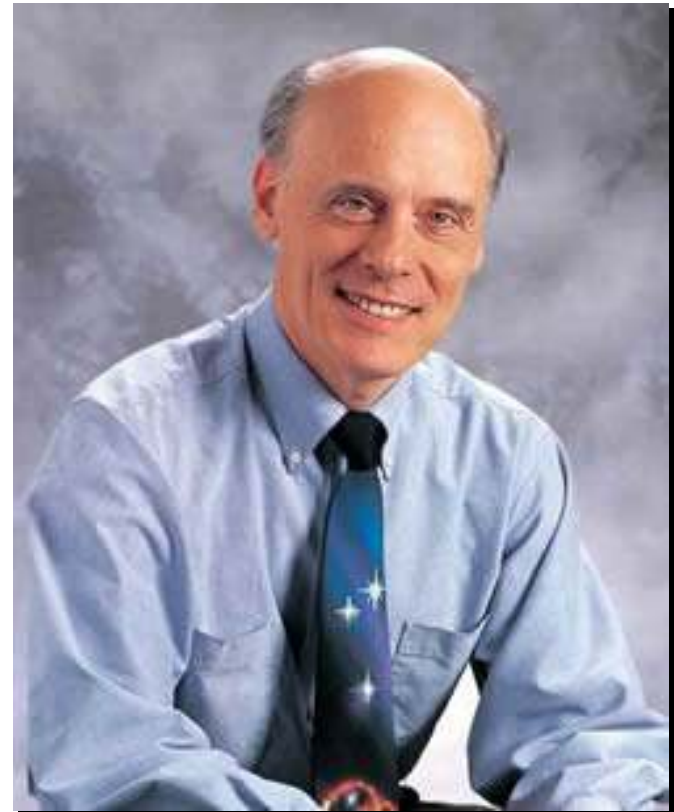


# Have the *real* “God Particles” been found?

A review of recent findings concerning  
Exotic Dark Matter, and some of its  
implications for Followers of Christ

# Thanks to Dr. Ross and RTB

- This information is derived from Dr. Hugh Ross' 4-part paper presented on the Reasons To Believe website, and from additional audio resources.
- He literally reviewed several hundred papers in the scientific literature to put all this together.
- As far as he knows, RTB is the first to publish this material in a way that lets you see how all the pieces fit together as a unified whole.
- In it, he describes recent observations and papers that indicate the probable signature of Sterile Neutrinos located around the core of our galaxy The Milky Way.
- Evidence for Axions is also presented.



# Agenda

- We will discuss
  - Ordinary and exotic matter and energy , and their abundances
  - The early history of the universe, and some effects still today
- We will discuss in particular
  - The Higgs Boson
  - The Sterile Neutrino
  - The Axion Inflaton
- We will predict
  - More fine-tuning evidence for, and strengthening of RTB's TCM

## Huge puzzle spread out on creation's table

- It's as if astronomers and physicists have had this crazy jigsaw puzzle made up of thousands of pieces, but now the pieces are distinctly starting to come together and in the proper order.
- There are still a few pieces left to discover and place correctly, but we're now beginning to have a clear pathway where to find those missing pieces and how to plug them in.

# Ordinary Matter

- Baryons (Protons, Neutrons)
- Anti-Baryons (Anti-Protons, Anti-Neutrons)
- Only constitutes 4.4% of the mass-energy of the universe.
- Strongly interacts with photons.
- The stuff we're all made up of...

# Exotic Dark Matter

- Active neutrinos – slow speed, W.I.M.P.s
- Sterile neutrinos – high speed, no interaction.
- Axions – primordial inflatons.
- Constitutes about 6 times the mass-energy of ordinary matter.
- Passes right through ordinary matter freely.

# Dark Energy

- AKA: “The Cosmological Constant” —a term first coined by Albert Einstein in the early 20<sup>th</sup> century.
- This vacuum energy is driving the continually accelerating expansion of the universe.
- BTW—numerically—it’s also the most *extreme* physical evidence for the Fine-Tuning abilities of the God of the Bible that’s known in all creation.

# Particle Soup

- A spicy, Well-Prepared blend of tangy species freshly harvested from the 'zoo', that further describes the nature and interactions of matter, energy, space and time.
- (See the LBL site for today's full menu...)

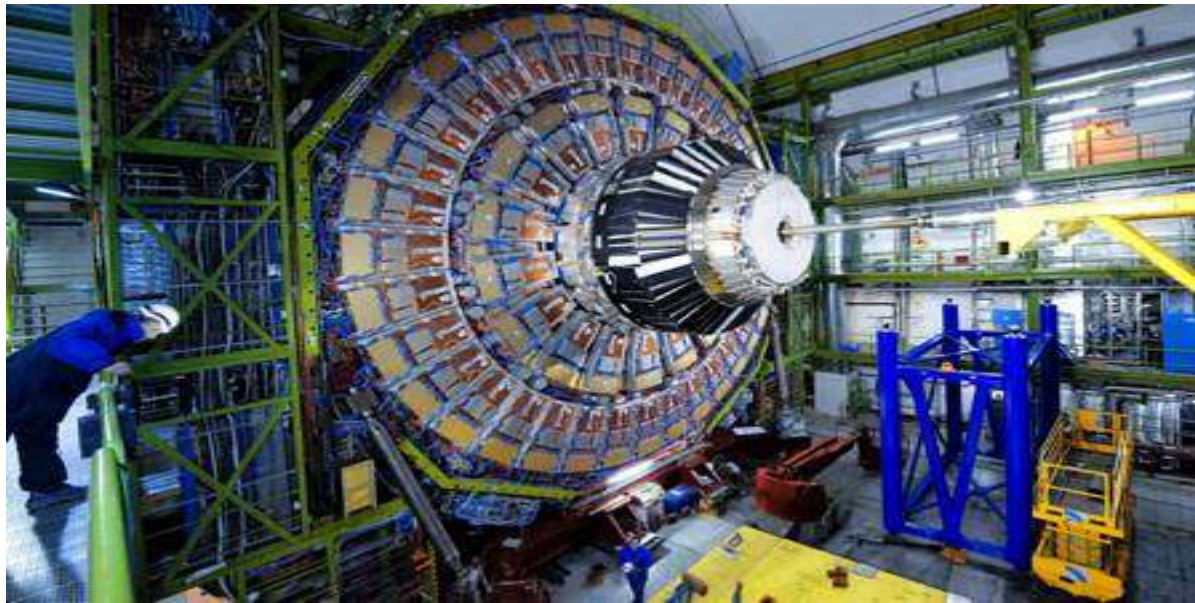
## ***Help!!*** We're surrounded & outnumbered!

- Exotic dark matter is about 6 times more abundant than ordinary matter in the universe (and it passes right through us).
- And dark energy 'stretches-out-weighs' us all...
- And we can't even see this stuff with our eyes!

# The competitors weigh in...

- In the best creation models, the total matter of the universe is dominated by exotic cold dark matter—mostly axions (apparently) and active neutrinos.
- But for these models, some warm dark matter must exist as well—the higher-speed sterile neutrinos.
- Normal baryonic matter only constitutes  $\approx 4$  to 5% of the total mass-energy density of the universe, while exotic dark matter is  $\approx 26\%$ .
- Dark energy makes up  $\approx 70\%$  of the total mass-energy.

# Large Hadron Collider (LHC)



Compact Muon Solenoid

“The entire complex, known as the Large Hadron Collider, ranks as the most expensive science experiment ever conducted—and as the most powerful particle accelerator in the world.” –Hugh Ross

## All this *spinnin'* is making me *DIZZY*...

- The Large Hadron Collider at CERN has taken over 25 *years* to complete—at a cost of more than \$9B—and ***millions*** of scientist man-hours! (plus ~ \$500M/yr. to maintain).
- But what's used instead to find these probable sterile neutrino signatures are *astronomical* instruments, teams, and observations—**much** cheaper in comparison to large, expensive particle colliders like the enormous LHC.

# The Higgs Boson?

- Branded “The God Particle”, this hypothesized fundamental particle explains why massive particles even *have* mass.
- That is, it’s the Higgs boson that’s responsible for imparting mass into the massive particles in the first place.
- It also successfully explains the difference between the photon, and the W and Z bosons.
- The photon governs electromagnetic radiation (e.g., *light*), and the W and the Z bosons govern the weak nuclear force (e.g., *radioactivity*).
- ...they’re similar in many ways, but their mass difference is HUGE.
- The Higgs boson explains this phenomenon.

# Where the VERY big meets the VERY small

- The Higgs boson neatly ties together the best *cosmic* creation model, and the best *particle* creation model.
- Since the earliest particle creation take place within the first few tiny split-seconds in the history of the universe, this helps us to understand the conditions of the very early history of the universe, and how the creation of these first particles fits into it all.
- It also strengthens the evidence for **God...**

## *Beyond* the Cosmos

- Showing a consistency between the best particle creation models, *and* the best cosmic creation models strengthens the case for a supernatural God beyond the boundaries of matter, energy, space and time.

# Consistency in Design

- If you can show there's consistency in detail between your cosmic creation model, and your particle creation model with a *strong agreement* between the two, this reinforces the evidence for a God beyond space and time that created all this and designed it for the benefit of all humanity—namely the God of the Bible.
- That is, the testable creation model points to a Personal, Loving, Caring, Super-Intelligent, Super-Powerful God Who is able to impart these detailed characteristics into the universe around us, and to use them in due course—*though within a relatively **brief** period of time*—to fully address the problem of sin.
- God's perspective is from **Eternity!**

# Hyperinflation?

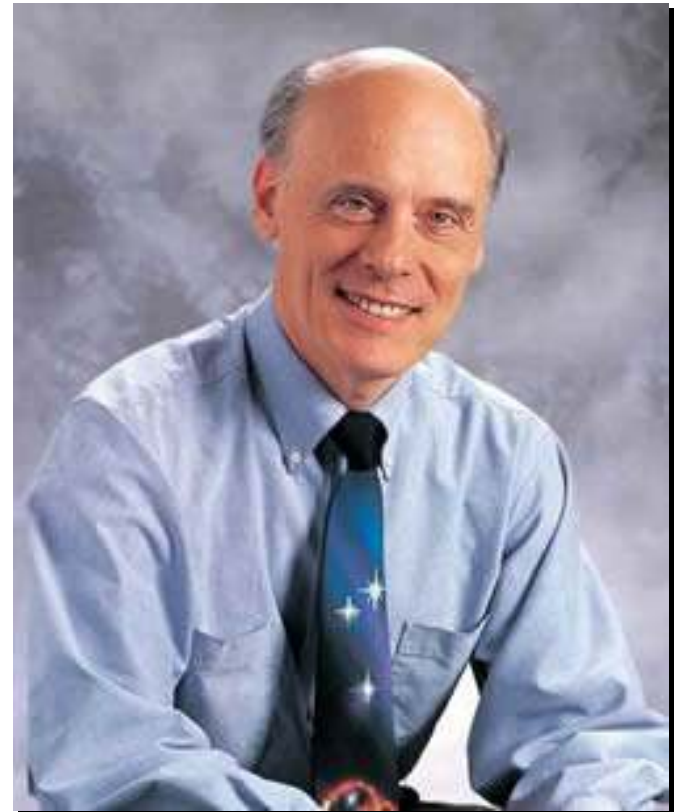
- The universe expanded many trillions of times its volume within a *very* brief period.
- It necessarily also expanded at a rate trillions of times faster than the speed of light  $c$  during this same period.
- It was enabled by the presence of inflatons.
- This event ensured thermal-coupling for the entire universe—which is a critical factor for life.

# “Revenge” of the WIMPs?

A review of recent findings concerning  
Exotic Dark Matter, and some of its  
implications for Followers of Christ, Part II

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- Evidence for Axions is also presented.



# Inflatons?

- *Very, very* low mass exotic particles that imparted the scalar inflation field into the universe during its hyperinflation period.
- This occurred during a very brief epoch, beginning at  $10^{-35}$  s after the Creation Event, and lasting only  $10^{-34}$  s.
- The majority of these primordial inflatons should still be around today...

# Sterile Neutrinos via Inflatons

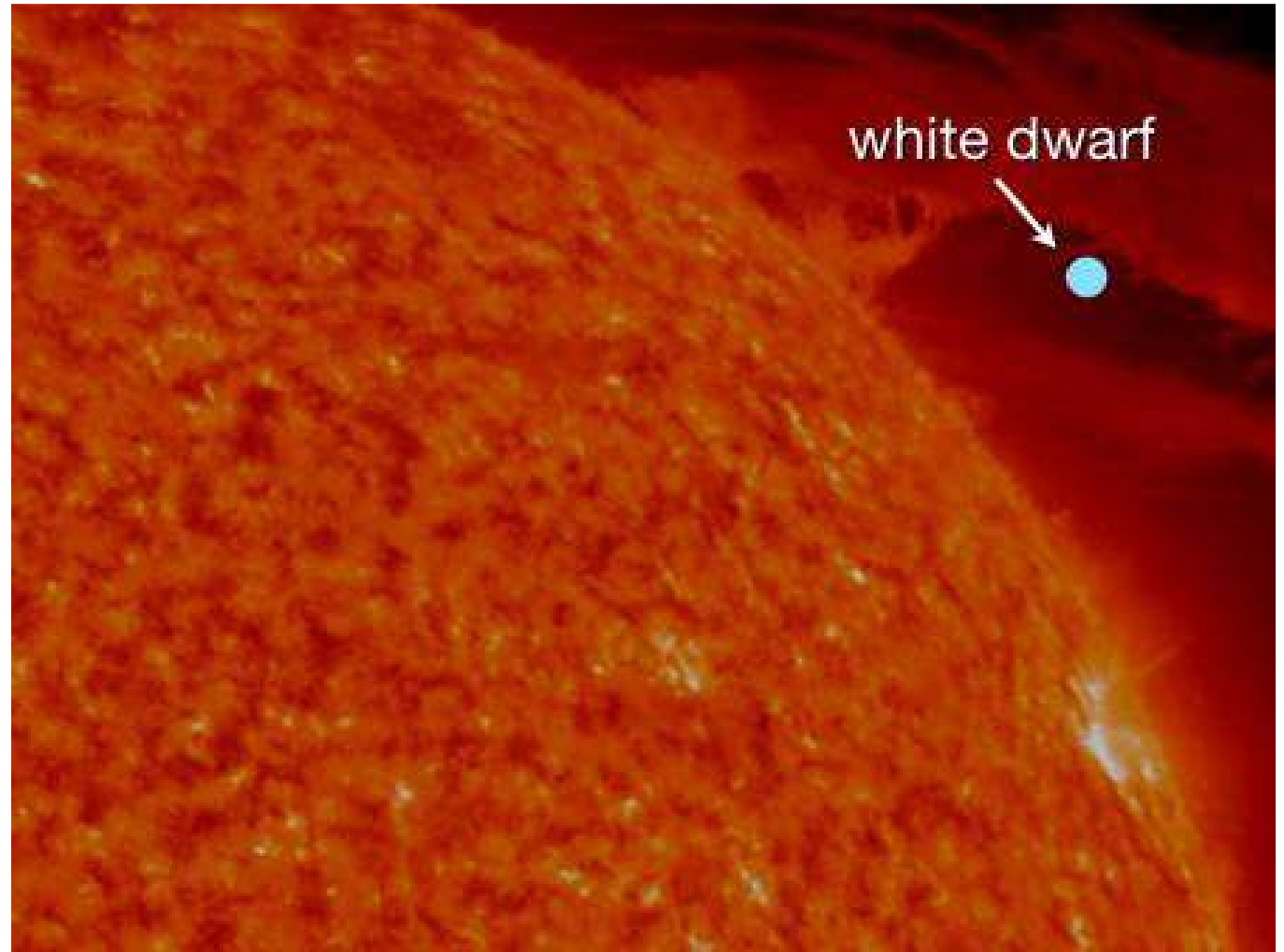
- A specific variety of these inflatons named axions generate sterile neutrinos as one of the products of their decay process.
- These sterile neutrinos must have *already* existed before the appearance of any baryons (at  $10^{-11}$  s) in the universe, and had a direct influence on the outcome of their numbers—another **critical** fact for us.

# Axions?

- These primordial exotic particles—while incredibly light individually—are the most likely constituent as the **majority** of the universe's mass in total. They were created during the initial epoch of the universe.
- *All* neutrinos (both active and sterile) are less in total mass compared to the axion total mass.
- And ordinary baryonic matter (protons, neutrons) only make up a small fraction of the entire universe's mass.

## White dwarf star compared in size to a typical star like our Sun

- White dwarf stars are burnt-out 'cinders' of stars, the leftover remnant of stars like our own that don't possess enough mass to eventually explode.
- They take literally billions of years to cool down, and are hotter than our Sun, but much smaller—about the size of planet Earth.



# Finding Axions (pt. 1)

The background of the slide is a photograph of a star field. A small, bright white star is highlighted with a white arrow pointing to it from the right. The text "white dwarf" is written in white next to the arrow. The overall color palette is warm, with reds, oranges, and yellows.

- All main sequence stars (our Sun for example) produce copious amounts of active neutrinos continually as an artifact of their nuclear burning (aka stellar fusion). However, white dwarves are burnt-out stars—they ***don't*** generate active neutrinos any longer.
- Therefore, the bulk of any exotic matter leaving these stars should be the primordial axions—not neutrinos.
- If axions dominant the exotic particles remaining inside these white dwarves, then they will be emitting from the stars at a high rate and will distinctively accelerate the cooling function of the white dwarves.
- This process signature has *already* been detected.

## Finding Axions (pt. 2) white dwarf

- Another way to detect axions is the oscillation rate of *variable* white dwarves.
- If axions are being streamed out at a high rate, then the oscillation rate of these stars will *also* be affected.
- Although only one of these type stars was studied in the first paper by this team—this particular signature *was* found.
- Additional good news: there are hundreds of these variable white dwarves out there, ‘let’s study them as well’ was the team’s recommendation.
- This approach should *also* yield both the abundances and the mass of these axion particles.

# Sterile Neutrinos? (pt. 1)

- Sterile neutrinos are a type of exotic dark matter particle.
- They are more deserving of the title “God Particle” than even the Higgs boson, according to Dr. Hugh Ross.
- Dr. Ross argues that since the sterile neutrino resolves **eight** outstanding conundrums of the  $\Lambda$ CDM, whereas the Higgs boson addresses only two, the sterile neutrino is more apt to this title.
- Simply put, the sterile neutrino answers more outstanding questions remaining within the *Theory Of Everything* than does the Higgs boson.
- (*T.O.E.* ==  $\Lambda$ CDM + GUT).
- RTB’s Creation Model is superior to the T.O.E. since it *additionally* brings to bear the *only* plausible explanation for the questions of WHY??

# Sterile Neutrinos? (pt. 2)

- They successfully explain several fundamental enigmas that are outstanding in the current  $\Lambda$ CDM creation model.
- The  $\Lambda$ CDM model serves as the primary astronomical and cosmological basis of RTB's '*two-books*' Testable Creation Model (TCM).
- These questions are only explained properly if sterile neutrinos actually *do* exist...

# Cosmic ‘Crazy Eight-Ball’?

## Sterile Neutrinos dictate *all* these outcomes...

1. Why the first stars formed so early, just 200–300 million years after the cosmic creation event
2. Why the creation of the universe produced slightly more baryons (protons and neutrons) than it did anti-baryons (if it did not, galaxies, stars, or planets could not exist)
3. Why certain pulsars manifest rapid kick-out velocities from their birthing locations
4. Why r-process nucleosynthesis (the means by which core-collapse supernovae produce about half of all the neutron-rich nuclei in the universe that are heavier than iron) generates the observed abundance pattern for elements of atomic weight greater than 100
5. Why certain supernova shocks are so energetic
6. Why exotic dark matter (which does not interact strongly with ordinary matter) halos are so smooth and symmetrical
7. Why supermassive black holes (exceeding one million times the Sun’s mass) form so early in the history of the universe
8. Why the successful  $\Lambda$ CDM model of the universe now appears to require a slight modification, namely the addition of some warm dark matter to complement the predominant cold dark matter. (According to the  $\Lambda$ CDM model, the cosmos is an inflationary hot big bang universe dominated primarily by dark energy and secondarily by exotic dark matter where most of the exotic dark matter is in a cold state, that is, where the particles making up the exotic dark matter are moving at low velocities relative to the velocity of light. Sterile neutrinos are warm, that is, move at velocities between close to zero and near the velocity of light.)

# Fundamental enigmas explained

- This is why they are more deserving of the title “God Particle”, because they explain all 8 phenomenon at once—as opposed to the Higgs explaining only 2.
- Because sterile neutrinos explain all 8 of these Grand Unified Theory and  $\Lambda$ CDM characteristics simultaneously, astronomers are utterly convinced that they *must* exist...
- But they haven’t been observed—until now.

# Super Massive Black Holes

- Black Holes that are many, many times the mass of our Sun.
- Sterile neutrinos explain how they can form so early in the history of the universe—only 300 to 400 million years old.
- They can only be formed by coalescing smaller black holes, themselves formed as the result of stellar supernova explosions.
- BTW, some of these are more than 9 *billion* times as massive!

# The Great Annihilation Event!

- At  $10^{-11}$ s all the baryons (both normal baryons and anti-baryons) appeared (symmetry-breaking of the Strong and ElectroWeak force)
- They instantly all annihilated each other! That is, whenever matter meets anti-matter...**BOOM!!**
- We can all be grateful however, that a tiny ratio of normal baryons (1 for every 10,000,000,000 destroyed) were left over.
- This ratio and resulting normal matter remnant is a direct result of the existence and influence of sterile neutrinos prior to this event.
- Without them, we couldn't even be having this talk...all the ordinary matter around us in the universe comes from this tiny remainder!
- This degree of fine-tuning is *one* good evidence for a Designer.

# A Mystery novel unfolds—and the race begins

- The search for these sterile neutrino particles has persisted for over 20 years, but without success.
- Over 100 papers have been written on this topic in *just the last year*—more than those written concerning the Higgs boson research efforts.
- But, the prolonged lack of observational success for these particles caused many researchers to question whether they were even on the right track in their hunt for them. Some thought they would never be discovered...
- However, recent observations detailed earlier this year (2011) are the probable signatures at last of sterile neutrinos—and will very likely win the Nobel Prize in Physics for the team that makes the clear and solid observations *first*.
- This event could easily take place within 2011.

# Delays, delays

- The reason for the 20-year wait was that astronomers and physicists were looking at the wrong decay processes and in the wrong locations, according to scientists Prokhorov and Silk. Instead of looking for sterile neutrinos decaying into active neutrinos (the Barbieri and Dolgov approach), a more productive method would be instead to look for inflatons decaying into sterile neutrinos.
- That's where the axions come into the picture...

# *Time Squared*<sup>1</sup>

- On a side note, the events surrounding this discovery have some intriguing echoes back to another (and Nobel Prize-winning) discovery from the past *also* having cosmological implications—the remnant Cosmic Microwave Background (CMB) radiation signal.
- (Later strongly confirmed by COBE, W-MAP).

# *Time Squared<sup>2</sup>*

- In 1965 two physicists working for Bell Labs in New Jersey inadvertently discovered a 'noise' signal that turned out to be the remnant echo of the Big Bang itself. It was *everywhere* they aimed their antenna.
- They finally contacted a researcher in Princeton leading a team who were **looking** for this predicted microwave radiation signal, had already built an antenna (Wilkinson), but he and his team were scooped by a few days...
- *The Bell Labs guys were the ones who won the Nobel Prize...*

# *Time Squared*<sup>3</sup>

- Prokhorov and Silk predicted the Axion->Sterile Neutrino decay process, and its diagnostic X-ray emission signature (Fe+ ~17keV).
- A NASA team subsequently found this exact X-ray signal coming from the center of our own Milky Way galaxy.
- This phenomenon was observed only coincidentally during that team's *primary* research effort—studying Iron and Nickel emissions.
- Prokhorov and Silk found this paper in the literature, and published in late 2010 pointing out that this result was very likely the specific signature of the Axion->Sterile Neutrino decay process which they had *already predicted*.

# No American Idol



Above: About 2.6 million light-years away, NGC 147 is a satellite galaxy of the Andromeda galaxy

## **The Dwarf Spheroidal Galaxy NGC 147**

... the derived “thermal warm dark matter particle mass has the equivalent effect to the mass of a sterile neutrino of 17.8 keV (kilo-electron Volts), produced from the decay of a very light inflaton.”

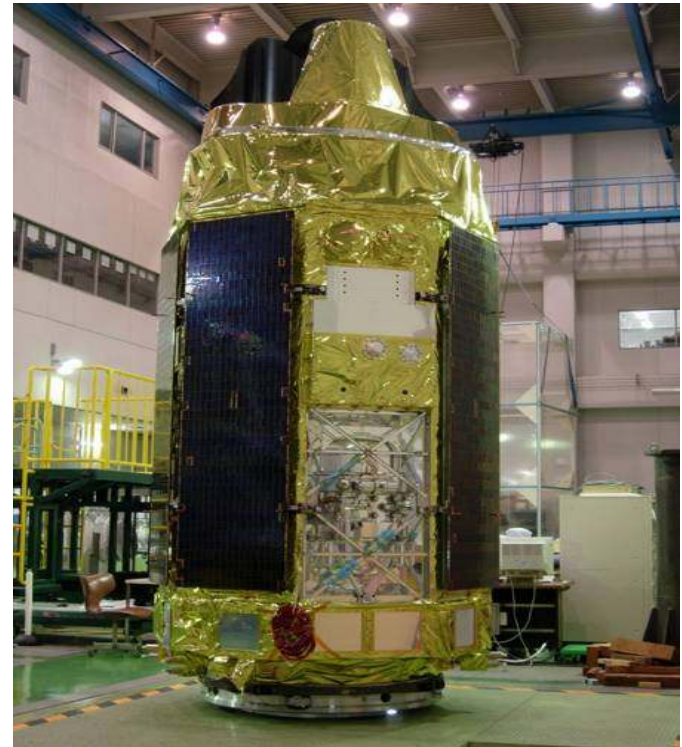
# Delving into the Mines of Moria?

- Dwarf galaxies have generally been the focal point of many sterile neutrino research studies and papers.
- However, Prokhorov and Silk point out in their paper the best place to look for these particle signatures *isn't* in the dwarf galaxies, but rather from within the cores of elliptical and spiral galaxies (particularly our own).
- They also pointed out that this probable signature had *already* likely been discovered in the Milky Way core.

# Eunuchs II: This time it's personal!



Prokhorov and Silk analyzed the iron spectral-line strength reported by Koyama's team who had found an unexpected (for Koyama) excess. P&S explained it as a result of axion inflatons decaying into sterile neutrinos, with a mass of 17.4 keV per neutrino.



Above: The Suzuka research Satellite.

Left: The central core of the Milky Way galaxy. (Spitzer image)

# Probable, not yet positive...

- BUT...the current Milky Way Sterile Neutrino signal is only 3 to 4 times greater than the background noise— not enough yet to be considered a definite positive by scientists.
- However, at this signal strength—and it's 90% statistical confidence level—it's a real measurement.
- It's just not yet a high-enough caliber one to fully satisfy the stringent requirements of physicists and astronomers for full acceptance.

# So, that's how it is... I see now...

- To allow for life anytime, anywhere in the history of the universe—and in particular for humans to exist with a capacity for launching and sustaining a global high-technology civilization—these characteristics of both Sterile Neutrinos and Axions must be highly fine-tuned;
- Their abundance.
- Their characteristic features.
- When they're formed.
- How they're formed.
- Their geographical locations throughout the universe.

# RTB's TCM: Fine-Tuning Evidence

- What's going to come out of these research efforts is evidence for a much more solid fine-tuning model as all these characteristics, and others, for these 3 particles are pinned down more accurately.
- These observations will greatly strengthen many of the hundreds of items in RTB's current Design Compendium, and add more insights for others.

# Recap

- We discussed
  - Ordinary and exotic matter and energy, and their abundances
  - The early history of the universe, and some effects still today
- We discussed in particular
  - The Higgs Boson
  - The Sterile Neutrino
  - The Axion Inflaton
- We predicted
  - More fine-tuning evidence for, and strengthening of RTB's TCM

# For further information:

- RTB's website and podcast:
  - <http://www.reasons.org/have-real-god-particles-been-found-part-1-4>
  - Science News Flash “Have the Real God Particles been found?”
  - Design Compendium: <http://www.reasons.org/fine-tuning>
- Particle listings page of the Lawrence Berkeley National Laboratory Particle Data Group:
  - [http://pdg.lbl.gov/2010/listings/contents\\_listings.html](http://pdg.lbl.gov/2010/listings/contents_listings.html)

# Thanks!

- I really appreciate all of you taking the time to attend this talk. 😊

**NEVER QUIT *LEARNING*...**

**NEVER!!**

