

Title: Keynote

Speakers: Shane Farnsworth

Collection: PSI 15th Anniversary Reunion

Date: June 18, 2024 - 11:30 AM

URL: <https://pirsa.org/24060003>

Survey of a PSlon and building Jordan Geometry

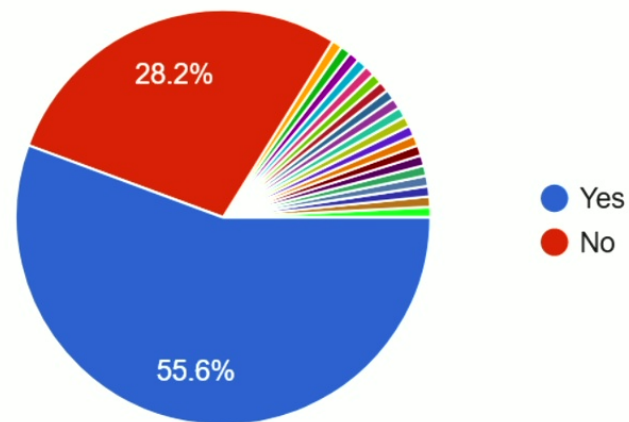
Shane Farnsworth
18 June 2024



What is the survey?

Do We Have Free Will?

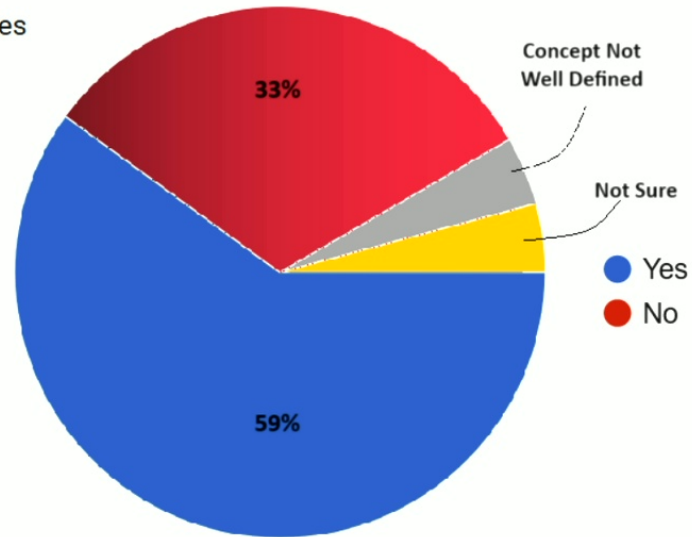
124 responses



What is the survey?

Do We Have Free Will?

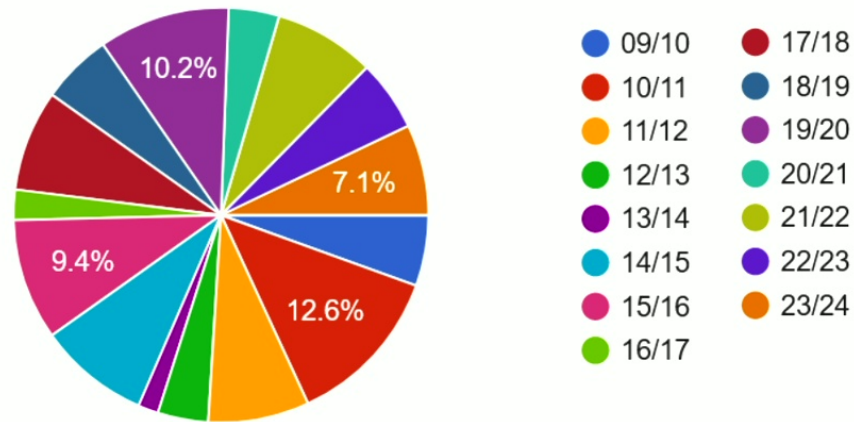
124 responses



Who Responded To The Survey?

Which PSI Cohort were you a part of?

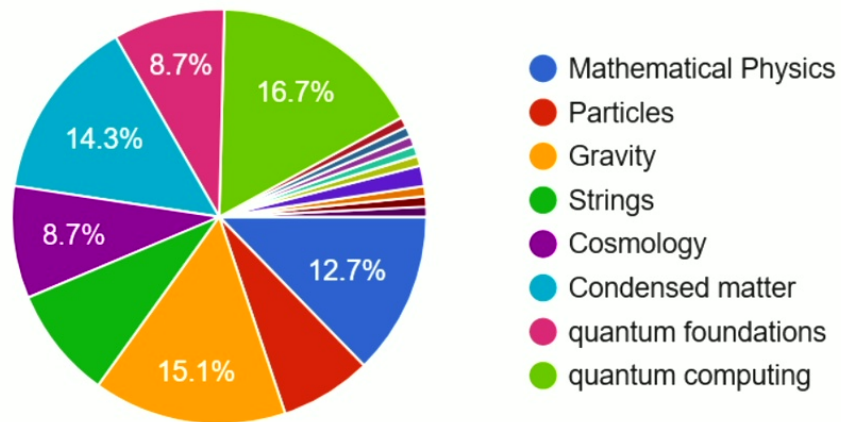
128 responses



Life In Research

Primary Field Of Interest?

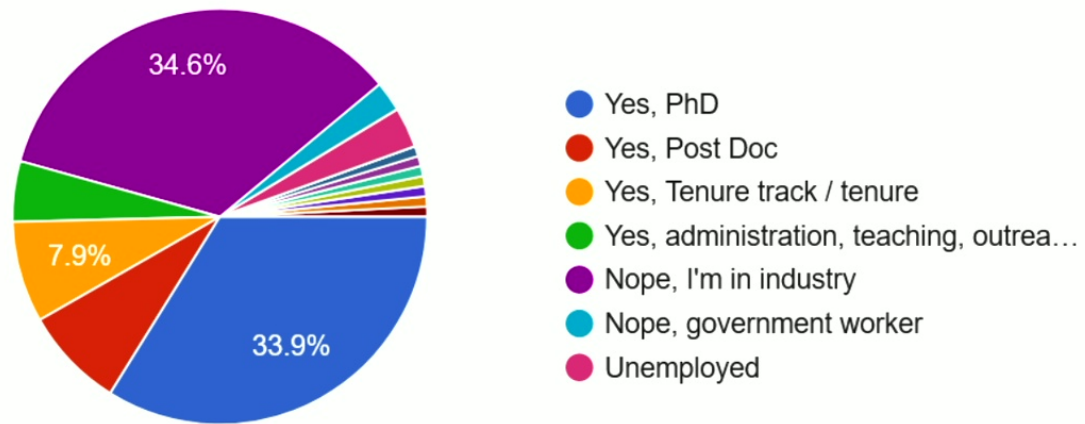
126 responses



Life In Research

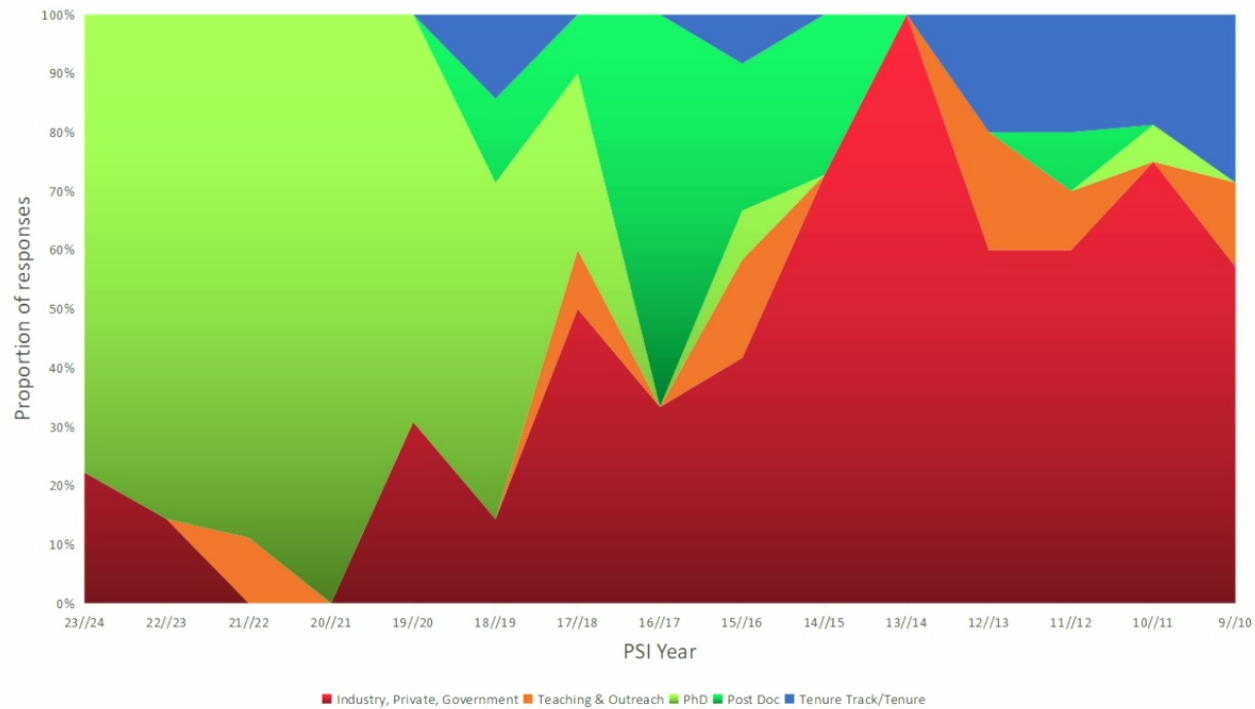
Do You Currently Work In Academia?

127 responses



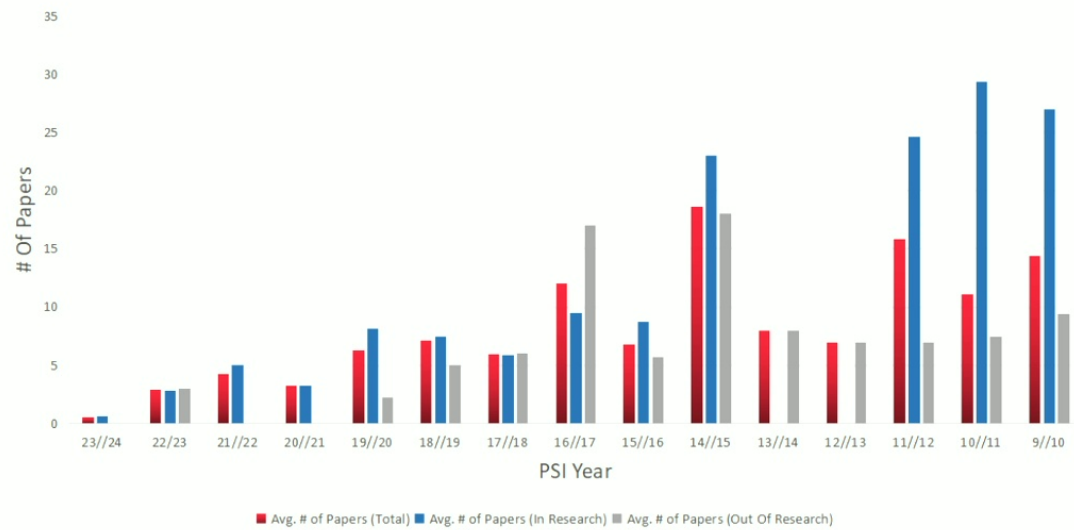
Life In Research

Do You Currently Work In Academia?



Life In Research

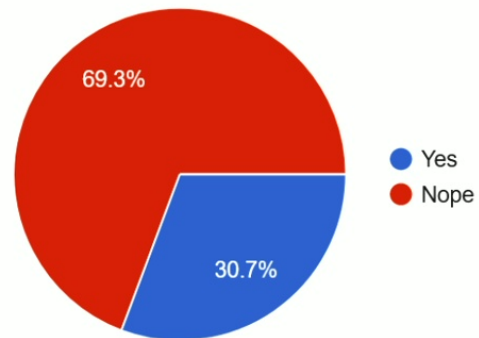
Number of Papers.



Life After PI?

Are You Still Living In Canada?

127 responses



Life After PI?

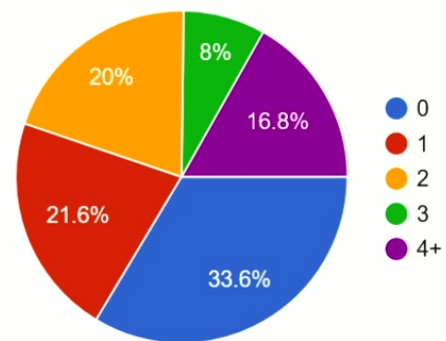
Are You Still Living In Canada?



Life After PI?

How many people from your PSI course do you still routinely speak with on a monthly basis?

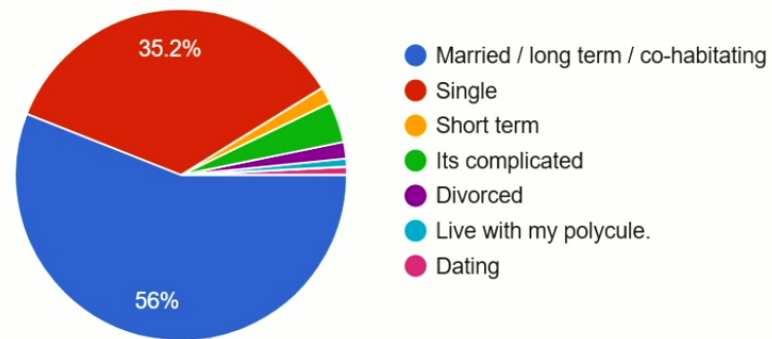
125 responses



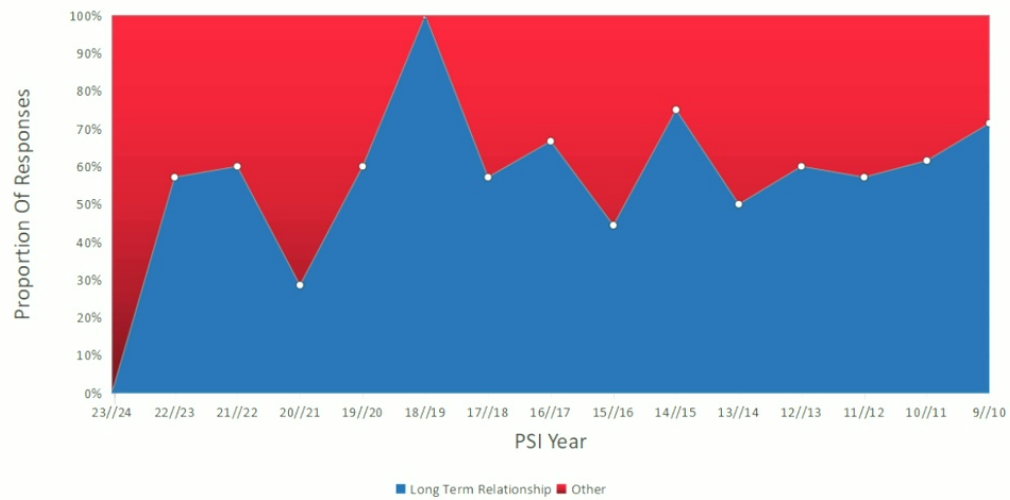
Life After PI?

Relationship Status.

125 responses



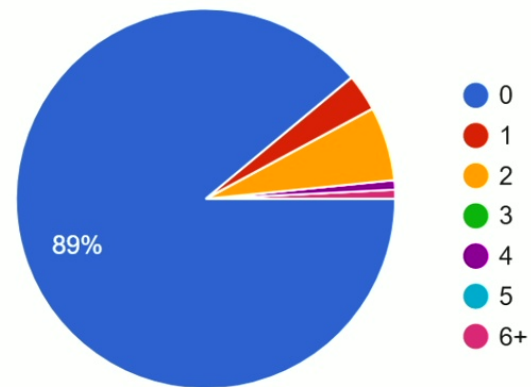
Life After PI? Relationship Status.



Life After PI?

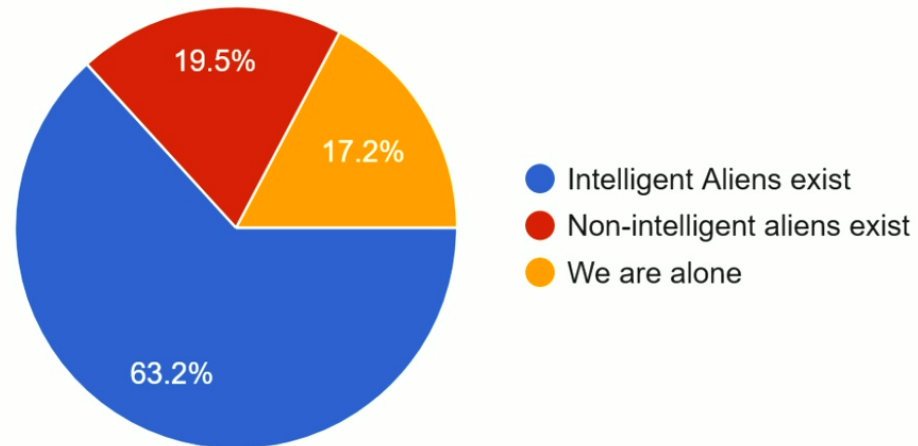
Number of Children.

127 responses



The Big Questions

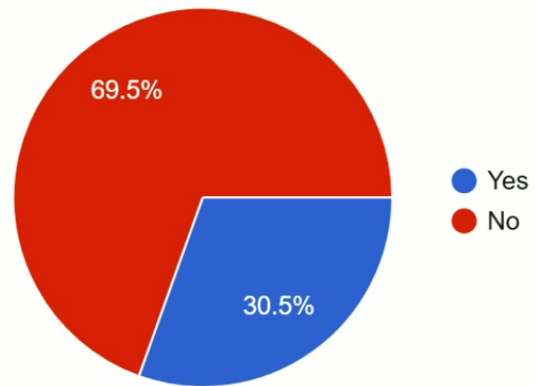
Are We Alone In The Universe?



The Big Questions

Do You Rock Climb?

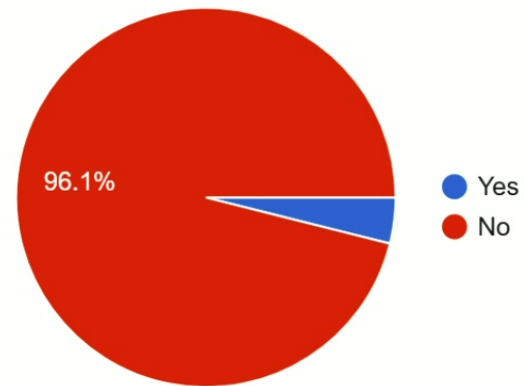
128 responses



The Big Questions

Have You Ever Fallen In Silver Lake?

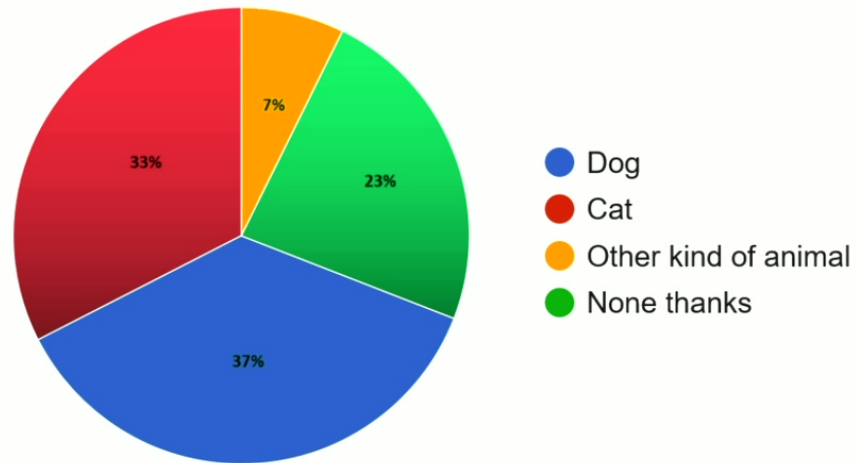
128 responses



The Big Questions

Favourite Kind Of Pet?

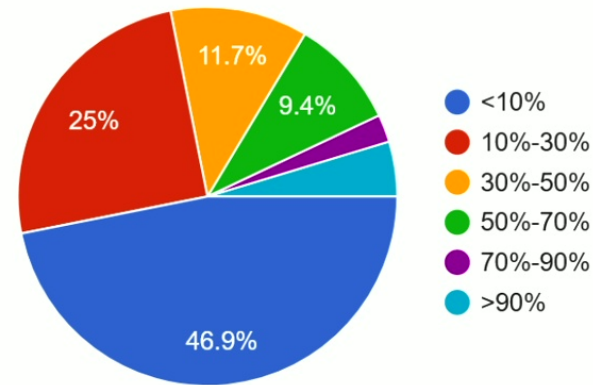
125 responses



The Big Questions

What is the chance that a PSlon will win either the Fields medal or a Nobel prize in the next 30 years?

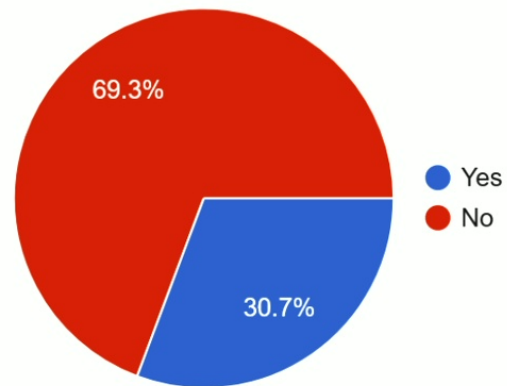
128 responses



The Big Questions

Will Quantum Computers Be Profitable Within The Next 15 Years?

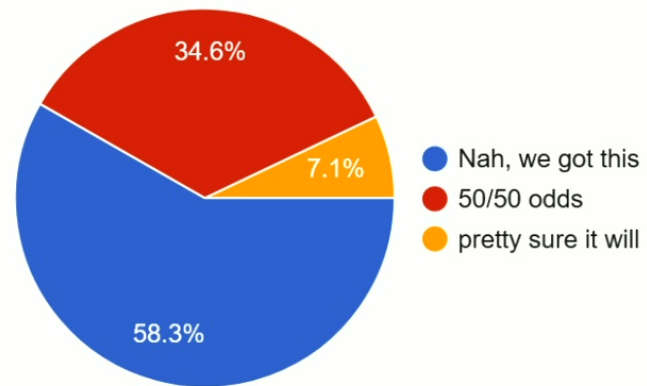
127 responses



The Big Questions

Will AI Wipe Out Humanity?

127 responses

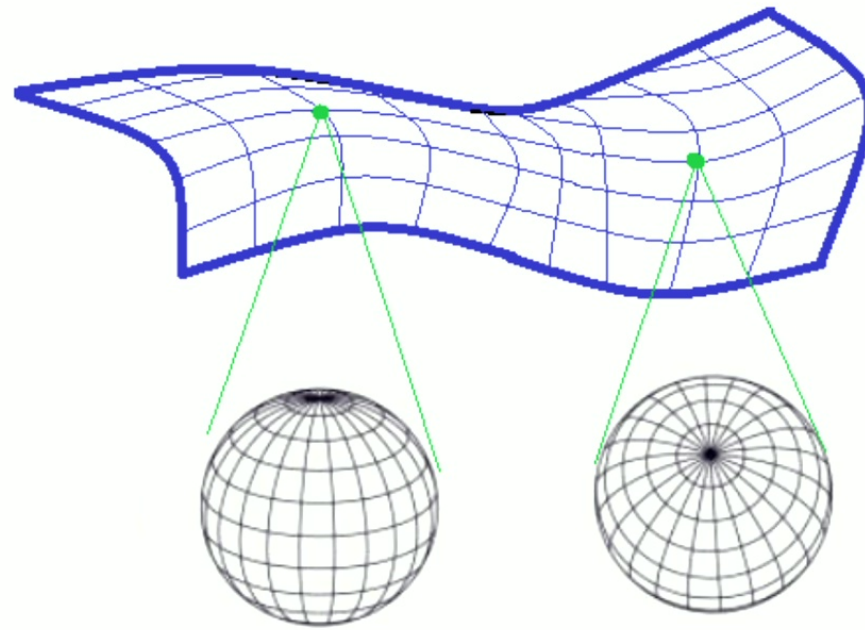


Part 2: Beautiful Ideas



A beautiful idea

Kaluza-Klein?

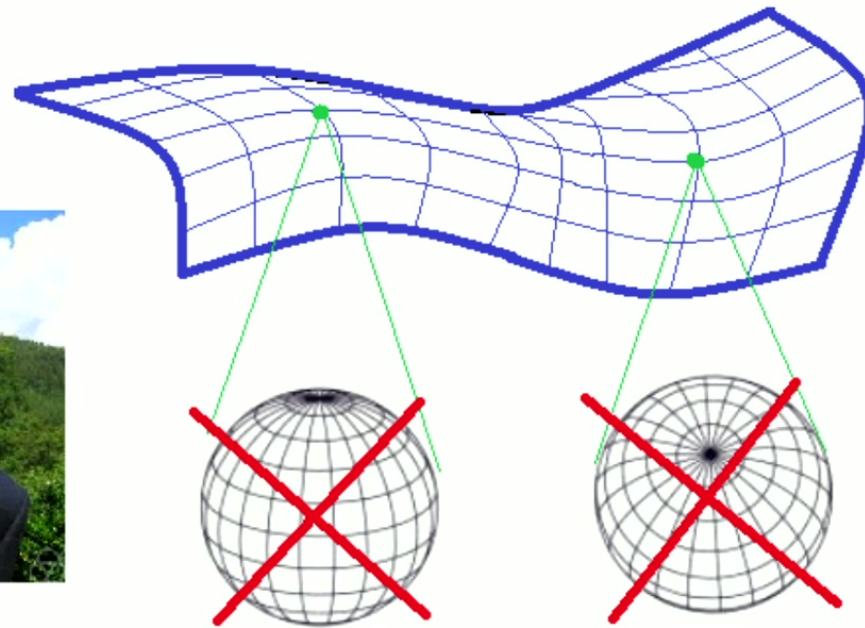


A beautiful idea

Kaluza-Klein?



Alain Connes



A beautiful idea

Q. How do you find the correct geometry?



A beautiful idea

What do we actually want from compactification?

$$\text{Diff}(M_N) \longrightarrow \text{Map}(M_4, G_{\text{gauge}}) \times \text{Diff}(M_4)$$

Why not just build the geometry that has the symmetries and representations that we want from the outset?

A beautiful idea

Q. How do you find the correct geometry?

A. Look for coordinate algebras with the correct symmetries!

$$\text{Diff}(M_4) = \text{Aut}[C^\infty(M_4)], \quad (\text{Riemann})$$

$$\text{Map}(M_4, G_{\text{gauge}}) \times \text{Diff}(M_4) = \text{Aut}[\underbrace{A_F \otimes C^\infty(M_4)}_{\text{Our Coordinate algebra!}}], \quad (\text{spectral})$$

A beautiful idea

The Idea:

$$(A, H, D) \longleftrightarrow (M, g_{\mu\nu})$$

It's lovely because

- No more need for compactification.
- Geometry might give new restrictions on particles!

A beautiful idea

IT **WORKS!!!!** (sorta) You can find the SM algebra, Dirac Operator, and representation space!!!! (kinda)

$$A = C^\infty(M) \otimes A_F$$

$$D = \nabla_S^2 \otimes \mathbb{I}_F + \gamma_5 \otimes D_F$$

$$H = L^2(M_4, S) \otimes H_F$$

But there are **problems** :,(

- ① Unwanted U(1) symmetry,
- ② Too many Higgs Fields
- ③ Incorrect Higgs Mass
- ④ etc ...

Revivifying a beautiful idea

Lets drop all unnecessary assumptions...

Why arbitrarily restrict attention to associative noncommutative geometries? Let's be agnostic and also consider **nonassociative geometries**.



Latham Boyle



Revivifying a beautiful idea

There are fairly strong physical hints that nonassociative geometry isn't crazy...

Example: The NCG SM has Fermion quadrupling (too many Fermions). Remove these by imposing Weyl and Majorana conditions.

$$JH = H$$

$$\Gamma H = H$$

Can only play this trick when $[A, J] = [A, \Gamma] = 0$. **Only works with nonassociative algebras!**

Revivifying a beautiful idea

We need to build nonassociative geometry. But this is really difficult!

Need to define: **nonassociative representations, symmetries, Dirac operators, connections, differential forms, etc...**



Fabien Besnard



Latham Boyle

Revivifying a beautiful idea

Jordan Geometry... IT **WORKS!!!!**

- ① Removes unwanted U(1) symmetry,
- ② Removes unwanted Higgs Fields
- ③ Removes Fermion quadrupling
- ④ Removes the technical problem of Junk forms at lowest order
- ⑤ Can be made compatible with detected Higgs Mass
- ⑥ Appears compatible with Pati-Salam and B-L extended standard model.

Thank You

Do you have anything you would like to say to to folks that made the PSI program possible?

Running a program like this is a huge task, and you did so excellently. Thank you!

This was one of the most pivotal years of my life, thanks for making it possible.

Thank you

I had an amazing time

PSI was easily the best year of my academic career

Thank you for the special experience and all the free food :)

Ten years later, every time I am asked about PSI I say that I would go through it again, no doubt



Thank You

Do you have anything you would like to say to to folks that made the PSI program possible?

PSI was an incredible experience, and I truly hope it remains so for future cohorts

Thanks!

Thank you!

You changed the path of so many people in so many good ways, keep it up

You changed my life for the better!

It was probably the best period of my life, all things considered.

PSI was an amazing experience for me, both the courses, and the people I got to meet. The year was a blast!



Thank You!

