What is "Progress"?

A study of Neutrino experiments

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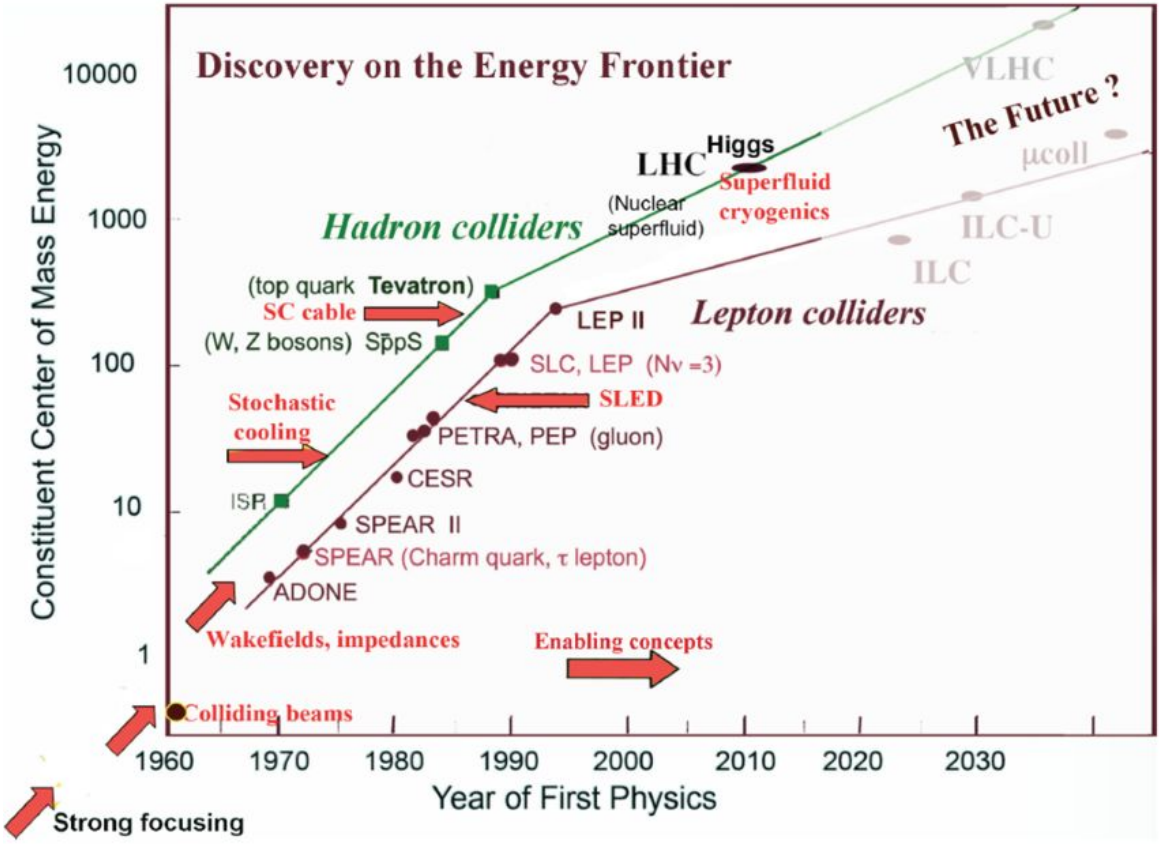
Yeon-Jae Jwa
Sameer Patel
Adryanna Smith

Livingston Plot

The Livingston plot is a famous representation of progress in the construction of particle accelerators



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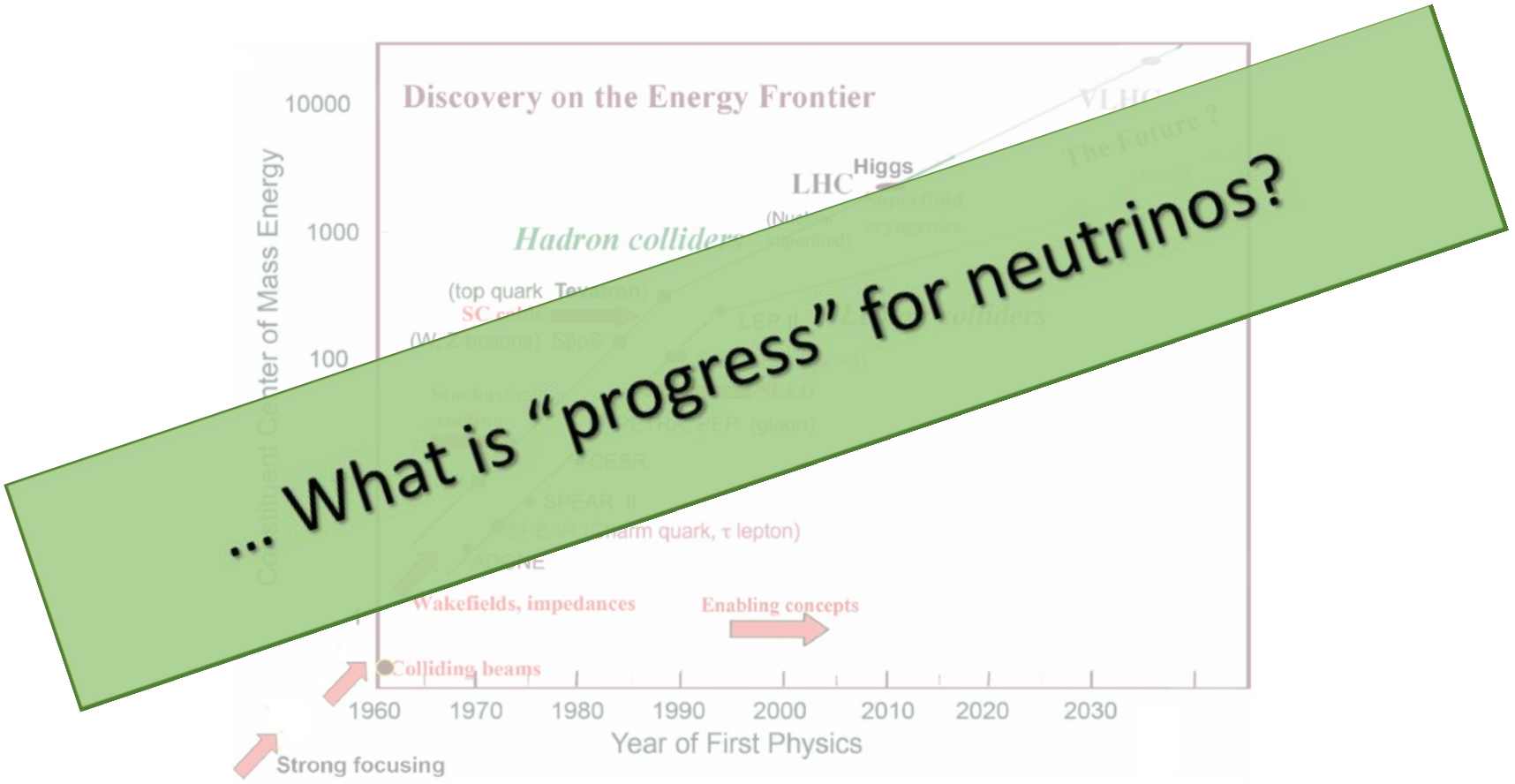
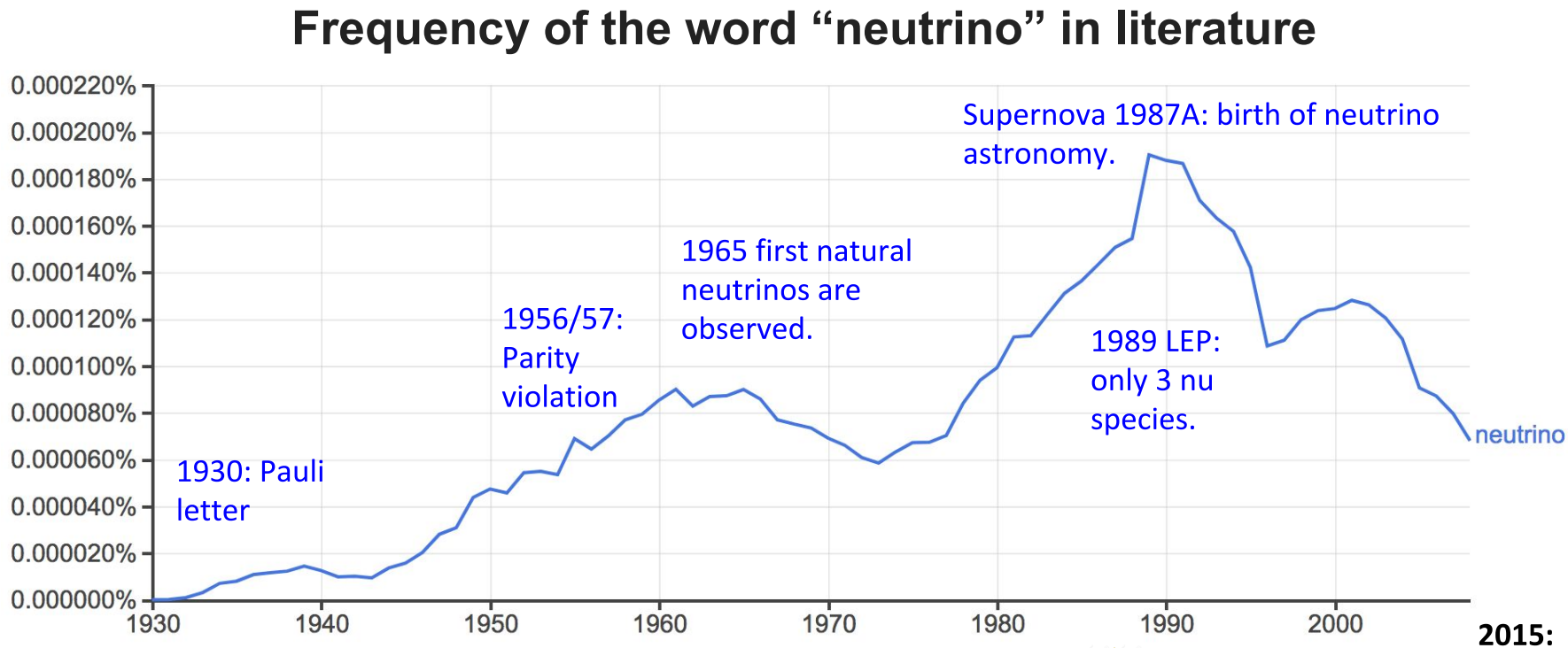


Google Ngram Viewer



For the neutrino beam method and the demonstration of the doublet structure of the leptons through the discovery (in **1962**) of the muon neutrino.

1988: Lederman, Schwartz, Steinberger

2015: Kajita, McDonald

1995: Reines & Perl

For his discovery, 40 years earlier, **1956**, of neutrinos.

2002: Davis, Koshiba, Giacconi

50 years to trapping sufficient numbers of solar neutrinos: the Homestake experiment began taking data in 1967. After 25 years of data taking, the spectacular results were published in **1995**, which discovered only one-third of the calculated rate at which the detector should capture neutrinos. This significant discrepancy in numbers was eventually explained by neutrino oscillations.

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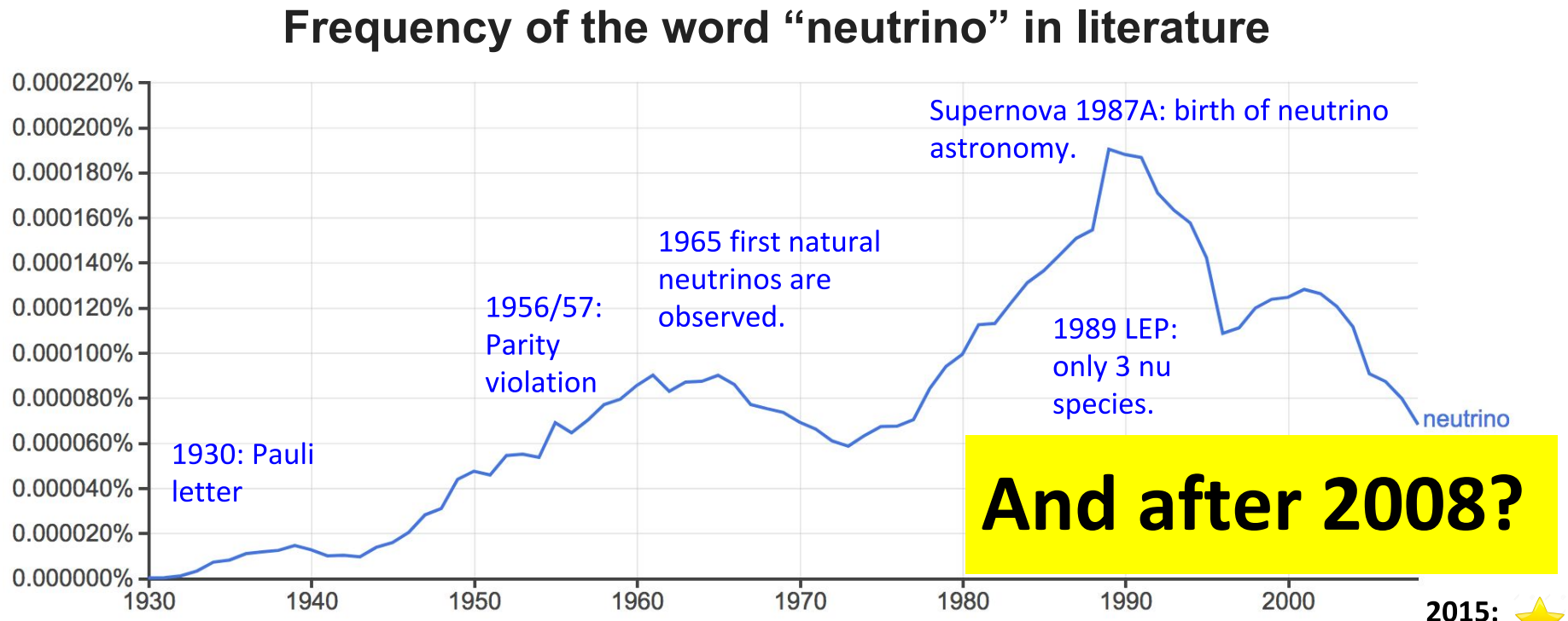

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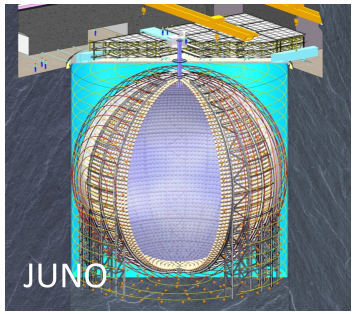
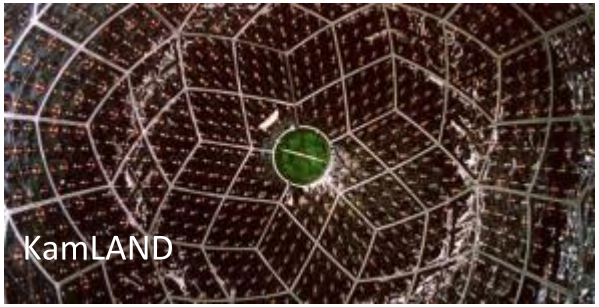
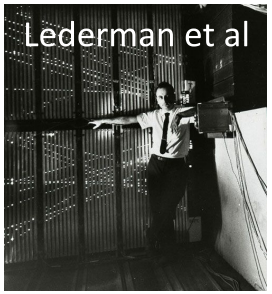
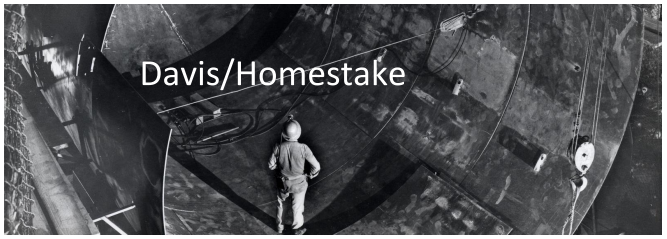
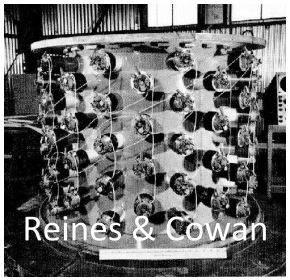
A variety of neutrino experiments

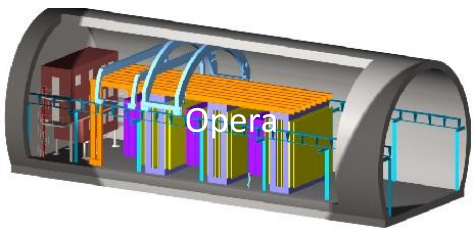


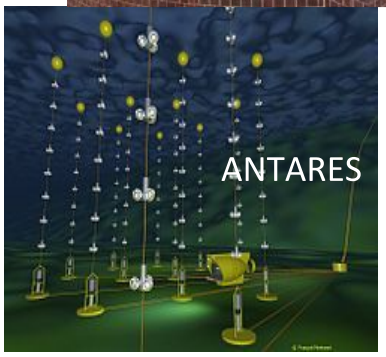


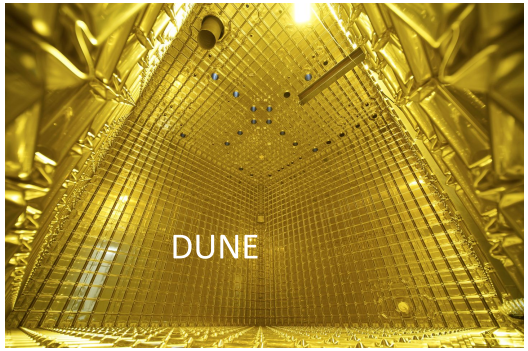


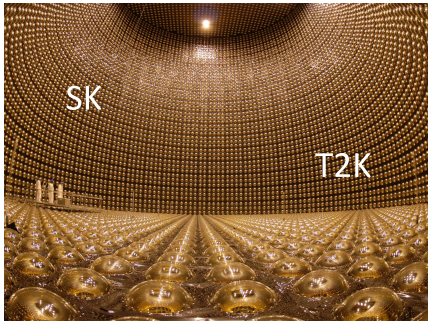


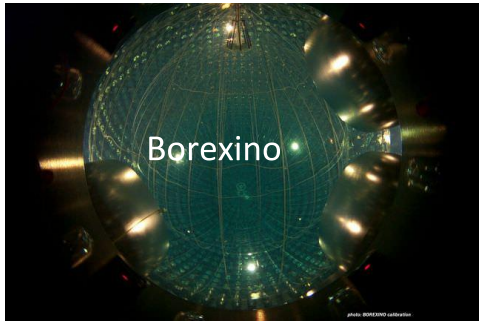




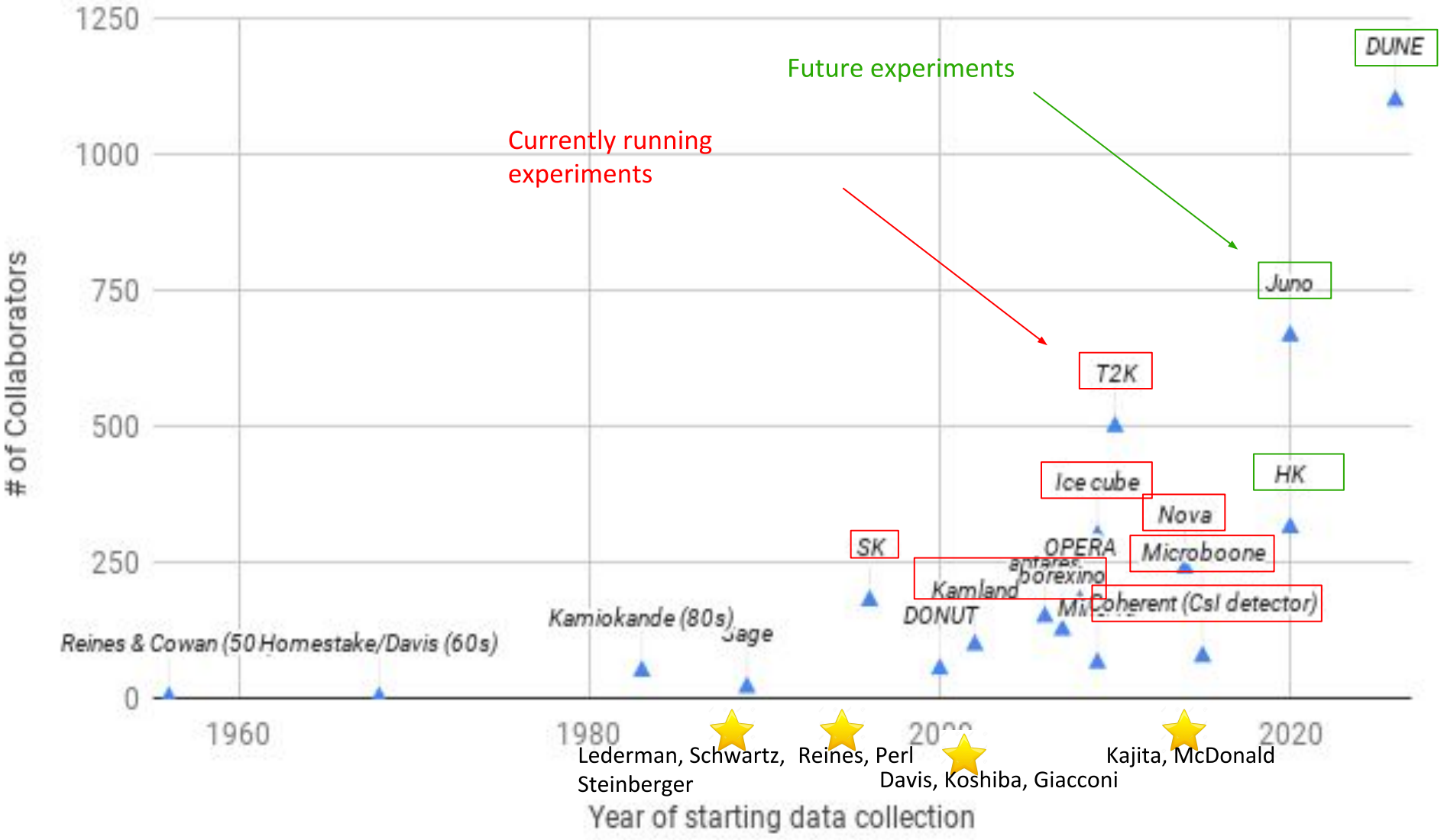




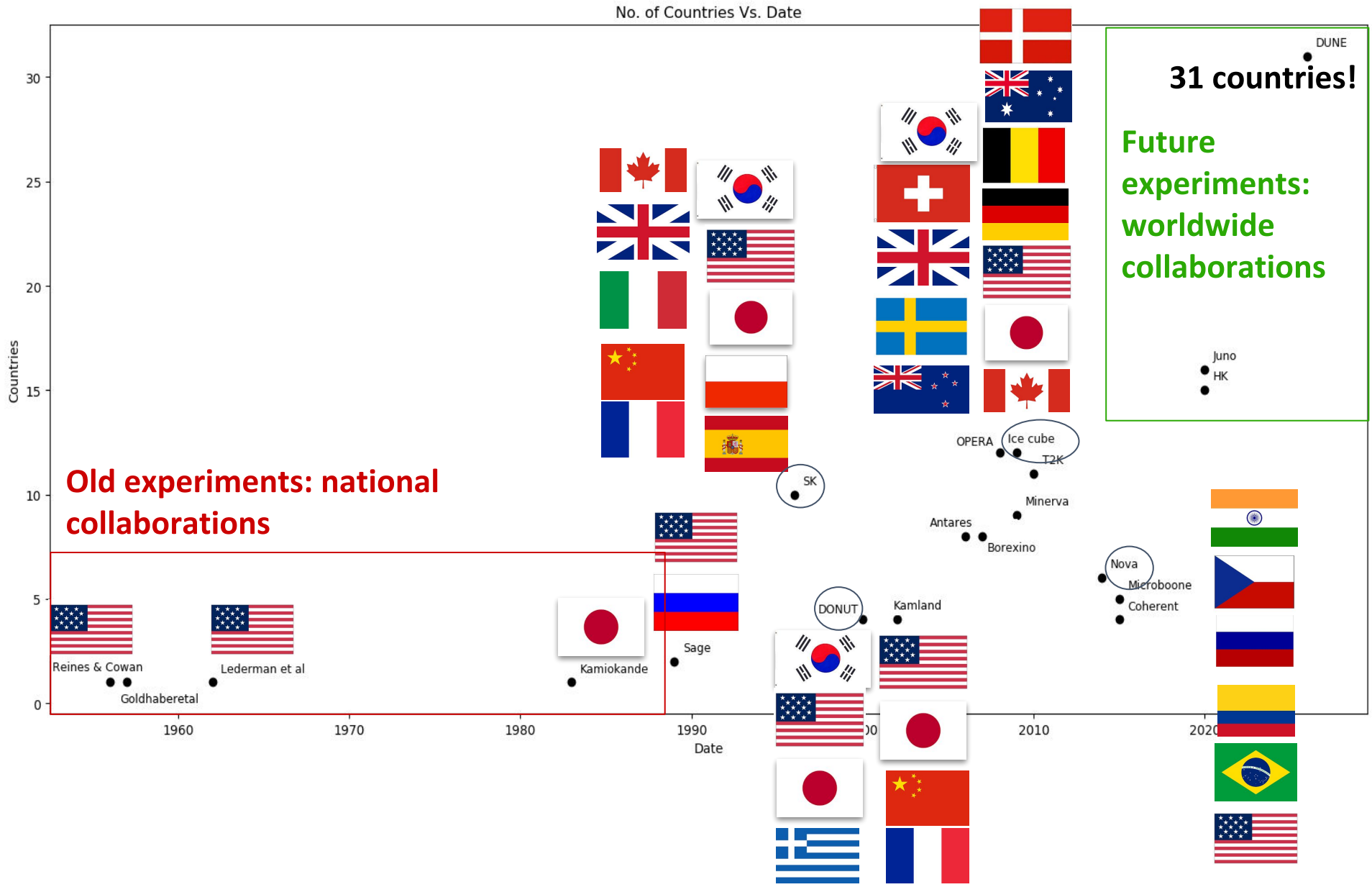




No. of Collaborators vs. Start Date



No. of Countries vs. Start Date



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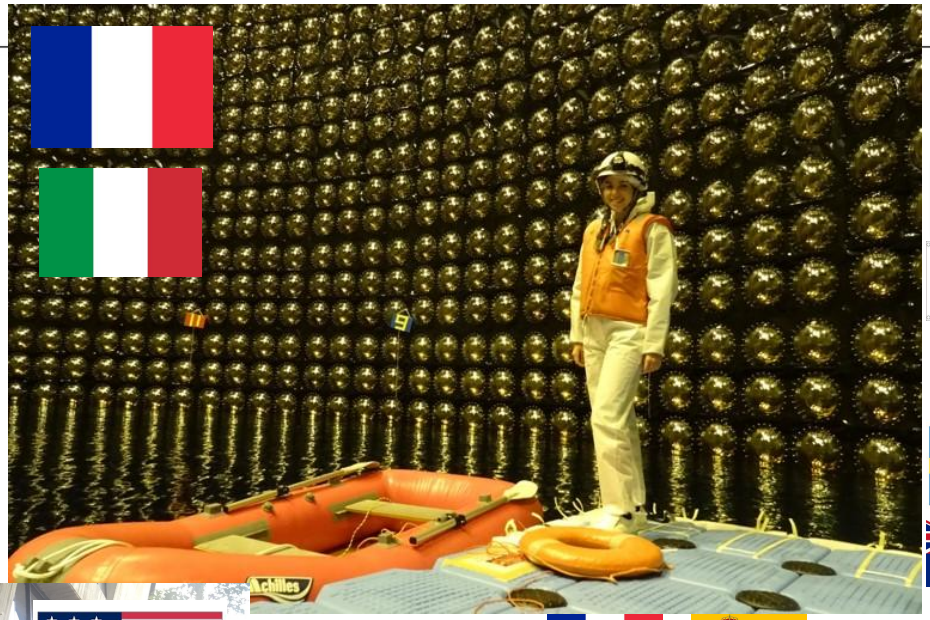

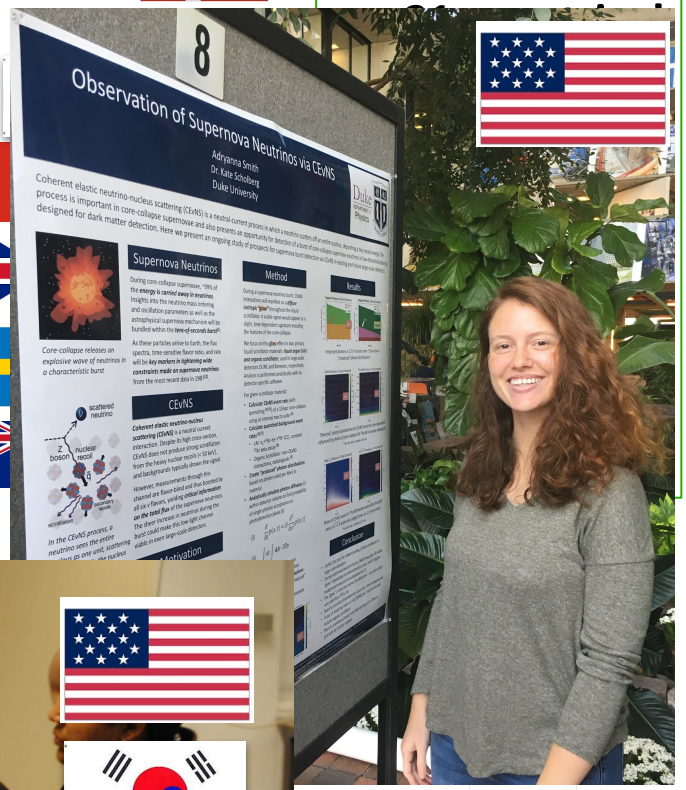

DUNE

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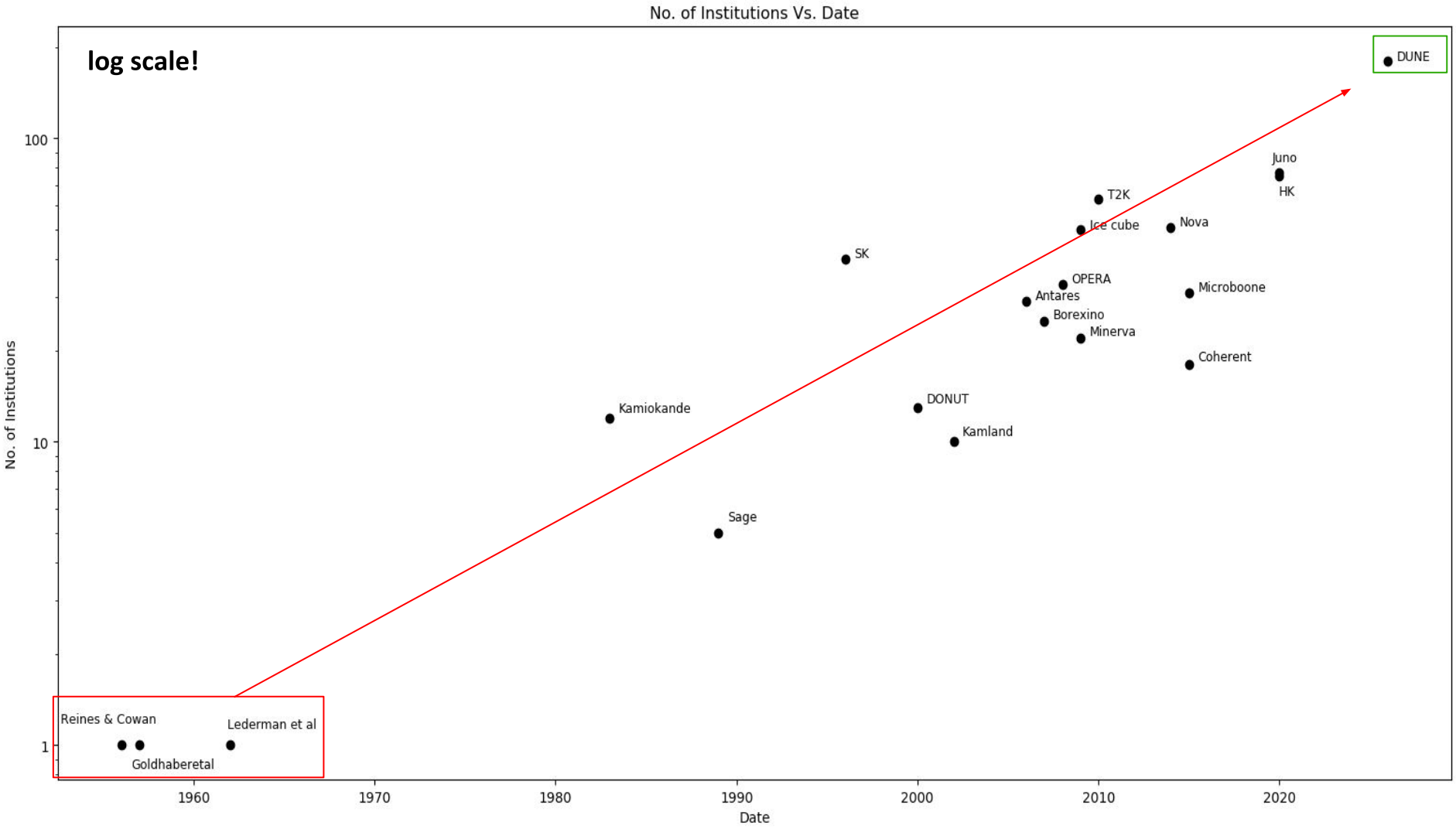
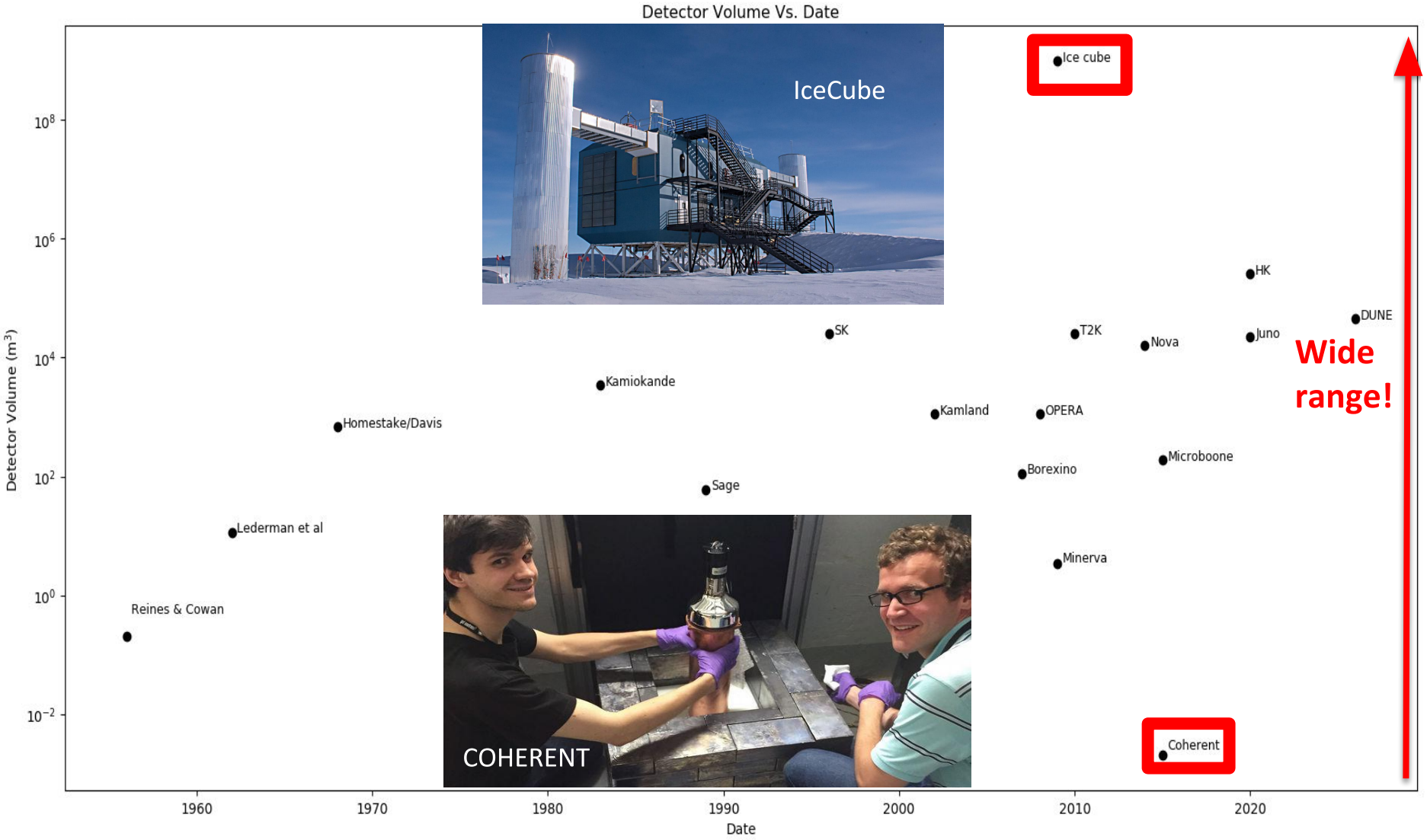
202

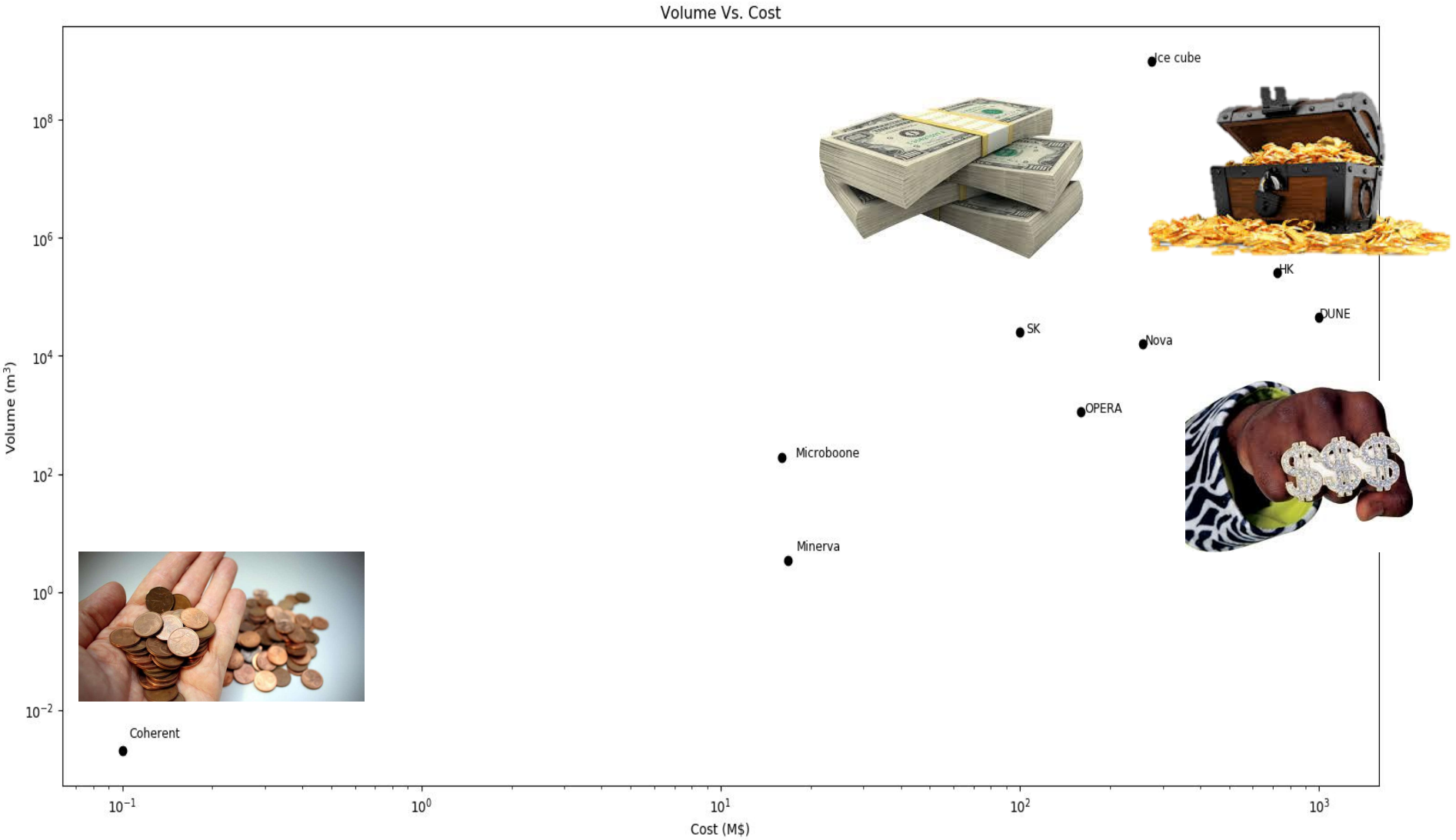
No. of Institutions vs. Start Date



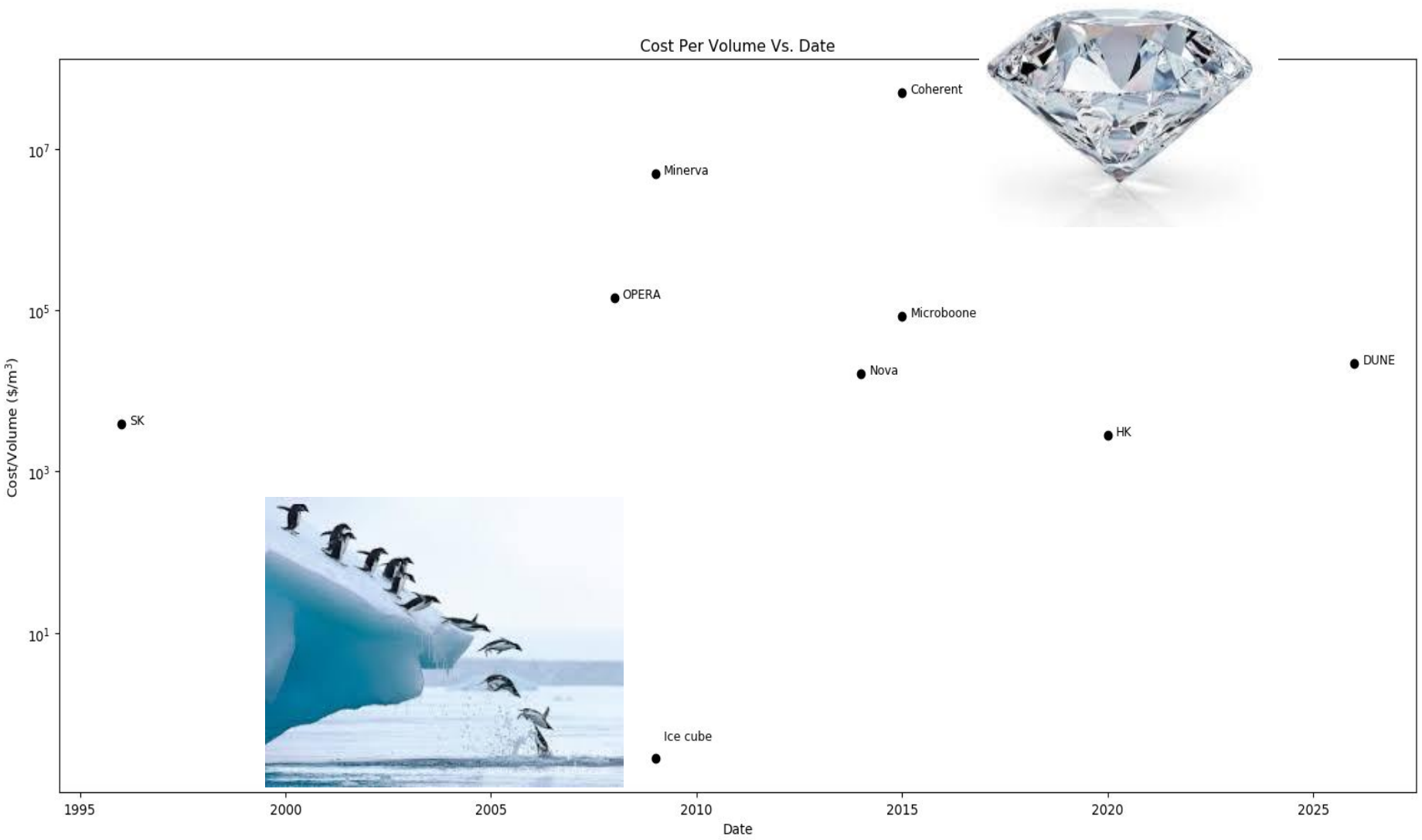
Detector Volume vs. Start Date



Detector Volume & Cost



Cost/Detector Volume



Conclusions

What could be the metric to show the progress in neutrino physics?

Regular Livingston plot with a single physical parameter would not do the justice to the progress of experimental neutrino physics

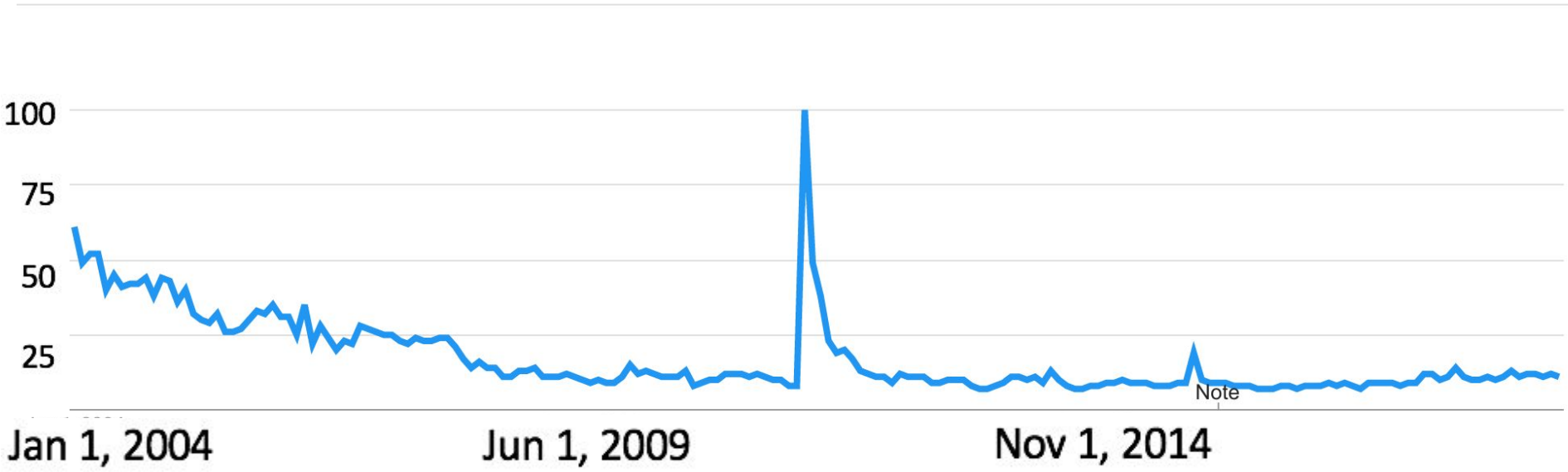
Progress appears in Many Ways!

- The experimental field is growing fast
- Diverse searches, clever technologies, & bold proposals
- More global collaborations than ever before!

Conclusions

What do YOU think could be the metric to show the progress in neutrino physics?

“Neutrino” Worldwide Google Trends



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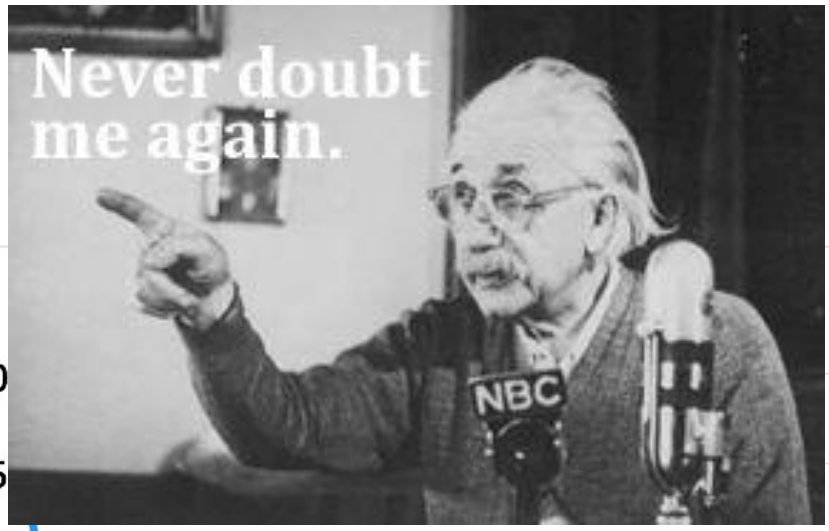
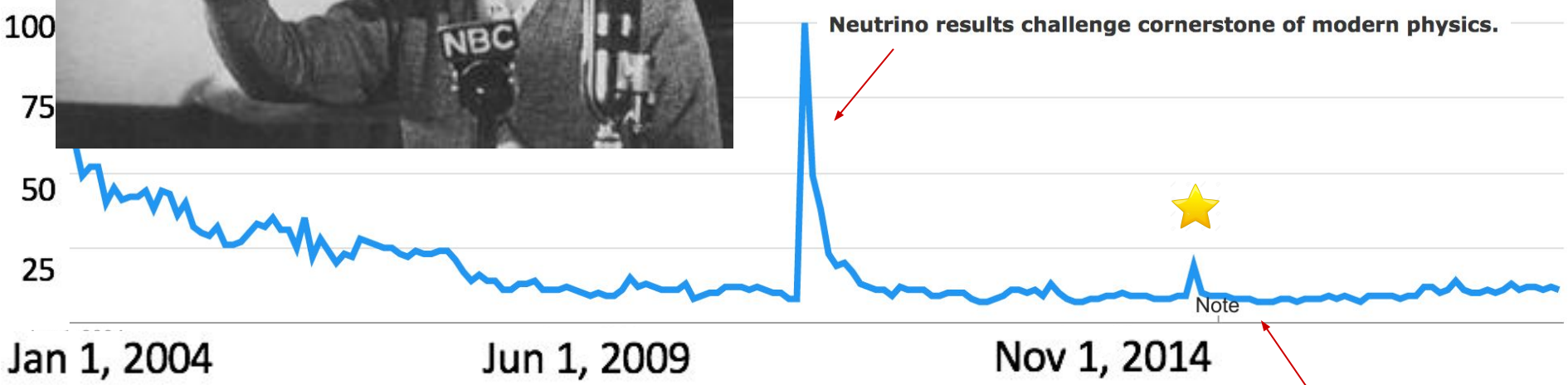


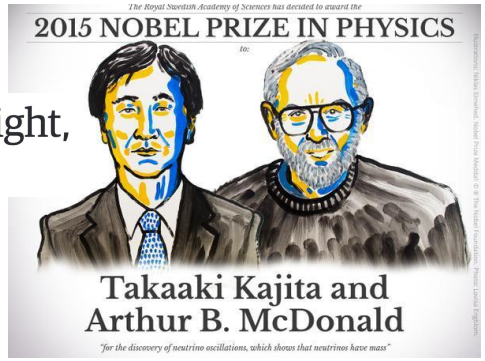


nature
Updated online: 23 September 2011
News

Particles break light-speed limit

Neutrino results challenge cornerstone of modern physics.

Neutrinos may not be faster than light, but they can shapeshift

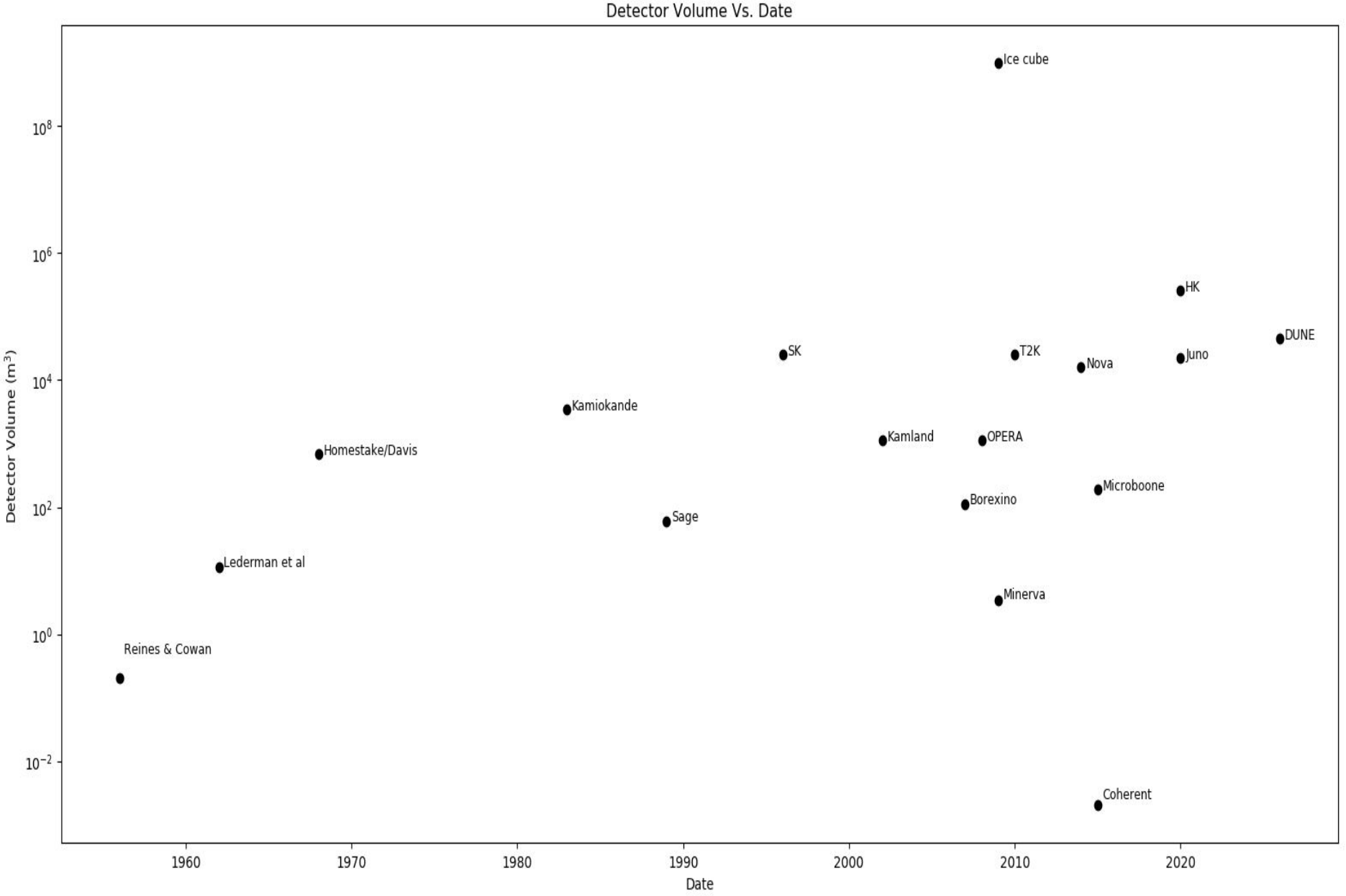


Fermilab

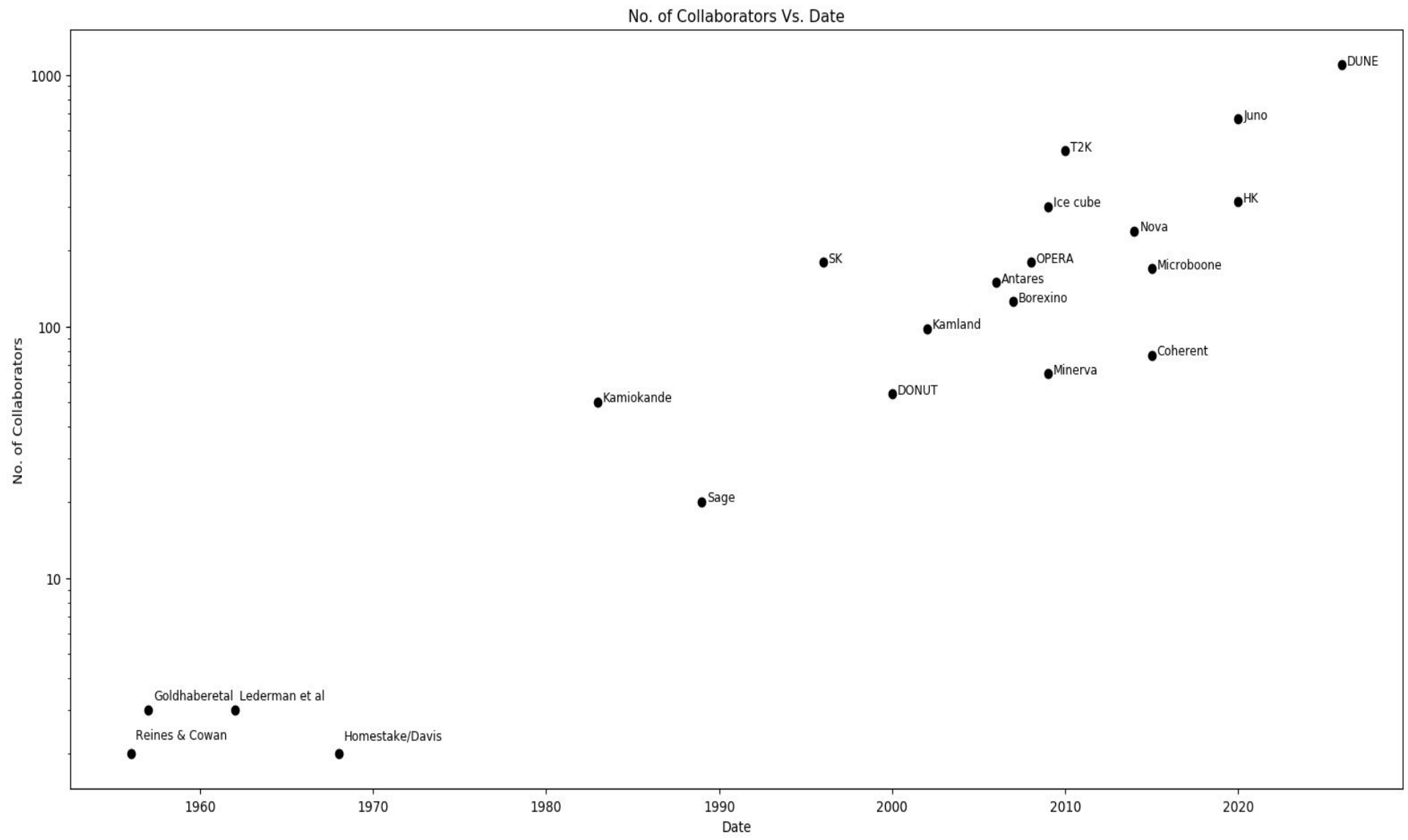
Thank you!

Backup

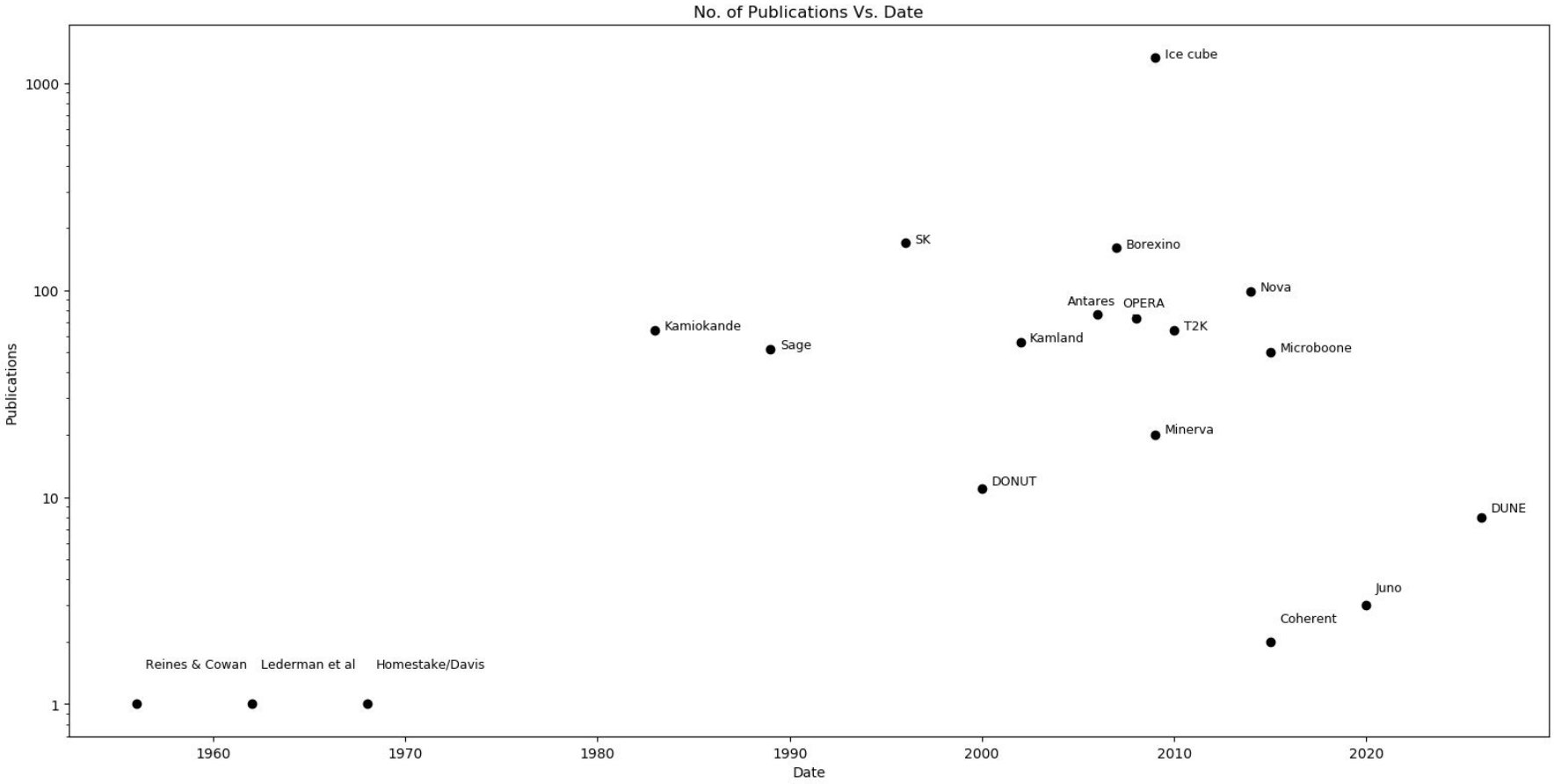
Detector Volume



Collaborators



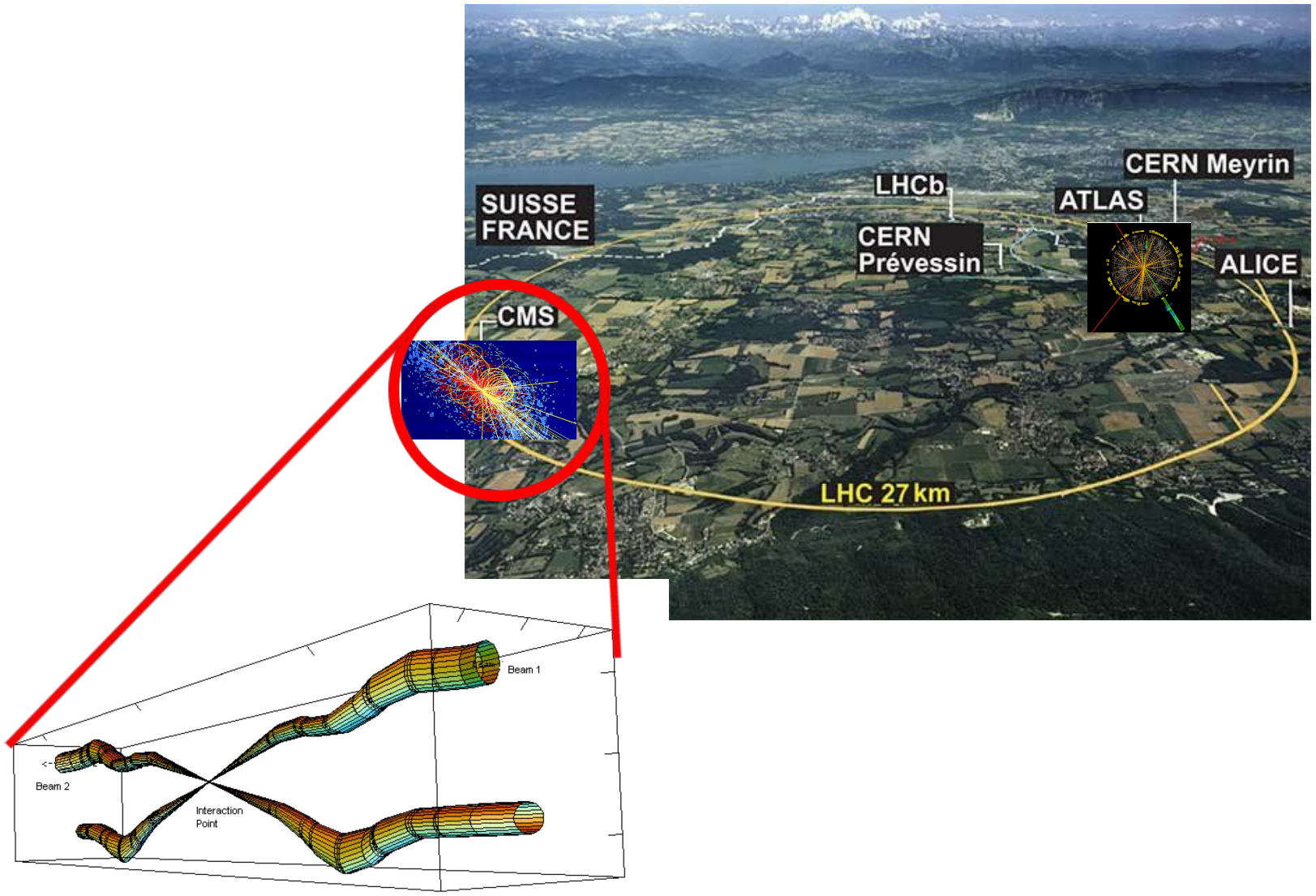
Publications



Funding Obscurity

- Difficult to obtain funding information
  - cost of experiment? (new materials, recycled infrastructure, existing beamline, etc)
  - cost of upgrades?
  - cost of maintenance over time?
- Ethics of remaining accountable when funded by the public

Livingston Plot



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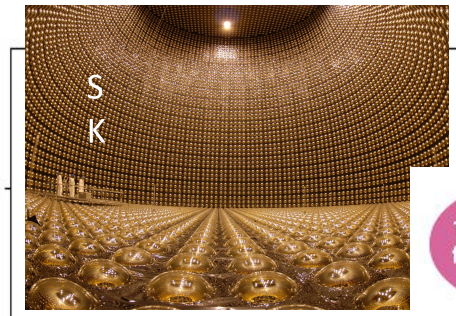

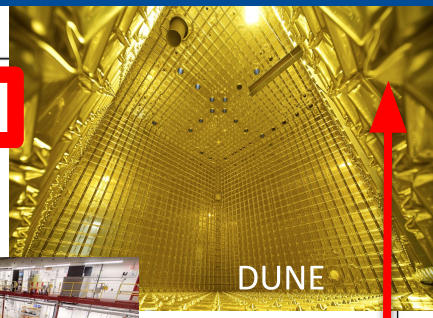

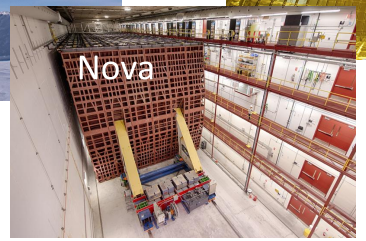

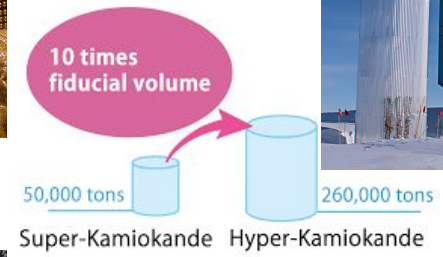

Wide range!