

# Doubts about Discovering New Physics at the Large Hadron Collider (LHC)

Bernd A. Berg

Florida State University

JSPS, 1<sup>st</sup> Multidisciplinary Science Forum, Seattle, 3/11/2011.

# Outline

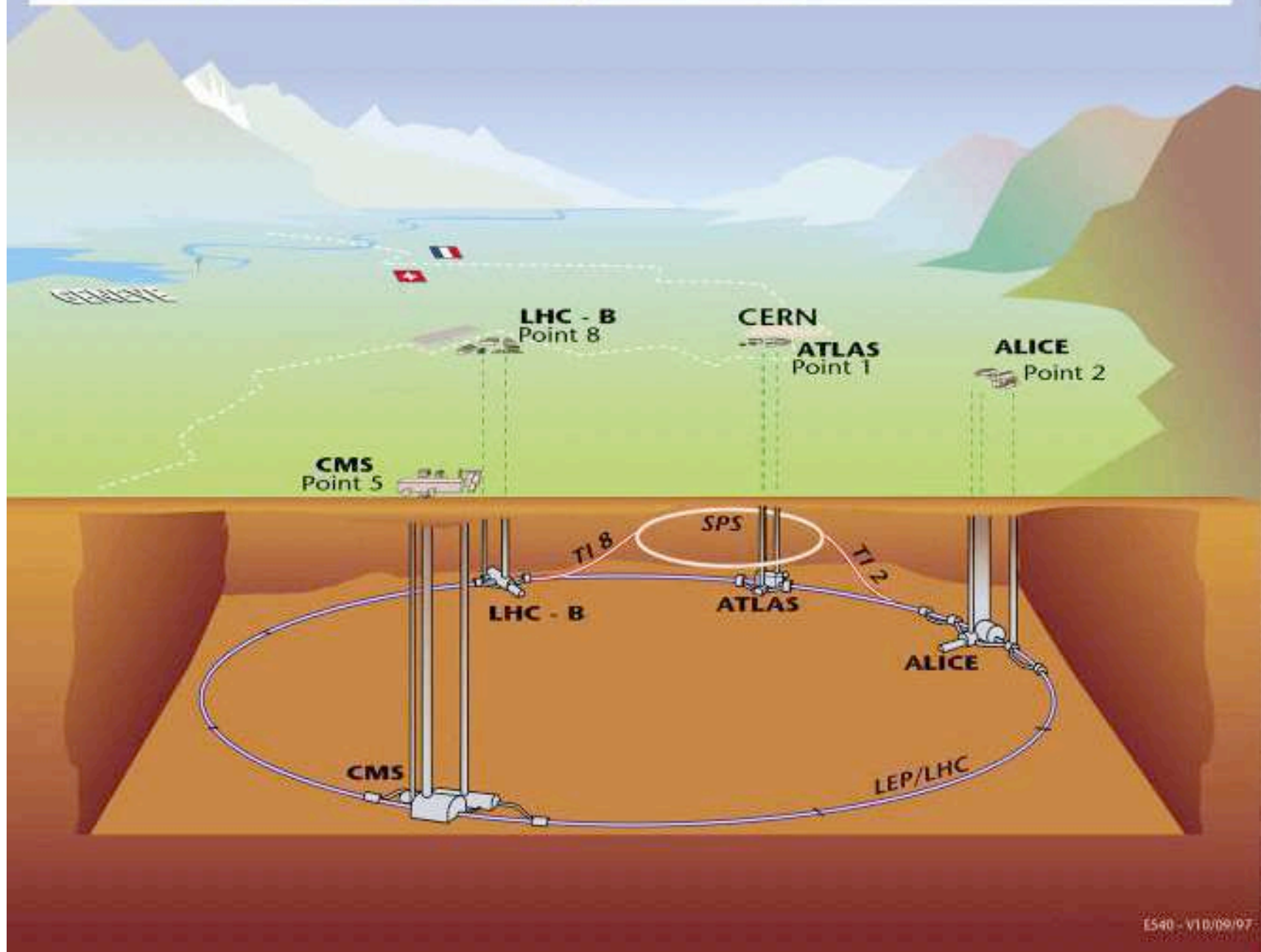
1. The LHC and its Purpose: Facts or just Hope?
2. Why New Physics?
3. Trouble with New Physics,  
A Loophole and Occam's Razor
4. Conclusions

the Geneva region

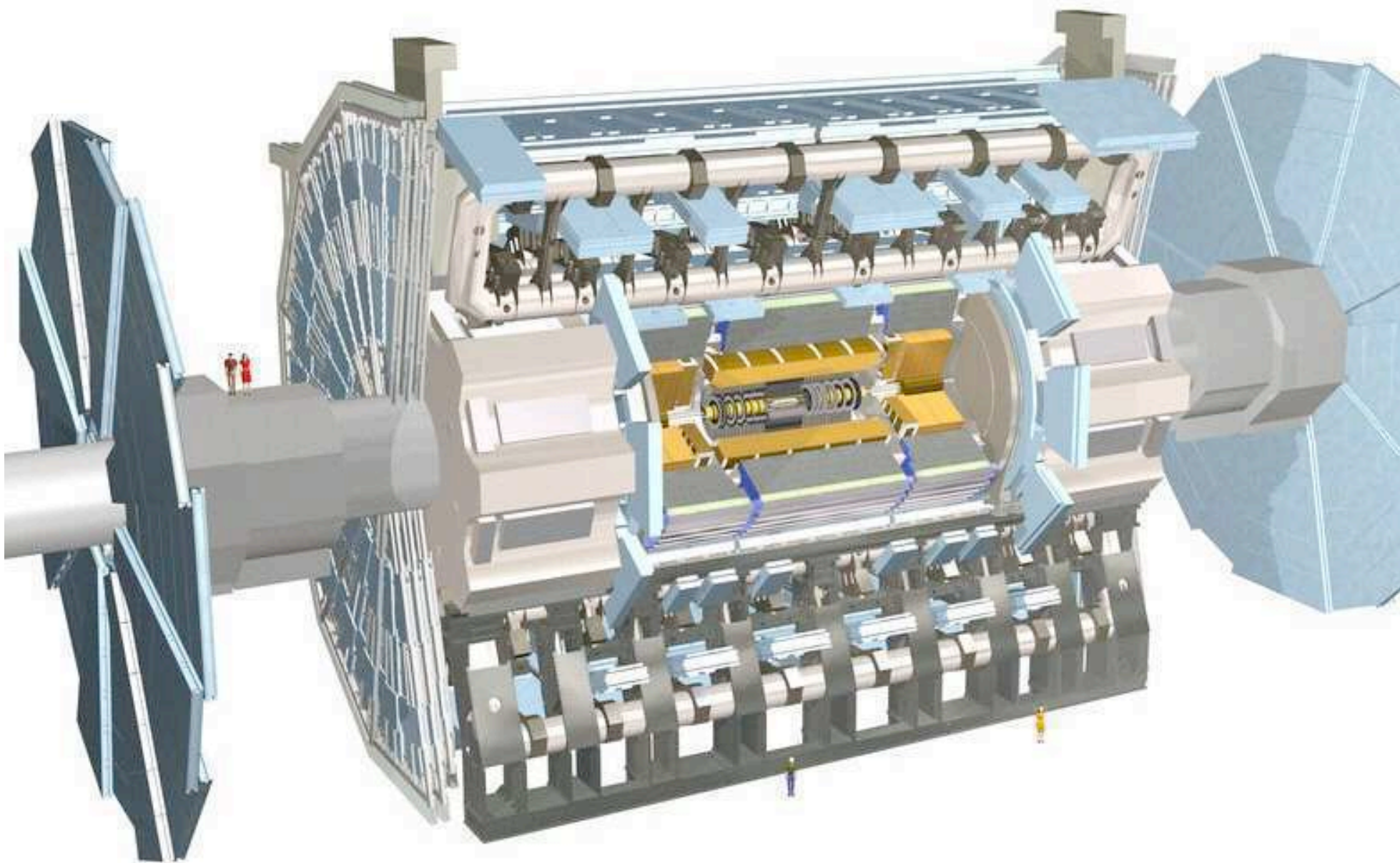


with the CERN Large Hadron Collider

# Overall view of the LHC experiments.



























the ATLAS experiment



### Member States Contributions to the CERN budget – 2010

		%	MCHF
	Austria	2.25%	25.032
	Belgium	2.82%	31.346
	Bulgaria	0.32%	3.556
	Czech Republic	1.08%	12.055
	Denmark	1.76%	19.601
	Finland	1.49%	16.514
	France	15.63%	173.786
	Germany	20.30%	225.767
	Greece	1.93%	21.489
	Hungary	0.69%	7.611
	Italy	11.64%	129.420
	Netherlands	4.55%	50.588
	Norway	2.76%	30.670
	Poland	2.66%	29.594
	Portugal	1.18%	13.114
	Slovak Republic	0.60%	6.700
	Spain	8.89%	98.908
	Sweden	2.40%	26.720
	Switzerland	2.41%	26.851
	United Kingdom	14.64%	162.831
		100.00%	1'112.153

# Facts or just Hope?

High expectations from the CERN website

<http://public.web.cern.ch/public/en/lhc/lhc-en.html>

Our understanding of the Universe is about to change

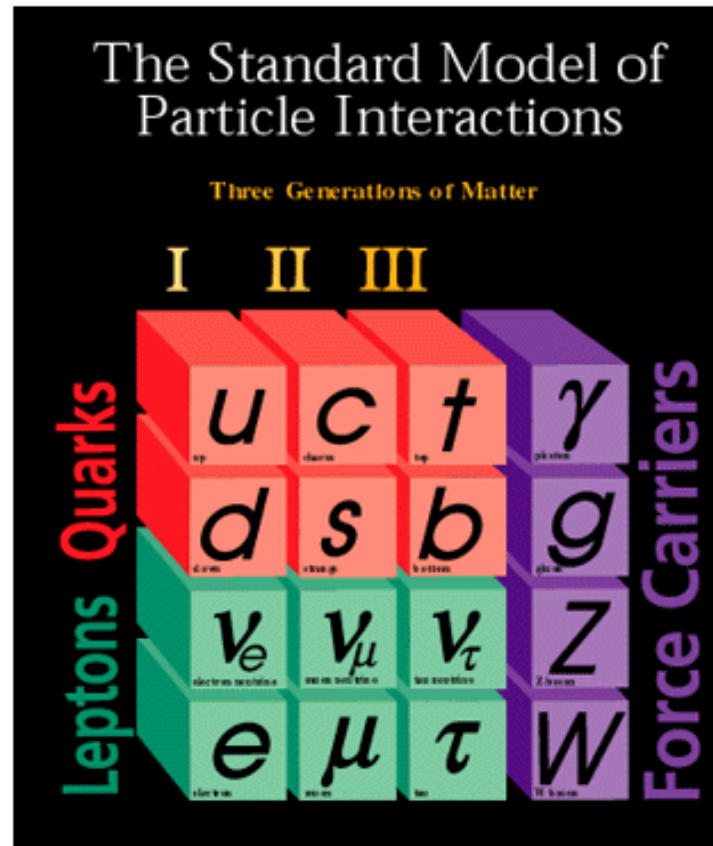
...

Physicists will use the LHC to recreate the conditions just after the Big Bang, ...

There are many theories as to what will result from these collisions, but what's for sure is that a brave new world of physics will emerge from the new accelerator, ...



# Why New Physics?



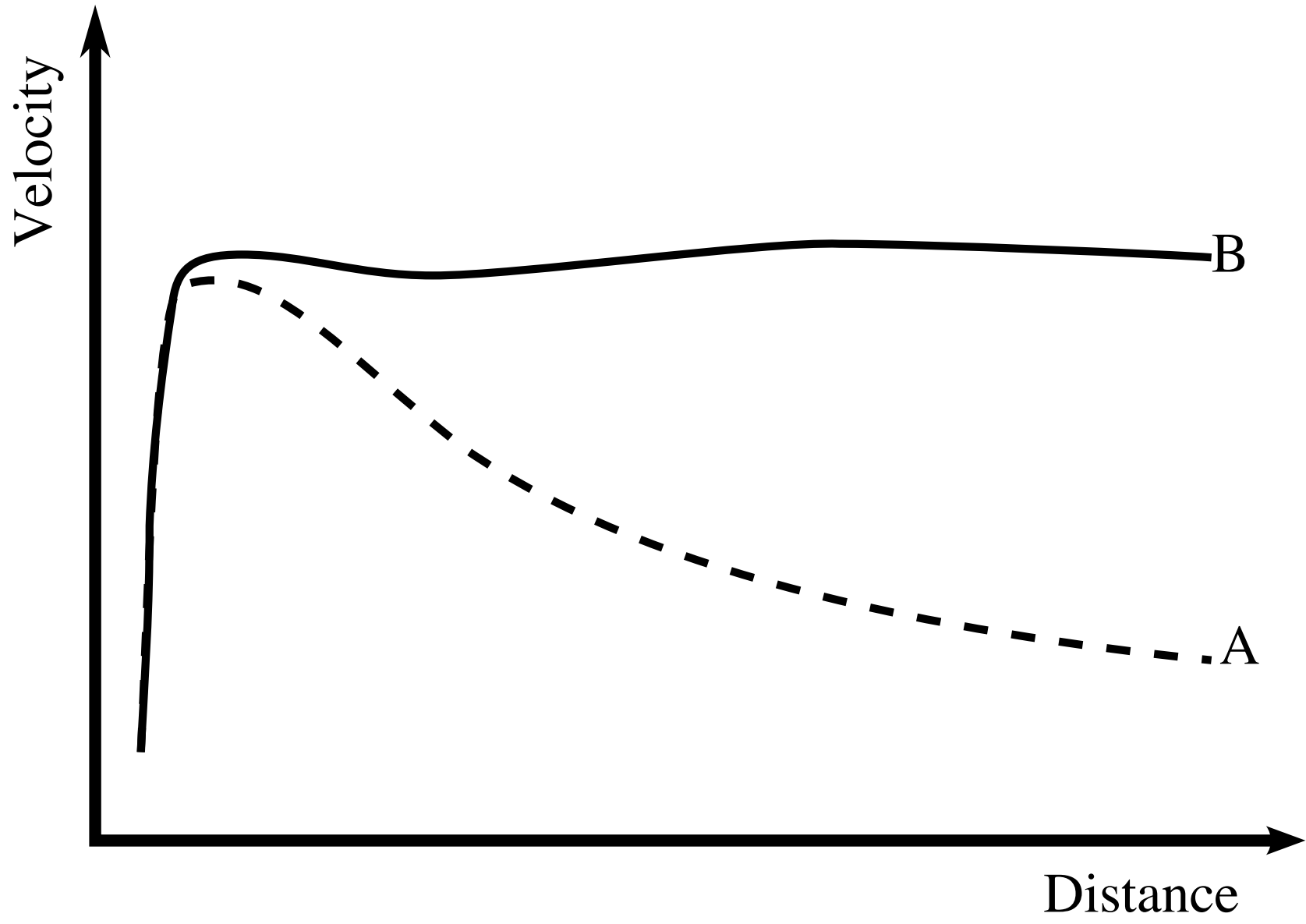
**Standard model:** Quantum Field Theory with interactions between fermion matter fields mediated by vector bosons. **Served us well:** So far consistent with all particle physics experiments.

# However,

- Free parameters not explained
- No QFT of Gravity (Quantum Gravity)
- Mechanism needed to give mass to W and Z

Problem from Astrophysics:

- Dark Matter?





## Gravitational Lens in a Galaxy Cluster 0024+1654

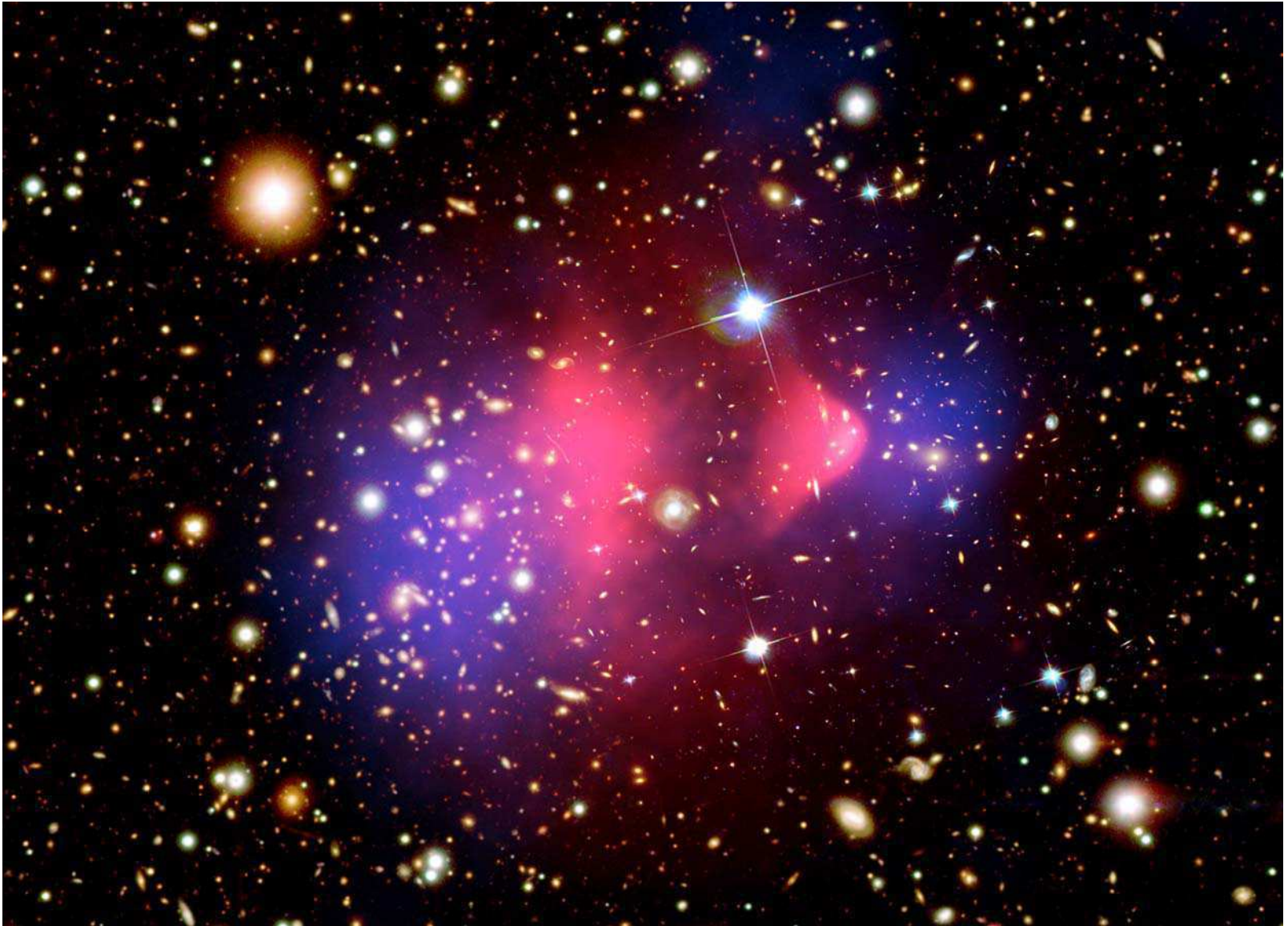
W. N. Colley, E. Turner, J. A. Tyson -- Hubble Space Telescope



# Chandra X-Ray Observatory

---

1E 0657-56



# Major Proposals:

- String Theory
- Supersymmetry
- Higgs Mechanism

All three would imply observations of

**New Particles.**

# Trouble with New Physics

**Free parameters:** In string theory and supersymmetric models there are far more than before in the standard model. Some are of exotic nature like extra dimensions. There is a **Multiverse** of  $10^{500}$  string theories. Like it was in **Greek philosophy** there are ideas for everything ... without experimental input.

**Quantum Gravity:** Interesting theoretical ideas in string theory and supersymmetry, but they are **not even wrong**. Experimental hints from LHC unlikely: Planck Energy  $\approx 10^{28}$  eV. Planned LHC Energy  $14 \times 10^{12}$  eV, a tiny  $\approx 10^{-16}$  fraction.

**Dark matter:** If it exists it could be really dark, so that there is no observable interaction with ordinary matter at LHC.

**Mass for W and Z:** It is generally accepted that a mass generating mechanism cannot be accommodated within the standard model. Either a Higgs particle or new physics are required and should show up at LHC energies. As the scalar Higgs boson is a very artificial object and dark matter appears to be around, many researchers favor some kind of new physics.



# A Loophole?

The argument that there is no mechanism within the standard model to give masses to the W and Z vector bosons goes back to the 1960s and is based on **perturbation theory**. Meanwhile **non-perturbative** investigations have become possible via computer simulations and could paint a different picture.

PHYSICAL REVIEW D **82**, 114507 (2010)

## **Deconfined SU(2) phase with a massive vector boson triplet**

Bernd A. Berg

*Department of Physics, Florida State University, Tallahassee, Florida 32306-4350, USA*

(Received 30 March 2010; revised manuscript received 26 September 2010; published 16 December 2010)

We introduce a model of SU(2) and U(1) vector fields with a local U(2) symmetry. Its action can be obtained in the London limit of a gauge invariant regularization involving two scalar fields. Evidence from lattice simulations of the model supports a (zero-temperature) SU(2) deconfining phase transition through breaking of the SU(2) center symmetry, and a massive vector boson triplet is found in the deconfined phase.

# Occam's Razor

If non-perturbative scenarios for mass generation can be substantiated, **Occams razor**, the principle promoted by Newton which recommends to select the competing hypothesis that makes the fewest new assumptions, suggests that LHC may not discover new physics at all.

Ultimately it is an

## Experimental Question.

Without the LHC experiment we remain in the dark and that is while the money is well spent.

# Conclusions

In my opinion scientists (not just physicists) should be more careful about raising high expectations within the general public. Though it may help funding in the short run it will further discredit science in course of time (used car salesman effect).

Popular critical literature on string theory:

Lee Smolin, *The Trouble with Physics. The Rise of String Theory, the Fall of a Science, and What Comes Next.* Mariner Books, 2007.

Peter Woit, *Not Even Wrong. The Failure of String Theory and the Search for Unity in Physical Law.* Basic Books, 2007.