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Darrel W. Johnston, PMP
Sr. Program Manager,
Demilitarization Laboratory Support
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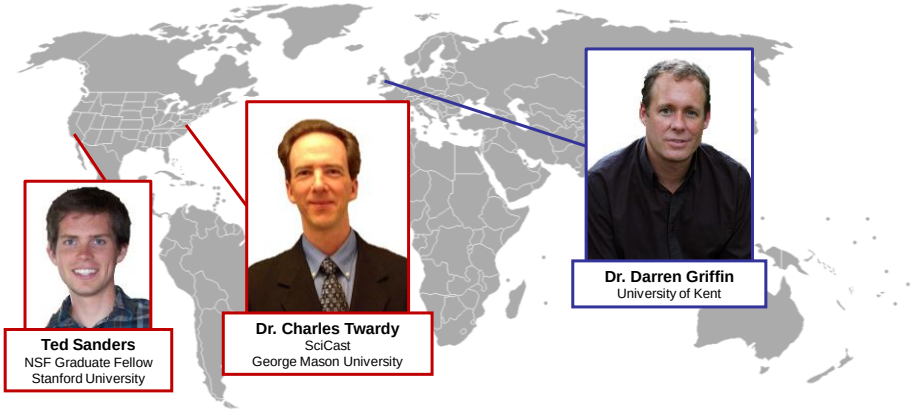
Forecasting Chemistry: Predicting Tomorrow's Cutting Edge Science, Today



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FORECASTING CHEMISTRY
Predicting Tomorrow's Cutting Edge Science, Today

SciCast

Charles Twardy, SciCast PI
ACS Webinar
August 21, 2014

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GOALS FOR TODAY

Introduce SciCast and forecasting

Introduce the team and project

Provide a tutorial and discussion

- Market overview
- How to make forecasts
- How to generate questions

Show examples

Get you involved

POLL: NOBEL PRIZE

In which branch will the 2014 Nobel Prize in Chemistry be awarded?

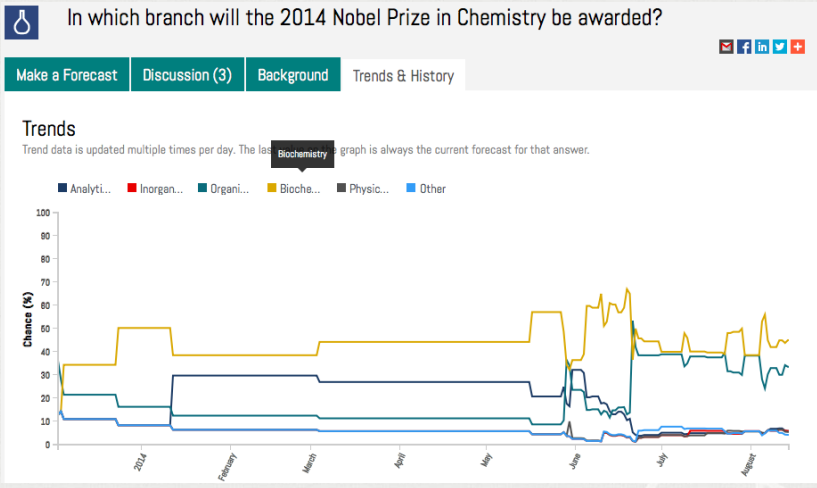
- Analytical chemistry
- Inorganic chemistry
- Organic chemistry
- Biochemistry
- Physical chemistry
- Other (type in your “other” response)

SCICAST FORECASTED RESULTS

In which branch will the 2014 Nobel Prize in Chemistry be awarded?

• Analytical chemistry	6%
• Inorganic chemistry	6%
• Organic chemistry	34%
• Biochemistry	45%
• Physical chemistry	5%
• Other	4%

SCICAST FORECASTED RESULTS



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Make Predictions

Track Results

Earn Recognition

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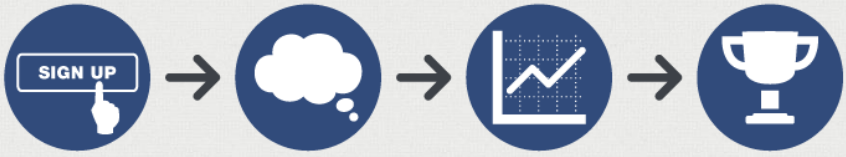

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Make Predictions

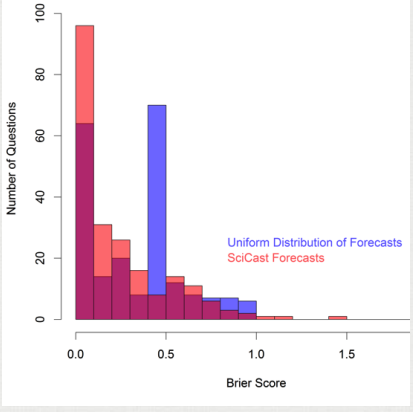
Track Results

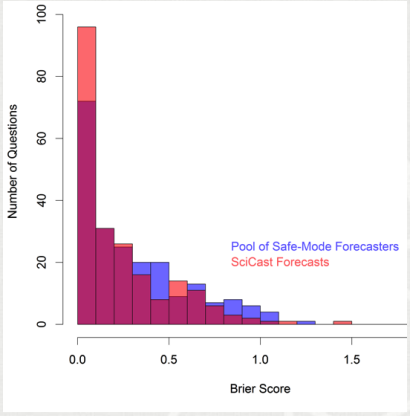
Earn Recognition

- You receive **points**.
- Each forecast **requires** points.
- Bigger changes cost more – but **gain more** if you're right.
- Better forecasters **have more influence**.

DOES IT WORK?

We beat the baseline more than 2/3 of the time.





THE PROJECT

Research project funded by IARPA

- Dr. Jason Matheny is the IARPA Program Manager
- Began as the DAGGRE team in the IARPA ACE geopolitical forecasting tournament
- One of two teams to pass Y2 hurdles
  - Moved to S&T forecasting under the new ForeST program and renamed SciCast
- Actively collecting data and testing forecasting related hypotheses

Collaborating with the IARPA FUSE program

- FUSE mines text from scientific journals around the world
- FUSE teams write many SciCast questions

OUR TEAM

George Mason University
Serving as the prime contractor and providing the scientific leadership of the effort.

Inkling Markets
Designing and implementing the user interface and operating the market.

GoldBrand Software
Developing the core and integrating other software.

Tuuyi
Developing the Recommender and a new Bayesian inference engine for the market.

KaDSci
Providing market operation and outreach support as well as intelligence analysis expertise.

TEAM LEADERSHIP

CHARLES TWARDY, PH.D.
PRINCIPAL INVESTIGATOR

Dr. Twardy is a research assistant professor at George Mason University with a dual Ph.D. in Cognitive Science and History & Philosophy of Science. He works on Bayesian inference.

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KATHRYN LASKEY, PH.D.
CO-PRINCIPAL INVESTIGATOR

Dr. Laskey is a professor of systems engineering and operations research at George Mason University. She focuses on knowledge representations for Bayesian inference and learning.

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ROBIN HANSON, PH.D.
ACADEMIC ADVISOR

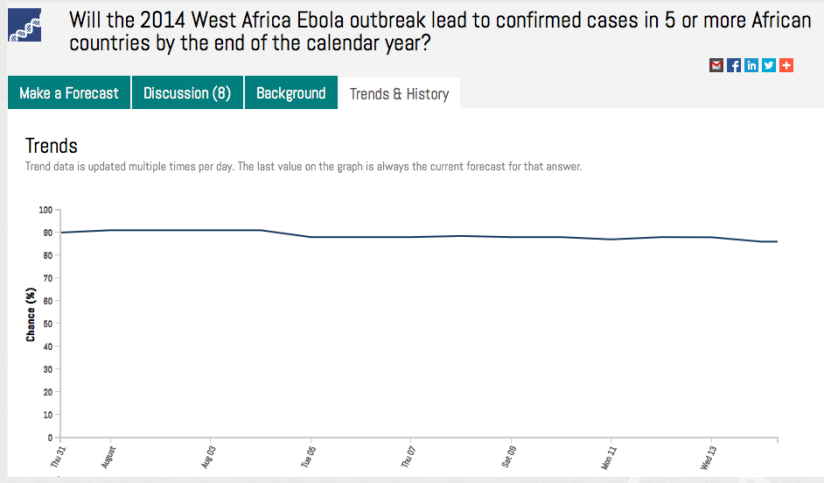
Dr. Hanson is an associate professor of economics at George Mason University. He has over 70 publications and has pioneered prediction markets since 1988.

rhanson@gmu.edu

POLL: EBOLA

Will the 2014 West Africa Ebola outbreak lead to confirmed cases in 5 or more African countries by the end of the calendar year?

SCICAST FORECASTED RESULTS



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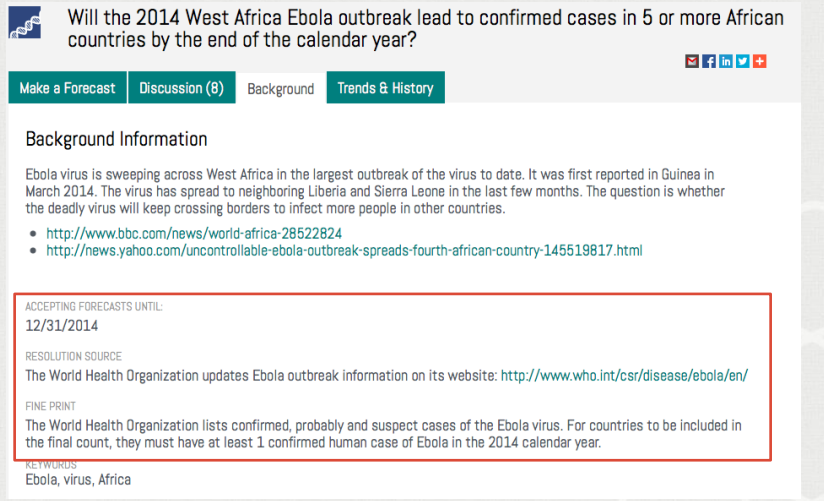


WHAT IS SCICAST?

SciCast is a prediction market focused on science and technology.

We aggregate the knowledge and expertise of a diverse group of professionals and non-professionals from around the world and return probable forecasts on future innovations.

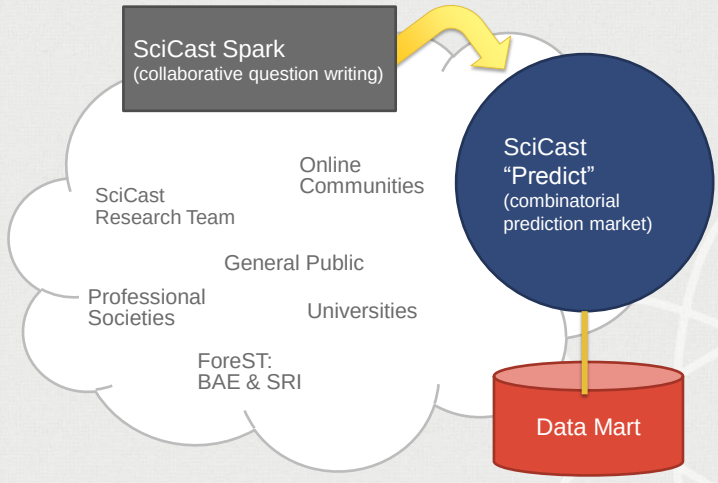
SciCast is different from other prediction markets because *it can create and explore relationships between questions*.

PARTICIPATION

79,316 Forecasts Made

- 9,000+ registered participants
- 800+ questions published
- 500+ questions currently live
- 300+ forecasts per day

SCICAST ECOSYSTEM



OUR CROWD

Collaborators

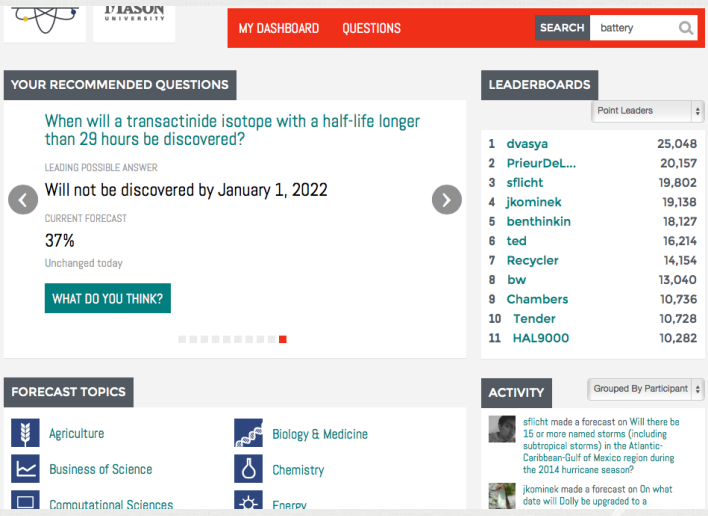
Partners

- Contribute original questions
- Contribute to other questions
- Monitor existing questions
- Provide feedback on content

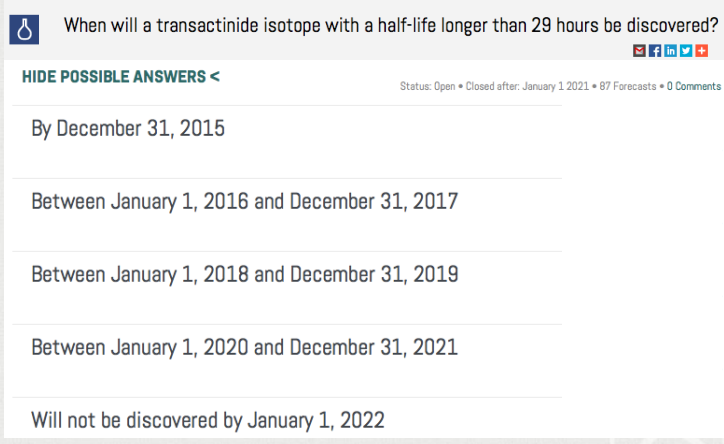
- For major S&T topic areas
- For interest areas (Challenges)
- Thought leadership / expertise
- Community engagement

- Process management
- Quality control
- Topic leader support
- Track performance metrics
- Spark development and technical support

LANDING PAGE



POLL: TRANSACTINIDES



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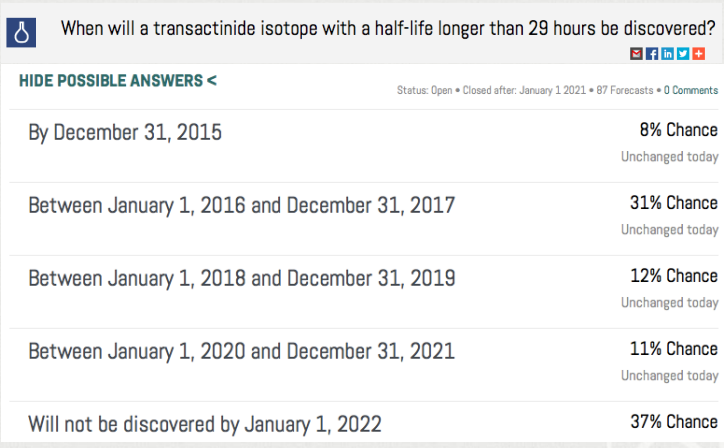
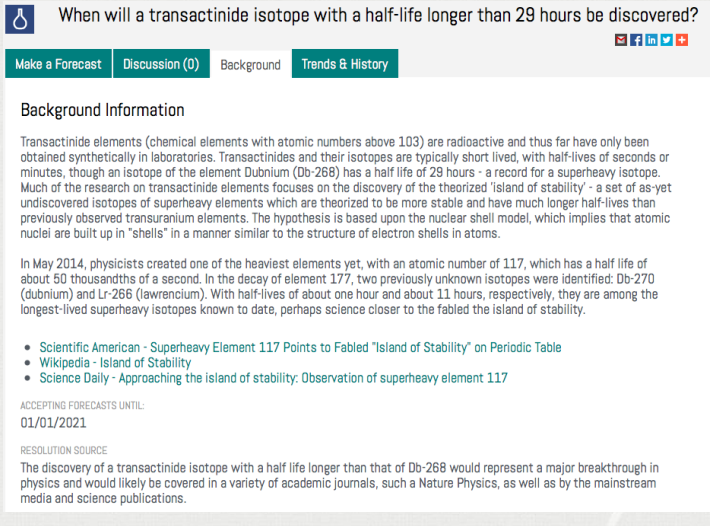
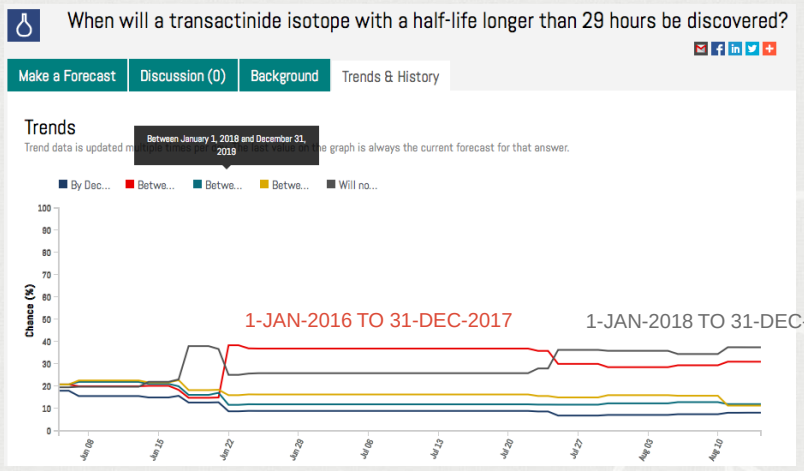


BACKGROUND INFO



BACKGROUND INFO



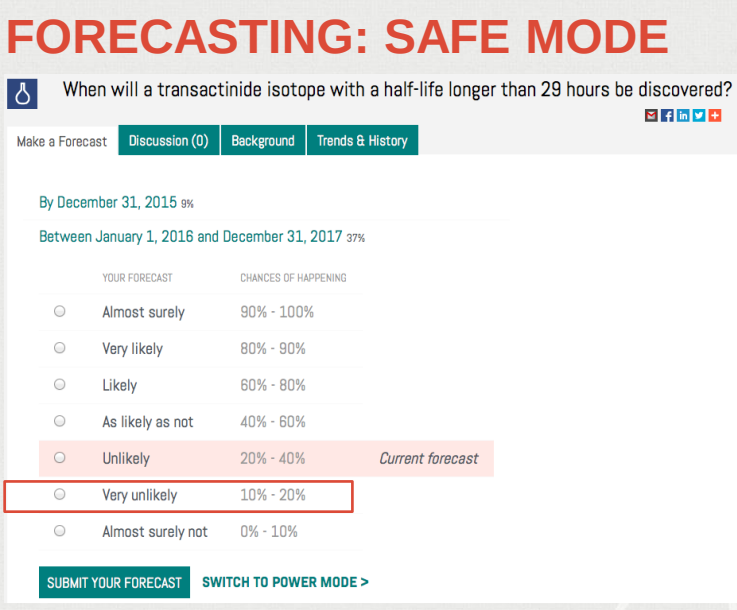
FORECAST HISTORY

When will a transactinide isotope with a half-life longer than 29 hours be discovered?

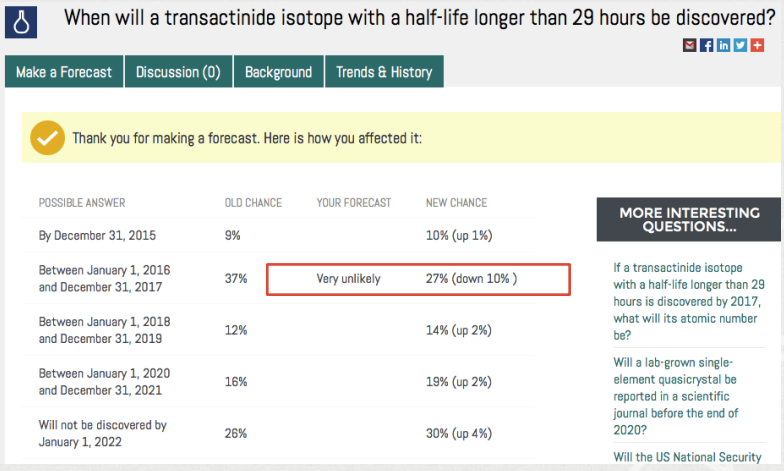
Forecast History

Date	Username	Possible Answer	Old Forecast	Forecast	New Forecast
August 12, 2014 07:39 PM	scicast33	By December 31, 2015	8% Chance	Very unlikely (10% - 20% Chance)	8%
August 10, 2014 01:35 AM	jkominek	Between January 1, 2020 and December 31, 2021	16% Chance	11% Chance	11%
August 05, 2014 07:39 PM	scicast33	Between January 1, 2018 and December 31, 2019	13% Chance	Unlikely (20% - 40% Chance)	13%
August 05, 2014 07:39 PM	scicast33	Between January 1, 2016 and December 31, 2017	29% Chance	Very unlikely (10% - 20% Chance)	29%
August 05, 2014 07:39 PM	scicast33	By December 31, 2015	7% Chance	Very unlikely (10% - 20% Chance)	7%
August 05, 2014 01:41 PM	pigmoose	Between January 1, 2016 and December 31, 2017	28% Chance	As likely as not (40% - 60% Chance)	29%
August 05, 2014 10:38 AM	william.quixote	Between January 1, 2020 and December 31, 2021	17% Chance	16% Chance	16%
August 05, 2014 10:37 AM	william.quixote	Between January 1, 2016 and December 31, 2017	29% Chance	28% Chance	28%
August 05, 2014 02:25 AM	Chambers	Between January 1, 2016 and December 31, 2017	29% Chance	29% Chance	29%

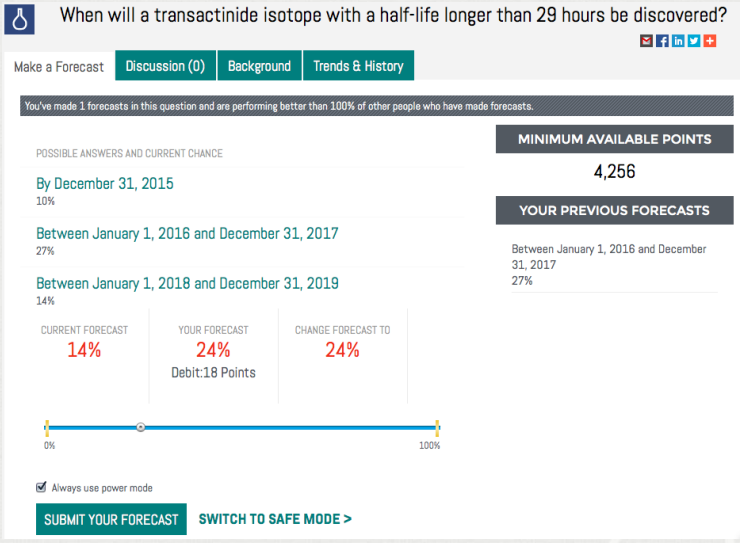
FORECASTING: SAFE MODE



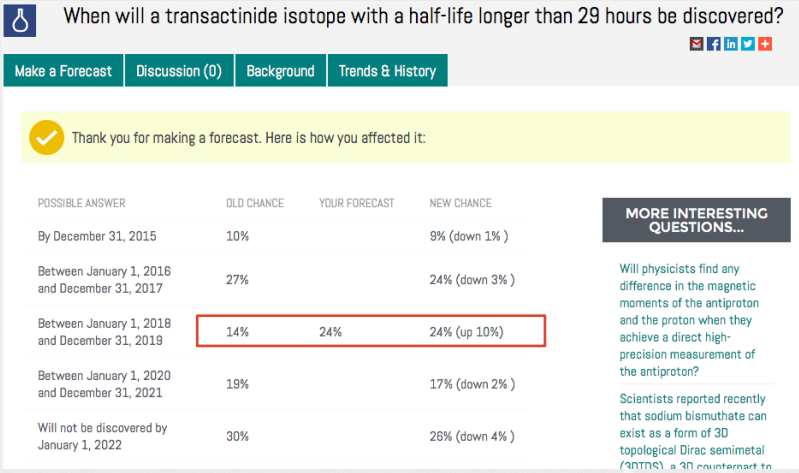
FORECASTING: SAFE MODE



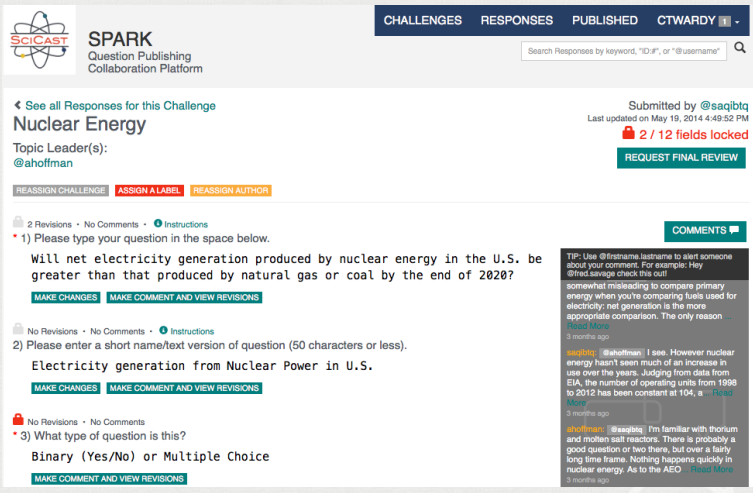
FORECASTING: POWER MODE



FORECASTING: POWER MODE



QUESTION WRITING



POLL: DRUG TO AID DEAF

When will the pharmaceutical industry produce a new drug to aid the deaf, by targeting the inner ear?

- By December 31, 2016
- Between January 1, 2017 and December 31, 2018
- Between January 1, 2019 and December 31, 2020
- Between January 1, 2021 and December 31, 2023
- Between January 1, 2024 and December 31, 2027
- Will not occur before January 1, 2028

RESOLUTION SOURCE

The question will resolve when the FDA approves a drug that targets the inner ear for the purpose of lessening or mitigating deafness and/or hearing loss in humans.

FINE PRINT

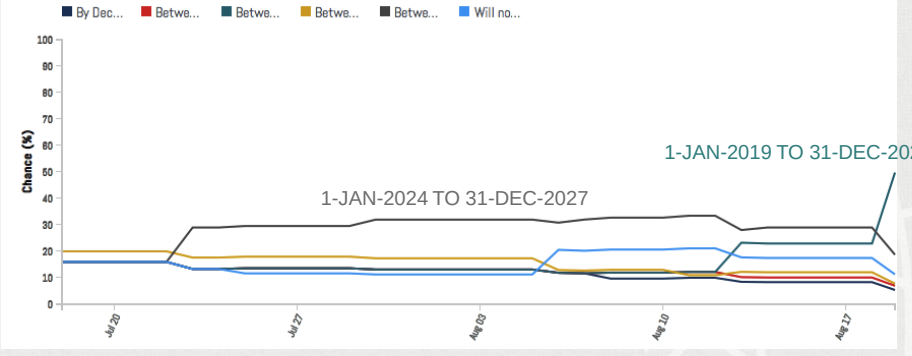
The drug must allow patients, clinically defined as deaf, to hear at a level greater than that of which they heard before.

SCICAST FORECASTED RESULTS

When will the pharmaceutical industry produce a new drug to aid the deaf, by targeting the inner ear?

By December 31, 2016	5% Chance Down 3% today
Between January 1, 2017 and December 31, 2018	7% Chance Down 3% today
Between January 1, 2019 and December 31, 2020	50% Chance Up 27% today
Between January 1, 2021 and December 31, 2023	8% Chance Down 4% today
Between January 1, 2024 and December 31, 2027	19% Chance Down 10% today
Will not occur before January 1, 2028	11% Chance Down 6% today

TRENDS: INNER EAR

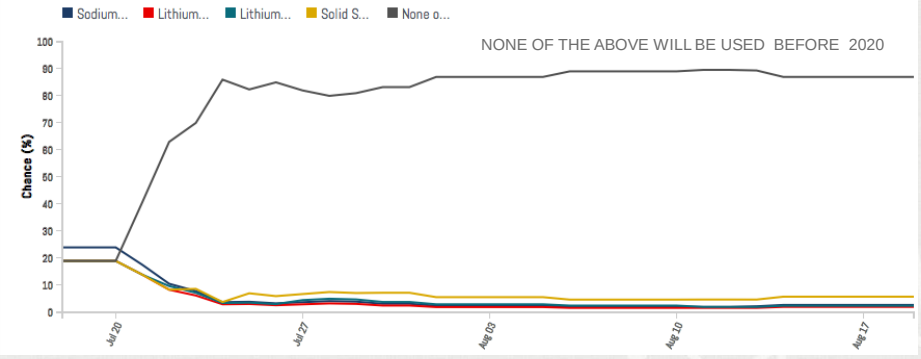


POLL: BATTERY TYPES

Which of the following battery types mentioned in the C&EN July 2014 issue will be the first to be used in an electric car sold by 2020?

- Sodium-Ion (Na-ion)
- Lithium Sulfur (Li-S)
- Lithium Air (Li-air)
- Solid State Lithium-Ion
- None of the above will be used prior to 2020

SCICAST FORECASTED RESULTS



SCICAST FORECASTED RESULTS

Showing 1 of 1

ted

1. None of these technologies are even close to lithium ion.
2. Even if they were close, the technologies would take years to develop commercially.
3. It would also take years to test for safety and get government approval.
4. It would also take years to redesign/reoptimize battery control electronics for a new chemistry.
5. It would also take years for the supply chain and manufacturing practices to catch up to lithium ion.
6. It would also take years for the new battery industry to grow and reach the economies of scales that lithium ion is already at…

Basically, the only way that these will supplant lithium ion is if they are significantly better AND even then, it will take many years.

Definite "none of the above."
Written at 02:04 PM on July 31 2014

INTERESTED?

You can help us measure and improve S&T forecasting

Forecast

- Sign up at https://scicast.org
- Search, specialize, update
- Watch for incentives & other events
- Host an “advanced” seminar on trading strategies

Write new questions

- Register for Spark at http://spark.scicast.org
- Work with research team to refine questions
- Longer-term questions
- Questions can be public or private

If there is another potential application of the prediction market technology, contact the research team!

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PUBLICATIONS & PRESENTATIONS

Karvetski, Christopher W., Kenneth C. Olson, David R. Mandel, and Charles R. Twardy. 2013. Probabilistic Coherence Weighting for Optimizing Expert Forecasts. *Decision Analysis* 10 (4): 305–26. doi:10.1287/deca.2013.0279. http://pubsonline.informs.org/doi/abs/10.1287/deca.2013.0279.

Twardy, C. et al. 2014. SciCast: Collective Forecasting of Innovation. MIT CI'2014.

Olson, K. et al. 2014. Interval elicitation of forecasts in a prediction market reveals lack of anchoring 'bias'. MIT CI'2014.

Sun, W. et al. 2014. Trade-based asset modeling using dynamic junction tree for combinatorial prediction markets. MIT CI'2014.

Twardy, C. 2014. SciCast: Collective Forecasting of Science and Technology. 5eyes Analytic Workshop. Oxford, MS. 25 March.

Twardy, C. 2014. SciCast. FEDLINK Analytical Methods for Technology Forecasting Workshop. Washington, D.C. 6 March.

Hanson, R. 2014. Presentation and discussion of prediction markets and SciCast. Potomac Institute CREST Seminar, 30 Jan.

Karvetski, C.W. 2013. Statistically improving prediction market forecasts. The Annual Meeting of the Society for Risk Analysis, Baltimore, MD.

Olson, K.C. Improving expert judgment by coherence weighting. The Annual Meeting of the Society for Risk Analysis, Baltimore, MD.

Olson, K.C., C.W. Karvetski. 2013. Analyzing Competing Intelligence Hypotheses with Belief Network Sharing. Intelligence Community Postdoctoral Research Conference, Washington D.C.

Karvetski, C.W., K.C. Olson. 2013. Optimizing Expert Forecasts with Probabilistic Coherence. Intelligence Community Postdoctoral Research Conference, Washington D.C.

Olson, K,C. Best practice for eliciting and weighting incoherent judgments. Society for Judgment and Decision Making, Toronto, ON, Canada

Powell, W.A., Hanson, R., Laskey, K.B. and Twardy, C. 2013. Combinatorial Prediction Markets: An Experimental Study. Proceedings of the Seventh International Conference on Scalable Uncertainty Management (SUM 2013). Alexandria, VA, September.

Twardy, C. Overview of ACE & DAGGRE lessons learned. Teaching & Researching Intelligence panel. Global Intelligence Forum. July 20, Dungarvan, Ireland

Sun, W., Hanson, R., Laskey, K., & Twardy, C. 2013. Learning parameters by prediction markets and Kelly rule for graphical models. Bayesian Modeling Application Workshop "Big data meet complex models" at UAI. 13 July 2013. Bellevue, WA.

Hanson, R. 2013. Bayes Net Based Combinatorial Prediction Markets. Prediction engines panel. Microsoft Research Faculty Summit. 15 July 2013. Redmond, WA.

------. Also presented to Microsoft Research New York. 18 July 2013.

Hanson, R. 2013. Prediction market forecasts – What gets used and why? MITRE Technology Forecasting Perspectives workshop, McLean, VA, 11 June.

Berea, A. 2013, Automated Trading in Prediction Markets - The Case of DAGGRE Autotraders. IAFIE Annual Meeting, El Paso.

Berea, A., D. Maxwell, C. Twardy, Forecasting the Failed States Index. IAFIE Annual Meeting, El Paso.

Berea, A., Maxwell, D., Twardy, C. 2013. Automated Trading in Prediction Markets. SBP'13, Washington, D.C.

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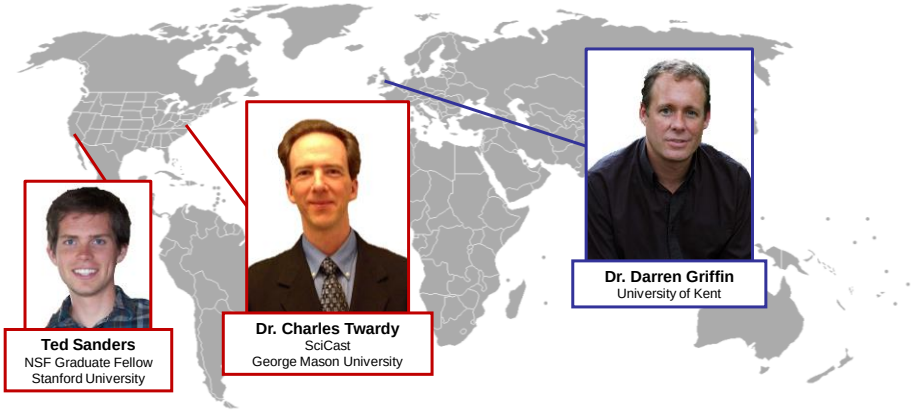

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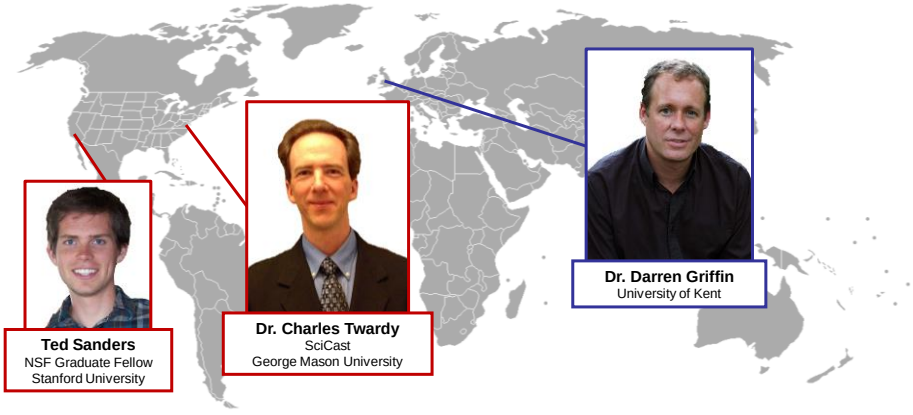

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Darrel W. Johnston, PMP
Sr. Program Manager,
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