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Type them into questions box!

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Sr. Program Manager,
Demilitarization Laboratory Support
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Thursday, September 4, 2014
“Planting the Seeds of Sustainable Chemistry”

Dr. Jennie Dodson, Chair of the Network of Early-Career Sustainable Scientists and Engineers (NESSE)

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FORECASTING CHEMISTRY
Predicting Tomorrow’s Cutting Edge Science, Today

Charles Twardy, SciCast PI
ACS Webinar
August 21, 2014
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)

George Mason University

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%

George Mason University
SCICAST FORECASTED RESULTS

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

Trends
Trend data is updated multiple times per day. The last week’s graph is always the current forecast for that answer:

- Analytical
- Inorganic
- Organic
- Biological
- Physical
- Other

Make Predictions
Sign up at SciCast.org
Earn Recognition

HOW SCICAST WORKS

Sign up at SciCast.org → 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.
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

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.

klaskey@gmu.edu

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

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

Trends
Trend data is updated multiple times per day. The last value on the graph is always the current forecast for that answer.

Background Information
Ebola virus is sweeping across West Africa in the largest outbreak of the virus to date. It was first reported in Guinea in March 2014. The virus has spread to neighboring Liberia and Sierra Leone in the last few months. The question is whether the deadly virus will keep crossing borders to infect more people in other countries.


ACCEPTING FORECASTS UNTIL: 12/31/2014

RESOLUTION SOURCE:

FINISH: The World Health Organization lists confirmed, probable and suspect cases of the Ebola virus. For countries to be included in the final count, they must have at least 1 confirmed human case of Ebola in the 2014 calendar year.

EXTRATOPS:
Ebola, virus, Africa
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**

SciCast Spark
(collaborative question writing)

SciCast
“Predict”
(combinatorial prediction market)

Data Mart

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SciCast Research Team
General Public
Professional Societies
Universities
ForeST: BAE & SRI

**OUR CROWD**

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- BAE Systems

**Partners**

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- IEEE
- ISACA
- AMIA
- TECHCAST

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

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

**SciCast Question Management Team**
- Process management
- Quality control
- Topic leader support
- Track performance metrics
- Spark development and technical support
**LANDING PAGE**

**POLL: TRANSACTINIDES**

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

- By December 31, 2015
- Between January 1, 2016 and December 31, 2017
- Between January 1, 2018 and December 31, 2019
- Between January 1, 2020 and December 31, 2021
- Will not be discovered by January 1, 2022
SCICAST FORECASTED RESULTS

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

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Chance</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>By December 31, 2015</td>
<td>8%</td>
<td>Unchanged</td>
</tr>
<tr>
<td>Between January 1, 2016 and December 31, 2017</td>
<td>31%</td>
<td>Unchanged</td>
</tr>
<tr>
<td>Between January 1, 2018 and December 31, 2019</td>
<td>12%</td>
<td>Unchanged</td>
</tr>
<tr>
<td>Between January 1, 2020 and December 31, 2021</td>
<td>11%</td>
<td>Unchanged</td>
</tr>
<tr>
<td>Will not be discovered by January 1, 2022</td>
<td>37%</td>
<td>Unchanged</td>
</tr>
</tbody>
</table>

BACKGROUND INFO

When will a transactinide isotope with a half-life longer than 28 hours be discovered?

Background Information

Transactinide elements (chemical elements with atomic numbers above 103) are radioactive and thus far have only been obtained synthetically in laboratories. Transactinides and their isotopes are typically short-lived, with half-lives of seconds or minutes, though an isotope of the element Dubnium (Db-268) has a half-life of 28 hours - a record for a superheavy isotope. Much of the research on transactinide elements focuses on the discovery of the theorized "island of stability" - a set of as yet undiscovered isotopes of superheavy elements which are theorized to be more stable and have much longer half-lives than previously observed transactinides. The hypothesis is based upon the nuclear shell model, which implies that atomic nuclei are built up in "shells" in a manner similar to the structure of electron shells in atoms.

In May 2014, physicists created one of the heaviest elements yet, with an atomic number of 117, which has a half-life of about 0.00001 of a second. In the decay of element 117, two previously unknown isotopes were identified: Db-270 (Dubnium) and Cn-268 (Oganesson). With half-lives of about one hour and about 11 hours, respectively, they are among the longest-lived superheavy isotopes known to date, perhaps science closer to the famed island of stability.

- Scientific American: Superheavy Element 117 Points to Fabled "Island of Stability" on Periodic Table
- Wikipedia: Island of Stability
- Science Daily: Approaching the Island of Stability: Observation of superheavy element 117

Accepting Forecast Due Date: 02/01/2021

Resolution Source:
The discovery of a transactinide isotope with a half-life longer than that of Db-268 would represent a major breakthrough in physics and would likely be covered in a variety of academic journals, such as Nature Physics, as well as by the mainstream media and science publications.
BACKGROUND INFO

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

Trends
Trend data is updated on a monthly basis. The graph is always the current forecast for that answer:

- By Dec...... Before...... - After...... - Will......

1-JAN-2016 TO 31-DEC-2017
1-JAN-2018 TO 31-DEC-2019

FORECAST HISTORY

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

Forecast History

<table>
<thead>
<tr>
<th>Date</th>
<th>Username</th>
<th>Possible Answer</th>
<th>Old Forecast</th>
<th>Forecast</th>
<th>New Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 13, 2016 07:38 PM</td>
<td>scient23</td>
<td>By December 31, 2019</td>
<td>5% Chance</td>
<td>Very unlikely (10% - 20% Chance)</td>
<td>5%</td>
</tr>
<tr>
<td>August 13, 2016 01:56 AM</td>
<td>Jormuk</td>
<td>Between January 1, 2020 and December 31, 2021</td>
<td>10% Chance</td>
<td>11% Chance</td>
<td>11%</td>
</tr>
<tr>
<td>August 26, 2016 07:58 PM</td>
<td>scient23</td>
<td>Between January 1, 2018 and December 31, 2019</td>
<td>10% Chance</td>
<td>Unlikely (10% - 40% Chance)</td>
<td>10%</td>
</tr>
<tr>
<td>August 26, 2016 07:58 PM</td>
<td>scient23</td>
<td>Between January 1, 2018 and December 31, 2019</td>
<td>20% Chance</td>
<td>Very unlikely (10% - 20% Chance)</td>
<td>20%</td>
</tr>
<tr>
<td>August 26, 2016 07:58 PM</td>
<td>scient23</td>
<td>By December 31, 2019</td>
<td>15% Chance</td>
<td>Very unlikely (10% - 20% Chance)</td>
<td>15%</td>
</tr>
<tr>
<td>August 26, 2016 01:41 AM</td>
<td>pgn nexus</td>
<td>Between January 1, 2018 and December 31, 2017</td>
<td>20% Chance</td>
<td>As likely as not (40% - 60% Chance)</td>
<td>20%</td>
</tr>
<tr>
<td>August 26, 2016 10:58 AM</td>
<td>williamsquarta</td>
<td>Between January 1, 2020 and December 31, 2021</td>
<td>17% Chance</td>
<td>18% Chance</td>
<td>18%</td>
</tr>
<tr>
<td>August 26, 2016 10:57 AM</td>
<td>williamsquarta</td>
<td>Between January 1, 2018 and December 31, 2017</td>
<td>20% Chance</td>
<td>20% Chance</td>
<td>20%</td>
</tr>
<tr>
<td>August 26, 2016 02:25 AM</td>
<td>Chambers</td>
<td>Between January 1, 2018 and December 31, 2017</td>
<td>20% Chance</td>
<td>20% Chance</td>
<td>20%</td>
</tr>
</tbody>
</table>
## FORECASTING: SAFE MODE

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

### By December 31, 2015

**Between January 1, 2016 and December 31, 2017**

<table>
<thead>
<tr>
<th>Your Forecast</th>
<th>Chance of Happening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost surely</td>
<td>90% - 100%</td>
</tr>
<tr>
<td>Very likely</td>
<td>80% - 90%</td>
</tr>
<tr>
<td>Likely</td>
<td>60% - 80%</td>
</tr>
<tr>
<td>As likely as not</td>
<td>40% - 60%</td>
</tr>
<tr>
<td>Unlikely</td>
<td>20% - 40%</td>
</tr>
<tr>
<td>Very unlikely</td>
<td>10% - 20%</td>
</tr>
<tr>
<td>Almost surely not</td>
<td>0% - 10%</td>
</tr>
</tbody>
</table>

Current forecast: 20% - 40%

Submit your forecast

---

## FORECASTING: SAFE MODE

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

Thank you for making a forecast. Here is how you affected it:

<table>
<thead>
<tr>
<th>Possible Answer</th>
<th>Old Chance</th>
<th>Your Forecast</th>
<th>New Chance</th>
</tr>
</thead>
<tbody>
<tr>
<td>By December 31, 2015</td>
<td>9%</td>
<td>10% (up 1%)</td>
<td></td>
</tr>
<tr>
<td>Between January 1, 2016 and December 31, 2017</td>
<td>37%</td>
<td>Very unlikely</td>
<td>27% (down 10%)</td>
</tr>
<tr>
<td>Between January 1, 2018 and December 31, 2019</td>
<td>12%</td>
<td>14% (up 2%)</td>
<td></td>
</tr>
<tr>
<td>Between January 1, 2020 and December 31, 2021</td>
<td>18%</td>
<td>18% (up 2%)</td>
<td></td>
</tr>
<tr>
<td>Will not be discovered by January 1, 2022</td>
<td>28%</td>
<td>30% (up 2%)</td>
<td></td>
</tr>
</tbody>
</table>

---

More interesting questions...

- If a transactinide isotope with a half-life longer than 29 hours is discovered by 2017, what will its atomic number be?
- Will a lab-grown single-atom quasimetal be reported in a scientific journal before the end of 2019?
- Will the US National Security...
**FORECASTING: POWER MODE**

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

**Possible Answers and Current Chance**

<table>
<thead>
<tr>
<th>Possible Answer</th>
<th>Old Chance</th>
<th>Your Forecast</th>
<th>New Chance</th>
</tr>
</thead>
<tbody>
<tr>
<td>By December 31, 2015</td>
<td>10%</td>
<td>9% (down 1%)</td>
<td></td>
</tr>
<tr>
<td>Between January 1, 2018 and December 31, 2017</td>
<td>27%</td>
<td>24% (down 3%)</td>
<td></td>
</tr>
<tr>
<td>Between January 1, 2018 and December 31, 2019</td>
<td>14%</td>
<td>24% (up 10%)</td>
<td></td>
</tr>
<tr>
<td>Between January 1, 2020 and December 31, 2021</td>
<td>10%</td>
<td>17% (down 3%)</td>
<td></td>
</tr>
<tr>
<td>Will not be discovered by January 1, 2022</td>
<td>30%</td>
<td>28% (down 2%)</td>
<td></td>
</tr>
</tbody>
</table>

Thank you for making a forecast, here is how you affected it:

- By December 31, 2015: Old chance 10%, your forecast 9% (down 1%)
- Between January 1, 2018 and December 31, 2017: Old chance 27%, your forecast 24% (down 3%)
- Between January 1, 2018 and December 31, 2019: Old chance 14%, your forecast 24% (up 10%)
- Between January 1, 2020 and December 31, 2021: Old chance 10%, your forecast 17% (down 3%)
- Will not be discovered by January 1, 2022: Old chance 30%, your forecast 28% (down 2%)

**More Interesting Questions...**

- Will physicists find any differences in the magnetic moments of the antiproton and the proton when they achieve a direct high-precision measurement of the antiproton?
- Scientists reported recently that sodium bismuthate can exist as a form of 3D topological Dirac semimetal (TMDT). Is this correct?
QUESTION WRITING

POLLS: 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
   (D) Down 3% today

Between January 1, 2017 and December 31, 2018  7% Chance
   (D) Down 3% today

Between January 1, 2019 and December 31, 2020  50% Chance
   (D) Up 27% today

Between January 1, 2021 and December 31, 2023  8% Chance
   (D) Down 4% today

Between January 1, 2024 and December 31, 2027  19% Chance
   (D) Down 10% today

Will not occur before January 1, 2028  11% Chance
   (D) Down 6% today

TRENDS: INNER EAR

1-JAN-2019 TO 31-DEC-2020

1-JAN-2024 TO 31-DEC-2027
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

NONE OF THE ABOVE WILL BE USED BEFORE 2020

George Mason University
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!
PUBLICATIONS & PRESENTATIONS


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


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


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. Bayesian 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.


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Dr. Darren Griffin
University of Kent

Dr. Charles Twardy
SciCast
George Mason University

Ted Sanders
NSF Graduate Fellow
Stanford University

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Sr. Program Manager,
Demilitarization Laboratory Support
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