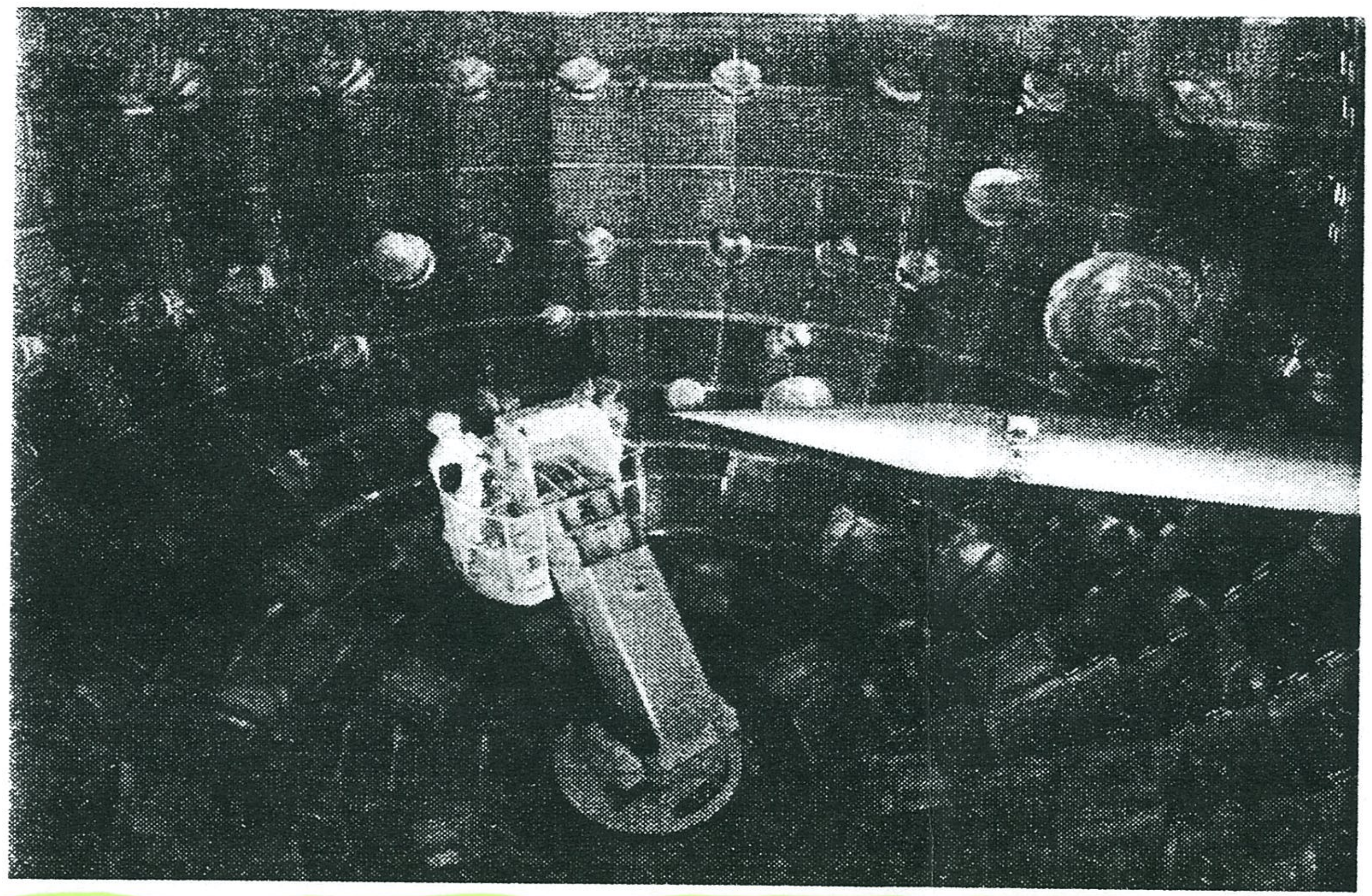
World's Most Powerful Laser Gets Government Go-Ahead

EXHIBIT A

The Extreme Light Infrastructure will be built in Eastern Europe

By Jennie Walters Posted 04.26.2011 at 2:07 pm



ELI Will Outshine The Mega-Powerful Laser of the National Ignition Facility *Department of Energy*

Who knew it would take so long to approve a project to build the world's most powerful lasers? Lasers are awesome. But after reconciling some paltry funding issues, the Commission finally approved the Extreme Light Infrastructure (ELI) project, which plans to build three superlasers by 2015.

The lasers will be the first to operate in the exawatt scale--a quintillion watts. That's about a million times more powerful than 10 billion 100-watt lightbulbs. And a fourth su should be forthcoming, one with beams twice the power of these three. This is the laser that was theorized to be the most powerful laser possible.

The list of implications for this never-before-seen technology is long, reaching into cancer diagnosis and treatment, elimination of nuclear waste, broadening of the techno and expansion of nanoscience and molecular chemistry research.

Several countries competed for the honor of hosting the laser. ELI's most important research laser will find its home in the Czech Republic while the other two will reside i and Romania.

EXHIBIT D

Where to see Saturday's total lunar eclipse

Video: Elvis monkey is one of several new species in Asia

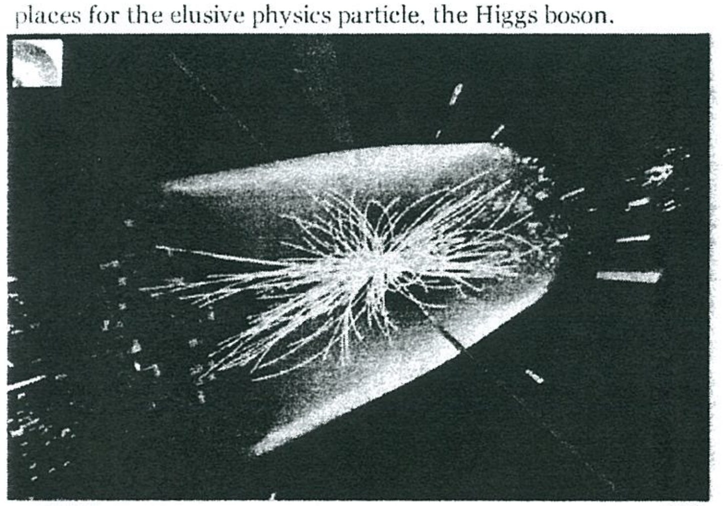
Dec 13, 2011

Higgs boson corralled by CERN detectors

By Dan Vergano, USA TODAY

Updated 2011-12-13 10:08 PM

An international physics team reports a narrowing of hiding places for the elusive physics particle, the Higgs boson.



CAPTION CERN

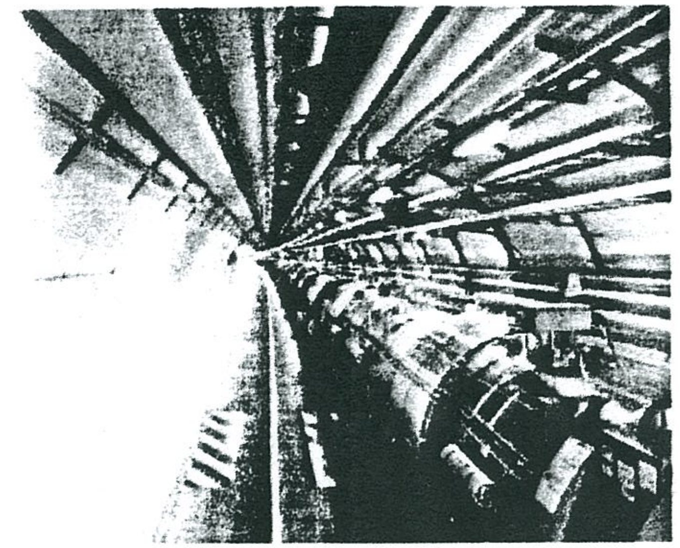
Before a packed audience, Europe's CERN laboratory hosted a Tuesday briefing on the results of two Large Hadron Collider experiments that smashed protons (the positively-charged sub-atomic particles at the center of atoms) together at near-light speeds to look for signs of the long-sought "God Particle". The teams report two detector experiments have narrowed the range of energies at which the particle emerges from proton mashups to 115 to 130 Gigaelectronvolts (a measurement of particle energy equivalent to a mass of .000000000000000205 to .000000000000000232 kilograms for the particles, for anyone keeping score).

"The window for the Higgs Boson gets smaller and smaller. However, it's still alive," said CERN director Rolf-Dieter Heuer at the conclusion of the briefing. The Higgs boson (named after

CERN announces LHC to run in 2012

January 31, 2011 | 11:09 am

CERN issued the following press release on January 31.



The Large Hadron Collider will restart in February. After a short technical stop at the end of the year, it will continue running through 2012.

CERN today announced that the LHC will run through to the end of 2012 with a short technical stop at the end of 2011. The beam energy for 2011 will be 3.5 TeV. This decision, taken by CERN management following the annual planning workshop held in Chamonix last week and a report delivered today by the laboratory's machine advisory committee, gives the LHC's experiments a good chance of finding new physics in the next two years, before the LHC goes into a long shutdown to prepare for higher energy running starting 2014.

"If LHC continues to improve in 2011 as it did in 2010, we've got a very exciting year ahead of us," said CERN's Director for Accelerators and Technology, Steve Myers. "The signs are that we should be able to increase the data collection rate by at least a factor of three over the course of this year."

The LHC was previously scheduled to run to the end 2011 before going into a long technical stop necessary to prepare it for running at its full design energy of 7 TeV per beam. However, the machine's excellent performance in its first full year of operation forced a rethink. Expected performance improvements in 2011 should increase the rate that the experiments can collect data by at least a factor of three compared to 2010. That would lead to enough data being collected this year to bring tantalising hints of new physics, if there is new physics currently within reach of the LHC operating at its current energy. However, to turn those hints into a discovery would require more data than can be delivered in one year, hence the decision to postpone the long shutdown. If there is no new physics in the energy range currently being explored by the LHC, running through 2012 will give the

Total US tax collected for fiscal year 2010=	$2,330,377,000,000
Total refunds returned fiscal year 2010=	467,302,973,000
Actual US income	$1,863,074,027,000

Considered the most reliable download; could not find 2011

Current social security expenditures	$731,000,000,000
Latest medicare/ins expenditures	$769,000,000,000
Total expenditures for these added together	$1.5 trillion

Considered reasonable to use the data from two consecutive years

Leaves the US federal government with	$363,074,027,000, for the year.
Current federal government expenditures	6.3 trillion
Every trillion dollars= one hundred million people paying	$10,000.00 each.
Median average income (all workers) for year 2008	$33,048.00
Total us state government tax revenue for 2010	$514,626,256,000
All States, tax income divided by 100 million workers=	$5146.26
IL tax income taken: 2010 $21 BILLION/ SPENT:	OVER 140 BILLION
IL population 12,830,632 per citizen taken (babies and all)	$1636.82
IL DEBTS ADDED: for 2010	$119 billion.
Federal tax expenditures per 100 million workers=	$63,000.00
Total state and federal expenditure per 100,000,000 workers=	$68,146.00
TOTAL debts for usa $121trillion. Total assets listed	$155.2 trillion

Divided by 308 million citizens= $504,056.81 **EACH! Do you see the inflation?**

Do you see a problem? Claimed employment was 155 million current / minus unemployed 12,710,000 current 142,290,000 employed: 16 years and up, all civilian categories.

http://www.irs.gov/taxstats/article/0,,id=102886,00.html
http://www.cbpp.org/cms/index.cfm?fa=view&id=1258
http://www.usgovernmentspending.com/illinois_state_spending.html
http://www.bls.gov/eag/eag.il.htm
http://www.federalreserve.gov/releases/z1/current/accessible/l5.htm

TreasuryDirect.

The Debt to the Penny and Who Holds It

(Debt Held by the Public vs. Intragovernmental Holdings)

Current	Debt Held by the Public	Intragovernmental Holdings	Total Public Debt Outstanding
04/05/2012	10,884,566,084,027.55	4,735,174,086,380.79	15,619,740,170,408.34

Social Security: Another 20 percent of the budget, or $731 billion, paid for Social Security, which provided retirement benefits averaging $1,229 per month to 35.6 million retired workers in December 2011. Social Security also provided benefits to 2.9 million spouses and children of retired workers, 6.3 million surviving children and spouses of deceased workers, and 10.6 million disabled workers and their eligible dependents in December 2011.

Medicare, Medicaid, and CHIP: Three health insurance programs - Medicare, Medicaid, and the Children's Health Insurance Program (CHIP) - together accounted for 21 percent of the budget in 2011, or $769 billion. Nearly two-thirds of this amount, or $486 billion, went to Medicare, which provides health coverage to around 48 million people who are over the age of 65 or have disabilities. The remainder of this category funds Medicaid and CHIP, which in a typical month in 2011 provided health care or long-term care to about 60 million low-income children, parents, elderly people, and people with disabilities. Both Medicaid and CHIP require matching payments from the states.

Safety net programs: About 13 percent of the federal budget in 2011, or $466 billion, went to support programs that provide aid (other than health insurance or Social Security benefits) to individuals and families facing hardship. Spending on safety programs declined in both nominal and real terms between 2010 and 2011 as the economy continued to improve and initiatives funded by the 2009 Recovery Act began to expire.

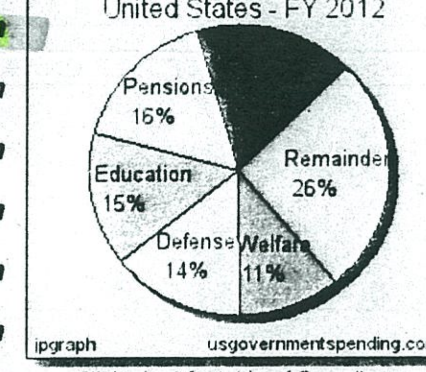
/ww.cbpp.org/cms/index.cfm?fa=view&id=1258

EXHIBIT E

Total Spending by Function

Function	2012
Total Spending	***$6.3 trillion***
Pensions	***$1.0 trillion***
Health Care	***$1.1 trillion***
Education	***$0.9 trillion***
Defense	***$0.9 trillion***
Welfare	***$0.7 trillion***

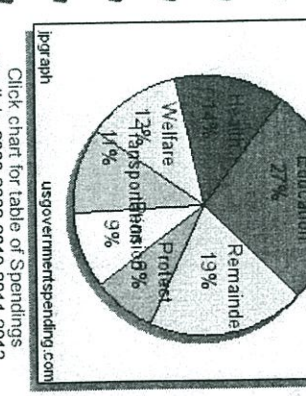
source: guesstimated[2]



Click chart for table of Spendings or click: 2010 2011 2012 2013 2014

Illinois State & Local Spending by Function

Function	2010
Total Spending	***$0.1 trillion***
Pensions	***$0.0 trillion***
Health Care	***$0.0 trillion***
Education	***$0.0 trillion***
Welfare	***$0.0 trillion***
Protection	***$0.0 trillion***
Transport	***$0.0 trillion***



Click chart for table of Spendings or click: 2008 2009 2010 2011 2012

Table 8. Amount of Refunds Issued, Including Interest, by Type of Refund and State, Fiscal Year 2010

[Money amounts are in thousands of dollars.]

State	Total Internal Revenue refunds [1]	Business income taxes [1, 2]	Individual income tax [1, 3]	Estate and trust income tax	Employment taxes [4]	Estate tax	Gift tax	Excise taxes
			Individual income tax, employment taxes, and estate and trust income tax					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
United States, total [5]	**467,302,973**	**98,338,609**	**358,431,274**	**3,542,928**	**4,216,048**	**814,842**	**93,227**	**1,866,046**
Alabama	6,515,251	1,117,862	5,325,526	16,657	37,860	8,582	535	8,229
Alaska	879,488	58,095	797,797	12,230	9,224	374	0	1,768
Arizona	8,124,825	1,248,009	6,772,453	26,735	49,198	9,987	470	17,972
Arkansas	3,146,961	182,511	2,924,183	8,913	21,345	2,666	2,300	5,043
California	50,687,921	7,296,244	42,459,336	264,867	431,415	151,902	14,896	69,261
Colorado	6,844,894	985,178	5,707,501	40,842	59,392	15,164	1,758	35,060
Connecticut	5,844,435	680,428	4,843,542	159,997	123,176	11,429	1,148	24,715
Delaware	2,855,777	1,417,552	1,011,766	223,907	196,384	3,741	283	2,145
District of Columbia	1,702,975	889,940	793,866	7,497	5,829	5,510	46	286
Florida	28,009,554	2,700,650	24,719,760	214,039	223,774	78,609	4,551	68,170
Georgia	14,136,716	2,673,603	11,256,122	38,195	128,186	12,290	2,543	25,777
Hawaii	1,502,019	107,095	1,371,234	5,964	10,944	5,008	633	1,141
Idaho	1,931,242	315,597	1,584,248	3,330	13,838	11,554	186	2,490
Illinois	20,715,578	3,829,715	16,232,126	381,767	205,446	24,869	1,584	40,071

Appendix Table A-1.

Totals for Selected State Government Tax Revenue: 2010

(Dollars in thousands)

State and U.S. summary	Total general sales tax	Individual income tax	Corporation net income tax	Severance tax	Documentary and stock transfer tax
United States	224,475,423	236,352,511	38,176,586	11,071,812	4,249,924
Alabama	2,097,434	2,589,249	428,245	90,538	30,354
Alaska	–	–	643,068	3,355,049	0
Arizona	4,409,603	2,416,324	413,193	33,372	0
Arkansas	2,615,290	2,091,082	385,365	65,147	26,275
California	31,197,154	45,646,436	9,114,589	24,409	0
Colorado	2,050,445	4,089,948	360,003	71,436	0
Connecticut	3,145,579	5,768,846	507,752	61	98,615
Delaware	–	853,107	142,417	–	52,875
Florida	18,537,000	–	1,793,200	71,000	1,252,500
Georgia	4,864,691	7,016,412	684,701	–	11,622
Hawaii	2,316,434	1,527,790	79,853	–	39,887
Idaho	1,126,671	1,068,754	98,327	6,730	0
Illinois	8,842,231	9,433,244	2,686,685	0	40,323
Indiana	[illegible]	[illegible]	[illegible]		

EXHIBIT E

Federal Reserve Statistical Release

Z.1

Flow of Funds Accounts of the United States

Release Date: March 8, 2012

Release dates | Announcements | Coded tables | Historical data
Current release | Screen reader | PDF (450 KB) | Data Download Program (DDP)

L.5 Total Liabilities and Its Relation to Total Financial Assets
Billions of dollars; amounts outstanding end of period, not seasonally adjusted

Description	2007	2008	2009	2010 Q1	2010 Q2	2010 Q3	2010 Q4	2011 Q1	2011 Q2	2011 Q3	2011 Q4	Line
All sectors; credit market instruments; liability	50875.7	53296.6	53065.8	52683.5	52666.8	52940.9	53353.1	53558.7	53499.4	53827.4	54134.3	1
All sectors; U.S. official reserve assets; liability	67.3	74.2	175.1	170.1	165.7	177.0	175.8	184.3	189.3	186.4	183.8	2
Monetary authority; SDR certificates issued by federal government; asset	2.2	2.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	3
Federal government; Treasury currency; liability	27.4	26.6	26.2	26.2	26.2	25.9	25.9	25.9	25.9	25.9	25.9	4
Rest of the world; U.S. private deposits; liability	1340.9	946.7	840.6	841.7	879.5	887.9	912.3	957.7	941.7	933.5	896.1	5
Financial business; net interbank transactions; liability	88.6	1890.5	1281.5	1194.1	1139.4	1029.3	1091.6	1802.4	1917.9	1979.4	1913.5	6
Financial business; checkable deposits and currency; liability	1532.9	2101.3	2093.4	2067.1	2173.1	2181.2	2359.8	2193.3	2314.6	2403.7	2592.6	7
Financial business; small time and savings deposits; liability	5224.5	5749.3	6326.5	6459.4	6443.4	6539.7	6624.9	6741.5	6898.8	7065.7	7202.8	8
Financial business; large time deposits; liability	2382.2	2191.6	1989.8	1887.8	1799.3	1836.9	1807.5	1811.8	1815.3	1658.4	1602.8	9
Money market mutual funds; total financial assets	3033.1	3757.3	3258.3	2930.7	2760.4	2746.1	2755.3	2679.4	2637.8	2578.4	2642.5	10
Financial business; federal funds and security repurchase agreements; liability	2159.8	1270.3	1452.4	1461.3	1324.0	1290.6	1227.4	1258.5	1220.8	1067.2	1108.2	11
Mutual funds; total financial assets	7829.0	5435.3	6961.6	7295.0	6764.2	7401.8	7934.5	8471.9	8570.5	7532.8	7955.9	12
All sectors; security credit; liability	1526.4	1128.5	1091.2	1108.8	1146.1	1173.7	1214.8	1258.1	1323.8	1380.9	1312.4	13
All sectors; life insurance reserves; liability	1201.5	1179.8	1242.1	1249.5	1235.7	1261.9	1278.3	1297.8	1311.2	1318.5	1338.9	14
Households and nonprofit organizations; pension fund reserves; asset	13390.7	10408.5	11914.5	12291.0	11610.2	12331.9	13088.3	13483.5	13412.8	12466.6	13160.9	15
All sectors; trade payables; liability	3398.0	3228.0	3204.2	3277.4	3313.7	3387.6	3403.0	3477.3	3553.4	3618.8	3679.0	16
All sectors; taxes payable; liability	167.7	44.0	40.6	49.5	43.7	53.9	51.8	78.2	66.5	68.6	72.1	17
All sectors; total miscellaneous liabilities	17441.8	19846.9	19678.3	19623.7	20415.9	20149.4	20433.6	20318.7	20416.6	21639.8	21267.7	18
All sectors; total liabilities	111689.7	112577.4	114647.2	114622.0	113912.4	115420.9	117743.0	119604.1	120121.5	119757.0	121094.8	19
All domestic sectors; monetary gold; asset	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	20
All sectors; corporate equities; asset	25580.9	15640.5	20123.2	21008.9	18733.5	21070.4	23249.0	24589.2	24451.5	20300.0	22211.4	21
Households and nonprofit organizations; proprietors' equity in noncorporate business	8951.2	7314.6	6428.9	6632.6	7004.3	6717.7	7162.7	7169.3	7145.0	7525.8	7298.7	22
Instrument discrepancies; Treasury currency (seigniorage)	-11.3	-12.1	-16.5	-16.5	-17.0	-17.5	-17.6	-17.9	-18.0	-18.2	-18.3	23
Instrument discrepancies; private foreign deposits	1082.9	735.8	661.4	660.1	684.8	670.6	679.6	713.6	688.7	701.3	690.3	24
Instrument discrepancies; net interbank transactions	21.1	51.7	86.1	58.9	74.0	69.4	61.8	75.3	83.3	104.2	89.4	25
Instrument discrepancies; federal funds and security repurchase agreements	628.0	32.6	410.9	462.0	438.8	359.3	295.6	223.4	208.8	186.7	172.6	26
Instrument discrepancies; taxes receivable	-174.8	-345.3	-375.5	-371.4	-386.2	-388.5	-397.1	-380.0	-400.3	-394.5	-401.9	27
Instrument discrepancies; total miscellaneous assets	-7147.8	-4807.1	-5298.2	-5421.3	-5181.1	-5534.7	-5366.2	-5427.8	-5487.4	-5163.6	-5523.2	28
Instrument discrepancies; state and local governments mail float	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
Instrument discrepancies; federal goverment mail float	2.8	1.2	2.0	1.4	-0.6	1.6	2.5	2.6	3.5	1.7	2.5	30
Instrument discrepancies; private domestic mail float	7.3	5.3	4.2	3.3	3.4	3.5	3.2	3.3	3.4	3.9	4.1	31
Instrument discrepancies; trade receivables	118.1	130.9	208.3	221.7	162.0	201.4	267.1	252.6	226.0	247.3	351.1	32
All sectors; total financial assets	151706.7	139750.5	145527.6	146676.5	143883.2	147855.1	152636.9	155928.5	156421.1	151925.0	155249.5	33

Release dates | Announcements | Coded tables | Historical data
Current release | Screen reader | PDF (450 KB) | Data Download Program (DDP)

Statistical releases

Home | Economic research and data
Accessibility | Contact Us
Last update: March 8, 2012

http://www.irs.gov/taxstats/article/0,,id=102886,00.html

Return to Tax Stats home page

2010 Tax Stats Card

Summary of Collections Before Refunds by Type of Return, FY 2009 [1]

Type of Return	Number of Returns	Gross Collections (Millions of $)
Individual income tax	144,103,375	1,175,422
Corporation income tax	2,475,785 [2]	225,482
Employment taxes	30,223,289	858,164
Excise taxes	809,461	46,632
Gift tax	245,262	3,094
Estate tax	47,320	21,583

Selected Information from Returns Filed

Corporate Returns (TY 2007) [3]	
Number filing with assets $250M or more	14,752
Percent of total corporate net income for firms with assets $250M or more	75.4%

S Corporation Returns (TY 2007) [3]	
Number of returns	[P] 3,989,893

Partnership Returns (TY 2008) [3]	
Number of returns	3,146,006

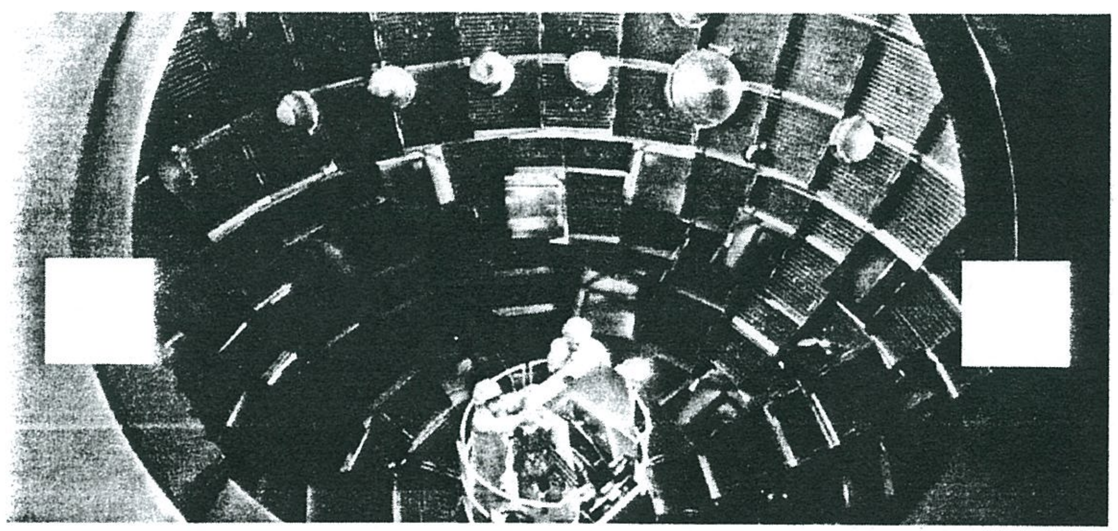
Individual Returns	
Top 1-percent Adjusted Gross Income (AGI) break (TY 2008) [3,4]	$380,354
Top 10-percent AGI break (TY 2008) [3,4]	$113,799
Bottom 10-percent AGI break (TY 2008) [3,4]	$5,942
Median AGI (TY 2008) [3,4]	$33,048
Percent that claim standard deductions (TY 2008) [3]	64.4%
Percent that claim itemized deductions (TY 2008) [3]	33.8%

White House Press Briefing

Launch Live

EXHIBIT B

World's most powerful laser fires most powerful laser blast in history



The largest laser in the world was turned on for a fraction of a second last week -- and it unleashed the most powerful laser blast in history.

The National Ignition Facility (NIF) -- a laser test facility at Lawrence Livermore National Laboratory in Livermore, Calif. -- turned on its 192 laser beams for a brief instant on March 15, unleashing a record-setting 1.875-megajoule blast into a target chamber.

The lasers were combined, gathered and focused through a series of lens

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World's most powerful laser fires most powerful laser blast in history | Fox News

RELATED STORIES

That pulse of energy lasted for just 23 billionths of a second, yet it generated 411 trillion watts of power, NIF said -- 1,000 times more than the entire United States consumes at any given instant.

"It's a remarkable demonstration of the laser from the standpoint of its energy, its precision, its power, and its availability," Moses told Nature magazine.

But it's barely half the battle. NIF hopes to dramatically increase the power of the laser shots by the end of year, intending to ultimately use the facility to harness the energy reaction that occurs naturally within the sun: fusion.

"This event marks a key milestone in the National Ignition Campaign's drive toward fusion ignition," Moses said.

In fission, atoms are split and the massive energy released is captured. The NIF aims for fusion, the ongoing energy process in the sun and other stars where hydrogen and helium nuclei are continually fusing and releasing enormous amounts of energy. In the ignition facility, beams of light converge on pellets of hydrogen isotopes to create a similar, though controlled, micro-explosion.

As the beams move through a series of amplifiers, their energy increases exponentially. From beginning to end, the beams' total energy grows from one-billionth of a joule to a potential high of four million joules, NIF said -- a factor of more than a quadrillion.

And it all happens in about five millionths of a second.

Because the laser is on for the merest fraction of a second, it costs little to operate -- between $5 and $20 per blast, said spokeswoman Lynda Seaver. But the potential is enormous.

NIF's managers hope by the end of the year to reach a break-even point, where the energy released is equal to if not greater than the energy that went into the blast.

"We have all the capability to make it happen in fiscal year 2012," Moses told Nature.

Experts aren't so sure, citing challenges that NIF and other types of fusion have had in the past.

Glen Wurden, a plasma physicist at Los Alamos National Laboratory in New Mexico, told Nature scientists should be wary of putting all their eggs in the laser basket.

"It's premature right now," he told the magazine, citing the troubles that have plagued a competing approach to fusion and its flagship project in F

TRENDING IN SCITECH

1 Amazon CEO seek recover sunken Ap engines from ocea

2 Unearthed fossil foot belong to new human scientists say

3 Marine monster myster Carolina beach

4 Teddy bear-faced robot is battlefields

5 New Milky Way photo capture stars

BUSINESS SOLUTIONS

Google Proposes Andro Revenue for Oracle: Fili

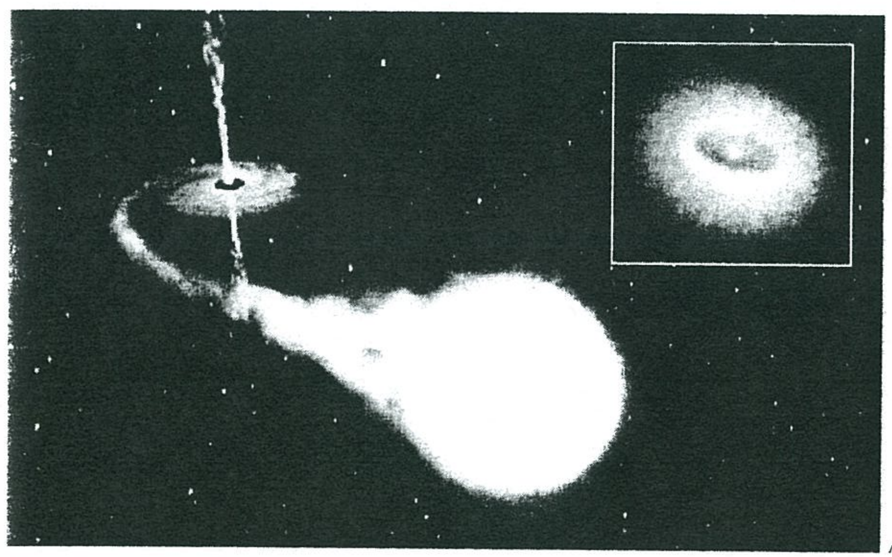
Nvidia, H-P, IBM Keep Techs Posit

Wall Street's Rally Sputters as En Shares Slump

EXHIBIT B

Science at the Extremes

When laboratory experiments begin at the National Ignition Facility in 2010, researchers will be able for the first time to study the effects on matter of the extreme temperatures, pressures and densities that exist naturally only in the stars and deep inside the planets. Results from this relatively new field of research, known as high energy density (HED) science, will mark the dawn of a new era of science. HED experiments at NIF promise to revolutionize our understanding of astrophysics and space physics, hydrodynamics, nuclear astrophysics, material properties, plasma physics, nonlinear optical physics, radiation sources and radiative properties and other areas of science.

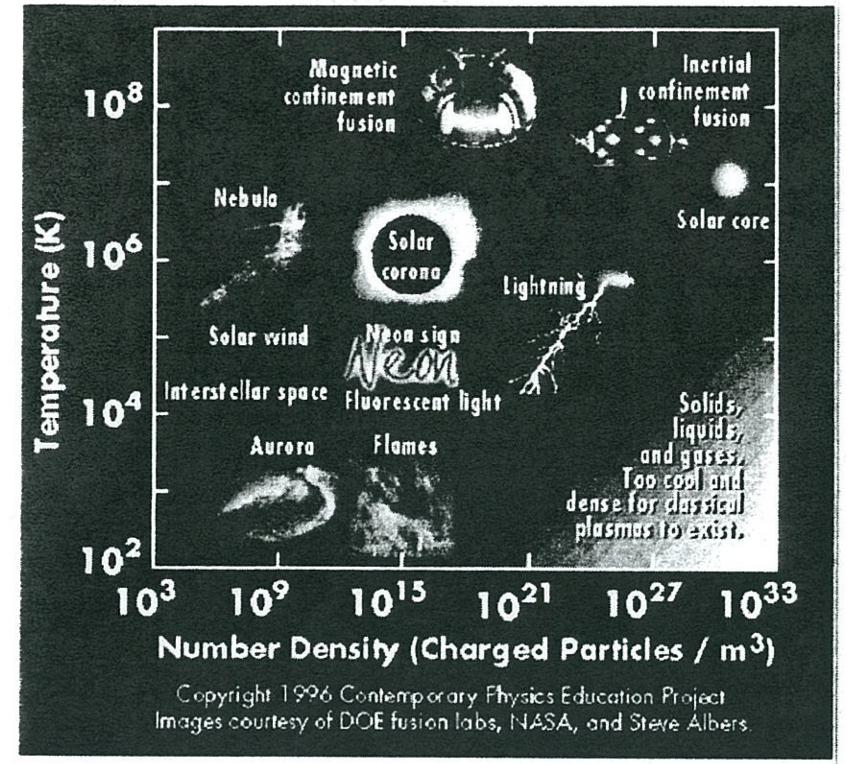


An artist's concept of a black hole in a binary system shows a star (at right) feeding an accretion disk surrounding the black hole. The insert shows an image recorded by the Hubble Space Telescope of a massive black hole at the center of the galaxy NGC4261.

NIF will achieve temperatures of more than 100 million Kelvin (180 million degrees Fahrenheit); densities of about 1,000 grams per cubic centimeter; pressures more than 100 billion times as large as the Earth's atmosphere; and neutron densities as high as 10^{26} per cubic centimeter. Only three places in the space and time of our universe have ever produced anything close to these conditions: the Big Bang, when the universe was born in a primordial fireball; the interiors of stars and planets; and thermonuclear weapons. Nothing within orders of magnitude of these extraordinary conditions has been available for laboratory experiments until now (see How to Make a Star). Because these conditions are so extreme, the connection between NIF and astrophysics is certain to excite scientists interested in using NIF to try to understand the objects in the cosmos, even to the beginning of the universe.

Plasma Physics

Almost all of the observable matter in the universe is in the plasma state. Formed at high temperatures when electrons are stripped from neutral atoms, plasmas consist of freely moving ions and free electrons. They are often called the "fourth state of matter" because their unique physical properties distinguish them from solids, liquids and gases.



Characteristics of typical plasmas

Plasma densities and temperatures vary widely, from the cold gases of interstellar space to the extraordinarily hot, dense cores of stars and inside nuclear weapon. On one end of the spectrum, plasma physicists study conditions of high vacuum, with only a few particles in a volume of one cubic centimeter – about the volume of a sugar cube. On the other end of the density range, plasmas with densities sometimes well above 1,000 times the density of a solid occur in stellar interiors and in laboratory experiments that attempt to reproduce the processes in the sun. Although we now most commonly encounter plasmas in energy-efficient light bulbs, plasmas may hold their greatest potential as a future inexhaustible source of energy (see Inertial Fusion Energy).

Two areas of plasma physics have been addressed with experiments using high-energy lasers and both are very relevant to the attempt to create inertial fusion (see How to Make a Star). First are studies of the phenomena created by the laser interacting with the plasma. Of particular importance in this area are two mechanisms of laser-plasma coupling: "stimulated Brillouin scattering" and "stimulated Raman scattering," two wa the energy of the laser beam is shared with the plasma (see Laser-Plasma Interactions). Both effects need to be minimized in order to drive the implosion of the ignition capsule as efficiently as possible.

The second area involves attempts to use the laser to emulate other phenomena occurring in nature. This research is also important to inertial fusion, but it extends well beyond that into fundamental areas of science, such as interpenetrating plasmas and plasma flow in a magnetic field.

The capabilities of NIF will allow production of hot dense plasmas that are sufficiently large and homogeneous to allow their detailed characterization, and thus to study these phenomena. NIF will allow measurement of electron and ion temperatures, charge states, electron densit and plasma flow velocities, all of which are essential for understanding experiments on the two basic areas of plasma physics described above.

More Information

Basic Research Directions for User Science at the National Ignition Facility, National Nuclear Security Administration and U.S. Department of Energy Office of Science, November 2011

"Taking on the Stars: Teller's Contributions to Plasma and Space Physics," Science & Technology Review, July/August 2007

"Duplicating the Plasmas of Distant Stars," Science & Technology Review, April 1999

Perspectives on Plasmas - The Fourth State of Matter

- Plasma Physics & ICF

EXHIBIT B

Recipe for a Small Star

- Take a hollow, spherical plastic capsule about two millimeters in diameter (about the size of a small pea)
- Fill it with 150 micrograms (less than one-millionth of a pound) of a mixture of deuterium and tritium, the two heavy isotopes of hydrogen.
- Take a laser that for about 20 billionths of a second can generate 500 trillion watts – the equivalent of five million million 100-watt light bulbs.
- Focus all that laser power onto the surface of the capsule.
- Wait ten billionths of a second.
- Result: one miniature star.

In this process the capsule and its deuterium-tritium (D-T) fuel will be compressed to a density 100 times that of solid lead, and heated to more than 100 million degrees Celsius – hotter than the center of the sun. These conditions are just those required to initiate thermonuclear fusion, the energy source of stars.

By following our recipe, we would make a miniature star that lasts for a tiny fraction of a second. During its brief lifetime, it will produce energy the way the stars and the sun do, by nuclear fusion. Our little star will produce ten to 100 times more energy than we used to ignite it.

The idea for the National Ignition Facility (NIF) grew out of the decades-long effort to generate fusion burn and gain in the laboratory. Current nuclear power plants, which use fission, or the splitting of atoms to produce energy, have been pumping out electric power for more than 50 years. But achieving nuclear fusion burn and gain has not yet been demonstrated to be viable for electricity production. For fusion burn and gain to occur, a special fuel consisting of the hydrogen isotopes deuterium and tritium must first "ignite." A primary goal for NIF is to achieve fusion ignition, in which more energy is generated from the reaction than went into creating it.

NIF was designed to produce extraordinarily high temperatures and pressures – tens of millions of degrees and pressures many billion times greater than Earth's atmosphere. These conditions currently exist only in the cores of stars and planets and in nuclear weapons. In a star, strong gravitational pressure sustains the fusion of hydrogen atoms. The light and warmth that we enjoy from the sun, a star 93 million miles away, are reminders of how well the fusion process works and the immense energy it creates.

Replicating the extreme conditions that foster the fusion process has been one of the most demanding scientific challenges of the last half-century. Physicists have pursued a variety of approaches to achieve nuclear fusion in the laboratory and to harness this potential source of unlimited energy for future power plants.

See How ICF Works for a more detailed description of inertial confinement fusion.

Committee on High Energy Density Plasma Physics, National Research Council

Simulation of a Supernova Explosion

Supernova explosion simulationThe temperature at which hydrogen undergoes fusion in the cores of stars for most of their lives is 10 to 30 million Kelvin, or 18 to 54 million degrees Fahrenheit – much lower than the temperature expected to be achieved in the NIF target. This phase of stellar evolution occurs at a density of some 100 grams per cubic centimeter, also well below what NIF will achieve. NIF's high pressures will permit planetary astrophysicists to study conditions at the cores of massive planets such as Jupiter and to understand the transition between large planets and stars. The extreme neutron density at NIF is larger than that achievedy by a core-collapse supernova – an exploding star – or when two neutron stars collide.

The conditions that NIF will produce will also permit research into:

- Materials at unprecedented pressures, and the possible phase changes that are certain to be discovered under these conditions (see Planetary Physics).
- Plasmas, the material that makes up the stars and constitutes almost all of the known matter in the universe (see Plasma Physics). The turbulent collections of electrons and ions that can carry electrical currents and generate magnetic fields are of interest not only for the production of energy from laser fusion, but also to astrophysics (much of our understanding of extreme objects, such as black holes, arises from studies of the X-rays emitted from the plasmas that are produced around them) and to nuclear physics (under conditions that are similar to those that exist in stars, unlike the usual accelerator-based experiments.).
- Instabilities produced by laser fusion (see Laser-Plasma Interactions). Although these phenomena are the bane of laser fusion researchers, they are the same instabilities that are produced in some stellar objects, such as supernovae, and so will provide a unique opportunity for astrophysicists to understand what makes stars, even exploding stars, operate the way they do.

More Information

"Dawn of a New Era," Commentary by NIF Associate Director Edward I. Moses, *Science & Technology Review*, July/August 2007

"Preparing for the X-Games of Science," *Science & Technology Review*, July/August 2007

"At Livermore, Audacious Physics Has Thrived for 50 Years," *Science & Technology Review*, May 2002

Frontiers in High Energy Density Physics: The X-Games of Contemporary Science, Committee on High Energy Density Plasma Physics, National Research Council, 2003

Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century, Board on Physics and Astronomy, National Research Council, 2003

"Science on the NIF," *Energy & Technology Review*, December 1994 (PDF)

EXHIBIT C

Animal-Human Hybrids Spark Controversy

Scientists have begun blurring the line between human and animal by producing chimeras—a hybrid creature that's part human, part animal.

Chinese scientists at the Shanghai Second Medical University in 2003 successfully fused human cells with rabbit eggs. The embryos were reportedly the first human-animal chimeras successfully created. They were allowed to develop for several days in a laboratory dish before the scientists destroyed the embryos to harvest their stem cells.

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In Minnesota last year researchers at the Mayo Clinic created pigs with human blood flowing through their bodies.

And at Stanford University in California an experiment might be done later this year to create mice with human brains.

Scientists feel that, the more humanlike the animal, the better research model it makes for testing drugs or possibly growing "spare parts," such as livers, to transplant into humans.

Watching how human cells mature and interact in a living creature may also lead to the discoveries of new medical treatments.

But creating human-animal chimeras—named after a monster in Greek mythology that had a lion's head, goat's body, and serpent's tail—has raised troubling questions: What new subhuman combination should be produced and for what purpose? At what point would it be considered human? And what rights, if any, should it have?

There are currently no U.S. federal laws that address these issues.

Ethical Guidelines

The National Academy of Sciences, which advises the U.S. government, has been studying the issue. In March it plans to present voluntary ethical guidelines for researchers

For example, faulty human heart valves are routinely replaced with ones taken from cows and pigs. The surgery—which makes the recipient a human-animal chimera—is widely accepted. And for years scientists have added human genes to bacteria and farm animals.

Continued on Next Page >>

LATEST NEWS VIDEOS

Artificial Life

Early Access
Posted Online February 22, 2012.
(doi:10.1162/artl_a_00056)
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Evolvable Physical Self-Replicators

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PDF (551.4 KB) | **PDF Plus** (537.155 KB)

Abstract

Building an evolvable physical self-replicating machine is a grand challenge. The main problem is that the device must be capable of hereditary variation, that is, replicating in many configurations—configurations into which it enters unpredictably by mutation. Template replication is the solution found by nature. A scalable device must also be capable of miniaturization, and so have few or no moving and electronic parts. Here a significant step towards this goal is presented in the form of a physical template replicator made from small plastic pieces containing embedded magnets that float on an air-hockey-type table and undergo stochastic motion.

particular, replication must be maintained by preventing side reactions such as spontaneous ligation, cyclization, product inhibition, and elongation at staggered ends. The last of these results in ever-lengthening sequences in a process known as the *elongation catastrophe*. The extreme specificity of structure required by the monomers is indirect evidence that some kind of natural selection took place prior to the existence of nucleotide analogues during the origin of life.

Alife XIII

...TERNATIONAL ...N & SYNTHES...

I. OVERVIEW

...is a great pleasure for the BEACON Center for the Study of Evolution in Action at Michigan State U... ...th International Artificial Life Conference. Artificial life (ALife) refers to the synthesis and simulation ...ese occur in nature and also to possible alternative life forms and concepts that may not have occ... ...that is, not only in "life-as-we-know-it", but also "life-as-it-might-be". ALife research may use not on... ...ut also computer models and robotics. The Artificial Life conference is held every other year under t... ...ernational Society for Artificial Life (ISAL), alternating with the European Conference on Artificial Li...

This year's major conference theme is "Evolution in Action." Life is shaped by evolutionary processe... ...powerful way to investigate and utilize this key characteristic of living systems. We encourage sub... ...well as by computer scientists and engineers, especially interdisciplinary papers that explore the ...olution and artificial life research intersect. Other tracks this year include Behavior & Intelligence, (...ynthetic Biology, and The Humanities and ALife. See the list of tracks below for examples of topics ...

V. TRACKS

- **Evolution in Action** – including evolutionary dynamics, simulations of evolution, developme... evolution, viral and bacterial evolution, evolution of drug resistance.
- **Behavior & Intelligence** – including animal behavior, evolution of cognition and intelligenc... embedded systems.
- **Collective Dynamics** – including group selection, evolution and stability of ecosystems, ne... dynamics, evolution of cooperation and conflict, collective motion and swarming in animal...
- **Synthetic Biology** – including synthetic cells, synthetic organisms, biological engineering ...rtificial chemistry, origin of life, paleogenetics.
- **The Humanities and ALife** – including art, music, history and philosophy of artificial life.

...the conference web site www.alife13.com for more detailed descriptions of each of the tra...

...n Embryos Cloned by U.S. ...any, But Don't Survive

...at a U.S. biotech company announced Sunday that they have ...first human embryos. The company said it intends to use such ...o provide an endless source of stem cells—which can develop ...e of adult cell in the human body—for the treatment of human

...some experts consider the research a complete failure because ...embryos all died very early, long before reaching the multi-cell, ...st, stage at which stem cells could be harvested.

"This is not a breakthrough or even a scientific contribution," said Nobel laureate Paul Berg of Stanford University, a frequent consultant on federal policy regarding stem cell research, human cloning, and biotechnology. "The experiment was a failure and does not warrant the amount of press coverage it has received," he added.

The company, Advanced Cell Technologies (ACT), based in Worcester, Massachusetts, said the technique could ultimately produce a source of healthy new tissue for ...ion into patients whose own cells had been damaged or destroyed by

EXHIBIT C

guardian

Synthetic life breakthrough could be worth over a trillion dollars

Ian Sample, science correspondent
guardian.co.uk, Thursday 20 May 2010 18.09 EDT
Article history

It was a dream that began nearly 15 years ago, when Craig Venter, a Vietnam veteran turned geneticist, resolved one day to create a genome from scratch – and with it, make the first ever synthetic life form. Last night, in a dramatic announcement that led some to accuse him of playing God, Venter said the dream had come true, saying he had created an organism with manmade DNA.

The feat, hailed as an epochal scientific breakthrough by some but an alarming development by others, was achieved by scientists at the J Craig Venter Insititute in Rockville, Maryland using little more than a computer, some common microbes, a DNA synthesizer and four bottles of chemicals.

The result – after $40m (£28m) and more than a decade – is the first microbe that thrives and replicates with only a synthetic genome to guide it. Every "letter" of its genetic code was made in the laboratory and stitched together, forming an artificial chromosome 1m characters long.

Despite the scale of the achievement, the organism in question could scarcely be more lowly – it is based on a bacterium that causes mastitis in goats.

While scientists and philosophers have already begun to debate the potential consequences and moral implications of the work, the motivating force for Venter is commercial. His team has an even more ambitious dream: to create organisms that are not only new, but also lucrative. Venter has secured a deal with the oil giant ExxonMobil to create algae that can absorb carbon dioxide from the atmosphere and convert it into fuel – an innovation he believes could be worth more than a trillion dollars.

The new bacterium, Venter said, is "the proof of the concept that we can make, in theory, changes across the entire genome of an organism, that we can add entirely new functions, eliminate those we don't want, and create a new range of industrial organisms that put all of their effort into doing what we want them to do. Until this experiment worked, the whole field was theoretical. Now it is real."

To create the organism, Venter's team began with a computer reconstruction of the genome of a common bacterium, Mycoplasma mycoides. The information was fed into a DNA synthesizer which produced short strands of the bug's DNA. These strands were

reassembled them.

After several rounds, the scientists had pieced together all 1m letters of the bacterium's genome. To mark the genome as synthetic, they spliced in fresh strands of DNA, each a biological "watermark" that would do nothing in the final organism except carry coded messages, including a line from James Joyce: "To live, to err, to fall, to triumph, to recreate life out of life."

The crucial step came next. The scientists took the synthetic genome and transferred it into another kind of common bug. As this bug multiplied, some of its progeny ditched their own DNA and began using the synthetic genome. Then the transformation began.

"It's pretty stunning when you just replace the DNA software in the cell. The cell instantly starts reading that new software, starts making a whole different set of proteins, and in a short while, all the characteristics of the first species disappear and a new species emerges," Venter said.

Venter calls the organism a "synthetic cell" because it survives thanks to a manmade genome, but apart from the watermarking woven into its DNA, it behaves like any other M. mycoides. Some scientists argue it is not a new kind of life, but others say that does not detract from the feat. "This is a remarkable advance," said Paul Freemont, a synthetic biologist at Imperial College London. "The applications of this enabling technology are enormous."

But the work drew immediate criticism from others who fear it could trigger an environmental disaster or hand a gift to terrorists bent of developing weaponised microbes. "This is a step towards something much more controversial: creation of living beings with capacities and natures that could never have naturally evolved," said Julian Savulsescu, an ethicist at Oxford University. "The potential is in the far future, but real and significant: dealing with pollution, new energy sources, new forms of communication. But the risks are also unparalleled. These could be used in the future to make the most powerful bioweapons imaginable."

Pat Mooney, of the ETC group, which opposes synthetic biology, said: "This is a Pandora's box moment. Like the splitting of the atom or the cloning of Dolly, we will all have to deal with the fallout from this alarming experiment."

Venter agrees that stringent regulations are needed to ensure synthetic organisms do not escape and cause damage. "It's clearly a dual-use technology and that requires immense responsibility for whoever's using it," he said. "We are entering an exciting new era where we're limited mostly by our imaginations."

And if the microbe were, somehow, to escape the tight security of Venter's lab? "It will not grow outside the lab unless it is deliberately injected or sprayed into a goat. And we don't work with goats."

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Alert: Synthetic Biology is 'Extreme Genetic Engineering' and Far More Dangerous

Extreme Genetic Engineering: ETC Group Releases Report on Synthetic Biology Findings to be presented at World Social Forum in Nairobi - 20-25 January
ETC Group, Jan 16, 2007
Straight to the Source

A new report by the ETC Group concludes that the social, environmental and bio-weapons threats of synthetic biology surpass the possible dangers and abuses of biotech. The full text of the 70-page report, Extreme Genetic Engineering: An Introduction to Synthetic Biology, is available for downloading free-of-charge on the ETC Group website: **www.etcgroup.org**

"Genetic engineering is passe," said Pat Mooney, Executive Director of ETC Group. "Today, scientists aren't just mapping genomes and manipulating genes, they're building life from scratch - and they're doing it in the absence of societal debate and regulatory oversight," said Mooney.

Synbio - dubbed "genetic engineering on steroids" - is inspired by the convergence of nano-scale biology, computing and engineering. Using a laptop computer, published gene sequence information and mail-order synthetic DNA, just about anyone has the potential to construct genes or entire genomes from scratch (including those of lethal pathogens). Scientists predict that within 2-5 years it will be possible to synthesise any virus; the first de novo bacterium will likely make its debut in 2007; in 5-10 years simple bacterial genomes will be synthesised routinely and it will become no big deal to cobble together a designer genome, insert it into an empty bacterial cell and - voila - give birth to a living, self-replicating organism. Other synthetic biologists hope to reconfigure the genetic pathways of existing organisms to perform new functions - such as manufacturing high-value drugs or chemicals.

A clutch of entrepreneurial scientists, including the gene maverick J. Craig Venter, is setting up synthetic biology companies backed by government funding and venture capital. They aim to commercialise new biological parts, devices and systems that don't exist in the natural world - some of which are designed for environmental release. Advocates insist that synthetic biology is the key to cheap biofuels, a cure for malaria, and climate change remediation - media-friendly goals that aim to mollify public concerns about a dangerous and controversial technology. Ultimately synthetic biology means cheaper and widely accessible tools to build bioweapons, virulent pathogens and artificial organisms that could pose grave threats to people and the planet. The danger is not just bio-terror, but "bio-error," warns ETC Group.

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synthetic life could be concentrated in the hands of major multinational firms. As gene synthesis becomes cheaper and faster, it will become easier to synthesise a microbe than to find it in nature or retrieve it from a gene bank. Biological samples, sequenced and stored in digital form, will move instantaneously across the globe and be resurrected in corporate labs thousands of miles away - a practice that could erode future support for genetic conservation and create new challenges for international negotiations on biodiversity.

"Last year, 38 civil society organizations rejected proposals for self-regulation of synthetic biology put forth by a small group of synthetic biologists," said Kathy Jo Wetter of ETC Group. "Widespread debate on the social, economic and ethical implications of synbio must come first - and it must not be limited to biosecurity and biosafety issues," said Wetter.

The tools for synthesising genes and genomes are widely accessible and advancing at break-neck pace. ETC Group's new report concludes that it is not enough to regulate synthetic biology on the national level. Decisions must be considered in a global context, with broad participation from civil society and social movements. In keeping with the Precautionary Principle, ETC Group asserts that - at a minimum - there must be an immediate ban on environmental release of de novo synthetic organisms until wide societal debate and strong governance are in place.

. . . .

Synthetic Biology Report Goes to World Social Forum

ETC Group will host three workshops and participate in several other events at the upcoming World Social Forum in Nairobi, 20-25 January. All events will take place at the Moi International Sports Center (Kasarani suburb). ETC Group's workshops and other events in which we'll participate appear below. Watch our web site for updates: **www.etcgroup.org">**

January 21:
"What Next?" Hosted by the Dag Hammarskjold Foundation

January 22:
"Ban Terminator! The Global Campaign to Ban Terminator: from Brazil (2006) to Bonn (2008)" ETC Group workshop

"Regaining control of our natural resources" Hosted by Friends of the Earth International

"New technologies - implications for health, environment & democracy" Hosted by the Dag Hammarskjold Foundation

January 23:
"From Biotech to Nanotech and back again - Synthetic Biology and Nano Foods: New technologies that will challenge human society and Food Sovereignty" ETC Group workshop

"The New Politics of Food in Africa: Gates Foundation, the Second Green Revolution and the role of international institutions" ETC Group workshop

EXHIBIT C