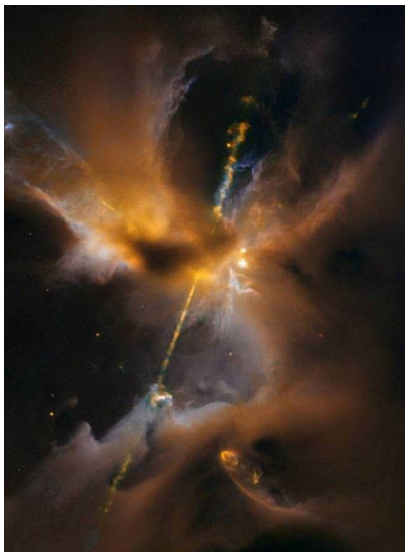


THE PURGING HYPOTHESIS

The definitive paradigm for solar system formation, solving all paradoxes and 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 50-year old 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 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 reversed engineering efforts, gradually a single sequence took shape that was able to explain the entire process in the desired flawless way.

Note for the reader:

Due to its very nature, this paper is not written in the scientific format of hypothesis - data set - analysis - confirmation. The approach has a distinctly different ***reversed engineering*** *signature which astronomers may not be used to;*

1. *Clean sheet start: All previous theories on SSF are ignored*
2. *Acceptance of all observational footage as key design requirement input*
3. *Discarding of any and all computer generated simulations*
4. *Analysis of the current top-20 paradoxes and issues: exposing the flawed human assumption behind each paradox.*
5. *Application of 'Paradox Based Reversed Engineering (PBRE): Redesigning SSF by carefully navigating around the drivers of the paradoxes*
6. *Upon completing the targeted avoidance of all paradoxes and issues, only one* ***–upfront unknowable-*** *end-to-end process remained; by sheer design logic, this ought to be the correct one:*
7. *Next astronomers may re-engage, collecting data to 'scientifically' test this new synthetically composed hypothesis.*

Author: ir. R. Winnubst

Summary

Our consensus theory for solar system formation (SSF) is the nearly 50-year old Solar Nebular Disk Model (SNDM) with various new hypotheses superseding it on details. Although solid scientific methods were used to justify each alteration, this does not mean they are necessarily correct, nor that the entire construct as such is valid. For this one has to look at:

1. Observational consistency: Consistency with existing and -above all- new observations
2. Physical consistency: The absence of paradoxes
3. Logical consistency: End-to-end connectivity between <u>all</u> aspects of a SSF model

When scored on the above criteria, SNDM -as well as its known alternatives- is strikingly inadequate. Moreover, recent observations point to ever more inconsistencies, causing top astronomers to admit they may have 'gotten it wrong'. The issue however is not so much a flawed SSF consensus theory in itself, but our incorrect approach used to construct it:

One cannot come to the correct SSF model simply by 'gluing together' scientifically tested hypotheses on the many isolated aspects of SSF. This leads to *man-made* internal inconsistencies or 'paradoxes'. The correct approach is to first reconstruct a paradox-free end-to-end 'grand hypothesis' and *only then* have it put to the test scientifically. This requires a multi-level reversed engineering approach –alien to most astronomers- whereby the synthesized outcome is inherently *not knowable* upfront. The design requirements for this 'grand SSF model' are threefold:

1. Consistency with all astronomical footage available anno 2018, focussing on accretion disks, jets and Herbig Haro objects.
2. Targeted avoidance of the top-20 well-defined SNDM paradoxes and design issues. Treating paradoxes as 'symptoms of flawed human assumptions', allowed for effective multi-level Root Cause Analyses uncovering each underlying flawed human assumption, resulting in 20 very clear markers to navigate around when redesigning. This proved to be the key insight.
3. Interconnectivity between *all* solutions to the ca. 20 individual aspects of solar system formation

This arduous work has now been done, resulting in only <u>*one*</u> possible flawless end-to-end process. Astronomers may next want to 'scientifically' test it. It is summarized below, starting with a key flaw in our consensus theory concerning the formation of proto stars:

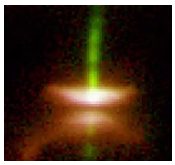
-Extended Summary-

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 physical problem of a proto star is ***<u>not</u>*** a supposed lack of mass. The problem is that its acquired mass can not exert enough *pressure* on the core due to three blockers:

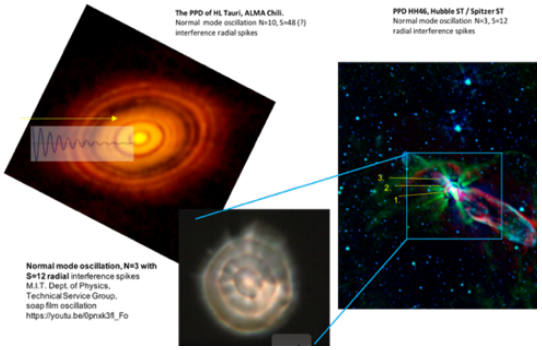
1. Too high angular momentum, counteracting the gravitational force the hydrogen exerts on the core
2. Too high *average* temperature, resulting in low density gas
3. A too large core, limiting the pressure the hydrogen can exert on the helium layer surface.

To further increase pressure, the star now 'changes tactics': In stead of accreting mass, it will now seek to <u>*purge*</u> momentum, heat and -above all- *core mass*. As with any high angular momentum disk shaped object -from tornado to galaxy- 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 like an elastic band, until the star *inevitably* 'gives up' and *purges* its equatorial mass in a widening ring outward. The central proto star, having lost considerable equatorial momentum, will now elastically coil back and <u>*reflate*</u> to its former, more voluminous sphere shape. This 'instant' reflation induces <u>*incoming*</u> bi-polar vortices of cool disk halo gas *(Hubble ST HH30, left*). This bi-polar influx: 1. cools the star 2. brakes its rotation and <u>3. *pushes out*</u> 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 thus be smaller and denser, ***<u>leaving behind a set of concentric purge remnants in the accretion disk</u>***, reflecting its shrinking size over time. ***<u>This</u>*** 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 schematically displayed on the next page.



Gaseous planets

Parts of the ring shaped high-momentum equatorial purges may condense and combine 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. The more metals at the star's core, the more purges are needed, the more gaseous planets may be expected.

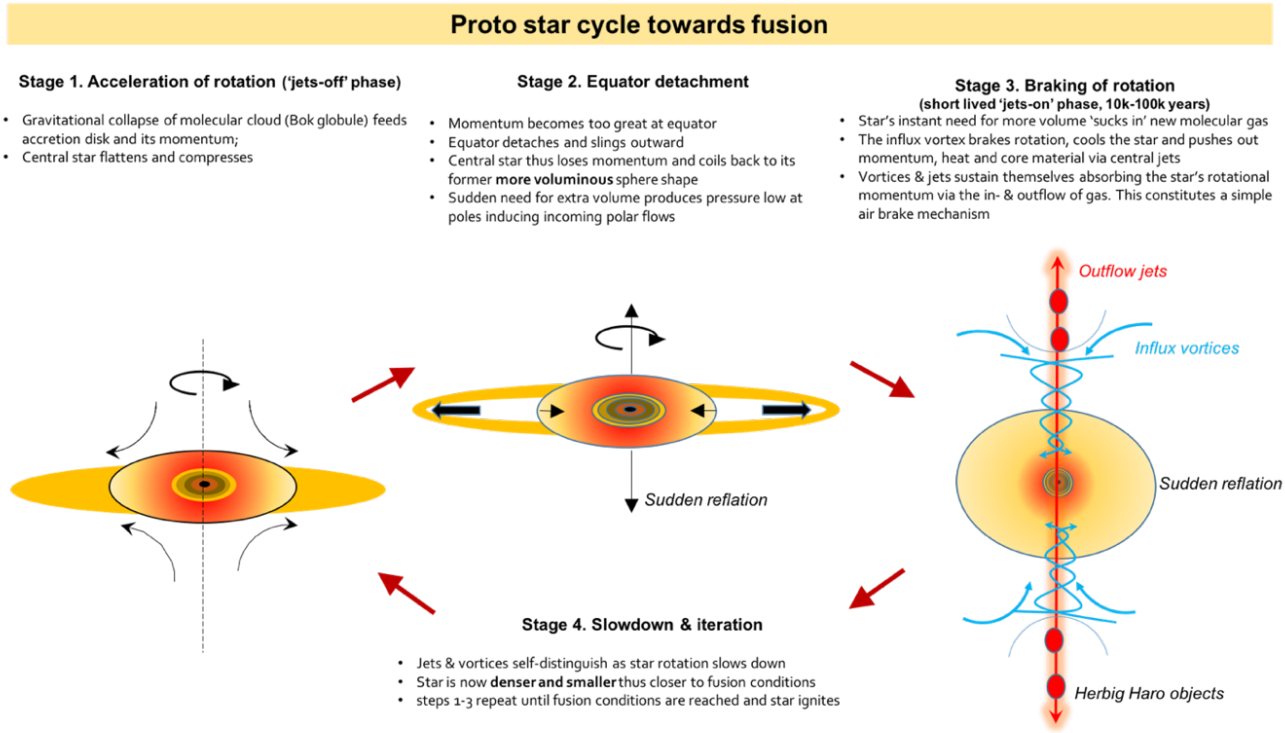
Terrestrial planets

The gaseous planets like Jupiter and Saturn are now explained, yet all other features in our solar system lack a direct link to the equatorial purges or even SNDM's 'proto planetary disk' (PPD): Neither the abundance of volatiles-rich silicate debris inside the PPD nor its hypothesised condensing into fast spinning terrestrial spheres can be explained without assuming unobserved, unlinked, paradoxal processes, violating all three consistency criteria. However, unlike SNDM, our new process fundamentally includes the cyclical bi-polar mass outflows and these ***do*** offer a 1. connected 2. paradox free and 3. observed sequence of events perfectly explaining the formation of high-spin silicon oxide spheres, including their return trajectory (!):

At the base of proto staller jets, in-falling cloud gas, dust and silicate debris are *observed* to get sucked into the jets at their base. Here the jet's phenomenal heat (8.000-12.000K) melts it into magmatic material, which is catapulted upwards in spirals during the star's periodic jet-purges of mainly H/He and minor quantities of heavier core material. Occasionally, this magmatic H/He engulfed material spins into condensed 'knots' in so called 'Herbig Haro objects' (*Hubble ST HH 111 – right-, HH34*) forming the embryonic stages of *all terrestrial spheres*, planets and moons alike. Slowing down their spin, gravity will next reorganise the elements of these proto-spheres into layers. Iron and nickel sink to the core, pushing the lightest elements -predominantly oxygen- outward. Here, the oxygen reacts with the jet's abundant hot diatomic hydrogen to form water vapour. On the inside the oxygen layer reacts with silicon, producing thermal-induced vertically circulating silicate melts forming zircons. Additionally, as *observed* at L1448-MM, the proto star itself may eject massive amounts of water and other volatiles into the jets ending up as outer layers on the spheres.

Next, since the jets' central beam consists of ionised hydrogen, it constitutes *an electric current* by physical law, invoking a powerful *magnetic field*. At the outer part of the jets, this central beam is *observed* to typically change from a collimated to helix shape, which by definition generates a *bar-magnet* shaped magnetic field. *Again by physical law*, this will *push out* all magnetised material -including metal core terrestrial spheres- curving their trajectory *straight back* towards the star along its magnetic field lines (*as observed e.g. at Hubble ST HH24, HH30).* Lighter, non-magnetic material is purged too far out and cannot return, forming the double donut (2 jets) shaped Oort cloud. Covered in a halo of hot hydrogen and orbiting the star's rotational axis, the ousted proto-spheres will cool down and freeze over, looking much like the still intact ice spheres of Europe, Enceladus and Ganymede. Eventually some will reach the outer regions of the former PPD. Due to their disk perpendicular momentum they will next migrate back inwards towards the star, 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 large gaseous planets or the star. Upon passing the gaseous planets, some will collide or be captured as terrestrial moons, while the largest only get gravitational slingshots, ending up as rogue planets, TNO's or as the inner planets near the Sun.

*The purging hypothesis can next integrally and elegantly explain **all** 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: In contrast to our current problematic human biased **2D** disk-only consensus theory, the purging hypothesis offers a superior logically synthesised **3D** paradigm solving all our ancient paradoxes while fully integrating stellar and planetary formation. One can literally not happen without the other….*



*The above cycle displays the interplay between gravity and rotational gas dynamics, resulting in a binary purging of mass, alternating horizontally and vertically. The key principle is similar to a cyclone. Its greatest asset is the extensive **observational** evidence from jets and PPD's (Hubble ST, Spitzer ST, ALMA). In all; astronomers have mistaken the 'lack of pressure' problem for a 'lack of mass' problem, insisting linear mass contraction must somehow continue, even when the disk forms. This innocent looking misconception resulted in our paradox-laden consensus SSF theories. It also caused astronomers to ignore any process that fundamentally involves the **purging** of mass, even in the face of countless observations suggesting this is how Nature actually works.*

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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 in 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 the Nebular Hypothesis 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 still 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. To make things worse, 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 50 year-old SNDM theory is just fundamentally flawed. To investigate which of the two it is, a 2-year long research project was started to find an alternative hypothesis that would solve not just 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 one needs 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, 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 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'** inside 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 it effectively constitutes a no-go theorem for SNDM. Nevertheless, astronomers did adopt SNDM in the early 70's and ever since hypothesized complex internal disk processes to yet 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 another problem for SNDM which suggests all terrestrial spheres are separately formed out of rocks inside the PPD. Astronomy 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. Recent ideas include a more general notion of 'shared magma oceans', yet they remain ad-hoc and simulated proposals only. 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 isolated ad-hoc theories from asteroids to dehydration of indigenous rocks. It is however unlikely such hypothetical processes would produce enough water, certainly in the case of our ice moons. In Earth's case there is the further complication of a close-by igniting Sun. In contrast, the purging hypothesis offers a sound and *observable* 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 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 our implicit and nearly religious ***assumption*** that all inner planets are born 'in situ' inside the PPD and the asteroids thus had to be dislocated to account for any bombardment. Yet, this bombardment can just as well be explained by the inner planets themselves migrating outside-in 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. As a 'paradigm' it is a loose conjecture of rather questionable and alternating throw-away solutions to individual aspects of SSF.

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 in stead of treating them as ominous symptoms of a deeply flawed consensus theory, as any good scientist should. To put it more clearly:

'…We tend to think of paradoxes as inherent complexities of nature. However, nature is working just fine. It has no paradoxes. Paradoxes are always and without exception symptoms of flawed human assumptions…'

As such, it is nonsense to suggest Nature is getting more complex; rather we are witnessing the growing disconnect between our leapfrogging observational capabilities and our sluggish pace or even blatant refusal to adjust our ancient theories that originate from an era when the latest observational material was not known or even dreamt of. Nevertheless; observational facts don't lie and we need to consider letting go of 50 years of SNDM theory and its weird collection of band aids entirely, even if intellectually or politically inconvenient. Specifically, one has to highlight the 'accretion disk' to which all key functionality is attributed in our ancient theories: 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 horrible' and hypothetic internal disk processes had to be invented to counter the paradoxes that come with this awkward 'disk only' 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 proto star. This would include the theorised 3D Oort cloud as the logical left-over 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, then one can easily synthesise a '3D' paradigm which is paradox free and perfectly in line with physics and *all* observations. This paper next lays out the case for this superior 3D model making it unequivocally clear our current consensus 'flat disk' SSF model is as good a concept as the 'flat Earth' model…

2. Research scope & approach

2.1 Defining the research scope

Given the great inconsistencies if not impossibilities of SNDM as mentioned in the previous chapter, research was started aimed at constructing an alternative, connected and paradox-free 'grand-hypothesis'. As a minimum it should solve in a *connective* way the following top-20 paradoxes and issues;

1. (chapter 4) The wave pattern of empty rings inside the PPD's of HL Tau (ALMA) and HH46 (Hubble ST, Spitzer ST)
2. (chapter 4) The origin of the proto stellar jets
3. (chapter 4) The process by which proto stars reach fusion conditions
4. The angular momentum paradox
5. The formation of water (e.g. on Earth, Europe, Ganymede, Enceladus, all 7 Trappist-1 planets)
6. The formation of terrestrial planets
7. The origin of Earth's magnetic field
8. Earth-Moon isotopic similarities
9. The Oort cloud
10. The Kuiper Belt
11. The distant formation of Uranus and Neptune
12. The tilted axis of Uranus
13. Rogue planets, TNO's, Pluto
14. Saturn's rings
15. Terrestrial moons of gaseous planets
16. The origin of the Lunar Aitkin Basin
17. The Late Heavy Bombardment
18. The Faint Young Sun Paradox
19. The formation of amino acids on Earth
20. The missing Hadean rocks

whereby each proposed solution must contribute to the overall consistency of the entire chain, as defined by 3 criteria:

1. Observational consistency: Consistency with all existing and -above all- new observations (not simulations!)
2. Physical consistency: The absence of physical or chemical paradoxes
3. Logical consistency: End-to-end connectivity between <u>all</u> aspects of a SSF model

2.2 Analysing the underlying problem

One might be inclined to think the above is a nearly impossible task, requiring still many more years of study and additional footage. However, such line of thinking is equivalent to saying that our current paradigm is more or less correct and we just need decades of additional observations and studies to explain the above.

From the previous chapter one can safely say such a line of thinking is not valid. When judged on the three consistency criteria above, our consensus paradigm is a failure on all three accounts. As such, simply adding more research is not the right path. On the contrary; we will shortly demonstrate we already <u>*have*</u> all the information we will ever need to solve SSF. We merely need to recognise that the root cause for our SSF problems is not at all within nature; it is *human* related and it can be broken down into three separate aspects:

1. A-synchronic relation between paradigm and footage

As mentioned, with 99% of all observations originating from the last few decades there is a time-disconnect between our ancient theories and the actual relevant observations. The resulting observational and logical inconsistencies are numerous and it makes little sense to try to squeeze all new footage into an ailing 300-year old concept that was never based on <u>*any*</u> observation. Obviously the more sensible thing to do is to reconstruct a SSF model *from scratch*, using all available footage and lessons learned from failed studies. If any of the old assumptions would be valid (unfortunately we will learn not many are) they would simply re-appear in the new model.

2. Academic inertia, the rise of paradoxes and budgets

With the growing employment, prestige and budgets at stake, admitting or even considering collective scientific failure is not a popular thing within the community. Rather, one prefers to re-brand the man-made inconsistencies in our consensus theories as 'paradoxes of nature' which need even more funding to explore. Likewise, new inconsistent observations are increasingly ignored or 'overruled' by computer generated simulations or animations. If meant as an attempt to actually solve SSF, it is highly counter productive.

3. SSF is a 'reversed engineering' challenge not a 'scientific' challenge

Next we arrive at the core issue; With all available observations and paradoxes to learn from, SSF in the 21st century is not a 'scientific challenge' but a 'reversed engineering challenge'. This requires the more sophisticated approach of 'reversed engineering' whereas astronomers are typically only trained in the limited 'scientific approach'. We will describe the difference between both approaches;

Reversed engineering

In industrial engineering there is a specialisation called 'reversed engineering' where one is presented an end result (a new product or circumstance) and the challenge is to next find out what the underlying processes must have been to produce it *end-to end*. It requires logic skills, RCA/FMEA analyses, multi-disciplinary education, creativity and above all the ability to rigorously 'kill' any idea that *adds* complexity rather then reduces it. Failure to deliver the correct process or just generating complexity is not appreciated and certainly does not lead to added personal prestige or additional funding…This is not to say governments should run research facilities as companies, but if you reward ever more complexity with Nobel prizes and more funding, than this is what you will get. Adding complexity is easy. If we truly want answers, then *reducing* complexity is what we should be looking for.

The scientific approach

The scientific approach is the 'forward' cycle of stating a hypothesis, a prediction, gathering data, analysing data and next reject or accept the hypothesis. Astronomers are quite skilled to scientifically underpin the hypothesis they are trying to validate, but the problem is in the poor quality of the individual hypothesis itself: It is mostly just derived from a personal 'aha-Erlebnis' relating to a *specific* answer for a *particular isolated problem*. In an isolated 'petri dish'-like test environment, that is fine. However, in an uncontrolled 'test' environment like SSF, there are always other potential explanations to the same problem that can have equally strong scientific underpinning. As such, the scientific route only ensures you present a verifiable path to substantiate a hypothesis; it does not ensure ***in any way*** that you are actually testing the correct hypothesis for the underlying issue in the first place! This is a phenomenal blind spot of the scientific approach when using it for reversed engineering purposes. ***It is not intended for this use!***

The scientific approach vs. reversed engineering

It is precisely in this respect that reversed engineering is by far the more fitting method. In stead of putting any isolated hypothesis to a scientific test, it aims to pre-design the correct overall hypothesis by analysing 20 key issues *all at the same time*. Only a grand-hypothesis that is consistent end-to-end without *any* remaining internal conflicts (paradoxes) should next be put to the test scientifically. Astronomers so far have worked precisely in the reversed order; they developed 20 individual answers to 20 isolated issues and next simply put them together claiming it to be a 'solar system formation model'. Any internal conflicts are labelled and institutionalised as 'problems in nature'. The internal logic structure of such a consensus 'SSF model' is horrible: Over the past decades, astronomers changed the consensus view on nearly all major subjects several times, each time celebrating them as 'major breakthroughs'. A 'contradictio in terminis' for sure, since any sound and connective SSF theory would *never* allow for such variations on individual issues.

The solution: Paradox Based Reversed Engineering

In line with the above, we developed a tailor-made 'smart method' to untangle the web of inconsistencies ('paradoxes') *astronomers* unintentionally created. This should automatically lead to the correct SFF model. Given its structure we coined the approach Paradox Based Reversed Engineering (PBRE) and its sole purpose is to come to a flawless '*grant hypothesis*', ready to be scientifically tested in its entirety. It does not -yet- concern itself yet with putting it to the test 'scientifically', although it already did in a spectacular way; *The new grant hypothesis explicitly predicts that the D/H ratio's of Saturn's icy ring particles would be identical to Earth/Moon water whereas consensus theories predicted a 10-fold difference! This prediction was shared with NASA summer 2017 and confirmed December 2018 at phys.org from data gathered early 2018 by NASA's Cassini spacecraft!* PRBE is next described in more detail, including an example to get astronomers used to its logic.

2.3 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. As such the conditions and actions of PBRE are the following;

Axiom 1: Ignoring existing studies

Since the research premise is that the 50-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.

Axiom 2: Ignoring the dysfunctional scientific method

The scientific method is not suitable for the reversed engineering nature of the problem as described before. One cannot develop a complex end-to-end new concept with this method.

Axiom 3: Allowing only 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. Likewise, we will not accept computer generated simulations since unlike actual observations, these can never capture reality as a whole. Moreover, they can inherently be tweaked to produce any desired outcome.

Axiom 4: apply PBRE (Paradox Based Reversed Engineering)
Since we are 'agnostic' to the consensus SSF model, one cannot assume any element of SSF being correct ab initio. We *do* however know with reasonable certainty which parts of our consensus theories must be flawed, since these generate the paradoxes. Hence precisely the paradoxes are excellent markers to start our redesign; For this, PBRE uses the following 'dogmatic' remediation approach:

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 the underlying flawed human assumptions, using the following steps:
   a) Targeted voiding of each individual paradox by injecting their PFA (Paradox Falsifying Argument)
   b) Generating potential alternatives or 'PFAAH's' (Paradox Falsifying Argument Alternative Hypothesis)
   c) Scoring each PFAAH; The 'best fit' PFAAH is the option that scores best on three consistency criteria:
   - It should be linked to an actual observation
   - It should not invoke a physical / chemical paradox
   - It should be ***logically linked*** to solutions of other paradoxes and issues

After analysing and voiding all of the ca. 20 main paradoxes this way, eliminating countless combinations and permutations, one eventually gets a chain of logically connected, paradox free and observation based PFAAH's, constituting the most likely SSF process. Scientists may engage to next test it.

2.4 Example of PBRE: The faint young Sun paradox

The inner workings of PBRE may require some elaboration and illustration: As an example we will take the 'Faint Young Sun paradox'. Like all paradoxes it is formulated as a logic operator: If 'x' then why 'y'?

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

Over the past 50 years since Carl Sagan coined the 'faint young Sun paradox', astronomers have unsuccessfully tried to solve 'y' countless times, mostly suggesting super-greenhouse effects or internal radiation. Given its status of paradox, PBRE suggests we should now identify the flawed human assumption in this paradox. At first glance there appears to be none, since 'x' and 'y' above are both correct. Maybe so, but there is a *hidden human assumption* in 'x' above, namely that our Sun would play a role in sustaining liquid water in the first place! We can therefor void the paradox by injecting the 'Paradox Falsifying Argument' (PFA) which in this case would be;

*'…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' and even though it is a merely a logical argument –not a conclusion yet- anyone will feel resentment. It directly calls into question whether Earth itself formed anywhere near our Sun, something which is also considered an 'incontrovertible truth' yet for which we will learn there is equally ***no*** support in either logical, observational or physical criteria. Emotions aside, PBRE next urges us to develop and score alternatives (PFAAH's). For this, one starts with the most exclusive criterion which in this case is the criterion of 'observation'. Do we have an *observed* example where primordial liquid water exists without the involvement of our 'faint young' Sun? We do: Saturn's ice moon of Enceladus –probably also Europa and Ganymede- has a formidable water ocean under its ice layer and the 'faint Sun' for sure plays *no role at all* here. PBRE now forces us to provisionally *assume* Hadean Earth was equally ice covered without the need of being anywhere near our 'faint young Sun'. We will coin this the 'O1' classification. Again, it does not *prove* Hadean Earth was like Enceladus, but we need to run by this option first, as it is the only one that can potentially generate the perfect 3 out of 3 criteria score. At this point the scientifically schooled reader will find it difficult to let pure logic prevail and contain the urge to seek instant scientific proof …Additionally our brain will emotionally object, since an Enceladus comparison runs so deeply counter to our shared education. Nevertheless, it is essential to stick to logic and keep an open mind so we can next effectively continue with the other two consistency criteria:

The next criterion in exclusivity ranking is the physical consistency ('P') criterion. Here we established two options:

- O1P1 is the option of Hadean Earth having actually been captured as part of an incoming cluster of terrestrial spheres and spending considerable time as a Saturnal (or less likely: Jovian) satellite. Given that Earth is larger than Enceladus, its mass ratio is greater to the 3rd power, while its surface ratio is larger by the 2nd power. This means Saturn's gravitational tidal pull would be more than enough to generate similar land-ice heat convection melting Earth's lower ice layers just like Enceladus.
- O1P2 is the option of Hadean Earth only *passing* Saturn and its gravitational slingshot causing Hadean Earth to collide with our (also ice covered) Moon. Our damaged ice layer would cause rotational imbalance, also able to generate enough heat convection between land and ice, as rotational energy is converted into heat. It is consistent with our considerable loss of rotational speed. Of course and even more impressive: As later confirmed (2018); the ice remnants in Saturn's rings have a D/H ratio identical to Earth's and Lunar water. Beyond O1P1 and O1P2 there was **no other** obvious source found for the needed heat convection. The collision option emerged in relation to the answers to other paradoxes as discussed in the chapter 3.

Deliberation;
The O1P1 option may sound 'exotic' but it is conceivable since we simultaneously analysed the angular momentum paradox and the terrestrial planet / water formation 'issue'. As described in the next chapter, *both* hinted at distant formation, water ice forming and inward migration for all terrestrial spheres. In addition, the recent Trappist-1 *observation* supports it, as all its 7 terrestrial planets have been observed to be water-ice covered, while migrating inward (..!).
Next, in the case of our solar system, clusters of terrestrial spheres travelling inward would be confronted with Saturn, the first gaseous giant on their path. Quite conceivably they could have been caught by Saturn and next orbit around it, some potentially even in retrograde orbits (Venus?). An incoming large gaseous planet (no longer existing) or a change in Jupiter's orbit could have distorted the orbital resonance of all these captured satellites, invoking a pandemonium of ice-sphere collisions. This would cause many to be ousted from their orbits, falling down to lower positions (up to our current). The fall-out would have been tremendous and the resulting mass of ice debris around Saturn could well have been a 10 - 100 fold of its current ring system mass. Such a theory *is* partially congruent with the current popular simulation based 'NICE model' of Prof. A. Morbidelli e.a. yet since we didn't allow ourselves to 'cheat' via hypothesized 'Theia-like' solutions or simulations we discarded this option. Nevertheless, the in-between step of disturbed orbital resonance is interesting!

The O1P2 was chosen since it was more practical and directly linked to explaining (16) and (17) in the sense that our Moon was fully exposed to the LHB and Earth was not from 4.1 GA onward. Next, one adds all the forward and backward connectivity elements forming the third criterion of logic ('L', relating to the 20 issues of page 7) and we may finalise the categorization as O1P2L (4,5,10,14-20). It is this extensive end-to end logic connectivity that offers primary validation!. In addition, O1P2 offered two specific ***predictions*** that have actually been confirmed in 2018 and 2019;

1. The isotopic D/H readings of Saturn's water ice rings should be identical to the water on Earth / Moon.
2. Given the much greater ice debris mass expected, Saturn's ring system should currently be loosing its ring mass in order to account for its estimated 90-99% decrease since 4.1 Ga.

Both predictions have now been confirmed by NASA's Cassini spacecraft. With all this overwhelming logical and observational backing we comfortably arrive at the alternative O1P2 hypothesis (FPAAH) of Earth migrating inward, carrying a liquid ocean underneath its ice layer, induced by its passing of Saturn. In all, let's again compare the **facts**:

*Consensus theory of Earth forming 'in situ' near our Sun scores a **'0 out of 3'** as it*

1. Has *never* been observed as a process.
2. is highly debated whether even physically possible
3. involves a Sun too weak to support its liquid surface water invoking a paradox
4. lacks a decent explanation of how water could have gotten there in the first place
5. has no logic connections to other aspects of solar system formation

*The alternative of an ice covered inward migrating Earth scores an impressive **'3 out of 3'** as it*

1. Solves the 'faint young Sun paradox' (!!)
2. Has **observational** support from our three ice moons and **all** 7 TRAPPIST-1 terrestrial planets all of which suspected of having a formidable outer water (ice) layer and to be migrating inward (Unterborn e.a., Nature 2018)
3. Provides excellent logic connectivity to other solutions e.g. terrestrial planet/water formation, Earth-Moon isotopic similarities, Oort cloud, Saturn's rings and the Late Heavy Bombardment as we will show later.

Connectivity. Since our main complaint regarding consensus ideas on SSF is 'ad hoc' fantasy and lack of connections, we were very rigorous about our design requirement of connectivity. Like a jig-saw puzzle, each individual solution had to logically connect to a solution of a different event (PFA) preceding or following it, *forcing* a coherent 'story line' that SNDM so desperately lacks. We assumed and were arguable proven correct that an (observed) solution that offers the best connections to others solutions, also offers the best explanation for the individual issue at hand.

3. The purging hypothesis and planetary formation

This chapter 3 deals with application of PBRE at a more accelerated pace on issues such as the angular momentum paradox, the water issue and terrestrial planetary formation. As presented, the solutions to all 17 issues suddenly all fall in place with self evident logic and supported by the fantastic footage of Hubble, Spitzer and ALMA. Although many trial & error scenario's are behind each subject, we present only the winning solutions in their logic relation.

3.1 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 seems impossible for a disk to form on the one hand our Sun with 99,8% of all mass, holding 1,7% of all angular momentum and on the other hand our planets with 0,2% of all mass and 98,3% of all momentum. Obviously, the simplest PFAAH solution to the paradox is that the disk did ***not*** produce the star, but rather the star produced the high momentum accretion disk during or after its own accretion. Thus, we have to redefine all planets as 'former solar mass'. By definition, this makes 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.

3.2 Solving the water issue

Since large scale comet/asteroid water-import 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 best fit reversed engineering solution for such large-scale water production of up to 20% of radius is mass *chemical* production of water via the simple reaction $2H_2+O_2 \rightarrow 2H_2O$. For this there are two options:

1. Either proto-Earth would be in an environment that produces and deposits liquid water on Earth, and/or:
2. Earth itself would have had a huge layer of unbound oxygen, while being in an environment of hot hydrogen.

Ad 1. The first option may seem unlikely, yet there is the case of L1448-MM (*Herschel ST*) where the proto star is observed to inject massive amounts of water into its jets (arguably the result of purging oxygen from its interior). On other occasions Spitzer ST has observed traces of unbound elements, simple carbon oxides and water at Herbig Haro jets (e.g. HH46). To receive a similar water influx, proto Earth would need to have formed inside a similar jet.

Ad 2. With respect to the second option; An outer layer of unbound oxygen is possible if Earth formed out of space debris broken down into individual elements, but this requires a phenomenal –external- heat source. Again this points to proto-stellar jets where in-falling dust and debris are *observed* to get superheated at 8.000-12.000K, and next catapulted upwards during periodic H/He purges. The additional requirement of a hot hydrogen-rich environment thus *again* points at the hot diatomic hydrogen filled jets.

In all; from a water perspective, a jet-based origin for Earth is physically, chemically and logically the best fit. It also avoids the complication of having an 'in situ' formation where the igniting Sun would have blown away the volatiles needed to form Earth. Thus, until proven incorrect our second premise becomes;

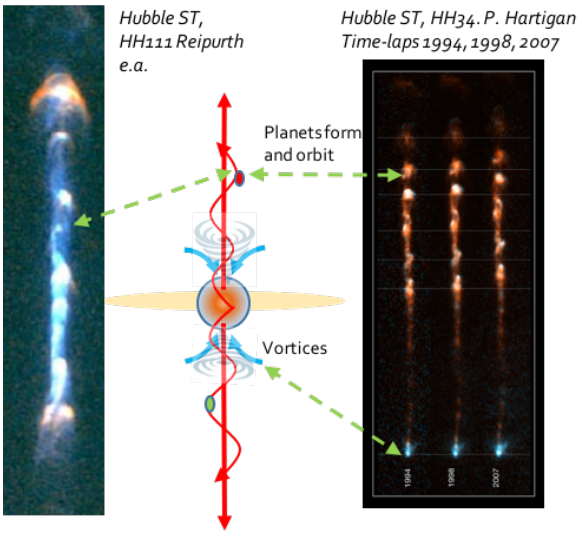
(2) '*…all terrestrial spheres are born out of super-heated magmatic silicate debris inside proto-stellar jets …'* .

Notice how elegantly this second premise connects to the first premise above, which of course is no coincidence.
In contrast, the big gaseous planets lack the water argument and are far too massive to have formed inside jets.

3.3 Solving terrestrial planetary formation

Given this quite radical break from SNDM, is there actual observable evidence of terrestrial spheres forming inside jets? Remarkably, Hubble ST has indeed *observed* the above described formation process on *many* occasions inside the hot hydrogen filled jets of proto stars. Such luminescent jet structures are referred to as a 'Herbig Haro' (HH) objects. In a Hubble time-laps movie study of HH 34 (*next page)* one can clearly see 'proto-knots' forming and start orbiting the rotational axis of a proto Star (!). In the top right of HH34, even a binary appears to form. Earth and Moon would have formed similarly out of identical material. If not viewed already, any astronomer should look long and hard at the iconic Hubble ST video footage of HH 34 jet dynamics (e.g. https://youtu.be/ufadgneScAM). The total mass inside jets is limited but the mechanics are such that the heaviest material is constantly pushed aside by the faster moving central beam of ionised hydrogen as observed at HH111 and HH34. Proto Earth would then have formed as follows:

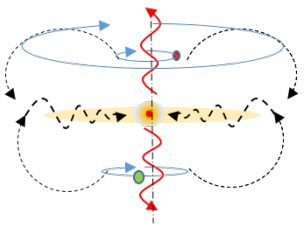
The jet's hot and partly ionised central beam spins magmatic material into proto spheres that start to orbit the star's rotational axis *(right)*. Next, upon decreasing its spin, gravity will reorganise proto Earth's elements into structured layers: Heavy elements like iron and nickel sink to the core, while oxygen and other lighter elements are pushed to its outer layers, reacting with the jet's abundant 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 produce thermal-induced vertically circulating silicate melts forming zircons. In addition, like L1448-MM, the proto star itself may eject massive amounts of water and other volatiles into the jets ending up as outer layers on the spheres.



At the outer end of the jets, the central beam of ionised hydrogen – constituting an electric current by physical law! - can typically be seen to change from linear into helix shape. This will change the jet's magnetic field into a *bar magnet* shape, which by physical law will oust all magnetised spheres, curving their trajectories straight back towards the star as ***observed*** in Hubble HH24 and HH30 (***see annex 1***). One should not forget that the electromagnetic force is fundamentally stronger than gravity by a factor of $\mathbf{10^{38}}$! Covered in a halo of hot hydrogen, fast spinning proto-Earth will now orbit at a wider radius, heading back *along the star's magnetic fieldlines*, before gravity takes over. It will cool down, solidify and eventually freeze over outside-in, looking quite similar to the current -still intact- ice moons of Enceladus, Europe and Ganymede. With its fast spin and outer ice shell, Earth is not just protected against collisions, but also carries 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:

3.4 Solving the Oort cloud and the Late Heavy Bombardment

The discussed return trajectory of magnetised spheres from the jets 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 overshoot the PPD due to their perpendicular momentum and migrate outside-in with oscillating orbits, back towards the star. Such a motion is consistent with the recent observations of the seven terrestrial planets of TRAPPIST-1, ***all*** of which suspected of having substantial water (ice) layers while migrating inward! In Earth's case, the central orbital plane is defined by the inline gravity of the Sun, Jupiter and Saturn. In all, we thus get the schematic fall back trajectory to the right. 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, debris that leaves the jets too late, will not be able to fall back to the PPD anymore. In stead, it 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 middle right, source Science News*). We now have a coherent and connected explanation where it came from and why it is shaped like it is. Looking at the actual Hubble observation of HH24 (*bottom right*) one gets further proof of the powerful 'double donut' magnetic influence of jets…

- *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.

3.5 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: Logically, 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 momentum towards the Sun and Saturn.

Confirmation→ Until now astronomers were at a loss how Uranus and Neptune could form so quickly 'in situ' 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 SE 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.

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

If the above 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, by logic extension 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. Also, the ice-remnants would likely be many more times (10 to 100 fold?) the current mass of Saturn's ring systems, in which case Saturn should be loosing its ring system at a considerable pace.

3.7 Solving the 'faint young Sun paradox' and the Lunar Aitkin basin paradox

The above solution of inner terrestrial planets colliding with their moon(s) at low speed and shallow angle near gaseous giants, has inherent strong connectivity to preceding events as described. But even better, it also has a very strong forward connectivity, producing answers to the main Earth/Lunar 'geological' paradoxes and issues:

The Aitkin basin paradox

Our Moon has a mysterious impact basin called 'Aitkin Basin', forged at 4.1 Ga and generally believed to be the result of a giant collision with an unspecified wide body. Although it was its greatest ever impact, it left no obvious visual damage to its surface while each and every minor impact afterwards did visually damage its surface (a minor paradox). Naturally, with our Moon and our Earth colliding while covered in substantial ice layers, we now get a perfect explanation as to where the brunt of the impact energy would have gone into, allowing the Lunar surface to remain visually untouched. It perfectly explains why –and where! - our Moon would have lost it entire ice envelope and some of its regolith. In addition, we get an answer as to why our Moon was next exposed and heavily scarred by the late heavy bombardment 4.1 Ga onward, while Earth was not, enjoying the protection of its damaged but still present ice layer. But there is a third, even more fantastic solution: the faint young Sun paradox can now be explained:

The faint young Sun paradox

Planet-moon collisions may be violent but they are also ***instrumental*** to making ice covered planets 'habitable'; It would severely damage Earth's ice layer leading to rotational imbalance. The imbalance logically 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 (again a solution to a key issue!)
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 collided with their moons, 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.

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 and some Earth ice. 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.

3.8 Summary: 17 issues solved in a single process

Recapitulating; in this chapter we have used PBRE logic on the angular momentum, the formation of water, and terrestrial spheres. The high level results of the respective RCA logic schemes are clear for anyone to follow as should be the case with any sound theory. Extrapolating the chain of paradox solving solutions, a whole range of in total 17 solutions unravelled as part of *one single process*; The jet-based formation of terrestrial planets and their collision-prone return trajectory:

Though seemingly simple –as if that would be a negative!-, the reader is challenged to construct an alternative connected chain of 17 explanations similarly satisfying all three consistency criteria; He or she will find it *cannot* be done. The key take-away is that this proves the superiority of unbiased 'a posteriori' problem solving logic, in contrast to our 300-year old approach of combining human biased upfront ('a priori') stated hypotheses. Astronomers are not trained to think along such reversed logic paths. This is why for 300 years they have been unable to recognise and next 'undo' the Gordian knot of paradoxes they created, preventing them to find the correct answer.

Looking back at 300 years of SSF theories, perhaps our most crucial mistake was our assumption that Earth must have formed 'in situ' near the Sun, just because that's where it is located now. There is ***no*** logic chain of solutions found that can even remotely substantiate this; No observations, no connective logic, no physics, nothing. In order to yet accommodate this assumption, modern astronomy chose to depart from observations, basic physics and logic altogether, fleeing into computer generated simulations which can never fully represent or replace reality: Objectively, and by its own scientific standards, such attempts ought to be labelled as pseudo-science. Hopefully astronomers will one day regain appetite for solid scientific thinking and in stead test the exiting new option of a jet-based formation of terrestrial spheres. One may look at the following specific predictions:

1. Isotopic differences between gaseous and terrestrial spheres given their perpendicular formation origins.
2. Isotopic similarities (D/H ratio's) between water ice in Saturn's rings and Earth/Lunar water
   For example: phys.org Dec 3rd 2018.
   '…By developing a new method for measuring isotopic ratios of water and carbon dioxide remotely, scientists have found that the water in Saturn's rings and satellites is unexpectedly like water on the Earth, except on Saturn's moon Phoebe, where the water is more unusual than on any other object so far studied in the Solar System. The results, found in the Icarus paper "Isotopic Ratios of Saturn's Rings and Satellites: Implications for the Origin of Water and Phoebe" by Planetary Science Institute Senior Scientist Roger N. Clark, also mean we need to change models of the formation of the Solar System because the new results are in conflict with existing models. Robert H. Brown (U. Arizona), Dale P. Cruikshank (NASA), and Gregg A. Swayze (USGS) are co-authors……Models for the formation of the Solar System indicate that the D/H should be much higher in the colder outer Solar System than in the hotter inner system where the Earth formed. Deuterium is more abundant in cold molecular clouds. Some models predict the D/H should be 10 times higher for the Saturn system than on Earth. But the new measurements show this is not the case for Saturn's rings and satellites except Saturn's moon Phoebe…'

3. Indications Earth's early water formation would be congruent with a distant jet-purged location. For example:
   Evidence for primordial water in Earth's deep mantle.
   From: https://www.researchgate.net/publication/283752386_Evidence_for_primordial_water_in_Earth's_deep_mantle .
   '..The hydrogen-isotope [deuterium/hydrogen (D/H)] ratio of Earth can be used to constrain the origin of its water. However, the most accessible reservoir, Earth's oceans, may no longer represent the original (primordial) D/H ratio, owing to changes caused by water cycling between the surface and the interior. Thus, a reservoir completely isolated from surface processes is required to define Earth's original D/H signature. Here we present data for Baffin Island and Icelandic lavas, which suggest that the deep mantle has a low D/H ratio (δD more negative than –218 per mil). Such strongly negative values indicate the existence of a component within Earth's interior that inherited its D/H ratio directly from the protosolar nebula. (PDF)
4. Indications that the Kuiper belt ice & rocks show isotopic similarities to the cores of Neptune and Uranus.
5. Finding more systems like Trappist-1 with its 7 water-rich and inward migrating terrestrial exo-planets which would further cement the jet-based option.

3.9 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 (our first premise) and earlier we reasoned they are too massive to have formed inside proto stellar jets like terrestrial spheres (our second premise), leaving only equatorial purges as an option for the origin of gaseous giants. Our third premise thus simply has to be:
(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 overwhelming support for this. Unexpectedly, it provides new insights into the accretion disk and its relation to jets and star birth.

4. The purging hypothesis and proto star formation

4.1 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 life 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:

4.2 The proto star problem: A lack of pressure, not mass

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 heavier elements like helium 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 should next **purge** momentum, heat and core material. Looking at disk-jet constellations at other scales (galaxies, whirlpools, tornados), 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 it would change beyond recognition.

4.3 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 and equatorial purge

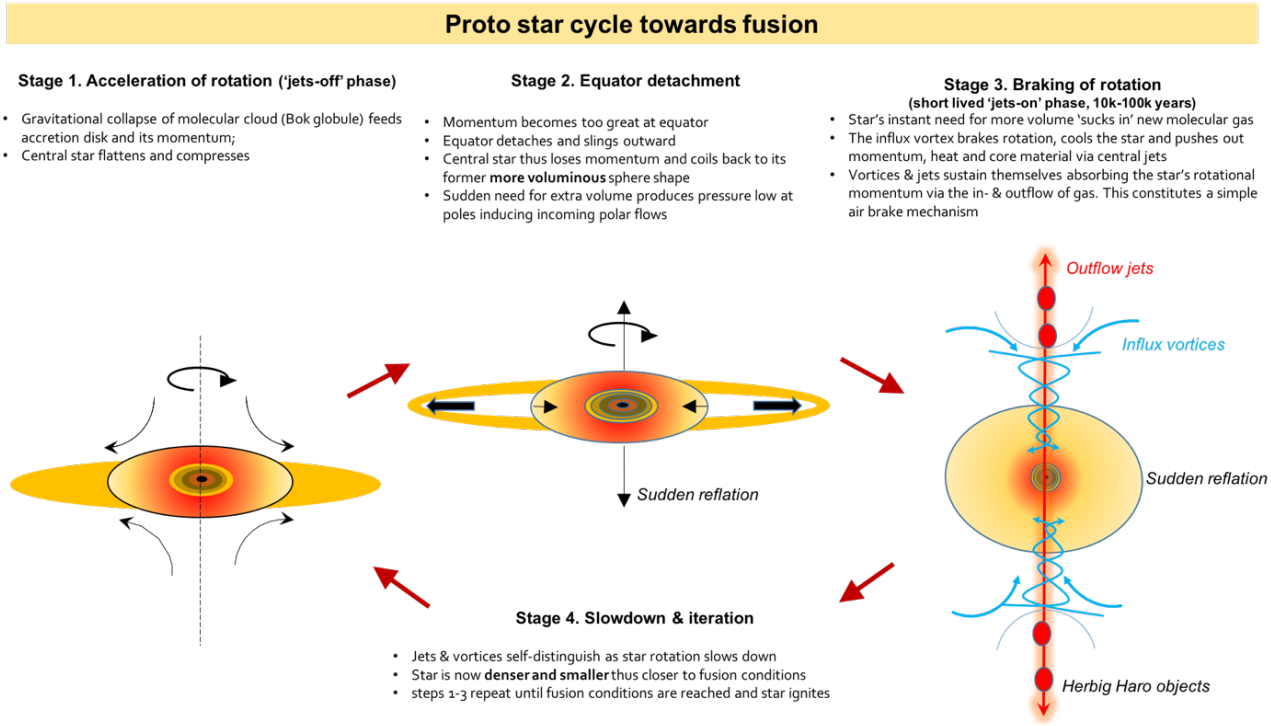
The ever increasing momentum and mass of the disk ('elongated equator') flattens the star to the extreme like an elastic band. Since there is *no logical stop* to this process, the outcome is inevitable: At some point the momentum of the disk becomes so great that it detaches from the central star, forming a ring shaped purge of equatorial mass moving outward due to centrifugal forces. Parts of this swirling ring may condense to form 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 vortex 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 a result, the H/He ratio of the polar influx will be 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. Furthermore, it is important to realise the star's sudden reflation is only needed to *'jumpstart'* the vortices and jets. Once initiated, the vortices and jets will physically sustain themselves by absorbing the the star's rotational momentum though the in- and outflow of gas. De facto, they constitute an elegant 'air brake' mechanism.

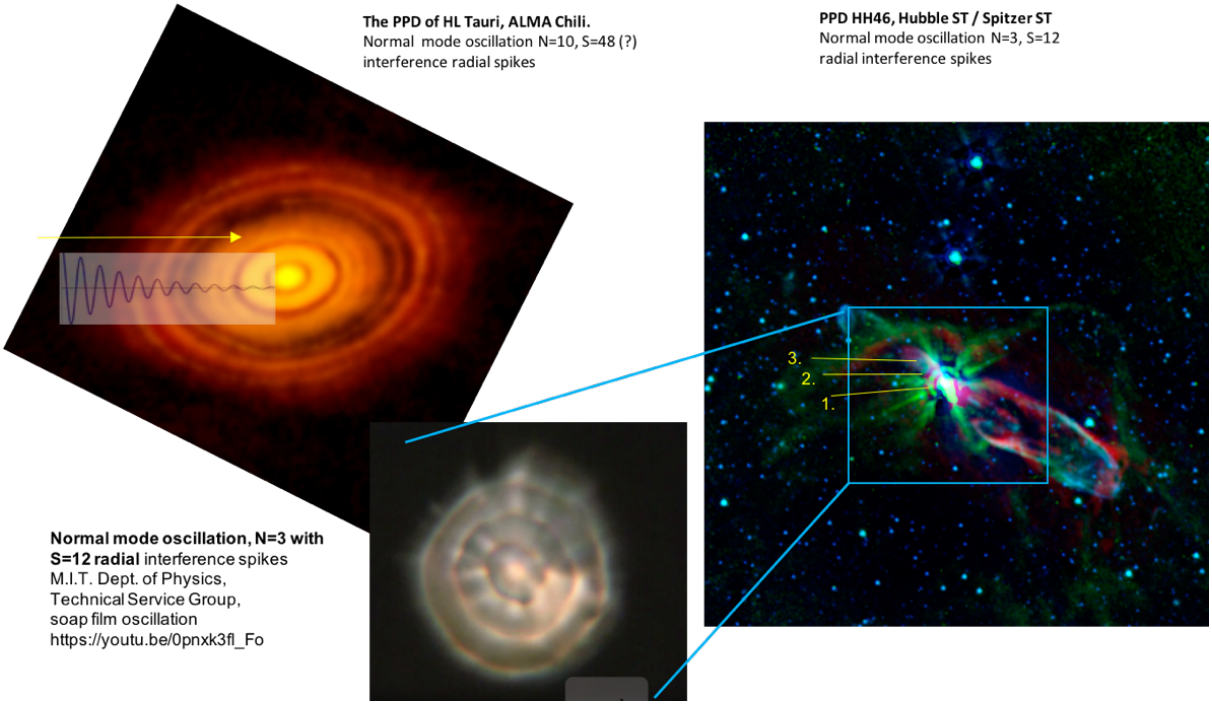
Stage 4. Iteration

Ultimately, the vortices and jets are self-distinguishing features; Once they have slowed down the star 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:



4.4 The disk wave patterns of HL Tau and HH46

If the described cycle of proto-stellar equatorial purges is correct, then this should ***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. The near perfect *wave pattern* becomes apparent by the superimposed sinus wave. The situation of e.g. HH46 also resembles a normal oscillation mode wave pattern.



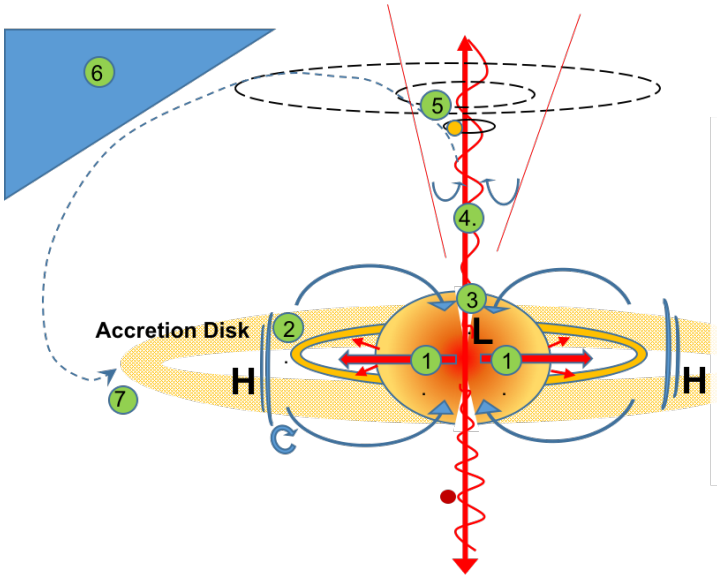
Remarkably, the open rings phenomenon was initially heralded by mainstream astronomy as 'indisputable evidence' for 'planetary formation'. Yet as time passed, no confirming indications for planetary formation were found inside the open spacings. Also, realisation began to sank in that 10 identical planets 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 this recent footage of the PPD of HL Tau or HH46 would lead astronomers to finally give up on SNDM and accept the obvious cyclical purging nature of proto stars. Yet to this day, mainstream astronomy sadly remains committed to the ailing SNDM theory, trying to yet somehow explain the open spacings as a function of planetary formation using computer animations. Such efforts merely reflect our inclination to deny human fallibility.

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 new 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 inevitable overhaul of our 300-year old, 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

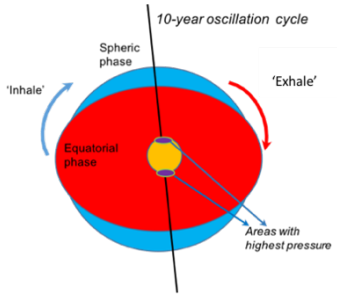
4.5 Herbig Haro knots, T-Tauri phase & alternative terrestrial planet formation

In this final paragraph we would like to spend some more thoughts on Herbig Haro objects. Although little footage is available at these scales, Hubble ST recorded a fantastic detailed time laps video of HH34. Here one can witness the series of H/He purges coming from its *interior*:

There are various supporting arguments for this:

1. At nearly all HH objects, one can see the knots form *incrementally* producing a string of periodic purges. If the H/He purges 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.
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 observed frequency of HH34 above; the H/He 'knots' are fired into the jets with a frequency of some 10 years. The proto star itself is the only object around that could produce such a steady 10y frequency, e.g. by oscillating between a slightly more sphere-shape and an equatorial bulge-shape, much like a large soap bubble does (*see right*). Perhaps our 11-year Sun spot cycle may have its origin here as well. Notice this oscillation will not influence the jets themselves: Once initiated the jets will stay active for as long as the star has fast rotation regardless this minor 10-year oscillation.



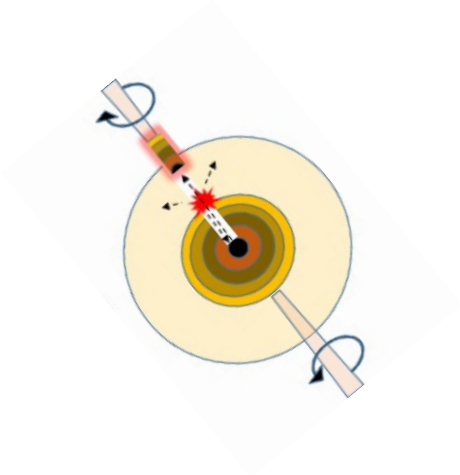
Following up on the minor 10y cycle; during the 'inhale' phase of the oscillation the pressure would gradually mount as the star becomes slightly more sphere-shaped. This would pinch the central interior outflow duct somewhat, causing a 'clogging' of outward bound core material. This in turn would lead to a gradual accumulation of hot core material under both rotational poles bursting into space every 10 years or so. At the moment of its outward burst, the clogged material on its turn would temporarily disrupt the *influx* vortex of new material. This is ***exactly*** what we see at the second HH34 picture from the left above!

In addition: Since jets typically last 10k-100k years, and the minor oscillation has a frequency of some 10 years, there would typically be some 1000 to 10.000 minor oscillations during a 'jets-on' period, producing the same amount of 'puffs' or HH objects, each producing one or a limited cluster of proto-planets. As our current solar system roughly contains some 100 terrestrial spheres (planets, moons, TNO's, KBO's, asteroids like Vesta), this means less then 1% of all jet-produced spheres may typically make it as stable objects in our solar system. Over 99% would have been destroyed, engulfed or travel as interstellar rogue planets.

First hydrogen blasts

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 might be able to purge cross-section core material either via a purge on the other side or after deflecting 180-degrees off the core as displayed to the right. The purges would logically consist of hot hydrogen wrapped He and Li with perhaps remnants of residual proto star layers of Fe, Ni, Si, C, N, O ,S -if the star has these-.



The core would re-organise on a slightly smaller scale and thus with a slightly higher pressure on it. If indeed this happens, e.g. during the T-Tauri phase, then effectively jets would no longer be needed as the star would now have a self-enforcing new method of purging, exponentially slashing its core 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.

Alternative terrestrial planetary formation

By logic extension, these non-jet purges of hot hydrogen wrapped 'metallic' core material would follow more shallow trajectories, allowing them to quickly end up in the outer PPD and constitute decently-sized cores heavy enough to accrete additional rocky material –e.g. produced by the jets-. These could next grow into mature terrestrial planets over the millions of years that the PPD exists.

Compared to a jet-based origin, the 'PFAAH score' for this terrestrial planet formation option is lower since it scores slightly less on connectivity and observation. Nevertheless, it could be a viable alternative to the jet-based option and perhaps both even apply. Both options are products of stellar purging -needed to counter the angular momentum paradox- and this qualifies them ab initio.

Zooming out a bit, it is also 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

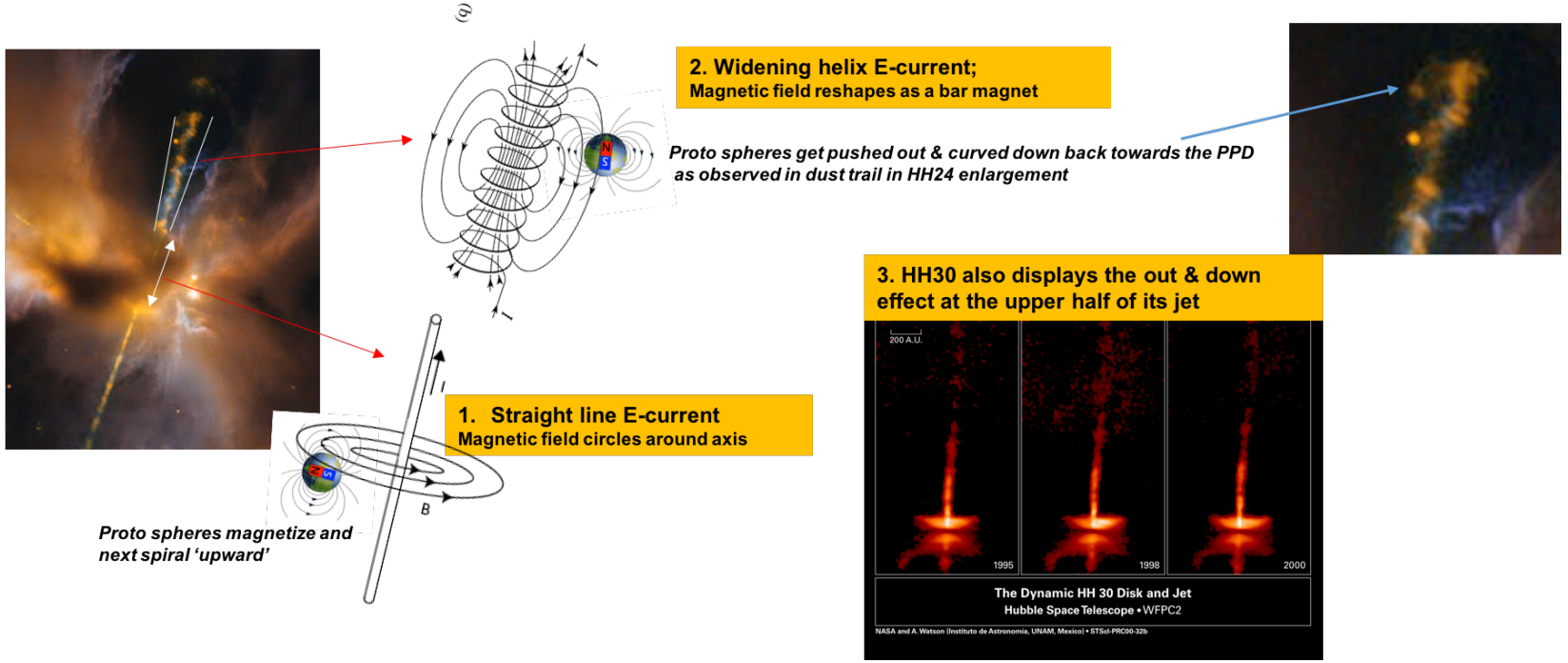
Star Birth
- Contraction in several steps
- *Purging* elements between helium and iron
- Final contraction and next expansion towards birth

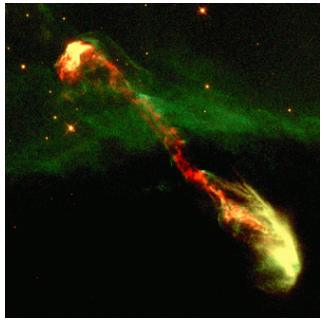
In closure, it is also worth mentioning that the observed periodic jet outbursts of hot ionised hydrogen during proto-star formation, de-facto lead to a charging of the star, rendering it into a giant cathode. As such the alternative –yet lesser accepted- narrative of an electrical origin of the Sun can be placed orthogonally *and complementary* to the more accepted narrative in terms of pressure and fusion. In fact, with only a minor correction in fundamental physics both approaches combined can in full describe the fundaments behind solar particle production and acceleration ('heating') –via electric field line discharge- in the Sun's corona. This however, is the subject of a different paper.

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 stretches further out, it typically changes into a more helix shape. Crucially, this means that its magnetic field structure now morphs into a bar magnet shape. It is a physical law, not a theory, that this WILL push out all magnetised objects and next curve their trajectory back towards the star: Below this is illustrated at HH24 (Hubble ST):





In some instances (e.g. HH47 left) the entire jet is helix shaped. Quite likely this erratic structure represents the end of a 'jets-on' phase, where the jet is about to dwindle and vanish completely. In such cases the return trajectory for jet-produced terrestrial spheres could start almost immediately. Given the limited distance such spheres would need to travel, it is plausible that precisely the erratic phase will produce the terrestrial spheres that actually end up inside the solar system.

In closing, the figure above displaying the coiled windings in the star's jet, actually creates an E-current in reversed direction. As such Earth would fall back with its magnetic south pole pointed upwards in this animation. In addition, the ousting would not need to happen at the very end of the spiral: A sudden 'cut' in the coiled flux of the positively charged hydrogen plasma would generate a counter induction field, ousting magnetised material as well. This would be consistent with the observed ousting of matter at HH30 above.