

# Open Innovation Enabled by Global Networking of Science and Technical Knowledge

**Collaborative Expedition Workshop  
National Science Foundation, Arlington, VA**

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U.S. Department of Energy



# OSTI Mission

To advance science and sustain technological creativity by making R&D findings available and useful to DOE researchers and the public



# Science progresses as knowledge is shared

**OSTI Corollary:**

*If the sharing of  
knowledge is  
accelerated,  
then discovery is  
accelerated*



*“If I have seen further, it is only by  
standing on the shoulders of giants.”*

– Isaac Newton 1676

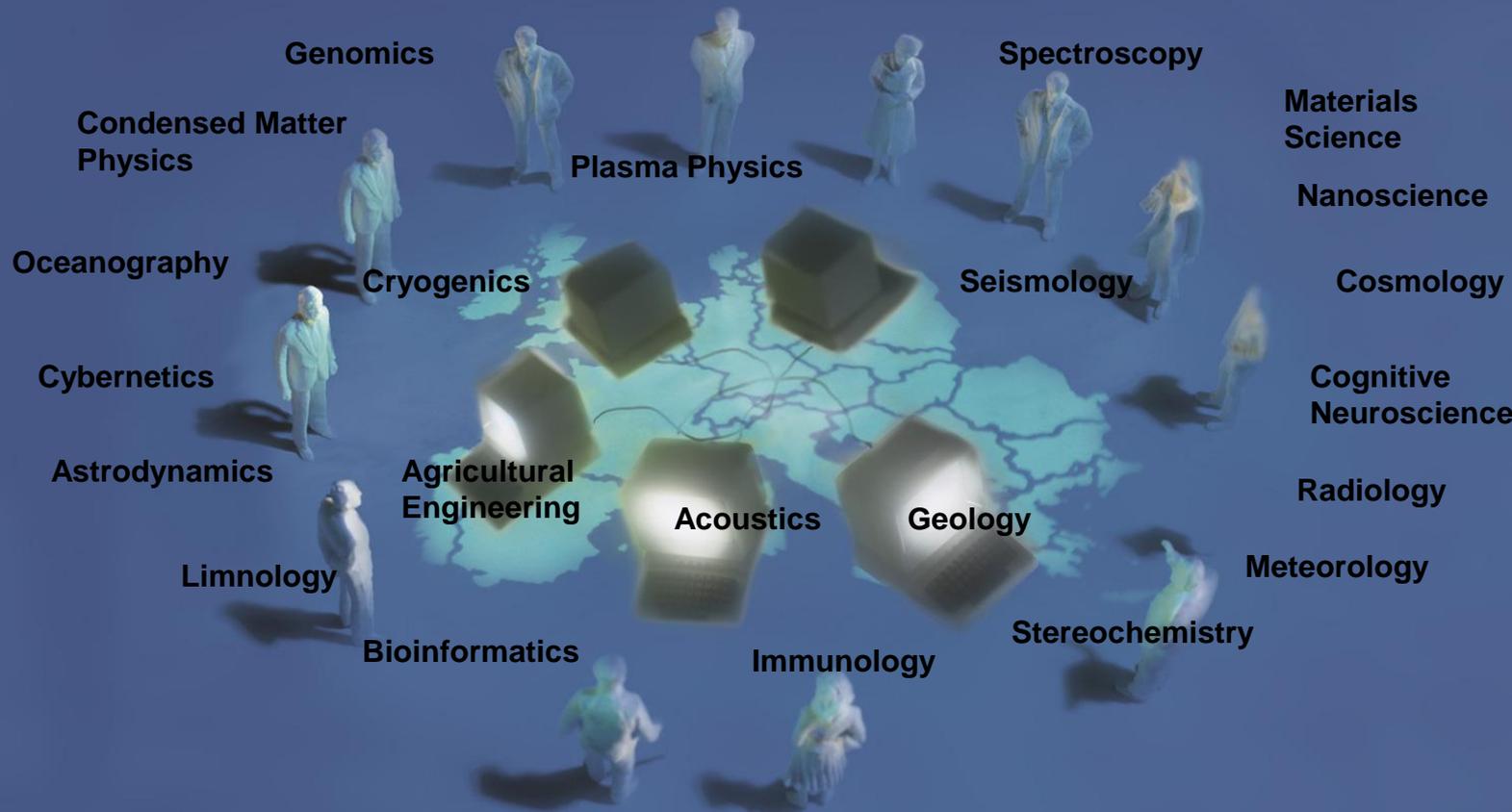
**Profound implications for everyone  
in the information business**



# How do we help researchers find the information they need for making life-altering discoveries?

We need innovative discovery tools to help researchers find the information they need

Often the knowledge scientists need resides in distant communities

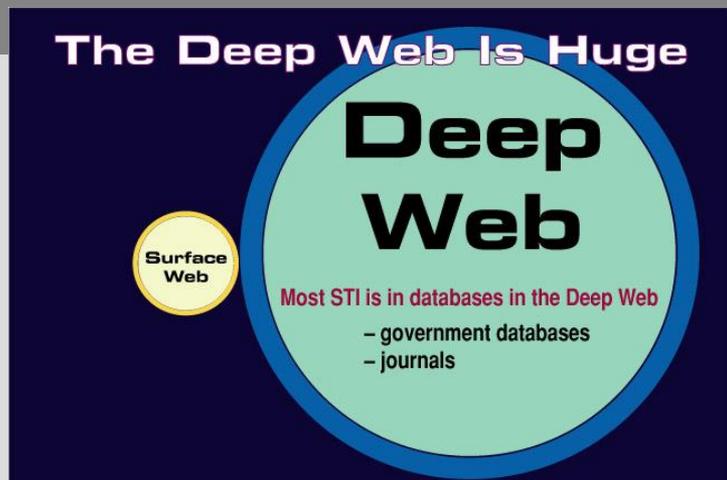


... because traditional “discovery tools”  
are not yet doing the job

We must  
dispel the  
misperception  
that traditional  
search engines can  
find whatever we  
seek



# Much of science is non-Googleable



In fact, the vast majority of science information is in databases within the deep web – or the non-Googleable web – where popular search engines cannot go

**We in the information business need to recognize this gap between availability and need, and seize the opportunity to ...**

**Provide science information consumers with better tools**

# The web is transformational technology for sharing knowledge

The web is still young and will certainly hold surprises as it evolves

Just as another well-known transformational technology held surprises ...



1903



1918



2010

# Eclipsing Current Search Technology

Google is capitalizing on this early era of web technology and is hugely successful, powering more than half the world's searching

But we must remember that we are just in the beginning of this transformation. Further technological transformations may very well eclipse today's search technology!

**A new, promising technology is now emerging:  
federated search**

# **We need systems, such as federated search, that probe the deep web**

**Federated search drills down to the deep web where scientific databases reside**

**Federated search involves a series of steps to create a novel web architecture:**

- (1) A user types in a query, hits send**
- (2) Query travels to server in Oak Ridge, TN**
- (3) In Oak Ridge, the query is replicated 61 times and fanned out to servers of national databases around the globe**
- (4) At each National server, a search is executed in real time**
- (5) Results transit back to Oak Ridge where they are collected & sorted**
- (6) A relevant, authoritative result list is returned to the user**

# OSTI federated search solutions



Integrates key DOE databases

Science Accelerator is the DOE contribution to Science.gov

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Integrates 14 U.S. science agencies – 200 million pages of science information

Science.gov is the U.S. contribution to WorldWideScience.org

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Integrates science information issued by over 60 Nations – 400 million pages of global science information

# OSTI, through federated search, ensures access to **non-Googleable** science

## Volume of Content Made Searchable by OSTI

**WorldWideScience.org:**  
400,000,000 pages of Global Scientific and Technical Information (STI)

These web-available pages would fill 62,000 traditional 2-foot deep file drawers.

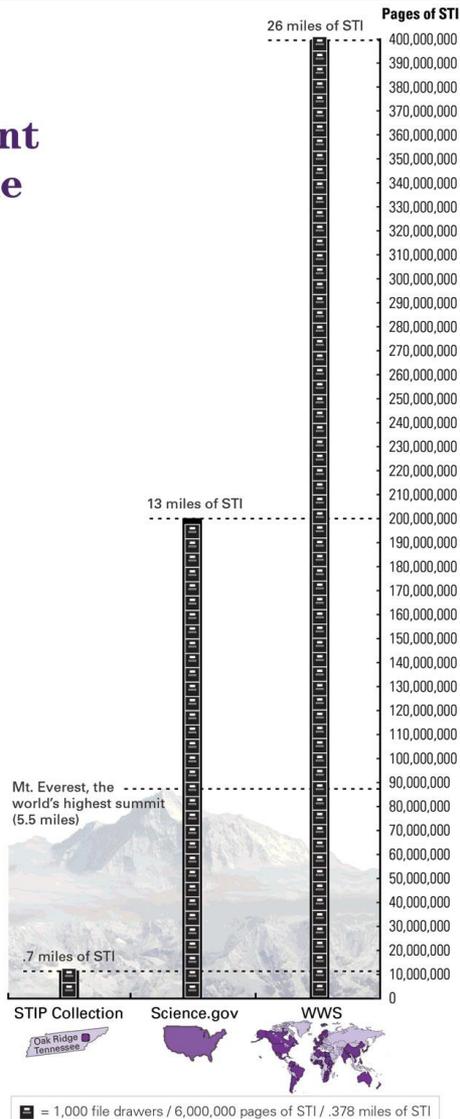
**Science.gov:**  
200,000,000 pages of U.S. Government STI

These web-available pages would fill 33,000 traditional 2-foot deep file drawers.

**STIP Collection:**  
11,400,000 pages of U.S. Department of Energy STI

These web-available pages would fill 1,900 traditional 2-foot deep file drawers.

Amount of Data Transferred in FY08: 9.95 terabytes



Through OSTI products, librarians, researchers and the public can access a science page count comparable to, but not duplicative of, Google's entire science content



## WorldWideScience.org History

Concept introduced by OSTI  
Director, Walt Warnick,  
June 2006, Bethesda, Maryland



Bilateral U.S.(DOE)/U.K. (British Library) partnership,  
January 2007, London

Demonstration of first prototype,  
June 2007, Nancy, France



Multilateral governance structure  
WorldWideScience Alliance, established  
June 2008, Seoul

Common ingredient:  
International Council for  
Scientific and Technical  
Information (ICSTI)





- **Searches 61 science databases and portals sponsored by governments and national institutions in 61 countries**
- **Covers scientific literature from over three-fourths of the world's population**
- **Includes a vast quantity of science (over 400 million pages), much of which is grey literature**
- **Proving WWS “deep web” value, recent analysis shows only 3.5% overlap with Google and Google Scholar**



- Current research in **multilingual** translations technologies will enable searching of non-English databases from within applications such as WWS
- Prototype allows users to select their preferred language. Queries are translated into the languages of the databases being searched and results are then returned in the user's language
- We are committed to launching **multilingual** WorldWideScience.org at the ICSTI Meeting in Helsinki in June 2010



## **Accelerates scientific networking**

- ✓ **A scientist in the United States can find the works of scientists in the same field from 60 other countries—all in a single search**
- ✓ **Alerts feature can keep one scientist apprised of the new work of other specific scientists**
- ✓ **Real-time translations of non- English queries and non-English databases will connect scientists in unprecedented ways**



**Refine Search**
 **New Search**
[Advanced Search](#)


Search: **Full Record: seismology**  
 1,182 ranked results of 11,938 available
 [Create an alert from this search](#)
 53 more results found. [Add Summary of All Results](#)
61 of 61 sources complete

Results 1 – 10 of 15    Sort by:     Limit to:

[My Selections \(0\)](#)   [Clear Selections](#)   [Alerts](#)   [Print Results](#)   [Email Results](#)   [Bookmark this search](#)   [Session Preferences](#)

**Clusters**

- All Results (1129)
- Topics
- Authors
  - Nerc (24)
  - Paulsson, Bjorn N. (15)**
  - Auvergne, M. (6)
  - Catala, C. (5)
  - Mora, P. R. (5)
  - More...
- Publications
  - ACTA SEISMOLOGICA SINICA (42)
  - EARTHQUAKE RESEARCH IN CHINA (21)
  - (15)



- 1 [Development of a 400 Level 3C Clamped Downhole Seismic Receiver Array for 3D Borehole Seismic Imaging of Gas Reservoirs](#)  
 ★★★★★ *Paulsson, Bjorn N.*  
 2006-05-05  
 Borehole **seismology** is the highest resolution geophysical imaging technique available today to the oil and gas industry for characterization and monitoring of oil and gas reservoirs. ... complex gas reservoirs using borehole **seismology** ...  
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- 3 [Development of a 400 Level 3C Clamped Downhole Seismic Receiver Array for 3D Borehole Seismic Imaging of Gas Reservoirs](#)  
 ★★★★★ *Paulsson, Bjorn N.*  
 2005-08-21  
 Borehole **seismology** is the highest resolution geophysical imaging technique available today to the oil and gas industry for characterization and monitoring of oil and gas reservoirs. ...

**Wikipedia**

[Seismology](#)  
**Seismology** (from Greek σεισμός, seismos, "earthquake"; and λόγος, logos, "study") is the scientific study of earthquakes and the propagation of elastic seismic waves through the Earth or other solid bodies. It also includes the study of seismic wave generation by other means, such as volcanic activity, landslides, ice calving, explosions, and impacts.

**EurekaAlert!**

[2010 Seismological Society of America Meeting in Portland, Ore.: Media registration now ...](#)  
 More than 500 seismologists from around the world will convene at the

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**Title:** Development of a 400 Level 3C Clamped Downhole Seismic Receiver Array for 3D Borehole Seismic Imaging of Gas Reservoirs

**Creator/Author:** Bjorn N.P Paulsson

**Research Org:** Paulsson Geophysical Services, Inc.

**Publication Date:** 2006 May 05

**Language:** English

**Description/Abstract:** Borehole seismology is the highest resolution geophysical imaging technique available today to the oil and gas industry for characterization and monitoring of oil and gas reservoirs. However, the industry's ability to economically do high resolution 3D imaging of deep and complex gas reservoirs using borehole seismology is currently hampered by the lack of the acquisition technology necessary to record the large volumes of the high frequency, high signal-to-noise-ratio borehole seismic data needed to do 3D imaging. This project takes direct aim at this shortcoming by developing a 400 level 3C clamped downhole seismic receiver array, and accompanying software, for borehole seismic 3D imaging. This large borehole seismic array will remove the technical acquisition barrier for recording the necessary volumes of data to do high resolution 3D VSP or 3D cross well seismic imaging. Massive 3D VSP{reg\_sign} and long range Cross-Well Seismology (CWS) are two of the borehole seismic techniques that will allow the Gas industry to take the next step in their quest for higher resolution images of the gas reservoirs for the purpose of improving the recovery of the natural gas resources. Today only a fraction of the original Oil or Gas in place is produced when reservoirs are considered depleted. This is primarily due to our lack of understanding of the detailed compartmentalization of the oil and gas reservoirs. The 400 level 3C borehole seismic receiver array will allow for the economic use of 3D borehole seismic imaging for reservoir characterization and monitoring by allowing the economic recording of the required large data volumes that have a sufficiently dense spatial sampling. By using 3C surface seismic or 3C borehole seismic sources the 400 level receiver arrays will furthermore allow 3D reservoir imaging using 9C data. The 9C borehole seismic data will provide P, SH and SV information for imaging of the complex deep gas reservoirs and allow quantitative prediction of the rock and the fluid types. The data quality and the data volumes from a 400 level 3C array will allow us to develop the data processing technology necessary for high resolution reservoir imaging.

**Subject:** 03 NATURAL GAS; BOREHOLES; DATA PROCESSING; ECONOMICS; FORECASTING; MONITORING; NATURAL GAS; RESOLUTION; SAMPLING; SEISMIC ARRAYS; SEISMIC SOURCES; SEISMOLOGY

**DOI:** <http://dx.doi.org/10.2172/882509>

**Country of Publication:** United States

**Resource/Doc Type:** Technical Report

**DOE Contract Number:** FC26-01NT41234

**Coverage:** Quarterly

**Sponsoring Org:** USDOF

# **Development of a 400 Level 3C Clamped Downhole Seismic Receiver Array for 3D Borehole Seismic Imaging of Gas Reservoirs**

**Quarterly Reports:**

**October 1, 2005 – December 31, 2005**

**Björn N.P Paulsson**

**May 5, 2006**

**DOE Contract: DE-FC26-01NT41234**

**Is there a better solution for a high quality science search tool just over the horizon?**

**We think so...**

**Live Federated Search Tools + Crawled Indexes**

**For Example:**

**WorldWideScience.org + crawled indexes**

# The stage is set for the future

**We are ready to scale up our efforts in federated search**

**A billion-page, high quality science search tool may be available soon to spread ideas, increase learning, and further accelerate the progress of science.**

# Cognition Budget

- Making more info available is not enough
- It must be presented more conveniently – easier and faster to find
- To this end, relevancy ranking is being reinvented for federated searching

**Try [WorldWideScience.org](http://WorldWideScience.org)**



Simply put, we intend to make more science accessible to more people more conveniently than has ever been done before.

**Search**

[view participants as list](#)

A world map where countries are colored in shades of purple and blue, indicating active participants or available resources. The map is centered on the Atlantic Ocean.

**INTERACTIVE MAP**

Click on country to view participants and visit their web sites