Michael Glinsky is a PhD theoretical physicist, educated at UCSD. He worked for LLNL, Shell Research, BHP (which you probably know is the world's largest mining company), CSIRO (the Australian National Laboratory), and Sandia National Laboratories; before founding BNZ Energy Inc., a sustainable energy company. This included working as a super-quant for both Shell and BHP, estimating the risk and uncertainty of major capital investment projects, that ranged up to $10 billion in size.

He has been working in physics-based AI since 1994. This started with developing a convolutional probabilistic neural network that became a key part of the Shell seismic processing library: it continued with developing a Bayesian model estimation, integrated with a Multi-Layer Perceptron with sigmoid activation that became the industry standard for estimating the risk and uncertainty of petroleum and mining resources: it came full circle with developing a Bayesian model estimation integrated with a Deep Convolutional Network for fusion energy development and nuclear weapons design. Canonical genAI has been the natural evolution to using a defined functional "transformer" as input to a Multi-Layer Perceptron with Rectified Linear Unit activation. The common thread is that they all are low parameter physics-based model estimation, that is physics-based AI.

Michael E. Glinsky

Michael Edwin Glinsky (18 October 1960) is an American theoretical physicist and member of the American Physical Society, Society of Exploration Geophysicists, and the Society of Petroleum Engineers. In 1993, he was awarded the APS Marshall N. Rosenbluth Outstanding Doctoral Thesis Award for "for seminal contributions to the theory of three-body recombination in strongly magnetized plasmas, and for a unified theoretical calculation of the collisional equipartition rate in strongly magnetized pure electron plasmas that has enabled quantitative comparison to experiment over a range of eight decades in the effective magnetic field strength".[1] He also received the 2004 CSIRO Medal for Research Achievement (for developing and applying innovative techniques to assess reservoirs in deep sedimentary formations),[2] and the 1994 LLNL Award for Outstanding Scientific Publication (for the fast ignitor fusion target and drive design, a paper that has been cited over 4400 times).[3] He attended UCSD as a National Science Foundation Graduate Fellow, and was a Department of Energy Distinguished Postdoctoral Research Fellow at Lawrence Livermore National Laboratory (LLNL).[4]

Early life and education

Glinsky was born in Akron Ohio, and graduated from Springfield High School in 1979, as valedictorian. He did his undergraduate studies at Case Western Reserve University, graduating in 1983 (B.S. in physics, with Highest Honors). His studies were supported by a four-year full-tuition A. W. Smith Scholarship,[5] based on a competitive chemistry and math examination. He was President of the Case Institute of Technology Senior Class, and Social Chairman of the Sigma Nu Fraternity. He received his Ph.D. in 1991 from the University of California, San Diego.[6][7][8] Glinsky has further post graduate studies in advanced finance

Michael Glinsky

Glinsky in 2010

Born	October 18, 1960 Akron, Ohio, US
Education	CWRU (BS) UC San Diego (PhD)
Known for	Plasma physics in strong magnetic fields. High Energy Density Physics (HEDP). Fast fusion ignitor. DELIVERY Bayesian software. Heisenberg Scattering Transformation (HST).
Spouse	Barbara Ann Doddek (m. 1996)
Children	Alexandria, Michaela
Awards	A. W. Smith Scholarship (1979) William Grauer Photography Award (1981) NSF Graduate Fellowship (1985) APS Outstanding Doctoral Thesis Award (1993) DoE Distinguished Postdoctoral Research Fellowship (1993) LLNL Award for Outstanding Scientific Publication (1994)

from the University of Chicago, negotiations from Harvard University, and artificial intelligence from Carnegie Mellon University.

	CSIRO Medal for Research Achievement (2004)
	Scientific career
Fields	Physics Geophysics Finance AI
Institutions	LLNL Shell BHP CSIRO Sandia
Doctoral advisor	Tom O'Neil Marshall Rosenbluth

Career

Strategic Defense Initiative @ LLNL

Glinsky started his career in 1982 and 1985, working with Bob Thoe and Art Toor, fielding X-ray spectrometers on the Star Wars' Project Excalibur, which developed the first X-ray laser, led by Edward Teller and Lowell Wood, at LLNL in L-division (the nuclear test division). These were the first curved-crystal, grazing incidence X-ray spectrometers ever built.[9][10][11][12] He also did computer calculations, using Peter Hagelstein's code, XRAZER, that supported Project Excalibur.

Shell Oil Company

This was followed by working for Shell Oil Company, before returning to graduate school. He received a comprehensive education in both geophysics and geology, at the Shell Bellaire Training Center from industy pioneers such as Rufus LeBlanc (petroleum geology), Jim Robinson (seismic imaging), David DeMartini (rock physics),[13] and “Woody” (seismic interpretation). Working under Jim Robinson and David DeMartini, he developed an efficient method of estimating near surface velocity profiles using a downward continuation of first seismic arrivals.[14] The program was called DowCon Jr. During this time he programmed the first interactive graphical seismic interpretation software.

UCSD

In graduate school, Glinsky was advised by Tom O'Neil and Marshall Rosenbluth in plasma physics. He was also mentored in algebraic topology and differential geometry, as it applied to physics, by Ted Frankel and Michael Freedman. He applied these concepts, doing seminal work on “Temperature equilibration and three-body recombination in strongly magnetized pure electron plasmas” — the title of his PhD dissertation.[15][16][17][18] This work helped in the design of experiments at CERN to form anti-hydrogen[19][20] in Penning-Malmberg traps — an important experimental test of the Standard Model. Dan Brown's novel *Angels & Demons*, and the movie made from it, use antimatter trapped at CERN as an important plot point.[21]

LLNL

After obtaining his PhD from UCSD, he returned to LLNL, but this time he became part of X-division (laser target and drive design for the Nova laser). He worked with Max Tabak, Jim Hammer, and Bill Kruer on the design of the Fast Ignitor.[3] His focus was on the production and transport of fast electrons produced by the new short pulsed petawatt lasers.[22] This was the time of the first Cooperative Research

and Development Agreements (CRADAs). This opportunity turned Glinsky's focus back to the private sector. He led a cooperative R&D effort between LLNL and Shell Oil to develop a Probabilistic Neural Network using wavelet transform (convolutional) attributes to pick prestack migrated gathers.[23] This tool eventually became part of the Shell Seismic Processing library, enabling 3D PreStack Depth Migration (PSDM) of seismic data.[24] He also worked as a member of LLNL's Center for Healthcare Technologies, along with Dennis Matthews (who is best known for leading the group who demonstrated the first X-ray laser in the laboratory using the Nova laser[25]). He worked with George Zimmerman to retool the laser design code LASNEX, adding material strength and failure, so that it could model laser medical device interactions with biological tissues.[26] He did design studies for a laser treatment of ischemic stroke,[27] developed the business pitch deck,[28] then gave the pitches that resulted in a consortium, lead by Vanguard Ventures (one of the original and most successful Silicon Valley venture capital companies, founded by Jack Gill in 1981),[29] forming the startup Endovasix. Endovasix is the subject of a case study at the Jones Graduate School of Business at Rice University.

Royal Dutch Shell

In 1997, Glinsky left LLNL, and joined Royal Dutch Shell, working at the Bellaire Research Center in Houston. His work focused on the addition of Amplitude Variation with Offset (AVO), MultiLayer Perceptrons (MLPs), and rock physics models to the Bayesian statistics-based seismic inversion program PROMISE.[30] He then integrated PROMISE (whose development was led by Jaap Leguijt at the Rijswijk Shell Research Lab in the Netherlands) into the interactive reservoir modeling program DepSim, went around the world working with the assets to apply the technology,[31][32][33] and developed a course which he taught at the Shell training centers in both the USA and the Netherlands.[34] This technology was recognized for realizing tens of millions of dollars of value with each application. At the same time he was part of a small team that developed a method of research portfolio optimization and valuation.[35] He developed the advanced stochastic financial evaluation and portfolio optimization software. This method came to be known as the Business and Technology Mapping (BTM) process that is still being used by Royal Dutch Shell, today.[36]

Jaap Leguijt, father of the seminal Bayesian seismic inversion code PROMISE, at a seismic inversion course in Houston (third from the right, in the back)

BHP

In 2000, Glinsky left Shell and joined BHP. There he developed into a technology leader, but still maintained active research. With James Gunning from CSIRO, he developed the DELIVERY suite of software[37] which improved and extended the PROMISE methodology, to include: stochastic wavelet derivation,[38] time-lapse inversion,[39][40] Controlled Source Electro-Magnetic (CSEM) inversion,[41][42] unconventional shale frackability inversion,[43] reservoir simulation inversion (in collaboration with Chris White at LSU),[44][45] a new rock physics model that allowed inversion for rock quality and shale frackability (in collaboration with Dave DeMartini and Steve Bryant of the University of Texas),[46][47][48] and converted-wave inversion (in collaboration with Jinsong Chen at LBNL).[49] This software was OpenSourced, and is now a part of most commercial seismic processing software.[50]

Glinsky led the effort to develop an uncertainty and risk analysis system for petroleum exploration and development, that integrated DELIVERY and proximal gradient sparse seismic inversion, with stochastic financial models (in collaboration with Sharon Sievert).[51] This effort also developed a petroleum portfolio analysis tool. These tools were used by BHP to risk over 200 projects,[52][53][54][55] with risk and uncertainty estimation verified by lookback studies. Based on this quantitative interpretation and financial evaluation software, he developed a course, that he co-taught with Dave DeMartini, to over 150 students at BHP and DUG Technology.[56][57][58] Sharon Sievert and Glinsky also developed and taught the Advanced Financial Evaluation continuing education course for the Society of Petroleum Engineers.[59][60] During his time at BHP, he started a long term collaboration with Stephane Mallat on the use of wavelets. The first outcome of this collaboration was one of the first applications of Ingrid Daubechies' proximal gradient sparse inversion to seismic data, which included AVO and converted-wave data[61][62][63] — a major quantitative improvement in seismic sparse spike inversion. The second outcome of this collaboration was the use of wavelet analysis to identify geologic lithofacies in seismic data (in collaboration with Jesse Melick).[64][65] There was another collaboration with Moshe Strauss from the Israeli Nuclear Research Center, Ben Kneller from UCSB, and Eckart Meiburg from UCSB on understanding the self-organization of turbidite deposition, via large scale computer simulation and wavelet analysis.[66][67] He was an expat in Australia, for the last part of his tenure with BHP, focusing on the application of the DELIVERY software suite to the evaluation of mining resources, especially iron ore and potash.[68] Glinsky led the development of the first Desktop as a Service (DaaS), called the qiWorkbench,[69][70][71][72][73] that was OpenSourced. This DaaS was used to deploy the software suite, both DELIVERY and risk-uncertainty-portfolio analysis, throughout BHP. This software architecture and suite of technology was also the foundation on which DUG Technology was built (in collaboration with Matt Lamont). This DaaS was enhanced by a research collaboration with Vivek Sarkar of Rice University, that extended the Java Just-In-Time (JIT) compiler to efficiently do complex arithmetic and matrix computations.[74]

Glinsky is on the right, Jim Robinson third from the left, Ben Kneller second from the right, Chris Lerch is second from the left, and Jesse Melick is on the left

Matt Lamont (Founder & Managing Director, DUG Technology Ltd.) top row second from left, James Gunning bottom row on left, Dave DeMartini bottom row second from right, Mark Flynn top row third from the right, and Mark Stanley bottom row second from the left

CSIRO

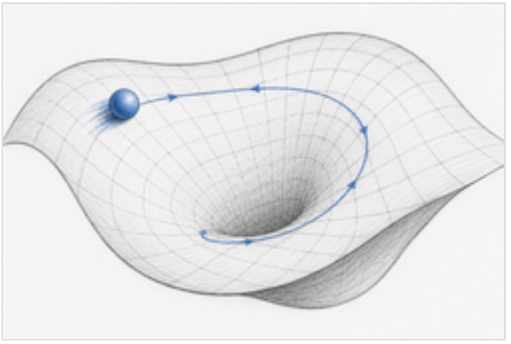
In 2010, Glinsky joined the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia as a Science Leader. There is an interesting article on him at this time in the publication EarthMatters.[8] The focus of his technical work was the application of the DELIVERY Bayesian seismic analysis software to CO2 sequestration;[75] and the physics field theory behind the iterative wavelet Scattering Transformation,[76] that his collaborator Stephane Mallat had recently invented.[77] The

Scattering Transformation has the form of a Deep Convolutional Neural Network (DeepCNN), but with no parameters to estimate. At the same time, Glinsky was an Adjunct Professor of Physics at the University of Western Australia.

Sandia National Laboratories

In 2016, Glinsky joined Sandia National Laboratories. His worked changed focus from geophysics, back to fusion energy. Instead of the laser Inertial Confinement Fusion (ICF) research that he had pursued at LLNL, his focus became pulsed-power Magneto-Inertial Fusion (MIF). He was the chief designer of a series of experiments on the National Ignition Facility (NIF) at LLNL, that explored how the MagLIF MIF concept would scale.[78] He used the Bayesian data assimilation concepts behind the DELIVERY software suite to lead the development of a similar method to analyze the MIF experiments at Sandia and LLNL.[79] His work on the Scattering Transformation also continued, as he applied it to quantify and analyze the morphology of the plasma self-organization that was being seen in the MIF experiments and computer simulations,[80] 3D X-ray imaging of integrated circuits (in collaboration with George Barbastathis of the Massachusetts Institute of Technology),[81] and additive manufacturing (in collaboration with Amir Barati Farimani and Francis Ogoke of Carnegie Mellon University).[82]

Recent work



Canonical genAI reduces evolution of the field, that is collective motion, to a low-dimensional geodesic motion, by use of the Heisenberg Scattering Transformation.

Since 2022, Glinsky has been focused on a new Artificial Intelligence (AI).[83][84] This new AI was built upon the work that he had done using: wavelets, the Scattering Transformation, low-dimensional Bayesian analysis of physical systems, and knowledge of the mathematics behind topology and nonlinear self-organization. Paul Dirac, late in his career, issued two theoretical challenges to physicists:[85] to make all field theory an issue of geometry (Lie group symmetry or topology), like Albert Einstein had general relativity, not probability; and, to find a logical mathematical process of renormalization (a method to calculate the S-Matrix of Werner Heisenberg's canonical approach to field theory). It is possible that Glinsky has addressed these two challenges by the invention of the Heisenberg Scattering Transformation (HST) — the formula at the heart of the new Canonical AI. The form of the HST is that of both DeepCNNs, and the Scattering Transformation. There are applications of this new Canonical AI that could enable high gain fusion target and drive design,[86] topological computation,[87] and a new theory of economics and finance.[88]

Finally, Glinsky's work has come full circle by re-examining plasma theory, from the perspective of exterior calculus in a coordinate-free way. This has resulted in a generalized Variational Theory of Reaction Rates.[89] This returns to his graduate work on three-body recombination and puts that work in the context of his most recent work on the HST — connecting the CERN antimatter experiments to a new way of approaching Generative Artificial Intelligence

Glinsky is the inventor of 8 patents, and the inventor of another 4 patent applications.

Personal life

He met and married Barbara Doddek in 1996, while working at LLNL. They had two children together. He is a life long cyclist, racing as an amateur in Southern California, Baja California, and France, as well as an award winning art photographer, as discussed in the Fall 2020 Case Alumnus magazine.[7]

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