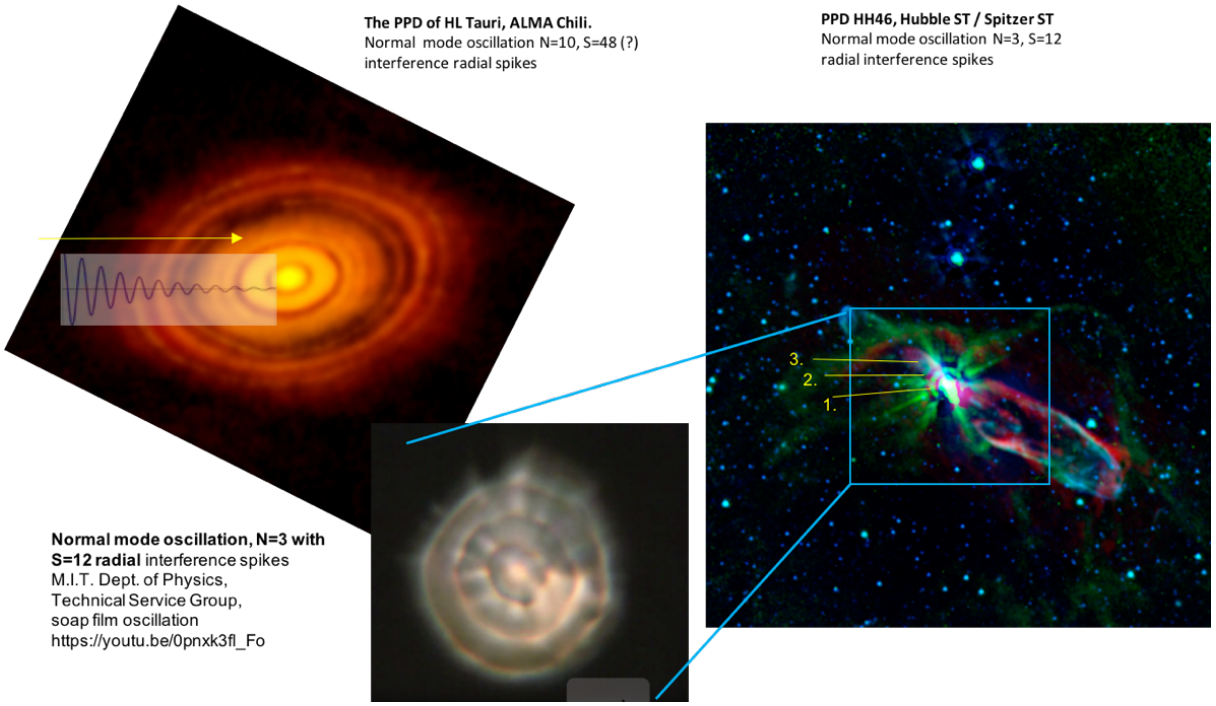


3.4 The disk wave patterns of HL Tau and HH46

The proto star cycle as described in the previous paragraph is an ingenious 'piston-like' compression process. It allows the star to periodically 'suck in' cool hydrogen, while purging hot core mass, compressing itself to fusion conditions. As such, the series of equatorial purges ***must logically leave behind a pattern of ever smaller concentric circles in accretion disks,*** reflecting the shrinking size of the proto star over time.

This is where the famous picture of the accretion disk of HL TAU by ALMA (*below left*) comes in, showing ***precisely*** this predicted wave pattern of concentric equal spaced rings. This phenomenon was initially heralded by mainstream astronomy as 'indisputable evidence' for 'SNDM planetary formation'. Yet as time passed, no confirming indications for planetary formation were found inside the open spacings. Also, realisation began to sank in that 10 identical planets forming at 10 identical distances is really not very likely. On top of this, new studies indicated several gaseous accumulations are forming inside the rings themselves, **not** inside their open spacings, again precisely as the purging hypothesis predicts.

One might expect that the footage of the PPD of HL Tau or HH46 would lead to giving up on SNDM, yet to this day mainstream astronomy remains committed to the ailing theory, trying to yet explain the open spacings as a function of planetary formation using computer generated animations. We will just suffice with the notion that the sensible interpretation is that we are witnessing **a series of ever smaller circles of purged equatorial stellar mass**, reflecting the proto star's shrinking size over time. The near perfect *wave pattern* becomes apparent by the superimposed sinus wave below. The situation of e.g. HH46 also resembles a normal oscillation mode *wave pattern*:

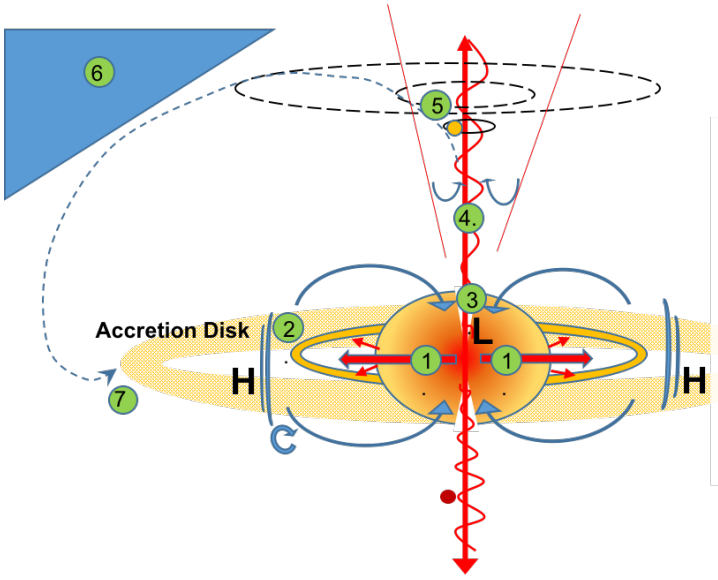


Overlooking all that is discussed and presented, we should acknowledge that the purging hypothesis:

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 observable and functionally linked, with clear and self-evident logic.
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

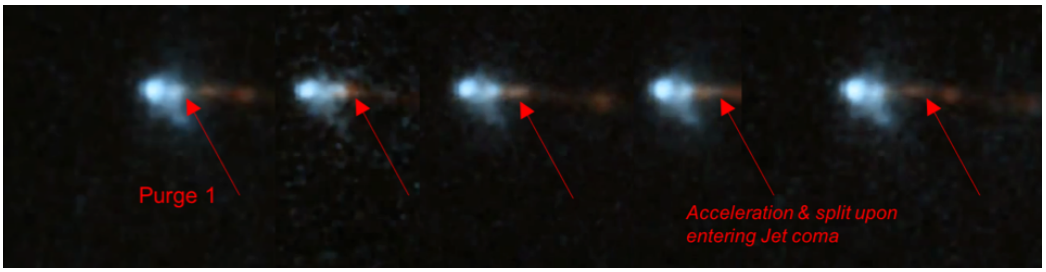
1. Fast rotation causes extreme equatorial flattening, blocking further accretion. Most likely outer core separates, spiraling outward; The proto star purges its equatorial ring,
2. Purge causes bow shocks and pressure high in PPD. Out of the condensed ring, gaseous planets (Jupiter and Saturn) form.
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

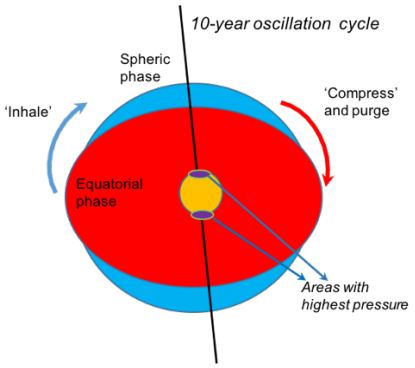
Although little footage is available at these scales, Hubble footage of HH34 recorded by a time laps video form which it would indeed seem the H/He purges come from the interior:



There are various supporting arguments:

1. One can see the knots form *incrementally* producing a string of periodic purges. If the knots were formed out of only 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.
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.

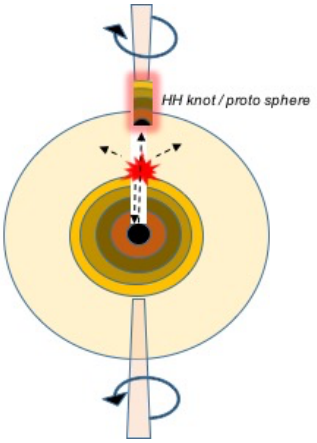
Referring to the above, the H/He purges appear to happen every 10 years or so (Hubble ST time-laps HH34). The proto star is simply the only object around that could produce such a steady frequency e.g. by oscillating between sphere-shape and equatorial bulge-shape, much like a large soap bubble does. Such an oscillation would be the logical aftermath of a big equatorial purge. Since jets last 10k-100k years, there could typically be some 1000 to 10.000 'puffs' or HH objects forming. Our Sun's current 11-year sunspot cycle my still reflect this natural oscillation.



Although the proto star would predominantly simply 'push out' helium and other core material into the jets, in final stages it may very well be that first hydrogen fusion blasts would also come into play. Although highly speculative, such first blasts would be able to purge cross section core material either via a purge on the other side or after deflecting 180-degrees off the core:

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



The core would re-organise on a slightly smaller scale and with a slightly higher pressure on it. Importantly this would now involve a self-enforcing new method of purging as jets would no longer be needed at some point. The core would be 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.
Such a hypothetical process might explain what is currently happening at protostar L1448-MM injecting phenomenal amount of water into the jets. It could be that when most helium is purged, it takes such fusion blasts to also get rid of any deeper residual layers of Fe, Ni, Si, C,N,O,S inside the proto star -if it has these-.

Zooming out a bit, it is worth noticing that the entire SSF process of the purging hypothesis would bring symmetry in the life of a star, making star birth the exact inverse of star death:

Star Death
Inflation in several steps
Creating elements between helium and iron
Final expansion and next contraction towards death

Star Birth
Contraction in several steps
Purging elements between helium and iron
Final contraction and next expansion towards birth

Annex 1. Jets and terrestrial spheres: a magnetic relation

The jet's fast moving central beam of –partly- ionised hydrogen constitutes an electric current and as such invokes a powerful magnetic field. The beam would magnetize all condensing objects containing metals and would next dominate their further motion within the jets. Near the star itself, the beam is collimated or 'wire-like', producing a circular shaped magnetic field, forcing material to orbit and accelerate upwards.

As the beam stretched further out, it typically changes into a more helix shape, especially upon interacting with distant gas clouds. Crucially, this means that its magnetic field structure would now morph into a bar magnet shape. This in turn would push out all magnetised objects and next curve their trajectory back towards the star: Below this is illustrated: