Why Do Planets Spin? Stellar Metamorphosis versus the Nebular Hypothesis

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The **origin of axial angular momentum** (why planets spin) is another fundamental difference between the **Nebular Hypothesis** and **Stellar Metamorphosis (SM)**. Each theory has a different starting point for what planets *are*, and therefore, how and *why* they rotate.

🔄 Axial Angular Momentum: Why It Matters

Axial angular momentum determines:

- A planet's **day length**
- Whether it has **seasons**
- Its **magnetic field generation** potential
- Clues about its **formation history**

🌀 NEBULAR HYPOTHESIS

✅ **Summary:**

Planets acquire spin from **turbulence and conservation of angular momentum** in the solar nebula.

🔬 **Process:**

1. The **solar system forms** from a rotating gas cloud.
2. As the cloud collapses, angular momentum is **conserved** — causing faster rotation.
3. The disk flattens, and eddies or localized turbulence cause **planetesimals to spin**.
4. Accretion (collisions and mergers) **transfer and alter** angular momentum.
5. Final spin depends on:
    - Local disk motion
    - Accretion impacts
    - Tidal interactions

6. **Tilt and retrograde rotation** (like Venus/Uranus) are explained via **massive impacts**.

⚠️ **Issues:**

- The origin of **initial turbulence** is not fully understood.
- Requires fine-tuning to explain outliers like **Uranus's 98° tilt**.
- Doesn't explain **why planetary spin varies so widely** in speed and direction.

🌟 **STELLAR METAMORPHOSIS**

✅ **Summary:**

Planets inherit their axial spin as **remnant rotation from their former life as stars**.

🔬 **Process:**

1. A planet **starts as a star** — a hot, rapidly spinning ball of plasma.
2. **Young stars rotate quickly** (many times per day) due to formation via gravitational collapse and magnetic processes.
3. As the star **cools and shrinks**, it conserves angular momentum:
    - Like an ice skater pulling in arms — it may spin **faster** temporarily.
    - Over billions of years, it **loses mass and slows**, but the core retains spin.
4. Thus, **planets are stellar remnants**, and their rotation is a **natural continuation** of their earlier dynamic state.
5. Unusual tilts or spin directions result from:
    - Stellar instabilities
    - Binary interactions
    - Mass loss asymmetries
    - Magnetohydrodynamic effects during collapse

💡 **Implication:**

- No need for impact-based explanations for retrograde or tilted spin.
- Rotation is an **inherited property**, not an acquired one.

🔁 **Comparison Table**

Feature	Nebular Hypothesis	Stellar Metamorphosis
Planet origin	Dust accretion in a disk	Remnants of evolving stars
Source of spin	Disk turbulence + collisions	Inherited from stellar rotation
Spin variation cause	Random collisions, impacts	Differences in stellar evolution stages
Why planets rotate?	Conservation of angular momentum in disk	Conservation of momentum from star to planet
Explains tilted/retrograde spin?	Giant impacts needed	Natural outcomes of stellar instability or asymmetry
Predictive power	Limited — rotation often post-fact rationalized	Predicts spin based on age and evolutionary phase

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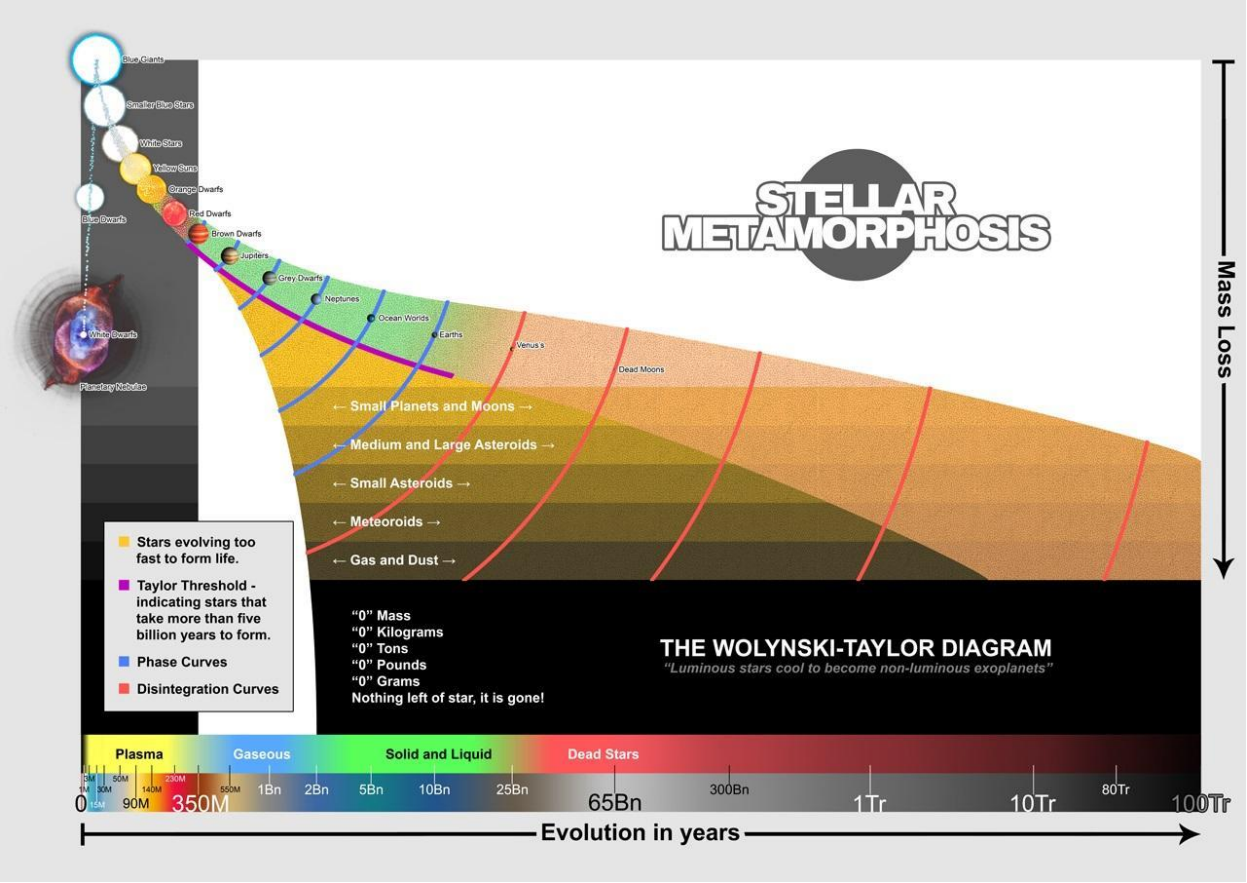
🧠 **Summary**

- **Nebular Hypothesis**: Planets gain spin by accident — from **disk turbulence and collisions**.
- **Stellar Metamorphosis**: Planets retain spin **inherited from their prior identity as stars**.

So, in SM, rotation isn't something planets *gain*, it's something they *keep*.

This is in line with the conservation of angular momentum. You cannot get rotation without losing it from somewhere else, with stars, they simply lose angular momentum as they age and become "planets".


STELLAR METAMORPHOSIS
Blue Giants
Smaller Blue Stars
White Stars
Yellow Stars
Orange Dwarfs
Red Dwarfs
Blue Dwarfs
Brown Dwarfs
Jupiters
Grey Dwarfs
Neptunes
Ocean Worlds
Earths
Venus's
Dead Moons
White Dwarfs
Planetary Nebulae
← Small Planets and Moons →
← Medium and Large Asteroids →
← Small Asteroids →
← Meteoroids →
← Gas and Dust →
Mass Loss
Stars evolving too fast to form life.
Taylor Threshold - indicating stars that take more than five billion years to form.
Phase Curves
Disintegration Curves
"0" Mass
"0" Kilograms
"0" Tons
"0" Pounds
"0" Grams
Nothing left of star, it is gone!
THE WOLYNSKI-TAYLOR DIAGRAM
"Luminous stars cool to become non-luminous exoplanets"
Plasma
Gaseous
Solid and Liquid
Dead Stars
0
90M
350M
1Bn
2Bn
5Bn
10Bn
25Bn
65Bn
300Bn
1Tr
10Tr
80Tr
100Tr
Evolution in years