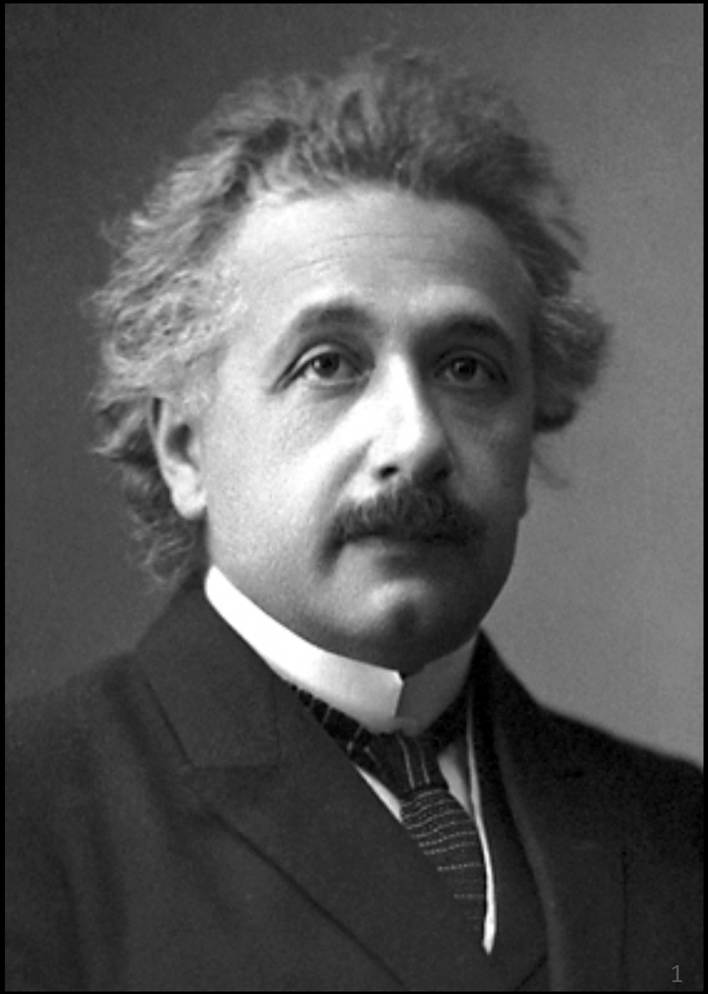
Gravitational Waves & Federated Identity

A Case Study

Warren G. Anderson
LIGO Scientific Collaboration

Albert Einstein



1879 – 1955

The General Theory of Relativity

Die Feldgleichungen der Gravitation.

Von A. Einstein.

In zwei vor kurzem erschienenen Mitteilungen[1] habe ich gezeigt, wie man zu Feldgleichungen der Gravitation gelangen kann, die dem Postulat allgemeiner Relativität entsprechen, d. h. die in ihrer allgemeinen Fassung beliebigen Substitutionen der Raumzeitvariabeln gegenüber kovariant sind.

Der Entwicklungsgang war dabei folgender. Zunächst fand ich Gleichungen, welche die Newtonsche Theorie als Näherung enthalten

Sitzungsberichte der Preussischen Akademie der Wissenschaften zu Berlin, (1915)

Curved Space-Time

Gravitational Waves

Näherungsweise Integration der Feldgleichungen der Gravitation.

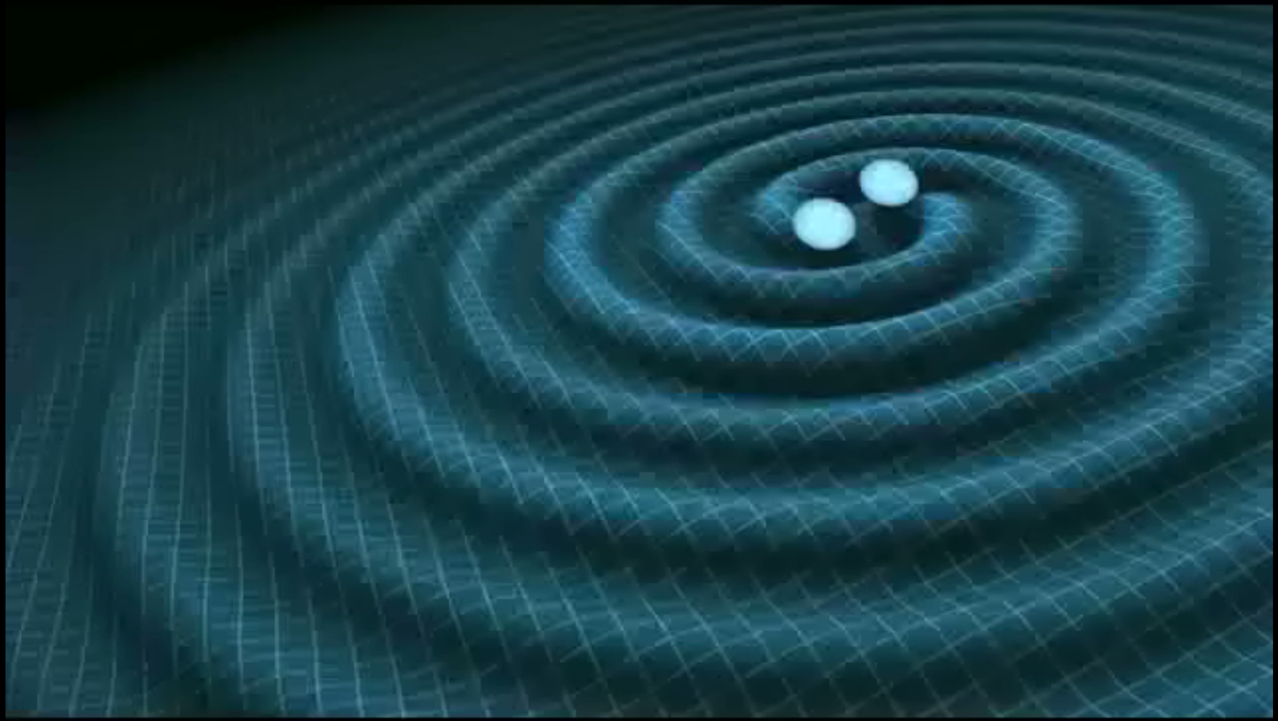
Von A. Einstein.

Bei der Behandlung der meisten speziellen (nicht prinzipiellen) Probleme auf dem Gebiete der Gravitationstheorie kann man sich damit begnügen, die $g_{\mu\nu}$ in erster Näherung zu berechnen. Dabei bedient man sich mit Vorteil der imaginären Zeitvariable $x_4 = it$ aus denselben Gründen wie in der speziellen Relativitätstheorie. Unter »erster Näherung« ist dabei verstanden, daß die durch die Gleichung

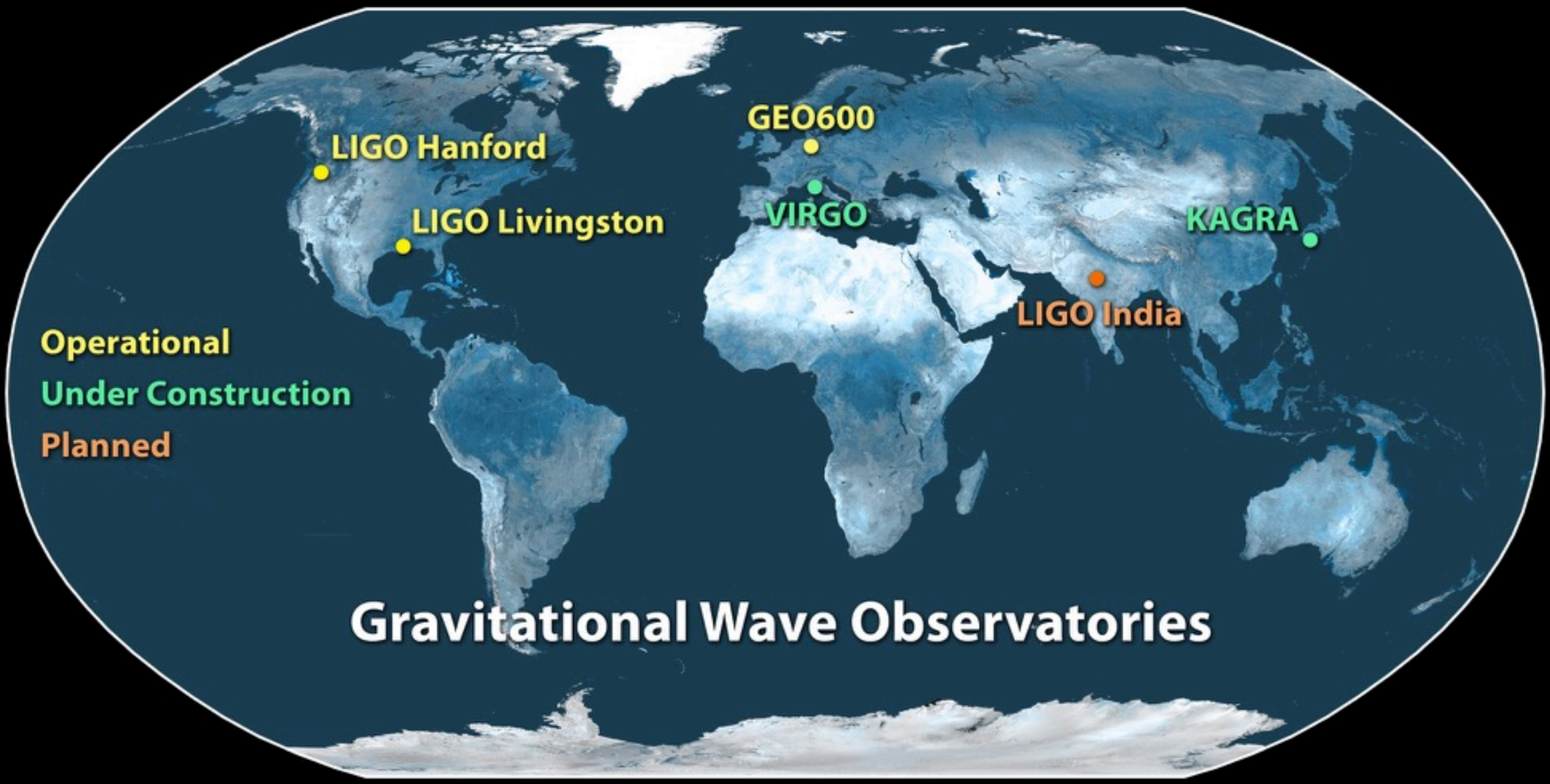
$$g_{\mu\nu} = -\delta_{\mu\nu} + \gamma_{\mu\nu} \qquad (1)$$

Sitzungsberichte der Königlich-Preussischen Akademie der Wissenschaften, (1916)

Making Gravitational Waves



Network of Observatories



LIGO Scientific Collaboration

Hanford Observatory

Livingston Observatory

September 14, 2015

At 09:50: 45 UTC

The Signal

The Source

The Paper

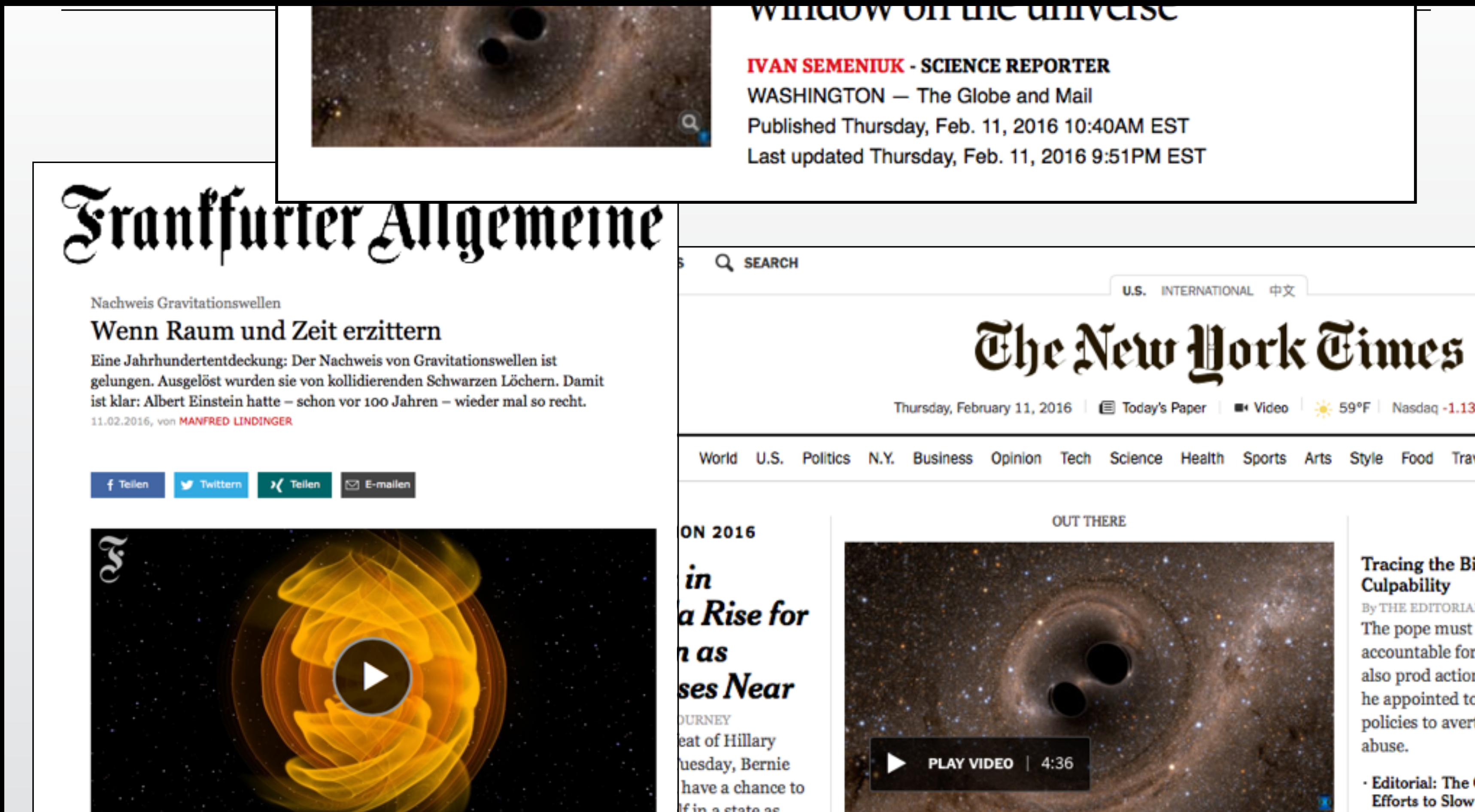
Selected for a Viewpoint in *Physics*
PRL **116,** 061102 (2016) PHYSICAL REVIEW LETTERS week ending 12 FEBRUARY 2016

Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.**
(LIGO Scientific Collaboration and Virgo Collaboration)
(Received 21 January 2016; published 11 February 2016)

On September 14, 2015 at 09:50:45 UTC the two detectors of the Laser Interferometer Gravitational-wave Observatory (LIGO) simultaneously observed a transient gravitational-wave signal. The signal sweeps upwards in frequency from 35 Hz to 250 Hz with a peak gravitational-wave strain of 1.0×10^{-21}. It matches the waveform predicted by general relativity for the inspiral and merger of a pair of black holes and the ringdown of the resulting single black hole. The signal was observed with a matched filter signal-to-noise ratio of 24 and a false alarm rate estimated to be less than 1 event per 203 000 years, equivalent to a significance greater than $5.1\,\sigma$. The source lies at a luminosity distance of 410^{+160}_{-180} Mpc corresponding to a redshift $z = 0.09^{+0.03}_{-0.04}$. In the source frame, the initial black hole masses are $36^{+5}_{-4}\,M_\odot$ and $29^{+4}_{-4}\,M_\odot$, and the final black hole mass is $62^{+4}_{-4}\,M_\odot$, with $3.0^{+0.5}_{-0.5}\,M_\odot c^2$ radiated in gravitational waves. All uncertainties define 90% credible intervals. These observations demonstrate the existence of binary stellar-mass black hole systems. This is the first direct detection of gravitational waves and the first observation of a binary black hole merger.

The News



IVAN SEMENIUK - SCIENCE REPORTER
WASHINGTON — The Globe and Mail
Published Thursday, Feb. 11, 2016 10:40AM EST
Last updated Thursday, Feb. 11, 2016 9:51PM EST
Frankfurter Allgemeine
Nachweis Gravitationswellen
Wenn Raum und Zeit erzittern
Eine Jahrhundertentdeckung: Der Nachweis von Gravitationswellen ist gelungen. Ausgelöst wurden sie von kollidierenden Schwarzen Löchern. Damit ist klar: Albert Einstein hatte – schon vor 100 Jahren – wieder mal so recht.
11.02.2016, von MANFRED LINDINGER
Teilen
Twittern
Teilen
E-mailen
SEARCH
U.S.
INTERNATIONAL
中文
The New York Times
Thursday, February 11, 2016
Today's Paper
Video
59°F
Nasdaq -1.13%
World
U.S.
Politics
N.Y.
Business
Opinion
Tech
Science
Health
Sports
Arts
Style
Food
OUT THERE
PLAY VIDEO
4:36

Federated Identity?

- Large distributed collaboration with services operated by dozens of local admins more-or-less independently.
- For the first decade, each admin operated independently – dozens of passwords and authorization rules per user.
- Minimal membership tracking system.

Federated Identity?

- 2008 – LIGO Identity and Access Management project (originally Auth Project) starts.
- Design by Scott Koranda, consulting with I2 experts.
- Scope:
  - identity management
  - authN/Z for web, command-line and custom clients
  - wikis, mailing lists, code repos, ticket tracking, etc

Federated Identity?

- We wanted to use federated identities but:
  - many US institutions in LIGO were not InCommon members.
  - those that are often won't release usable (R&S) attributes
  - there was no way to easy way to get federated identities for non-US LIGO institutions.
  - there was no place to get a federated identity if your institution did not supply it.
  - LIGO security was worried about incident response for federated identities.

External Collaborations

- In 2014 LIGO signs co-observing MOUs with 90 other astronomy groups:
  - use gw-astronomy.org (operated by UWM and LIGO) to provide mailing lists, wiki space, file exchange service
  - use federated identities to access gw-astronomy
  - becomes testbed for eduGAIN metadata usage in InCommon

Going Forward

- In a new era of *gravitational wave astronomy*:
  - more external collaborations, LIGO can't be responsible for collaboration space for all of them.
  - SIRTFI in the process of being implemented for incident response (LIGO IdP will be early adopter)
  - InCommon includes majority of US research institutions
  - InCommon has joined eduGAIN for international federated identities
  - IdP of last resort options available (gw-astronomy.org uses Cirrus Identity Gateway)

By the Numbers

- 75% of US institutions in LIGO members of InCommon.
- 95% of US researchers in LIGO at InCommon institutions.
- 75% of nations participating in LIGO have identity federations in eduGAIN
- 93% of LIGO researchers are in nations with identity federations in eduGAIN.

By the Numbers

- 44% of all LIGO researchers at institutions that support R&S attributes
- 78% of US LIGO researchers at institutions that support R&S
- only one other LIGO institution supporting R&S, in the UK (21% of UK researchers in LIGO)

The End

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