The Gdfather Is Reborn Mark's 60th Birthday Celebration



Mark Vagins

Kavli IPMU, University of Tokyo/UC Irvine

The Gdfather is Reborn @ Kavli IPMU April 25, 2025

The Gdfather Is Reborn Mark's 60th Birthday Celebration



Mark Vagins

Kavli IPMU, University of Tokyo/UC Irvine

The Gdfather is Reborn @ Kavli IPMU April 25, 2025

You've heard a lot about Super-Kamiokande, EGADS, gadolinium loading, supernova astrophysics, and many other related topics (rust!) during the last three days.

This conference was a completely unexpected surprise, as well as a very meaningful experience for me!

Many thanks to the organizers (Elisa G. M. Ferreira, Saeko Hayashi, Saki Fujita, and Simeon Hellerman) and to all the speakers who traveled from near and far or joined remotely to help me commemorate completing my first 60-year cycle through this remarkable universe.

So, since much of the science which I - and many others - have been working on for decades has already been beautifully covered by previous speakers, I'm going to tell you about some of the key events in my life which have brought us all to this happy point.



I was born in the USA in Columbus, Ohio, literally on the campus of Ohio State University (where John Beacom now works). Ohio <u>does</u> sound just like <u>bittj</u>! "Ohio" means "good river" (not "good morning") in the language of the Native Americans who lived there first.



My parents were Milton and Sandra Vagins. He was a mechanical engineer, and she was an English teacher and technical editor (the cat's name was Sweety Cat).



If you've ever thought that "Vagins" is an unusual name, you're not wrong. My father's parents' last name was "Vaginsky." This name got shortened in a rather bizarre fashion after they moved from Jerusalem to New York City in the 1920s. There are now exactly five people in the world with the last name "Vagins."



One day in 1965, when I was a newborn infant, my mother was pushing me around in a stroller when a random woman approached and admired the baby. She asked my mother what my birthday was.

After being told, this complete stranger then said, "Oh, I bet his name is Mark!"

My mother was <u>most</u> surprised, and could only imagine that this unknown woman must be a witch or something similar.



It was then that she learned that, in a total coincidence (since my parents were Jewish and had selected my name *six years* before I was born), that April 25th is Saint Mark's Day! I was always very interested in how things worked. Here's a picture of me in Ohio when I was 7 years old... and still had hair.



To illustrate how early my basic nature was already in place, consider this story from 1973, when I was 8 years old...



In the US in the 1970s, a family vacation often necessitated taking a rather long (100s or even 1000s of km) drive...



With my father having stopped to refill our car's gas tank, I was stretching my legs when I noticed a fenced lot next to the gas station. I thought it must be an electric fence. Mom didn't agree!





I looked around to try and find some bits of scrap metal to toss at the fence, but couldn't find any. So, little Markie decided that there was only one path of action available...







See, Mom, I was right!





In 1974, at the age of 9, my family (my father, mother, 5 year-old sister Debbie, Fluffy the dog, Snuggles the cat, and I) moved from Columbus, Ohio, to Richland, Washington, a journey of 3500 km.



Hair!

I was 11 years old in 1976, and still had thick, strawberry blonde hair (but that would only last for 8 more years).

During three consecutive years in Richland, Washington, I created three science class projects of rapidly increasing ambition...



#1) 1976: 6th grade – "Our Solar System" which I made using painted styrofoam balls.





I did not realize it at the time, but styrofoam solar systems are a classic elementary/middle school science project, much like baking soda volcanos and celery stems in colored water.

At any rate, even though it took a fair amount of messy work, the reactions of the teacher and class were distinctly muted.



#2) 1977: 7th grade – "H is for Hydrogen" discussed the wonderful hydrogen-based future I anticipated, including limitless fusion energy and non-polluting hydrogen powered cars. For a grand finale, I electrolyzed water in front of the class and made a satisfying explosion. Good reactions all around!



#3) 1978: 8th grade – "An Alternative Design for Radar" proposed using a feedback circuit to switch from radar's standard, steady pulses to variable frequency pulses, enabling a way of ranging targets without needing precision timing.



#3) 1978: 8th grade – "An Alternative Design for Radar" But what made this project special was that I had built a <u>working model</u> with my Science Fair 160 in One Electronic Project Kit (which I got for Hanukkah) and proceeded to demonstrate its operation for the class. Now this got the reaction I had been looking for!



In 1979, at the age of 14, my family (my father, mother, 9 year-old sister Debbie, and I) moved from Richland, Washington, to Silver Spring, Maryland, a journey of 4200 km. In Maryland I went to high school, where I took three years of physics. At the end of 1982, when it was time to apply for college, I took a recognizably Mark-like approach to my college essays: I told jokes, but with purpose.

For example, that year the MIT admission essay was simply:

"Write a question, and answer it."

Ooooh, tricky!

Where I was applying to college, in order of preference: Caltech MIT Stanford Princeton Columbia Brown Stevens Institute of Technology

The question I decided to write was:

"What is the most important thing you've ever learned in a class *besides* the subject being taught?"

My answer involved the integration of humor and hard work during my first two years of high school physics. *It worked!*

So, off I went to Caltech in October of 1983. My professors there eventually included...















The entire entering class (186 people my year) plus some upperclassmen and a few professors spent three days on the island, explaining the Caltech way of doing things and getting to know each other. This was a bit intense.

The first thing that happens to incoming freshmen at Caltech is what's called "Frosh Camp," which was held at Camp Fox on Catalina Island, 36 km off the coast of Southern California.





You are supposed to spend your time at Frosh Camp talking with professors in your desired field of study. I looked around and saw someone sitting on the lawn, holding up a small paper sign on a wooden stick which read, simply, "Physics." I went over and sat down next to him. This is how I first met Richard Feynman.







A sign seen on a laboratory door at Caltech:





BTW, both Caltech and MIT have beavers – creatures that engineer their environments – as their mascots. In 1987 I graduated from Caltech, and went off to Yale for graduate school.





Some YDS graduates...

STATES.

I dedicated my physics Ph.D. thesis, on rare kaon decays, to the Yale School of Drama!



I still maintain connections to the world of performing arts:





I (barely) appeared in this major Hollywood movie back in 1997...

...I frequently give interviews on radio, TV, and the internet...

...I've directed and performed voiceover work for award-winning professional video productions...

...and I've been in talks with Discovery Networks for my own US television show!



In anticipation of receiving my Ph.D. in 1994, I answered an ad in the classified section at the back of *Physics Today* magazine. It was for a postdoc on Super-Kamiokande, based at Louisiana State University.



As a result, I've been a part of Super-Kamiokande (and wearing brightly-colored shirts) from its very early days...



January 1996




After helping to build Super-Kamiokande as an LSU postdoc and creating its main online event display, in 1996 I moved to the University of California, Irvine, where I became a

research scientist.









At UC Irvine I joined Frederick Reines's research group. He discovered the neutrino in 1956, and (finally!) won the Nobel Prize in Physics for it in 1995.







In 1998 I was appointed the co-convener of Super-Kamiokande's solar and supernova neutrino group.







Now, I am honored to be carrying on the work of Koshiba-sensei!



"Everyone complains about the (supernova neutrino) weather, but no one does anything about it..." So, after one of the sessions at Neutrino 2002 in Munich, John Beacom and I spent hours sitting in a subway station, brainstorming ideas. But we did NOT start with gadolinium!



Date: Tue, 30 Jul 2002 03:45:09 -0700 (PDT) From: Mark Vagins <vagins@danka.ps.uci.edu> To: John Beacom <beacom@fnal.gov> Subject: The briny, briny deep

Hey John,

I just spoke with Yoichiro Suzuki, who is also attending this meeting in Amsterdam. I brought up our scheme for making SK 1% salty.

He liked the idea a lot, and in fact said that salting SK was one of the future options he had been musing about. Naturally, he did say that we needed to carefully model a salty detector and get a feel for the true numbers.

He went on to say that the necessary water system modifications were possible, and that in the near future

"we must do something to get the new physics."

He also felt that 500 tons of salt was reasonable, saying to me,

"It's just 50 truckloads - you can shovel it yourself!"

This is a very positive thing indeed (other than the part about my shoveling half a kiloton of salt myself).

So, things sound pretty promising on this end. <u>I wonder if it's worth putting out a phenomenological paper</u> outlining how this will-salt-for-relics could work... it probably is, especially if there is a non-zero likelihood that SK will actually do something about it!

> We must do something to get the new physics, -Mark

As everyone now knows, we did indeed eventually put out that "phenomenological paper."



High Energy Physics - Phenomenology

https://doi.org/10.1103/PhysRevLett.93.171101

[Submitted on 26 Sep 2003]

Related DOI

GADZOOKS! Antineutrino Spectroscopy with Large Water Cerenkov Detectors

John F. Beacom, Mark R. Vagins

We propose modifying large water Čerenkov detectors by the addition of 0.2% gadolinium trichloride, which is highly soluble, newly inexpensive, and transparent in solution. Since Gd has an enormous cross section for radiative neutron capture, with $\sum E_{\gamma} = 8$ MeV, this would make neutrons visible for the first time in such detectors, allowing antineutrino tagging by the coincidence detection reaction $\bar{\nu}_e + p \rightarrow e^+ + n$ (similarly for $\bar{\nu}_{\mu}$). Taking Super-Kamiokande as a working example, dramatic consequences for reactor neutrino measurements, first observation of the diffuse supernova neutrino background, Galactic supernova detection, and other topics are discussed.

 Comments:
 4 pages, 1 figure, submitted to Phys. Rev Lett. Correspondence to beacom@thal.gov mvsgins@ucl.edu

 Subjects:
 High Energy Physics - Phenomenology (hep-ph); Astrophysics (astro-ph); High Energy Physics - Experiment (hucl-ex); Nuclear Theory (nucl-th)

 Report number:
 FERMILAB-Pub-03249-A (or arXiv:hep-ph/0309300/1 for this version) https://doi.org/10.4855/0arXiv:hep-ph/0309300 ①
 [Phys. Rev. Lett. 93 (2004) 171101 has exactly 598 citations!]

 Journal reference:
 Phys.RevLett. 33 (2004) 171101
 Subjects:
 [Phys. Rev. Lett. 93 (2004) 171101

Search. He

Now, John and I never wanted to merely <u>propose</u> a new technique – we wanted to make it work!



Suggesting a major modification of one of the world's leading neutrino detectors is indeed <u>not</u> the easiest route...

...so began many years of experimental and theoretical studies.

Indeed, getting Gd into SK required work in:

- Particle Physics
- Nuclear Physics
- Astrophysics
- Astronomy
- Cosmology
- Chemistry
- Chemical Engineering
- Computer Science
- Optics
- Materials Science
- Grant Writing
- International Trade, and of course
- Plumbing!

My next major life-changing event happened in a most unexpected way and place.

Delphi, Greece June 2005



Delphi, Greece 6-11 June, 2005

International Advisory Committee

V. Brisson - LAL, Orsay, France B. Cabrera - Stanford U., USA P. Dornan - Imperial College, UK D. Haidt - DESY, Germany R. Heuer - DESY/Hamburg U., Germany J. Morfin - Fermilab, USA H. Murayama - UC Berkeley/LBNL, USA S. Nagamiya - KEK, Japan K. Niwa - Nagoya U., Japan P. Oddone - Fermilab, USA V. Palladimo - U. & INFIN Napoli, Italy E. Paschos - U. Dortmund, Germany J. Peoples - Fermilab, USA V. Brisson - LAL, Orsay, France J. Peoples - Fermilab, USA H. Pietschmann - U. Vienna, Austria N. Samios - BNL, USA S. Sarkar - U. Oxford, UK J. Schneps - Tufts U., USA M. Shaevitz - Columbia U., USA S. Stone - Syracuse U., USA J. Vergados - U. Ioannina, Greece R. Viollier - U. Cape Town, South Africa M. Witherell - Fermilab, USA S. Wojcicki - Stanford Ú., USA

20th International Workshop on Weak Interactions and Neutrinos **WIN' 05**

Electroweak Symmetry Breaking

Neutrino Physics

Astroparticle Physics

Decays, CKM, CP Violation

Program Committee

G. Barenboim - Valencia U., Spain R. Fleischer - CERN, Switzerland F. Gilman - Carnegie-Mellon U., USA M. Goodman - ANL, USA J. Mnich - DESY, Germany H. Minakata - Tokyo Metro U., Japan V. Papadimitriou - Fermilab, USA A. Para - Fermilab, USA B. Sadoulet - UC Berkeley/LBNL, USA

- G. Tzanakos (Chair) Athens U., Greece P. Vogel Caltech, USA

Local Organizing Committee

- T. Alexopoulos N.T.U. Athens, Greece G. Fanourakis Demokritos, Greece D. Fassouliotis Athens U., Greece

- N. Saoulidou Fermilab, USA E. Styliaris Athens U., Greece
- G. Tsipolitis N.T.U.Athens, Greece G. Tzanakos (Chair) Athens U., Greece

http://conferences.phys.uoa.gr/win05 e-mail: win05@phys.uoa.gr

Registration deadline: 21st May 2005 (Special accommodation price requires early registration)







I told them I was an astrophysicist, who spent much time in Japan.



We're here to reinstate the ancient Delphic Games. First Meeting with Michiyo Sato – Delphi, Greece June 2005





First Dance – Expo 2005, Aichi, Japan July 2005



First Real Date – Tokyo DisneySea October 2005



Wedding – Kohala, Hawaii June 2007 My most recent career move was, of course, to IPMU.



In 2008 I underwent a significant transformation...

As you have already heard, thanks to Hitoshi Murayama I joined UTokyo's newly-formed IPMU as their first full-time foreign professor, with the goal of making the Gd loading of Super-Kamiokande a reality.



MATHEMATICS OF THE UNIVERSE



In November of 2009 a call went out on the Kashiwa campus for someone who met the following three criteria (I quote directly):

"someone who has a bouncy tummy, looks good on beard, and has happy smiling face"

Proving to be a good fit to these parameters, I quickly got an annual gig playing Santa Claus for the children of the Donguri nursery school on campus and did this for many years, often encountering IPMU parents whose young kids were attending the school.

This has led to bigger things...





~サンタさんの魔法~

鈴やタンバリンなど おもちゃの楽器を 持ってきてね。)

【全席指定】 〈一般〉 前売 2,000 円 / 当日 2,500 円 ④開場10815 開演11800 ②開場14815 開演15800 (約1時間予定) 〈さくらメイト〉 前売1,500円/当日2,000円 〈小学生以下〉 700 円 チケット購入はこちら 浦安市文化会館 047-353-1121(第2・4 木塚(株町日) 浦安市民ブラザ 047-350-3101(第1・3 木塚(株町日) (さくらメイト先行発売) 10/17(木)10時~Web販売 10/17(木)10時~Web販売 四 浦安市又化云嶋 047-350-3101(#1・3# 湘安市民プラザ 047-350-3101(#1・3# うらやす財団オンラインチケットサービス ♪大人1名につき3歳未満のお子様1名膝上鑑賞無料。お座席必要な場合は有料。 ⇒車いす席をご希望の場合は、文化会館までお問い合わせください。 ⇒専用駐車場はございません。ご来場の際は公共交通機関をご利用ください。 der and the -主催◆公益財団法人うらやす財団(浦安市文化会館) 後援◆4PD 法人文化交流^{りポート}浦安 協力◆TSUTAYA 浦安さくら通り店・**CREATION** - 株式会社木田屋商店



Here's our little family visiting the recently re-named Kavli IPMU on September 13, 2012. Say "hi," Isaac Sato Vagins!



In Fukuoka in 2013.

........

10

-



Our 12-year-old son graduates elementary school – March 2023

At home in Tokyo; December 21, 2024



Above the main entrance to our home you'll find this custom-made stained-glass window.

Please note EGADS, Michiyo, Isaac (as a flower), our old cats, the solar system, sun and moon, calla lilies, atomic symbols, Stars of David, and, in the background, Mt. Parnassus and the Temple of Apollo in Delphi, Greece.

Son Isaac, Mother Sandra, and Sister Debbie in Maryland; December 27, 2024

\$ 120

N.

Which, combined with other talks you've heard, brings us to the present day...

I currently control more gadolinium than any other private citizen in the world, and I readily share it and my Gd-enabling filtration technology with all who ask.



Gd-H₂O: Everybody's Doing It, Man...

_	Name	Location	Main Goal	Water Volume	Gd ₂ (SO ₄) ₃ Loaded
LELS GUDIULE	EGADS	Kamioka	Gd R&D, SN Watch	200 tons	Since 2013
	ANNIE	Fermilab	High-E Neutron Multiplicity	26 tons	Since 2019
AUXILEDETECTORS	Super-K-VI/VII	Kamioka	DSNB, SN Burst, PDK, ATM/Sol/LB v	50 ktons	Since 2020/2
	XENONnT Water Shield	Gran Sasso	Dark Matter Detection	700 tons	Since 2023
	WCTE	CERN	IWCD/mPMT Demonstrator	50 tons	May 2025 (planned)
LETS CADIQUE	30-ton Test Tank	BNL	Nuclear Non- Proliferation Demonstrator	30 tons	Mid-2025 (planned)
8	BUTTON	Boulby	Underground Demonstrator	30 tons	2026(?)
ALL THE DETECTORS!	Hyper-K-II(?)	Kamioka	DSNB, SN Burst, PDK, ATM/Sol/LB v	258 ktons	203X(?)

BLISHED hand I'm a 0 SOON TO BE MEUTRINO FOUND! FROY-AL PAST SUPERNOV IIGADZOOKS 2º 2 Watercolor painting by Saki Fujita



[AI image by Alex Kusenko]




T \diamond 000 0