

# Nuclear Weapons

and Stuff

by @emtiu

at #31C3

It looks like you're trying to develop nuclear weapons. How can I help?

- Hold this Plutonium sphere for me.
- Don't tell the UN.
- Do Google search for "cover up nuclear explosion excuses".
- Make phone call to A. Q. Khan.



# What Ever Happened to Nuclear Weapons?

by @emtiu  
at 31C3



Washington Post, 1946-11-08, p. 18

# **'Disclaimer':**

## **I try to be unbiased, but ...**

- ... my world view is shaped by my socialization
- ... I use sources accessible to me, language-wise

If you find my representation of your/some country's history, motives or actions unfair:

- I'm sorry
- I'd like to know – feel free to talk to me later

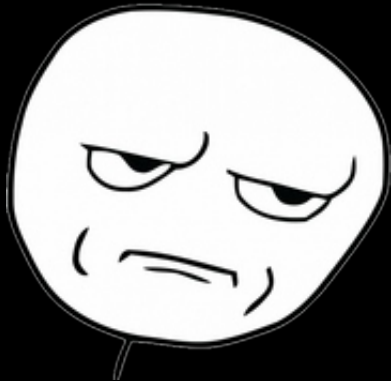
**What Ever Happened  
to Nuclear Weapons?**

**They are still around!**



# Main questions

- The number of nuclear weapons states is legally limited to 5, was at one point 13 and is now 9.  
→ *Okay, What the hell is going on?*
- SALT, SORT, NPT, NWS, NNWS, IAEA, START, PTBT, CTBT, CTBTO
- What can you do?



→ *ORLY SRSLY WTF*



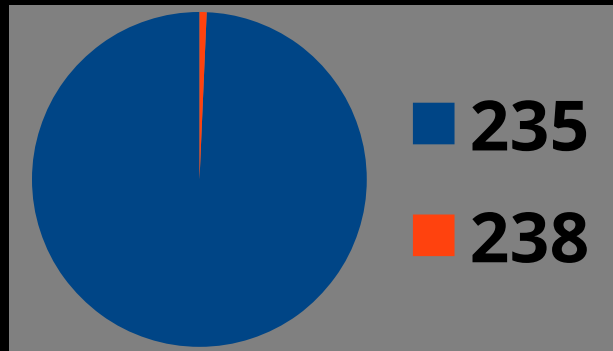
# Nuclear weapons materials and designs

## Uranium

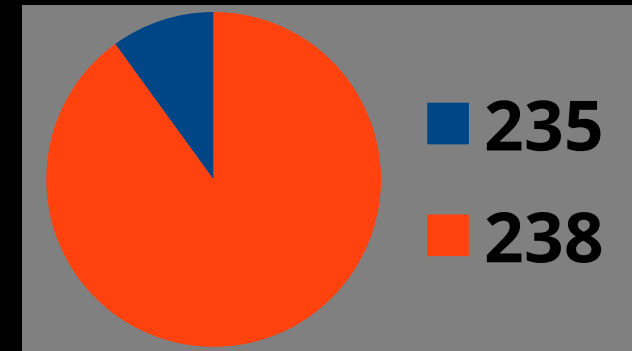


- Found in nature
- Enrichment needed for weapons use
- Complicated and expensive to prepare

Natural



Weapons grade



Enrichment



# Nuclear weapons materials and designs

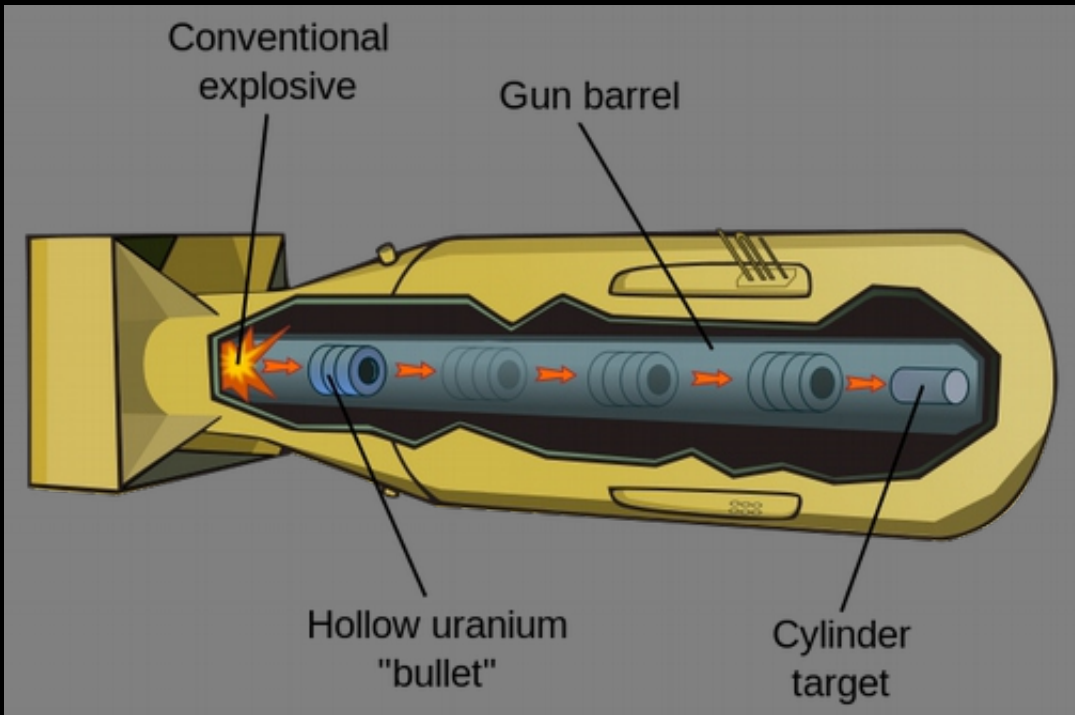
## Plutonium



- Not found in nature
- Production in nuclear reactor, extraction by 'reprocessing'
- Comparatively simple/unexpensive (if nuclear reactors available)



# Nuclear weapons designs and materials: "Gun-type"

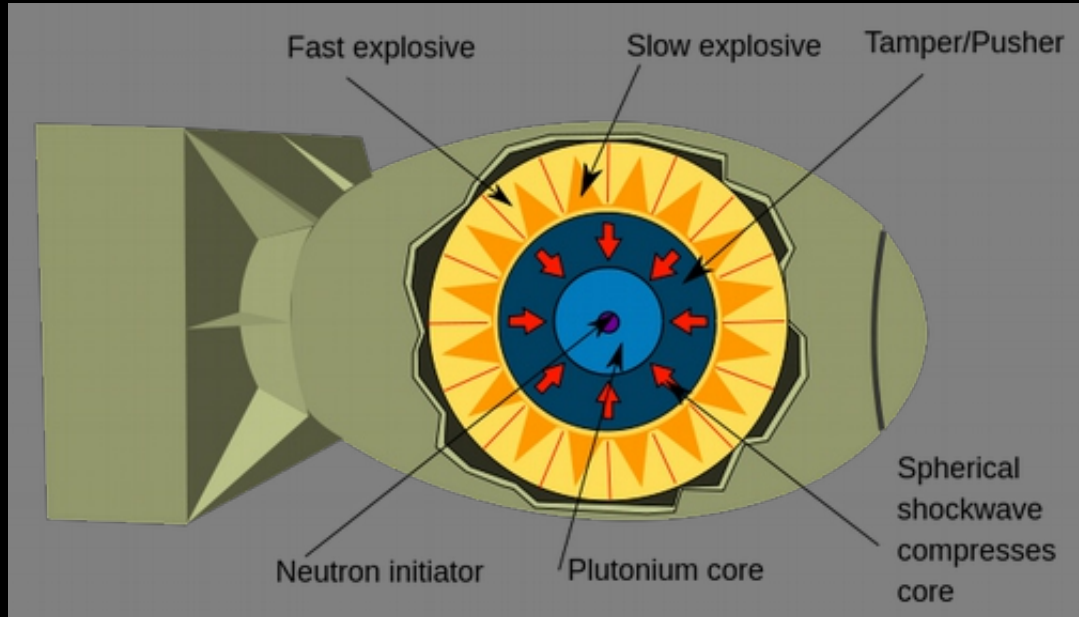


- Very simple design
- Lower safety from accidents
- Lower explosion yield and materials efficiency
- Larger and heavier
- No Plutonium

Mid-1940s



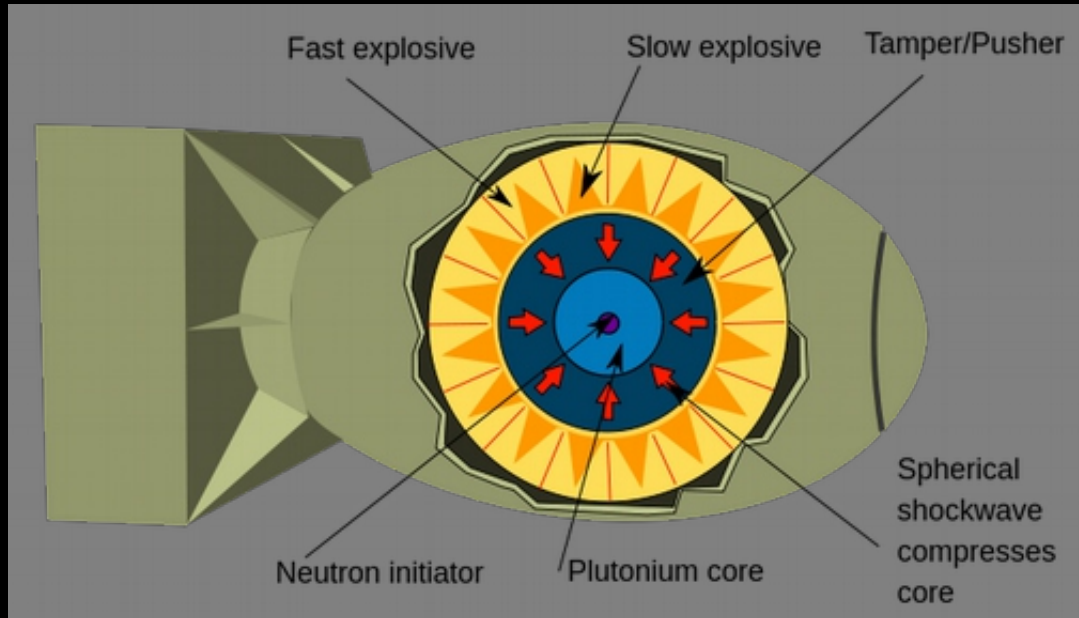
# Nuclear weapons designs and materials: “Implosion type”



- Very complicated design
- Higher safety, efficiency, larger explosion yield
- Smaller and lighter
- Evolved further (deuterium/tritium 'boosting')

Early 1950s

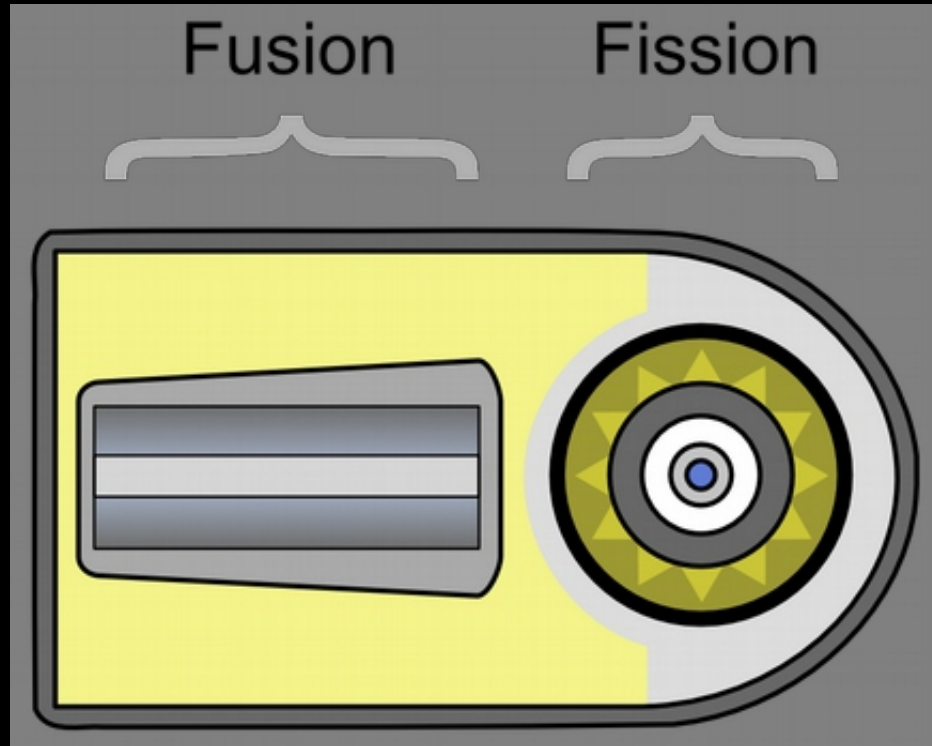
# Nuclear weapons designs and materials: "Implosion type"



Early 1950s



# Nuclear weapons designs and materials: “Teller-Ulam design”



Early 1960s

- 2-stage ‘thermonuclear’:  
Fission ‘primary’,  
Fusion ‘secondary’
- Very (very!) large  
explosions

# Explosive yield of nuclear weapons designs (symbol area to scale of yield)

gun-type



~15 kT

# Explosive yield of nuclear weapons designs (symbol area to scale of yield)

gun-type



~15 kT

boosted  
implosion  
type



~400 kT

# Explosive yield of nuclear weapons designs (symbol area to scale of yield)

gun-type



~15 kT

boosted  
implosion  
type



~400 kT

2-stage thermonuclear  
fusion weapon

~50 MT



# Use in war

- Two wartime uses of nuclear bombs, ~15 and ~20 kT yield
- Both against large cities: Hiroshima and Nagasaki, Japan
- Three major effects:
  - Explosive blast (~40–50% of bomb energy)
  - Heat radiation (~40–50% of bomb energy)
  - Radioactivity (~5% of bomb energy)



# Explosive blast

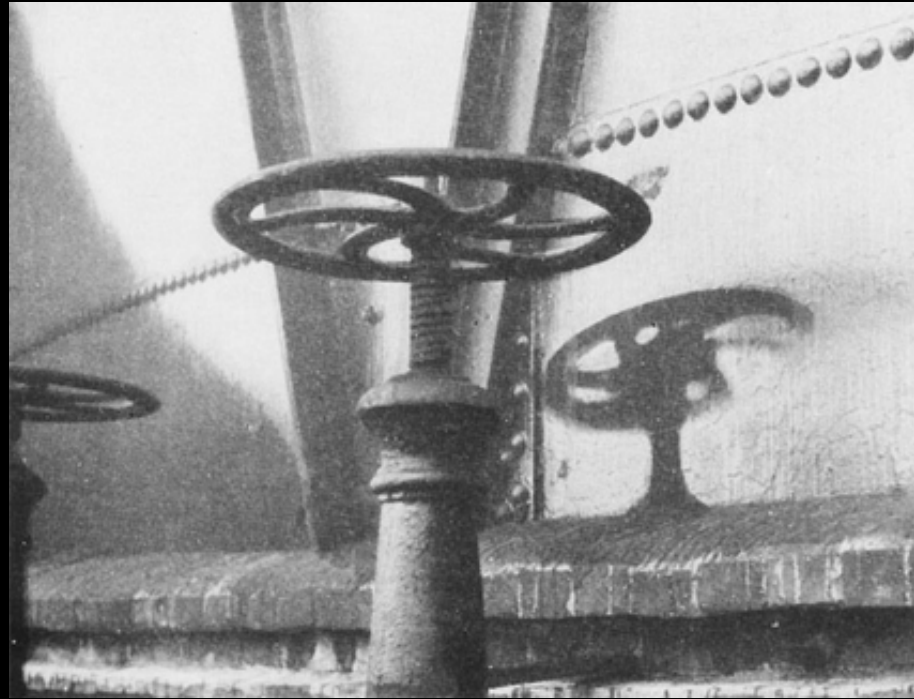


Hiroshima:  $\sim 10 \text{ km}^2$





# Heat radiation



~2km distance from blast

~half of total  
bomb energy



# Radiation poisoning

- Large portion of deaths in attacked cities (several 10,000s)
- Typical duration of sickness before recovery or death:  
3 to 30 days
- Effect compounded by pollution from fallout (esp. water)

# Effects of modern weapons on cities

- Attack on 31C3 with ~10 MT bomb (largest ever US weapon)  
(because we <3 Snowden and be hating the NSA)

ohai #31c3 dieplzkthx lol



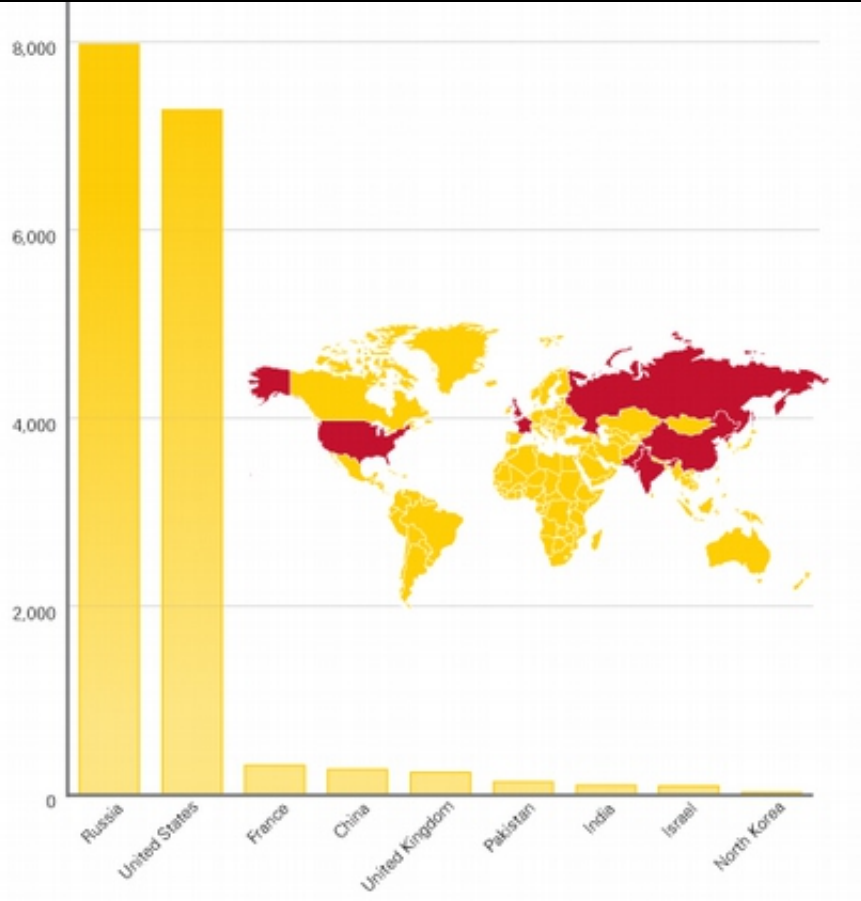
# Effects of modern weapons on cities

- Attack on 31C3 with ~10 MT bomb (largest ever US weapon)
- Ground zero: CCH, Hamburg
  - 1,000,000 deaths with ~10 MT bomb
  - crater of ~2km in diameter
  - ~400 km<sup>2</sup> of building destruction

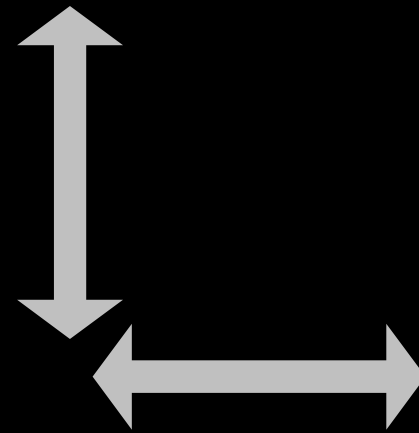


[nuclearsecrecy.com/nukemap/](http://nuclearsecrecy.com/nukemap/)

# Proliferation: Who's got weapons, and how many?



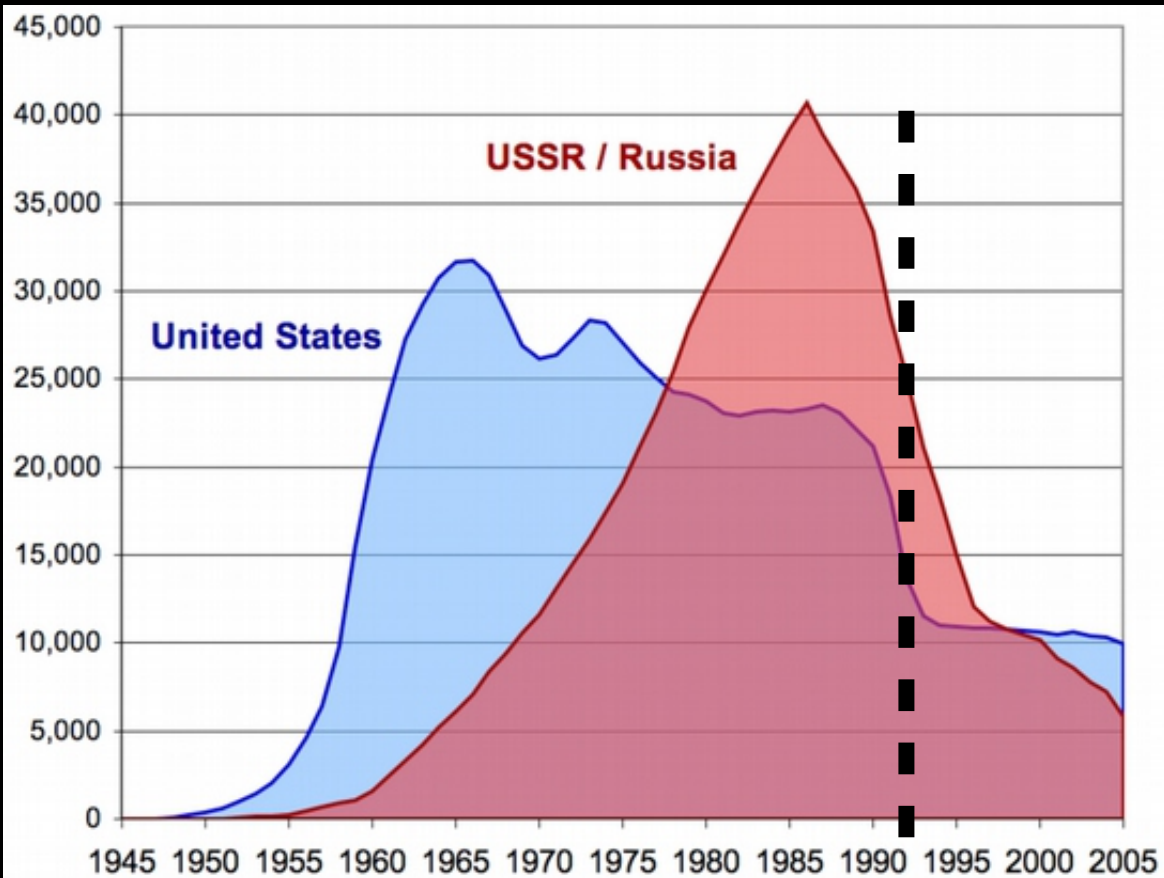
- Vertical proliferation:  
How many weapons?



- Horizontal proliferation:  
How many holders?

Data/image: Ploughshares Fund

# Proliferation: Vertical proliferation



- SALT (60s): ABM treaty (first-ever nuke limit)
- START (90s): 12,000 each
- SORT (2000s):  
~2,000 deployed ready
- New START (2010s):  
~1,500 deployed on  
800 carriers



# US–Russia ‘Mutual De-targeting’

1994:

Missiles set to  
“No Target”-Mode  
or pointed into  
open ocean



# Tom Lehrer, 1965: Who's Next?

## First nuclear test

1944 **USA**

1949 **USSR**

1952 **UK**

1960 **France**

1964 **China**

1952 **USA**

1953 **USSR**

1957 **UK**

1967 **China**

1968 **France**

## First fusion test







### International Atomic Energy Agency

Okay, so here's the deal: Only the USA, Russia, UK, France, and China can have nuclear weapons. Everyone else gets cheap nuclear reactors, but we'll be watching you. Also, we'll talk nuclear disarmament real soon. Promise!

Like · Comment · 1968

 USA, Russia, UK, France, China and 184 others like this.

# Nuclear Non-Proliferation Treaty (NPT)

- Signed 1968
- Only 5 states can be Nuclear Weapons States (NWS)
- No giving away nuclear weapons technology
- Non-NWS get support with nuclear energy

# Is the NPT working?

NPT defines 5 nuclear weapons states,  
but 5 other states have developed nuclear weapons:

- Israel
  - Motivated by national security
  - Technology help from France, Germany
  - Nuclear weapons not acknowledged, no (confirmed) nuclear test
  - Officially: “Would not introduce nuclear weapons in the Middle East first”



# Is the NPT working?

NPT defines 5 nuclear weapons states,  
but 5 other states have developed nuclear weapons:

- India
  - Motivated by national security, deterrence against China
  - Mostly domestic scientists, research, industry
  - “Smiling Buddha” test in 1974 (“peaceful”)
  - Reactor technology embargo (now irrelevant)
  - Considers NPT unfair, but would join as NWS



# Is the NPT working?

NPT defines 5 nuclear weapons states,  
but 5 other states have developed nuclear weapons:

- Pakistan
  - Motivated by conflict (esp. with India)
  - Technology and materials from 'peaceful' foreign programs (esp. The Netherlands)
  - Success of program considered the achievement of Abdul Qadeer Khan
  - First test in 1998 after new Indian tests



# Is the NPT working?

NPT defines 5 nuclear weapons states,  
but 5 other states have developed nuclear weapons:

- North Korea
  - Motivated by 'self-reliance' ideology/defense
  - Alleged help from Abdul Qadeer Khan
  - First test in 2006, again in 2009, 2013 (real-world test for CTBTO)





## International Atomic Energy Agency

Okay, so here's the deal: Only the USA, Russia, UK, France, and China can have nuclear weapons. Everyone else gets cheap nuclear reactors, but we'll be watching you. Also, we'll talk nuclear disarmament real soon. Promise!

Like · Comment · 1968

 USA, Russia, UK, France, China and 184 others like this.



**Israel** The government you have tried to reach is currently unavailable. Please try again later.

1968 · Like



**India** WTF, what's so special about those 5? Everybody should be allowed to have nukes! Fight the power!

1974 · Like ·  1



**Pakistan** what india said yo

1998 · Like



**North Korea** Totally be right back, just gotta take care of something real quick.

2003 · Like



**South Sudan** Hey guys, just signed up here. Is this like a group or something? How do you join?

2011 · Like

# Nuclear Non-Proliferation Treaty (NPT)

# Has the NPT worked?

NPT defines 5 nuclear weapons states,  
but 5 other states have developed nuclear weapons:

- South Africa
  - Motivated by strategic position in the Cold War
  - Nuclear materials shipments from Israel
  - No (known) tests, but weapons confirmed
  - Gave up nuclear weapons with end of Apartheid regime, joined NPT





# Has the NPT worked?

NPT defines 5 nuclear weapons states,  
but 3 states gained nuclear weapons by accident:

- Ukraine, Kazakhstan, Belarus
  - Nuclear weapons remnant from USSR collapse
  - 1994: Budapest Memorandum. Give up the nuclear weapons for money and security guarantees!

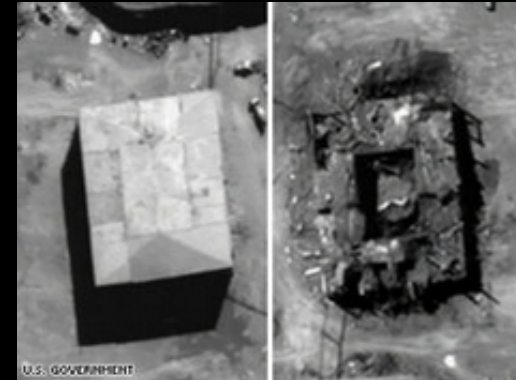




# Has the NPT worked?

NPT defines 5 nuclear weapons states,  
but it's an arbitrary historical 'cut'

- Some countries came too late (after 1968)
  - Algeria, Iraq, Libya, Syria, Iran failed
  - Israel, India, Pakistan, North Korea succeeded



# “Nuclear Sharing”

NWS gives nukes to NNWS:  
Violation of the NPT!?



NATO program: US nukes in  
Germany, Italy, Turkey,  
Belgium, The Netherlands



# “Nuclear Sharing”

US/NATO position:

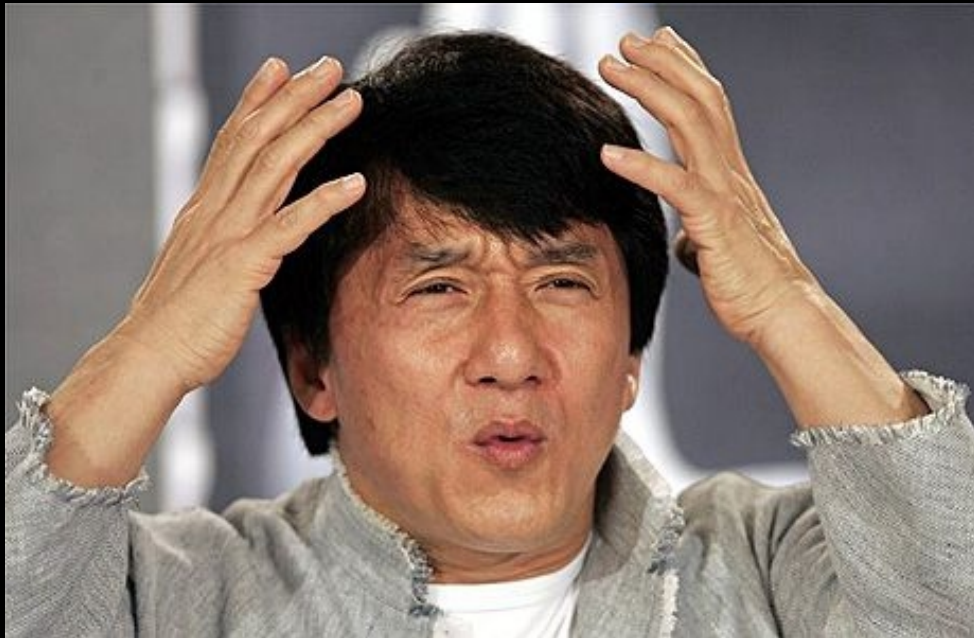
- Weapons only ‘stationed’ (to be used by host state)
- NPT is for keeping peace. In nuclear war, peace failed. Okay to give weapons away in peace ... for use in war.

- NATO program: US nukes in Germany, Italy, Turkey, Belgium, The Netherlands



# “Nuclear Sharing”

US/NATO position:



- NATO program: US nukes in Germany, Italy, Turkey, Belgium, The Netherlands





**Is the NPT working?**



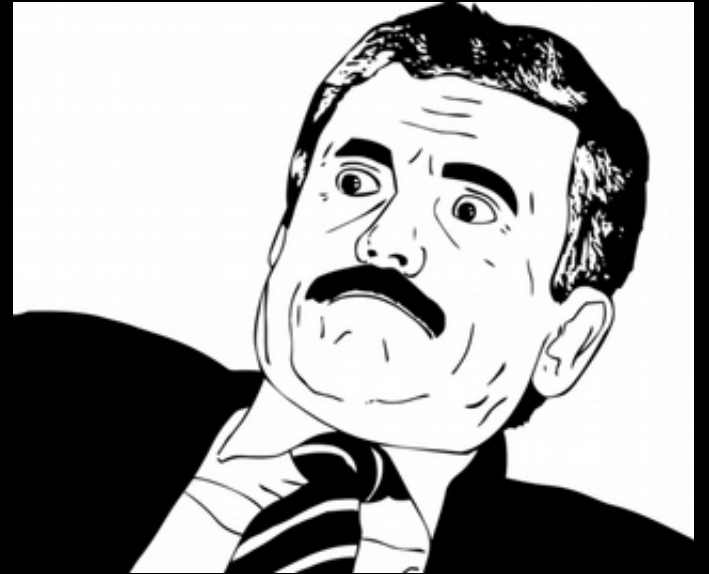
# Is the NPT working?

- Before the NPT:  
5 new nuclear weapons states in 20 years,  
scarcely tested technology, reactors not widespread
- After the NPT:  
4 (net) new nuclear weapons states in 50 years,  
well-developed technology, reactors globally widespread

# Nuclear testing



# Nuclear testing





# Nuclear testing

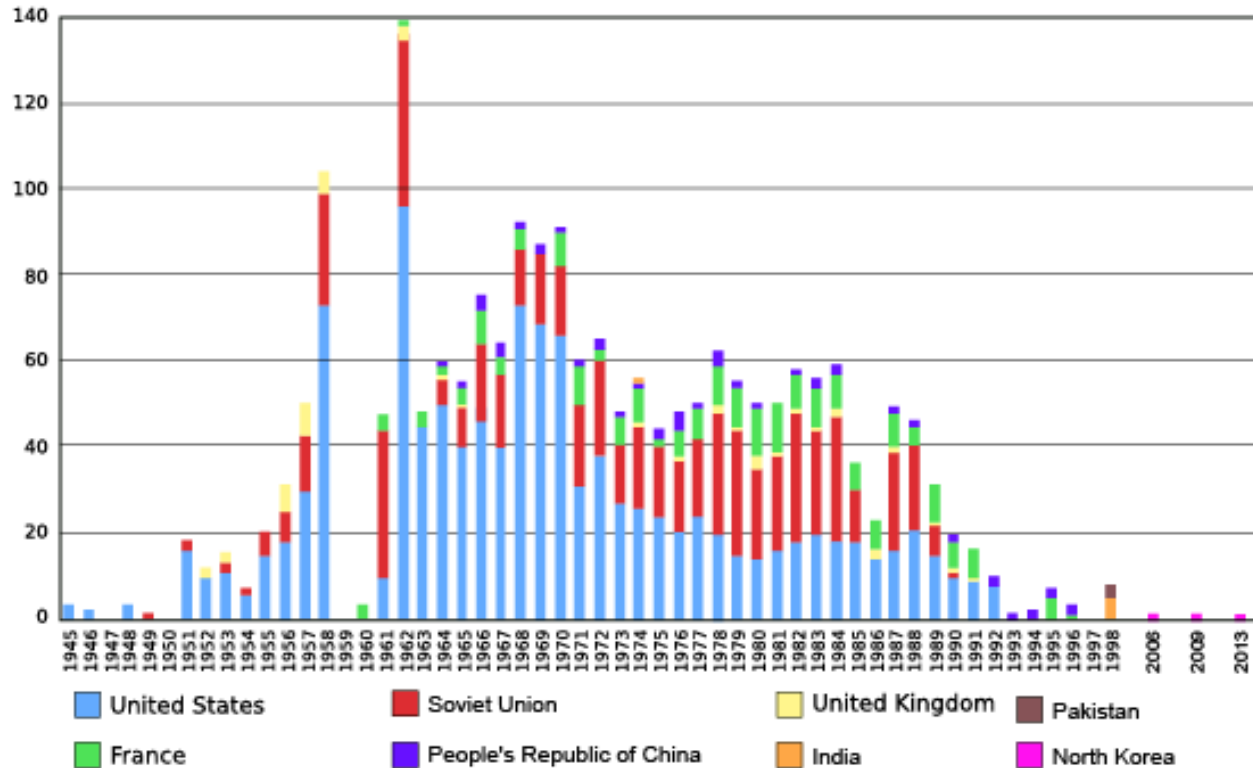


# Nuclear testing



# Nuclear testing

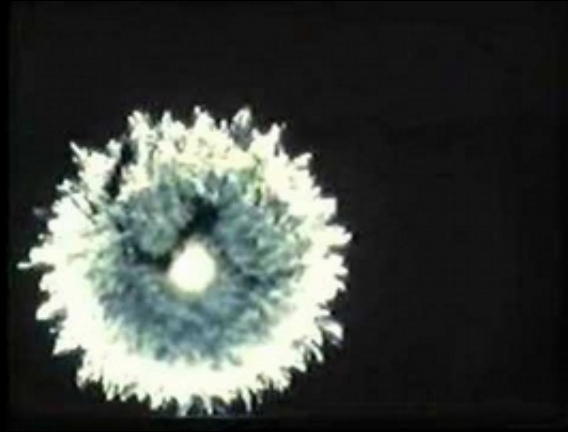
Worldwide nuclear testing, 1945 - 2013



- 1963: PTBT
- 1996: CTBT

# Partial Test Ban Treaty

- “Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water”
- Signatories: Important players, except
  - France
  - China
  - North Korea



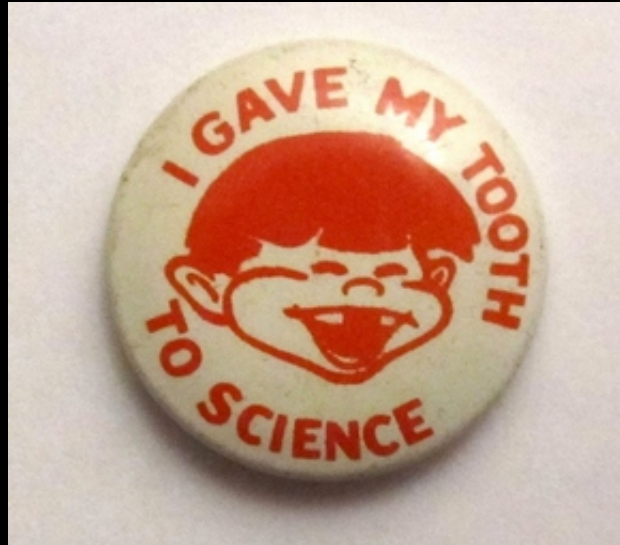
# Partial Test Ban Treaty: Why?

Dear Science,  
My name is Kathy  
Zeiss.   
This tooth  
came from  
my upper left  
bicuspid.  
Please send me  
a badge

Love

(over)

Kathy



Pics/full story: **The Appendix:**  
Atomic Anxiety and the Tooth  
Fairy: Citizen Science in the  
Midcentury Midwest

Longish-lived (~15 yr)  
beta-radioisotopes

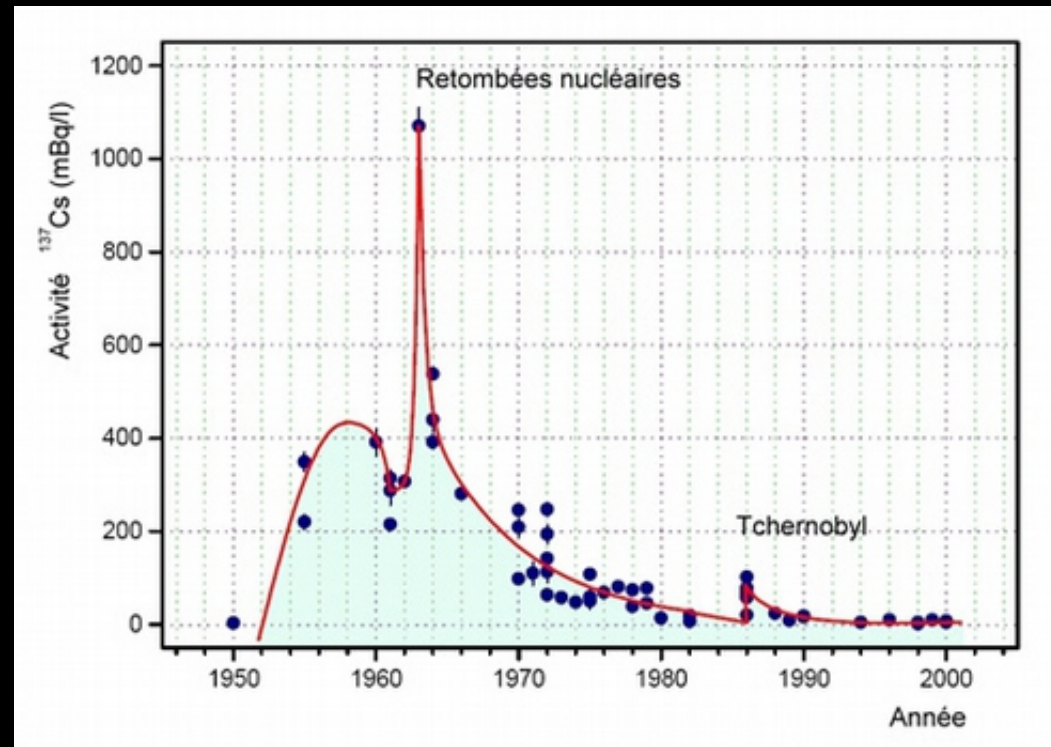
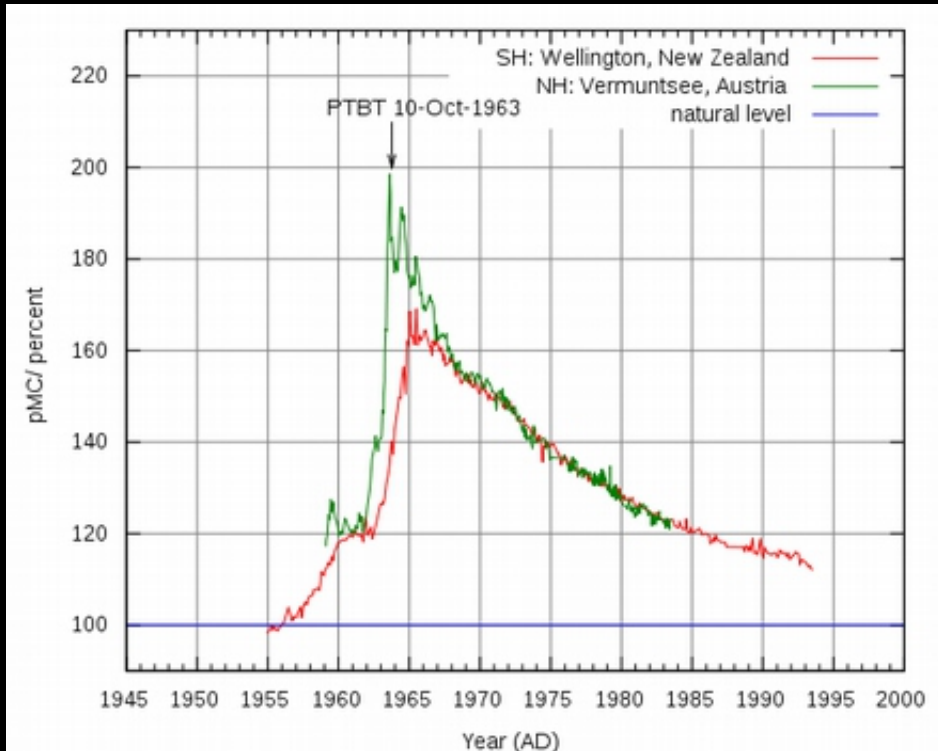
- Caesium-137
- Strontium-90

Found in milk and  
childrens' teeth



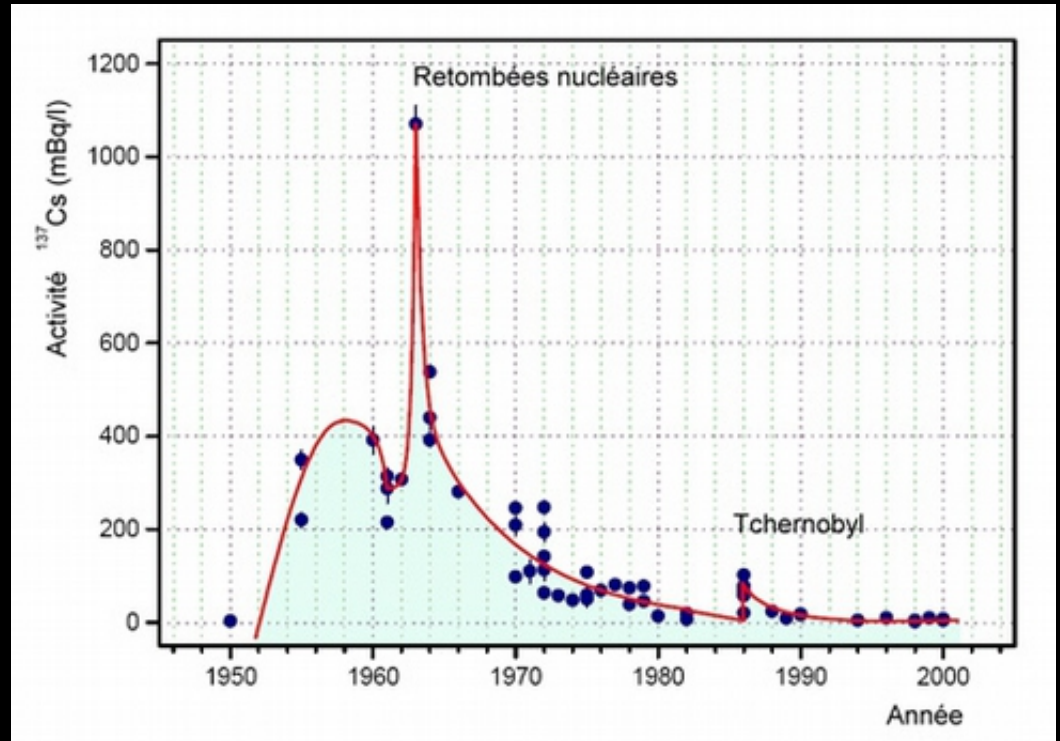
# Partial Test Ban Treaty: Why?

Short-lived radiogenic isotopes as historical markers:



# Partial Test Ban Treaty: Why?

Short-lived radiogenic isotopes as historical markers:



Research: Centre d'Etudes Nucléaires de Bordeaux Gradignan

# Comprehensive Test Ban Treaty

1996: Don't cause nuclear explosions, period.

- Comprehensive Test Ban Treaty Organization Preparatory Commission





# Comprehensive Test Ban Treaty: Why?



CTBTO-sponsored  
video artwork:  
"1945-1998"

by Isao Hashimoto

# Comprehensive Test Ban Treaty Organization Preparatory Commission



31<sup>ST</sup> CTBTO PREPCOM  
Member States support Entry into Force  
of the Comprehensive Nuclear-Test-Ban Treaty

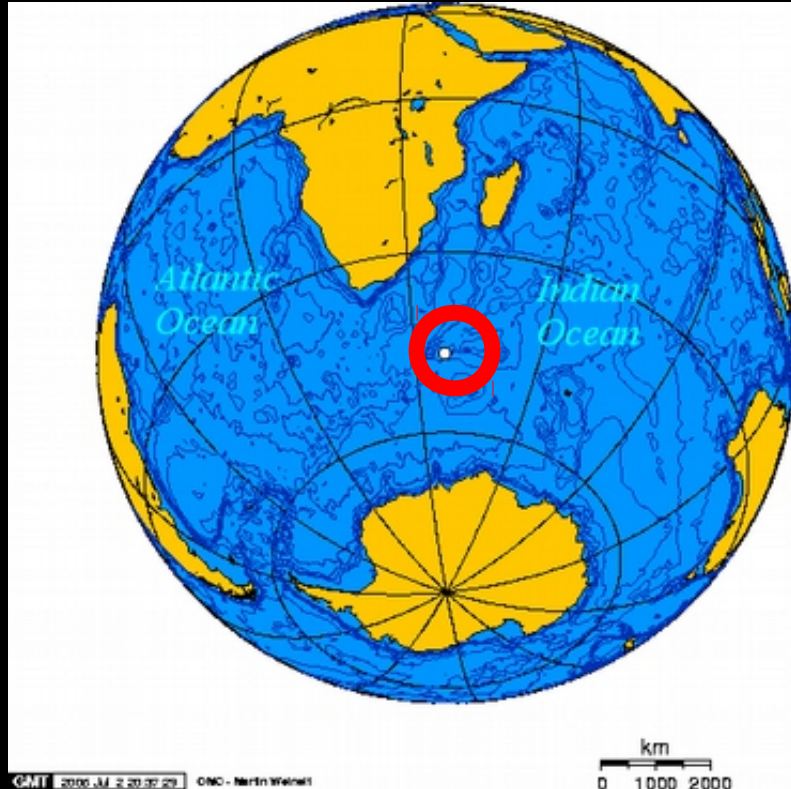


ON-SITE INSPECTION

IFE14

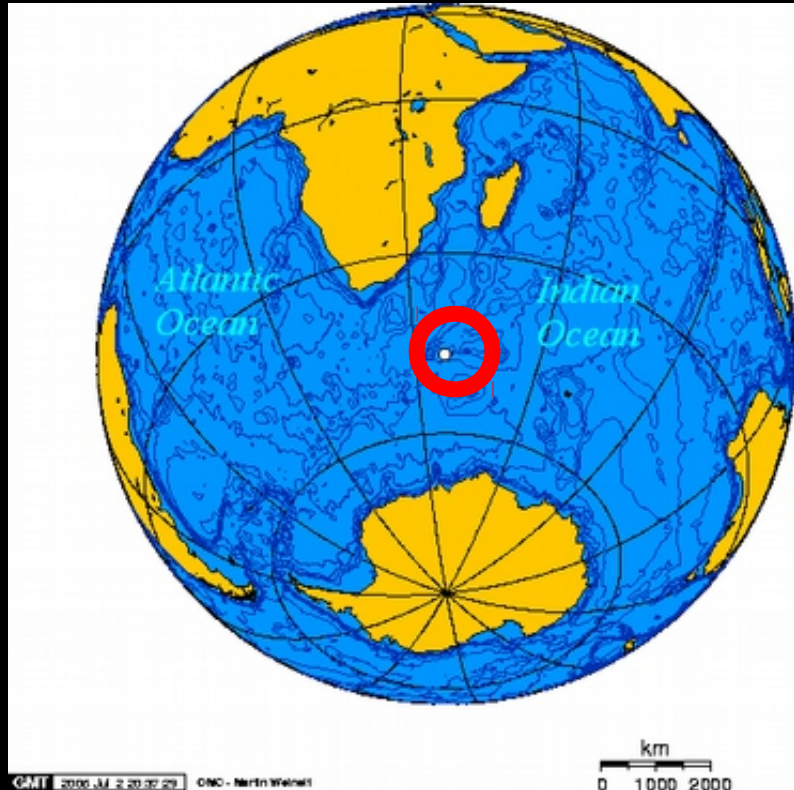
JORDAN الأردن

# Nuclear explosion detection: Vela incident



- Sets of specialized satellites to detect nuclear blasts 1963–1989
- 'Vela Incident' in 1979: classified info, inconclusive analysis, no consensus

# Nuclear explosion detection: Vela incident



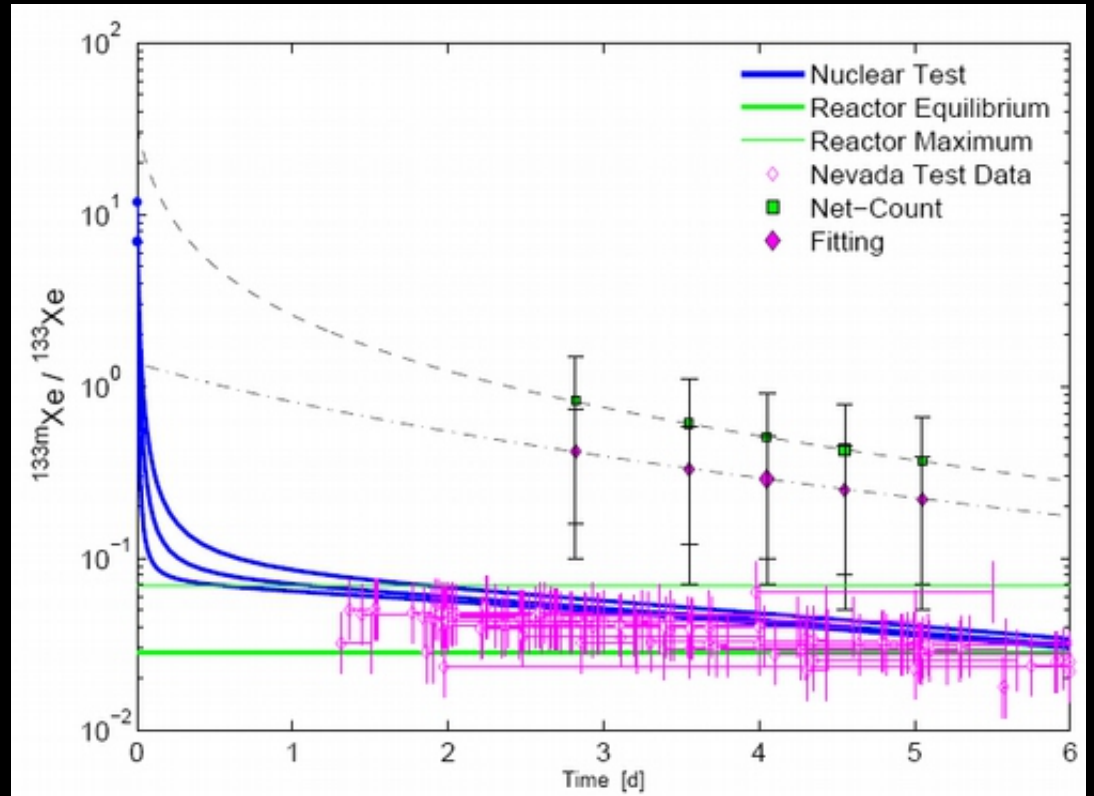
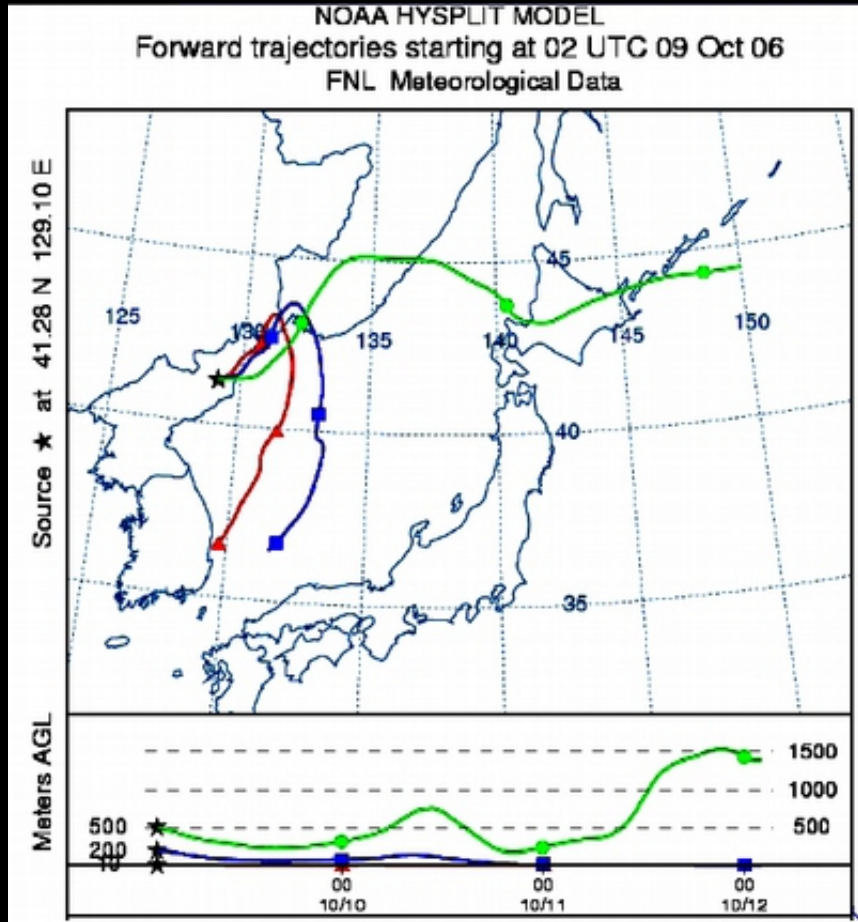
- Sets of specialized satellites to detect nuclear blasts 1963–1989
- 'Vela Incident' in 1979: classified info, inconclusive analysis, no consensus
- Most popular conspiracy theory: Joint South African/Israeli test
- Discovered cosmic gamma-ray bursts by accident



# Comprehensive Test Ban Treaty Organization Preparatory Commission



# North Korean nuclear test 2006

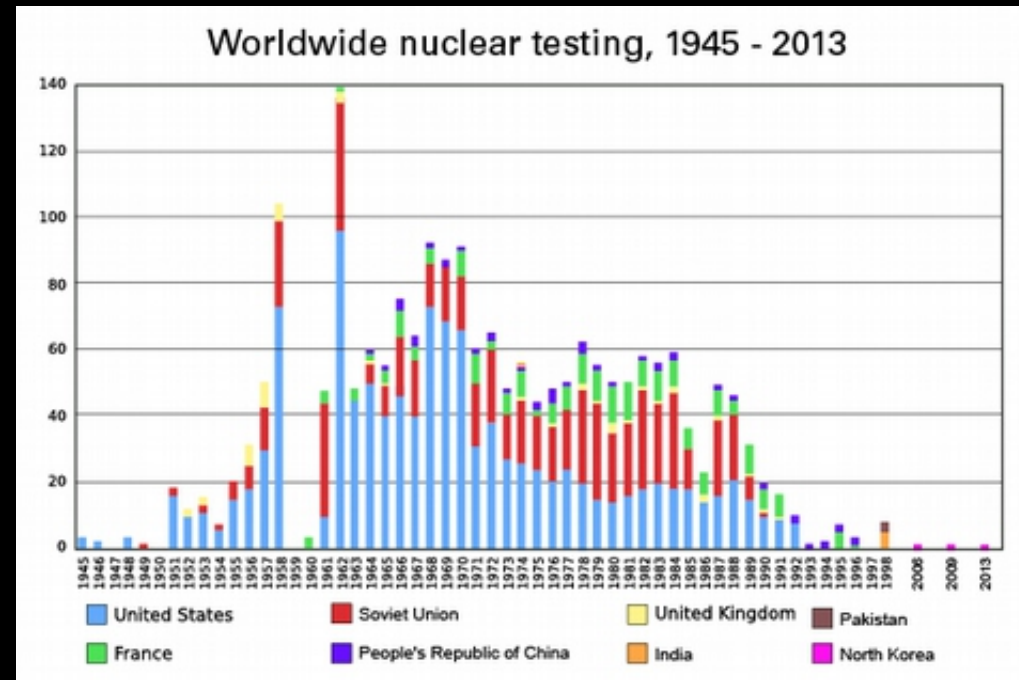


# What's the problem with the CTBT?

It's never entered into effect!



- Missing ratifications:
  - China, USA, Israel, Iran, Egypt
- Missing signatures:
  - India, North Korea, Pakistan

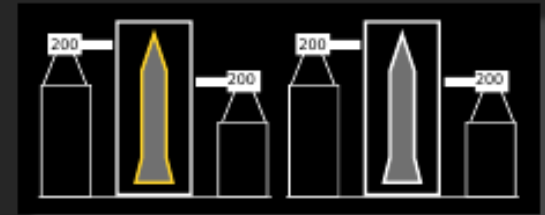
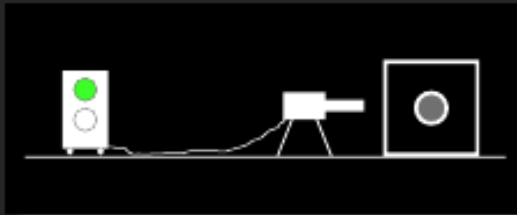


# What can you do?

- Hackers: Look up “Nuclear Disarmament Hacks” on [media.ccc.de](http://media.ccc.de) – great introduction by Moritz into technological challenges of getting rid of nukes

Nuclear Disarmament has relation to computers & technology.

```
while(totalnukes > 0) {  
  for(i=1; i<=9; i++) {  
    weaponstate[i]->disarm();  
  }  
}
```





# What can you do?

- Citizens of Pakistan, India, [North Korea]:  
Push for CTBT signature!
- Citizens of the USA, Iran, Israel, China, Egypt:  
Push for CTBT ratification!
- Citizens of Pakistan, India, Israel, [North Korea]:  
Push for NPT signature!
- Citizens of Germany, Italy, Turkey, The Netherlands, Belgium:  
Get rid of NATO nukes!

# What can you do?

What everyone can do (democratic pressure, publicity, ...!):  
(in order of pink-fluffy-unicorns-dancing-on-rainbows factor)

- Find a concept for a new NPT to include all NWS
- Help the CTBTO spread nuclear test awareness (@ctbto\_alerts)
- Solve the problem of proliferation through nuclear power

# What can you do?

What everyone can do (democratic pressure, publicity, ...!):  
(in order of pink-fluffy-unicorns)

- Find a concept for a new NPT to
- Help the CTBTO spread nuclear
- Solve the problem of proliferatio
- **Get rid of nuclear weapons!**



# Thank you!

- Find me on Twitter as @emtiu
- I read email sent to science@michael-bueker.de

GREETINGS PROFESSOR FALKEN

HELLO

A STRANGE GAME.  
THE ONLY WINNING MOVE IS  
NOT TO PLAY.

HOW ABOUT A NICE GAME OF CHESS?

Find this talk, slides etc. through [media.ccc.de](http://media.ccc.de) later