

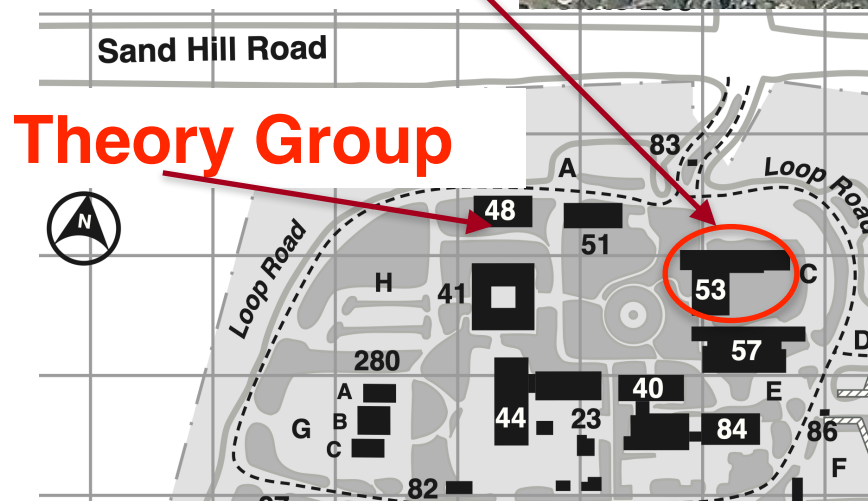
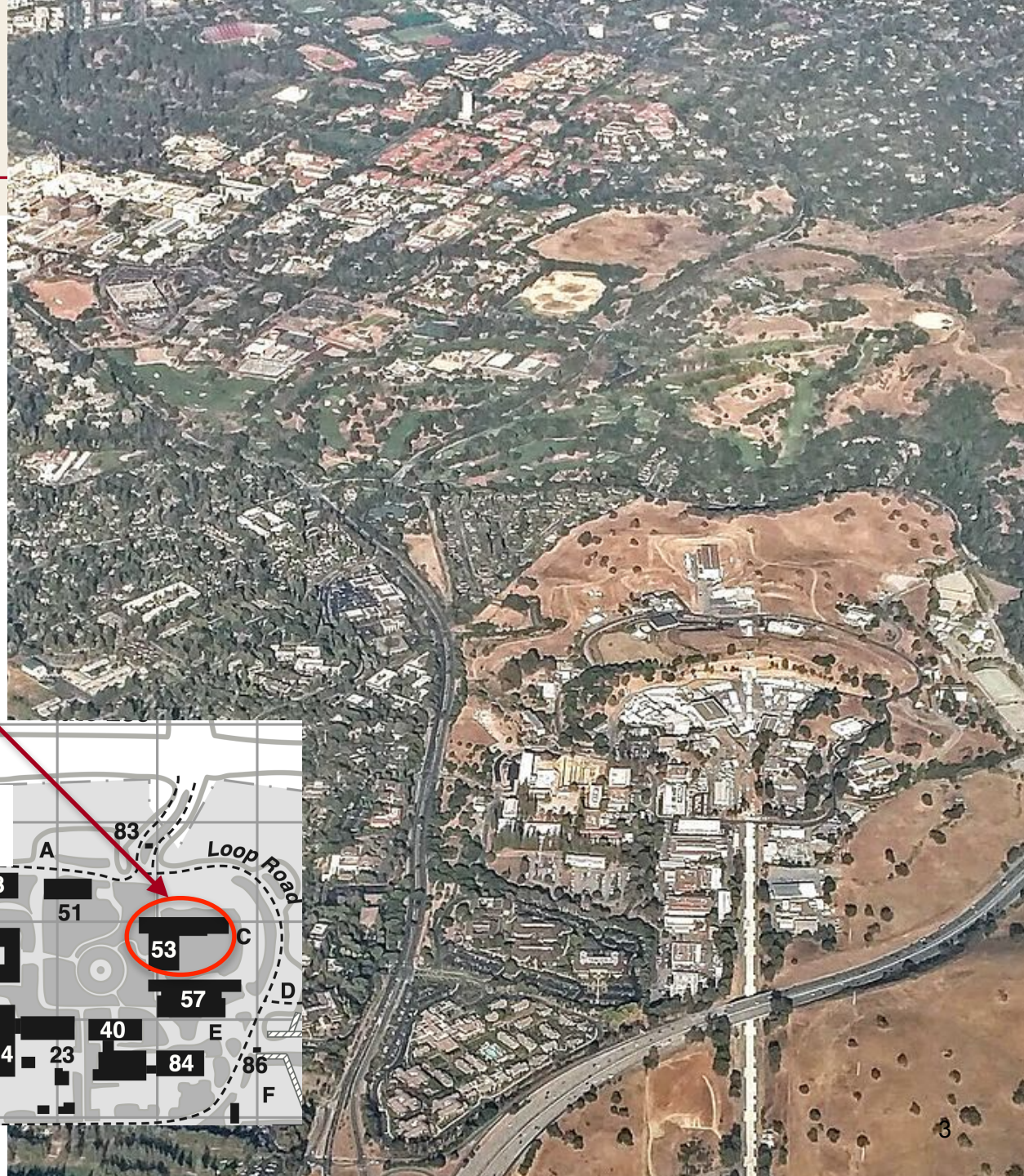
SLAC EPP Theory Group

Open House 2026

- Involved in multiple areas of modern theoretical physics
 - Theoretical quantum field theory
 - Neutrino physics, astrophysics and cosmology
 - Precision calculations for state-of-the-art experiments
 - Particle astrophysics
 - Models of dark matter and novel search strategies
- Major emphasis on connecting theoretical work to existing and planned experiments
- Long history of our students and postdocs becoming intellectual leaders in the field
 - Numerous recipients of prestigious fellowships and faculty positions
 - **Rotation opportunities available!**

SLAC National Accelerator Laboratory

- ✿ Well connected by bus, bike and car.
- ✿ We are here



SLAC HEP Theory Group

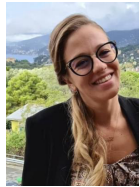
SLAC



Alex Friedland



Lance Dixon



Federica Devoto



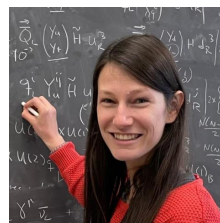
Anjie Gao



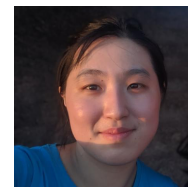
Sumit Banik



Michael Ruf



Julie Pages



Linda Xu



Xin Guan



Bernhard Mistlberger



Rebecca Leane



Michael Peskin



Tom Rizzo



Natalia Toro



Philip Schuster



Giuseppe Lucente

Polylogs
 NewPhysics
 QCD N=4SYM SuperNova
 Amplitudes Dune
 SCET DM-Radio Electroweak
 Substructure
 MachineLearning
 ILC Searches Jets
 Faser LDMX
 Generators
 Models N3LO Genie Precision
 Higgs Beyond
 Dark-Matter
 Neutrinos

Graduate students



Federico Pavone



Derek Li



Adi Prasanna Suresh



Shayarneel Kundu



Gowri Sundaresan



Andrew McEntaggart



Lillian Santos-Olmsted



Alessandro Russo



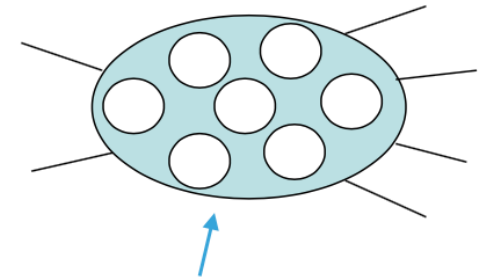
Polylogs
 NewPhysics
 QCD N=4SYM SuperNova
 Amplitudes Dune
 SCET DM-Radio Electroweak
 Substructure
 MachineLearning
 ILC Searches Jets
 Faser LDMX
 Generators
 Models N3LO Genie Precision
 Higgs Beyond
 Dark-Matter
 Neutrinos



Lance Dixon

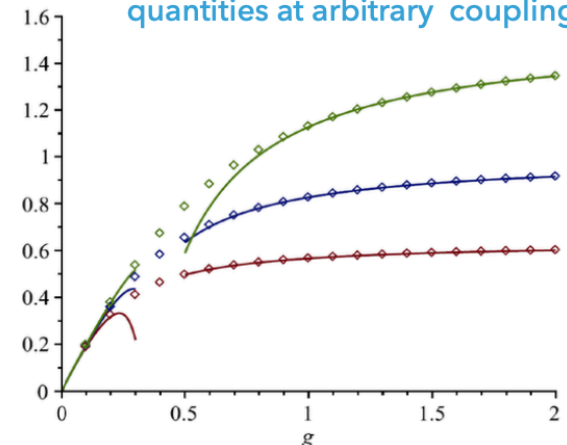
N=4 SUPER-YANG-MILLS: THE HYDROGEN ATOM OF THE 21ST CENTURY

- ❖ **Solvable** quantum field theory, like QCD, which describes quarks and gluons, but has all sorts of extra handles: supersymmetry, conformal invariance, integrability
- ❖ **"Bootstrap" technique:** use general principles to calculate amplitudes at very high loop order.
 - * 6 gluons at 7 loops
 - * 7 gluons at 4 loops
 - * Higgs boson and 3 gluons at 8 loops
- ❖ **Machine Learning and Perturbative QFT**
- ❖ **New Dualities in Scattering Amplitudes**



~ 1 billion Feynman diagrams in here

Can calculate specific quantities at arbitrary coupling



Ever wondered about those diagrams Sheldon was staring at?

7

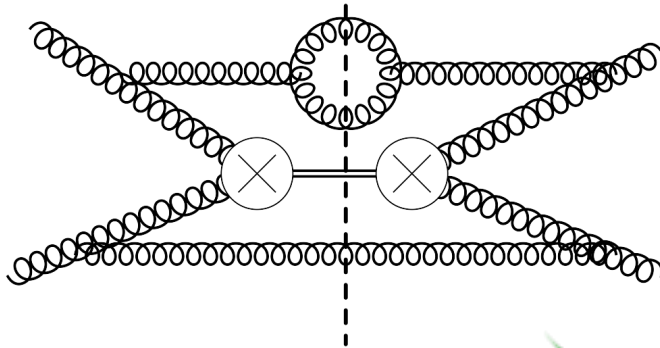
SLAC

Talk to Lance!





Probing Fundamental Interactions of Nature with Precision

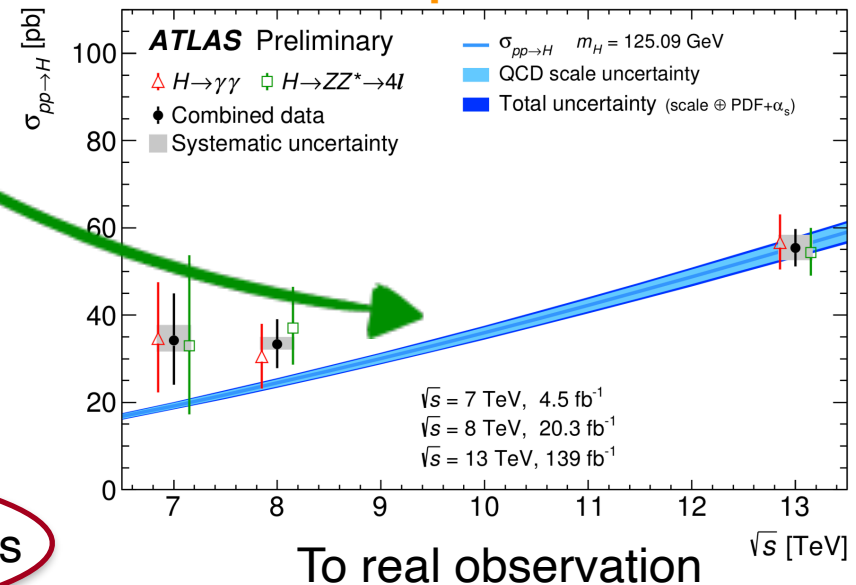


From first principles

Advance our understanding of QFT and improve our capabilities to predict outcome of scattering processes of fundamental particles.

Higgs boson - QCD - Electroweak

How many Higgs bosons do we expect at the LHC?



The precision frontier of QFT computations



Michael Ruf

The same precision techniques are applicable to collider physics and to gravitational waves



Colliders

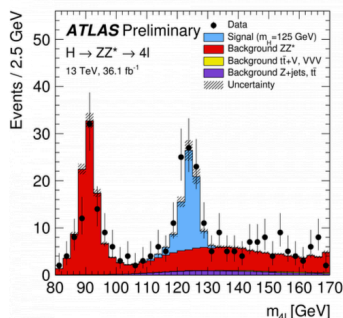
GW



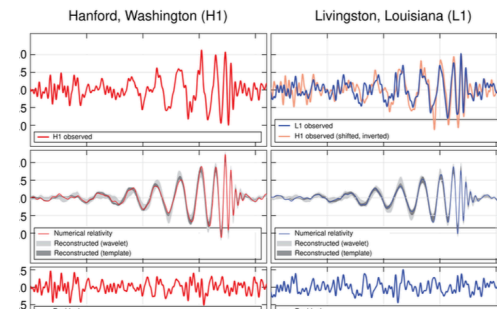
Precise measurements

+

Precise theory predictions



- Detect (Higgs/GW)
- Map (couplings, NS equation of states)
- Constrain (beyond SM/GR)
- Discover? (Exotic compact objects, dark matter)

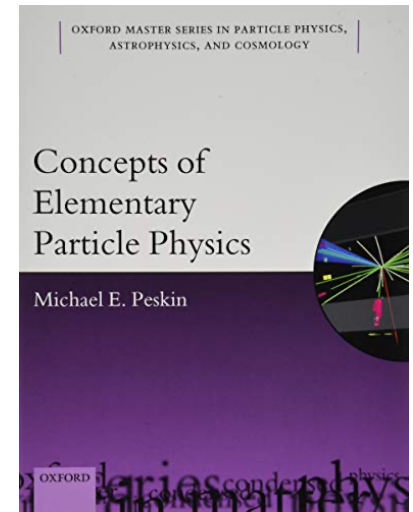
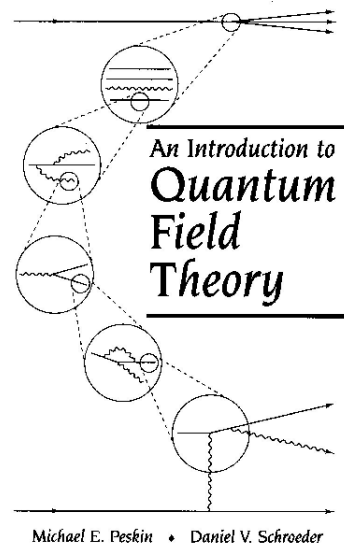


I have questions about my favorite quantum field theory book!

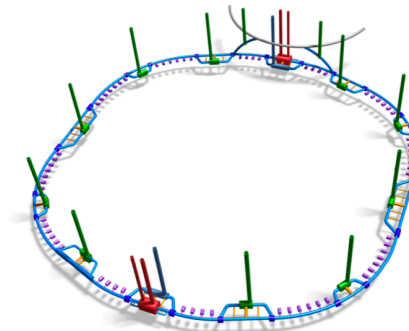
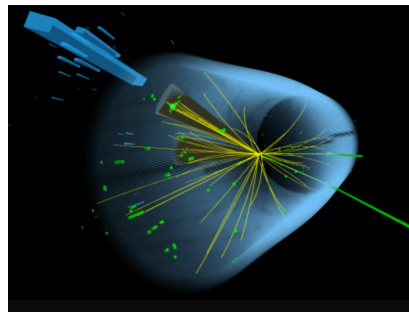
10

SLAC

Talk to Michael!



Michael will also be happy to talk to you about the Higgs boson and particle colliders

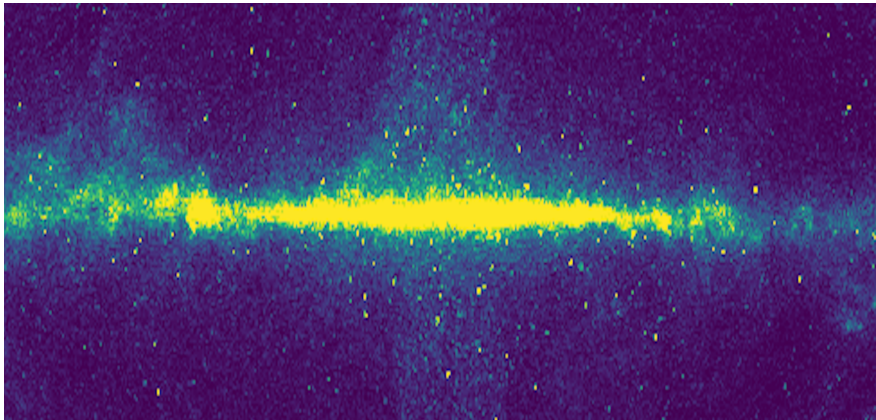




Rebecca Leane

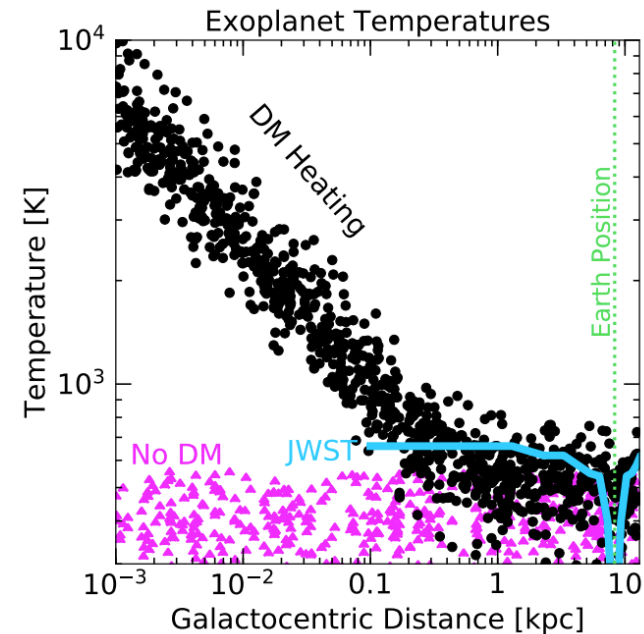
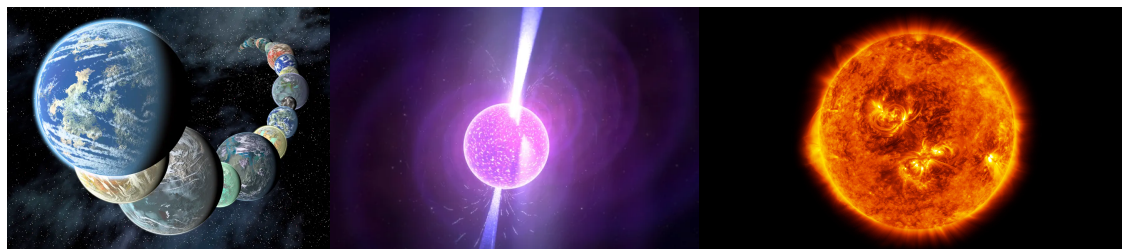


Particle Theory Meets Astrophysics



Techniques to find dark matter in astrophysical datasets

Does dark matter cause the gamma-ray glow
at the heart of our Galaxy?



New dark matter searches in astrophysical systems

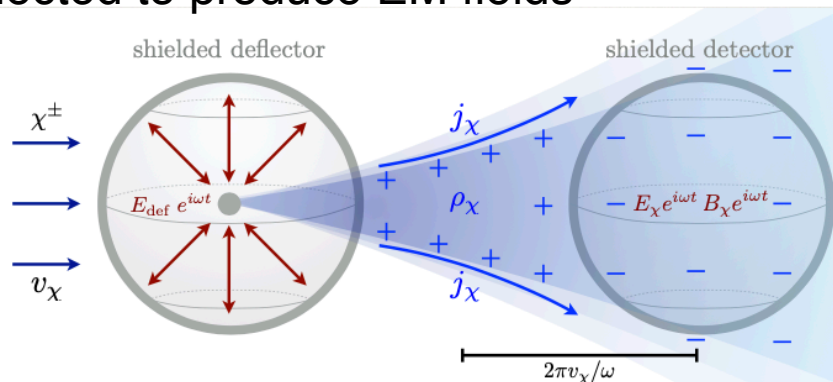
How does particle dark matter affect
stars and planets?



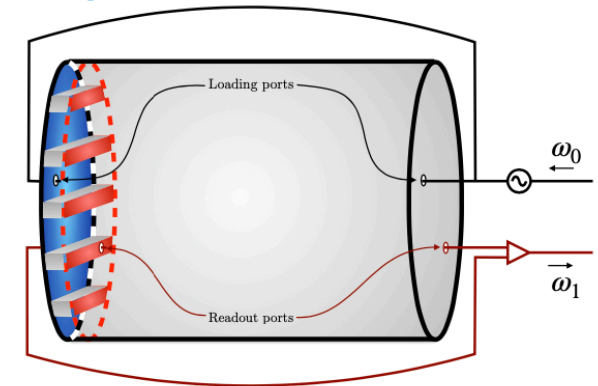
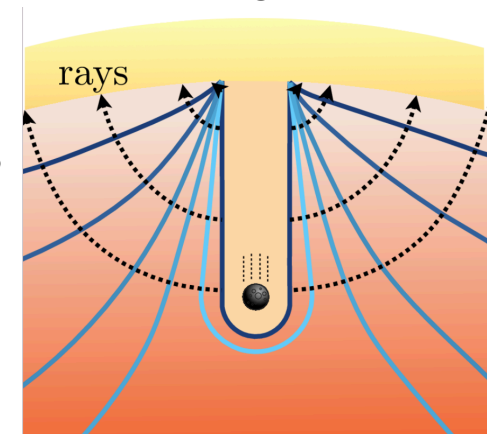
Imagining what Dark Matter might look like

- ❖ Most of the matter in our Universe is “dark matter” - **We don't know what it's made of!**
- ❖ Each possibility suggests new ways of looking for it.

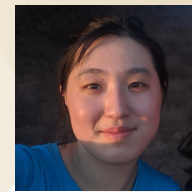
Milli-charged dark matter can be deflected to produce EM fields



Dark asteroids can cause shocks in celestial bodies



Axion dark matter can excite resonant transitions in superconducting RF cavity



Linda Xu

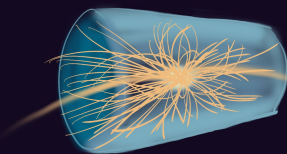
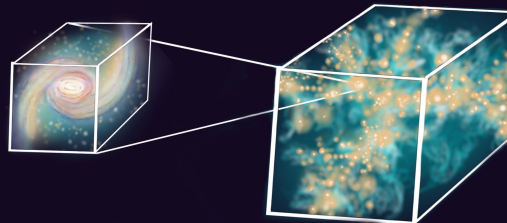
We work on new physics and where to find it

Recently, on finally testing **minimal electroweak dark matter**:



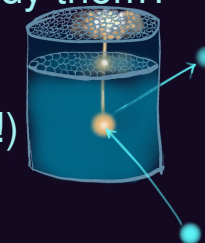
How to best leverage current and upcoming gamma ray observatories?

What do we really know about our local DM abundance and velocity?
And how can we do better?



What sort of future collider would we need to study them?

How excited should we be about the recent LZ event (!)



SLAC HEP Theory Group

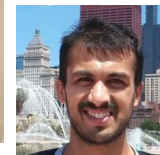
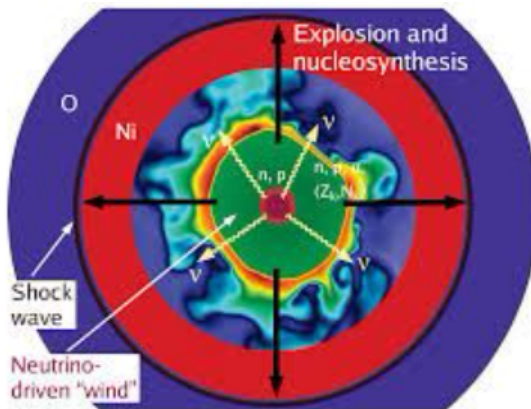
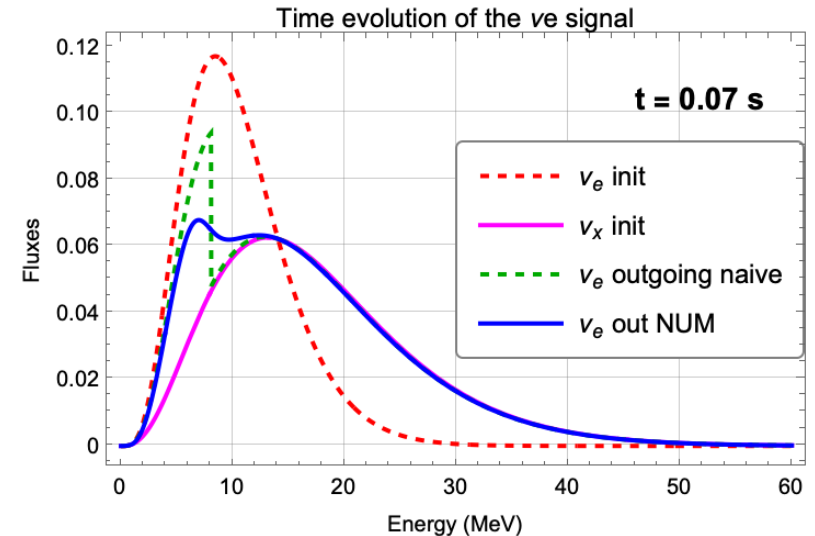


Alex Friedland



Using neutrinos to see inside a supernova

- ✿ When a massive star explodes, neutrinos undergo very complicated oscillations near its core.
- ✿ We explore how these oscillations are imprinted on the signal that will be detected at DUNE

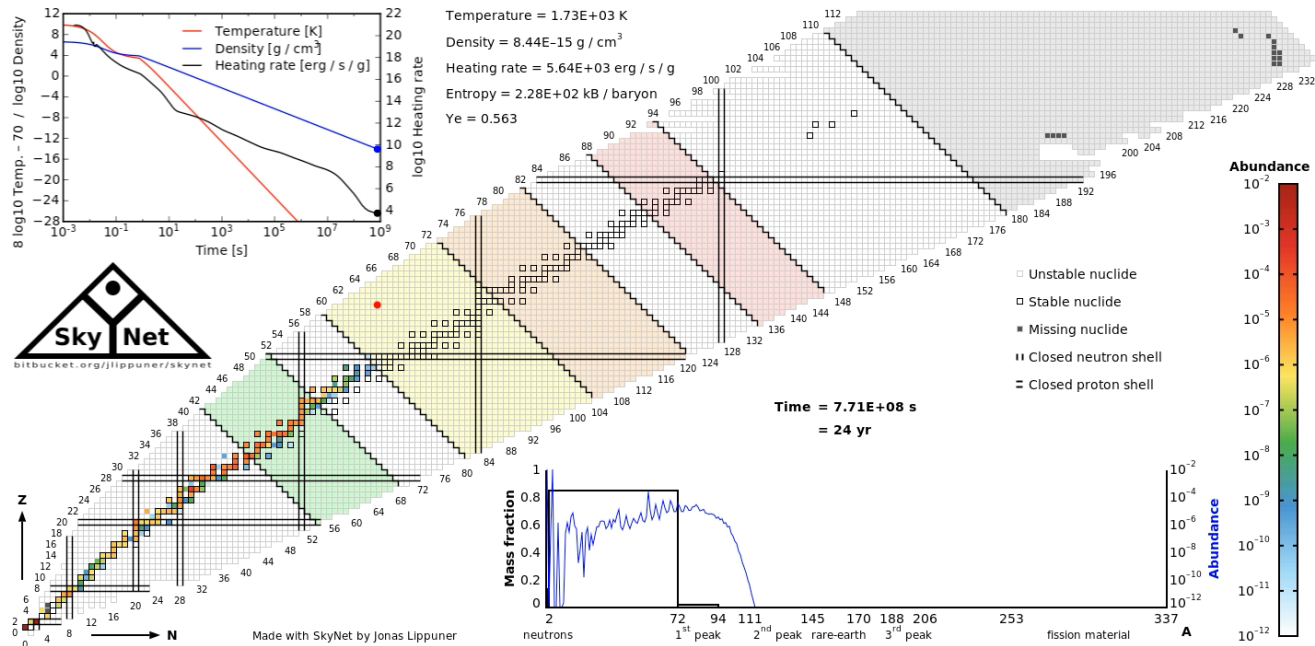




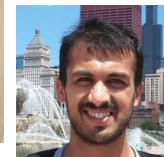
Alex Friedland

Neutrinos driving nucleosynthesis

- ✿ We also found how collective flavor oscillations are imprinted in the pattern of proton-rich isotopes observed in the Solar System



Details in arXiv:2607.15392





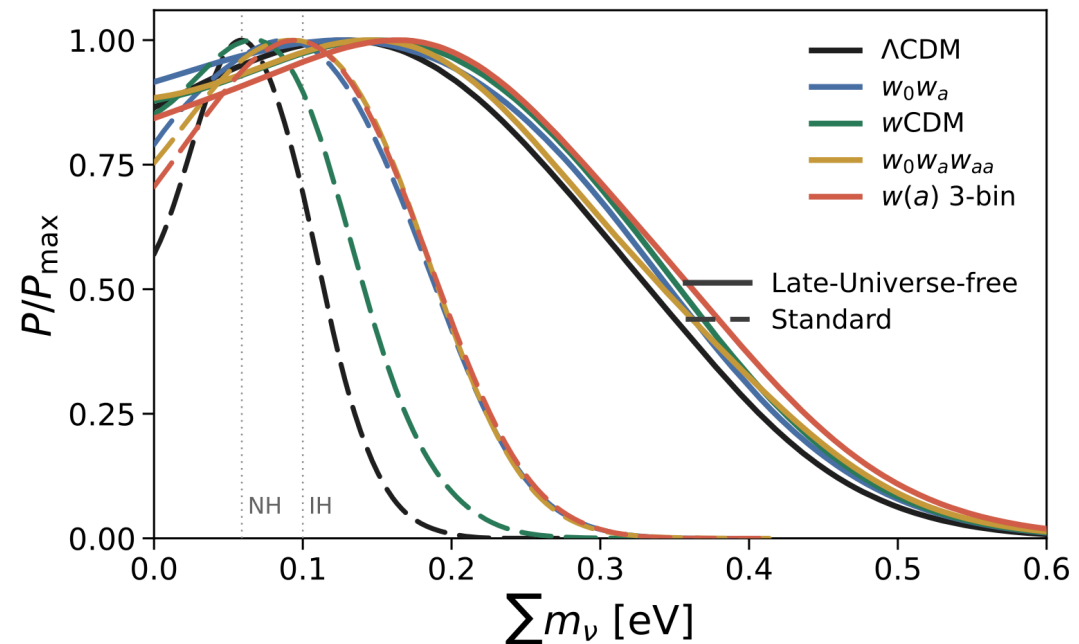
Alex Friedland

Using cosmological data to weigh the neutrino

With Manu Schaan and the team from KIPAC and Caltech



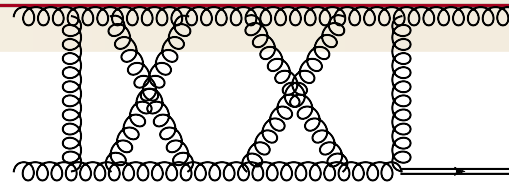
- ✿ The strongest upper limit on the neutrino mass comes from modern cosmological data
- ✿ Recently, tensions with the LambdaCDM paradigm have appeared
- ✿ Question: what is the bound on the neutrino mass that is independent of the late-universe measurements (where the tensions reside)?



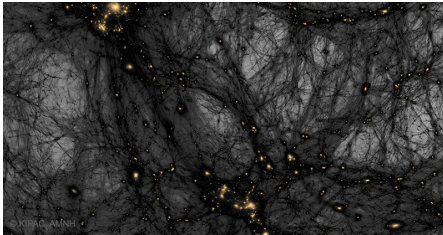
Details in arXiv:2607.24742

Advancing Particle Physics: SLAC HEP Theory Group

SLAC



Mathematical Foundation



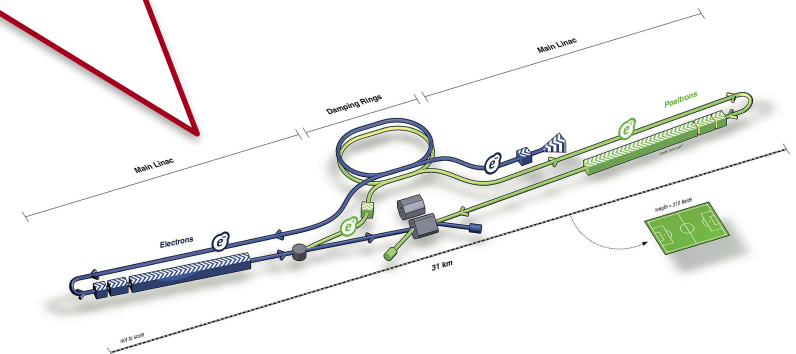
Mysteries of our Universe



Particle Phenomenology

Particle Theory

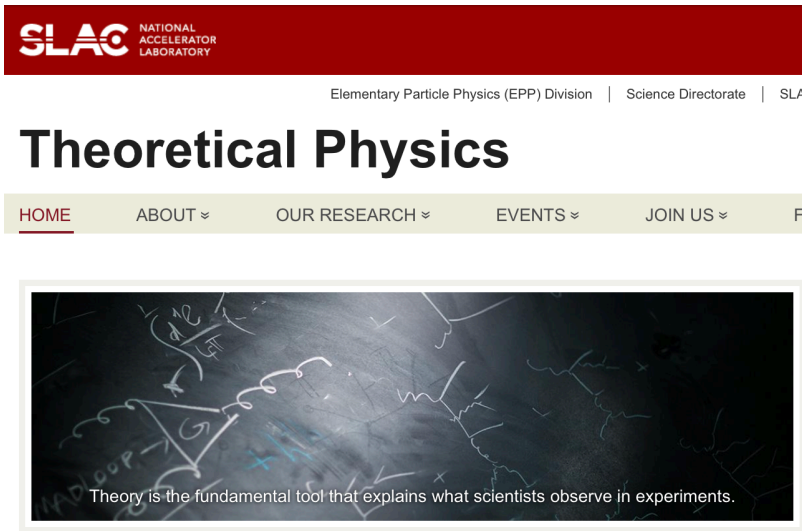
Largest Experiments of Nature



Design Future of Experimental Exploration

How to get in touch with us

- Find us at <https://theory.slac.stanford.edu>.



- Send us an e-mail, we are happy to chat:

- ♣ Lance Dixon: lance@slac.stanford.edu
- ♣ Alexander Friedland: alexfr@slac.stanford.edu
- ♣ Rebecca Leane: rleane@slac.stanford.edu
- ♣ Bernhard Mistlberger: bernhard@slac.stanford.edu
- ♣ Michael Peskin: mpeskin@slac.stanford.edu
- ♣ Thomas Rizzo: rizzo@slac.stanford.edu
- ♣ Philip Schuster: schuster@slac.stanford.edu
- ♣ Natalia Toro: ntoro@slac.stanford.edu

- Seminars:
We & Fr at 12:30 in Madrone (B048, rm 224)
- Amplitudes & QCD Journal Club
Contact Bernhard Mistlberger
- Dark Matter Journal Club
Contact Rebecca Leane

SLAO

- Second floor of Bldg 48, Madrone conference room (224), 2:00-3:30 pm

