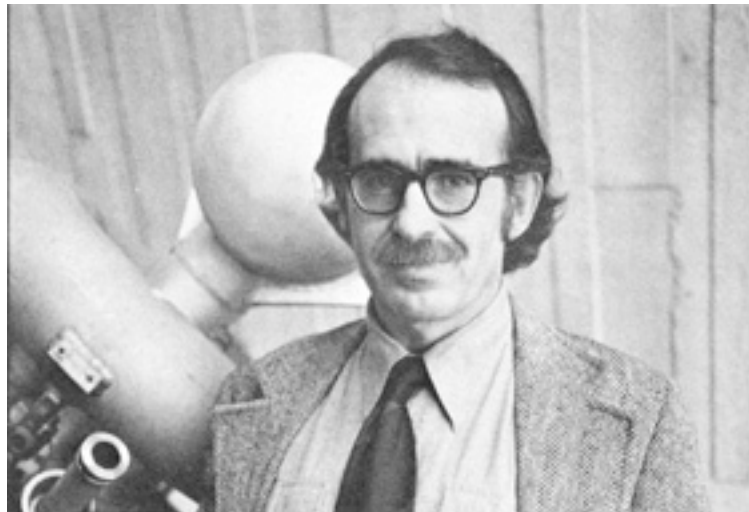


My memories of Dave Cline



June 1975 - Fermilab

- I came to Fermilab as a new Assistant Professor at Harvard
 - I was to run Rubbia's interests in E301, a daughter of E1A the Cline-Mann-Rubbia neutrino DIS experiment.
 - It was a new ball game for me. I quickly learned the legacy from the high- γ anomaly and oscillating neutral currents.
 - It was several months before I met Dave. He showed up one day and gave me a crisp, clear rationale for our search for di-muons and tri-muons as final states of the charm-containing interactions of neutrinos.
 - I loved the Hawaiian shirts that he designed.

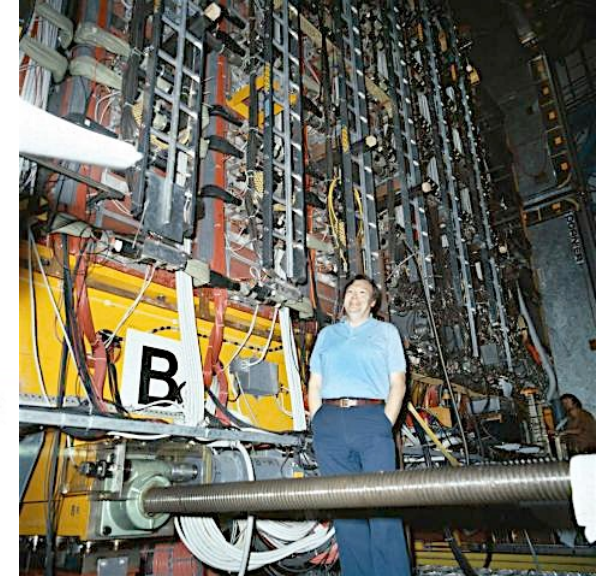
Oscillating neutral currents

I came to realize that this episode (a year before my time) had set an attitude at Fermilab that would not be warm when I came forward a year later with proton-antiproton colliding beams, and Dave and Carlo joined me in that adventure.



How Experiments End

By Peter Galison



Professor A. Lagarrigue, Director
Linear Accelerator Laboratory
University of Paris - SUD
Centre D'Orsay
Batiment 200
91405 Orsay
France

Dear Professor Lagarrigue:

We write to inform you of the preliminary result of our recent experiment to search for neutrino interactions without final state muons. As you know, our apparatus was modified to provide a much larger detection efficiency for muons relative to the apparatus that was used in our earlier search for muonless events. We also improved our ability to locate accurately vertices of observed neutrino interactions, and lowered the threshold on the total energy of the hadrons in the final state.

From about one half of the data obtained in our recent run, we find the raw ratio $R_{\text{raw}} = 0.18 \pm 0.03$. We estimate the muon detection efficiency of the apparatus for the enriched antineutrino beam that was used in this experiment to be approximately 0.85. Taking into account small backgrounds produced by incident neutrons and by ν_e in the incident beam, the corrected ratio is $R_{\text{corr}} = 0.02 \pm 0.05$, where the error includes an estimate of the uncertainty in the calculated detection efficiency. We are continuing to process the remainder of the data and to improve our understanding of the experiment.

We have written a paper intended for Physical Review Letters which will soon be submitted. A copy will, of course, be sent to you but for obvious reasons we wanted to convey our result informally to you before its publication.

With kindest regards

Yours sincerely,

D. Cline *D. Cline*

A. K. Mann *A. K. Mann*

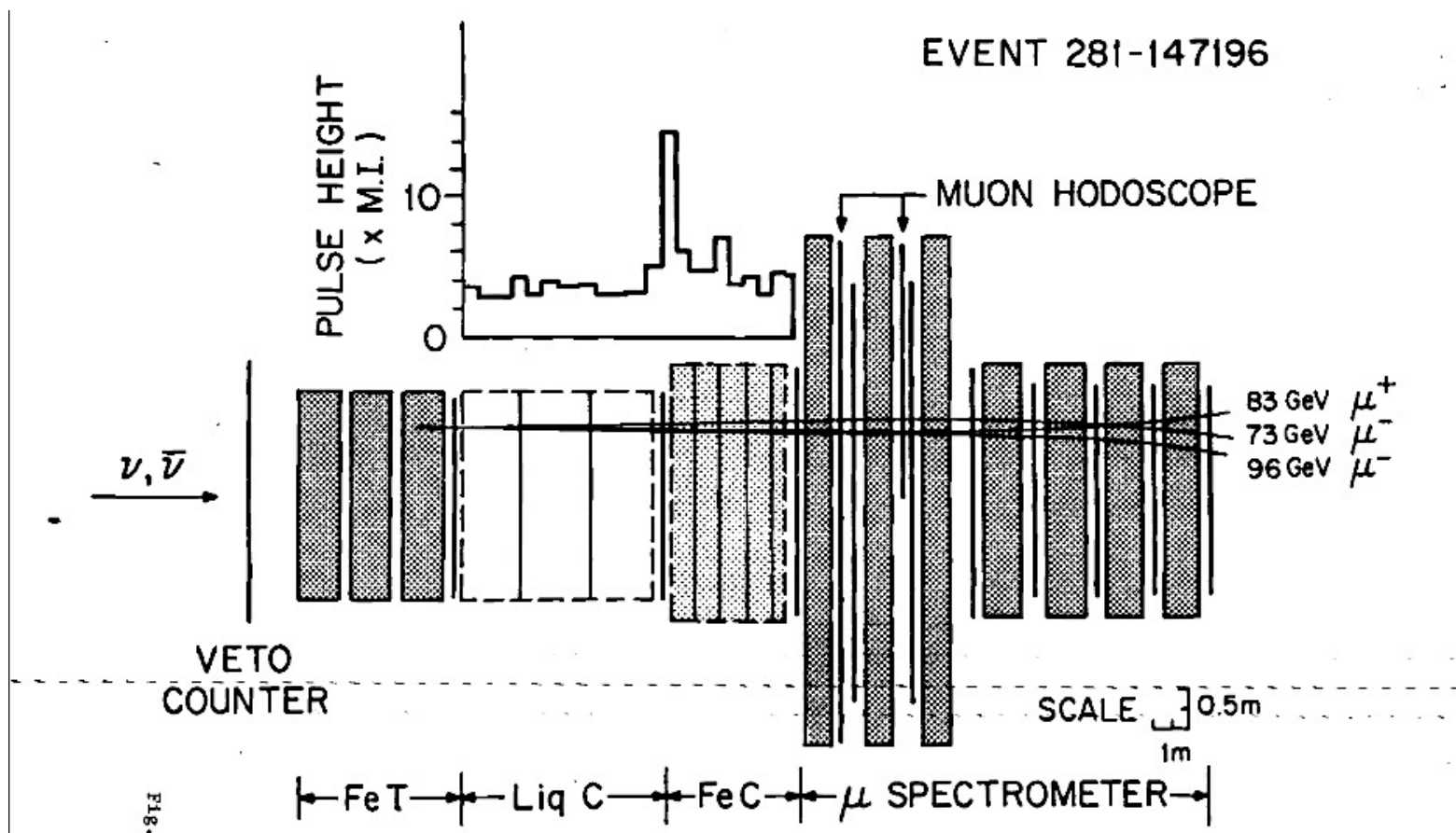
D. D. Reeder

C. Rubbia *C. Rubbia*

Trimuons

- Imlay, Benvenuti, Ling, Wanderer, and I ran E310 and focused all efforts on trying to find trimuons that would evidence charm decays.
- Day after day, we would scan the spark chamber film, looking for gold. We found lots of silver = dimuons, but no gold.
- Days turned into weeks, weeks into months.
- Then one day Day breezed into the counting house and said 'Just got into town; I'm going to scan for 10 minutes.'
- He found this:

Luck o' the Cline...



December 1975

- I invented the idea of using the newly discovered beam cooling techniques to cool and accumulate antiprotons, then accelerate them and collide in the Main Ring at Fermilab to make weak bosons.
- The idea started while I was at CERN a year earlier as a post-doc. Paolo Strolin and I were tremendously excited about van der Meer's stochastic cooling and Budker's electron cooling.

Bob Wilson was charged up about his Tevatron

- Tevatron was conceived and built as an accelerator, *not* a collider.
- DOE had anointed BNL as the lab to make pp colliding beams (ISABELLE), and did not favor poaching from Fermilab.
- Wilson got a spate of letters proposing ways to make colliding beams:
 - Cline & Rubbia wanted to collide Main Ring & Tevatron.
 - Lederman and Walker proposed to collide a 30 GeV ring with Tev.
 - Richter wanted to collide electrons on protons.
 - and McIntyre proposed $p\bar{p}$ in the Main Ring to discover W,Z...

Some reminiscences...

- At the end of the day of the Fermilab meeting, Dave and Carlo switched horses and we formed the three musketeers.
- We revved up an intense working group at Fermilab, Dave and Carlo would fly in once a week to commune.
- Dave and Carlo nearly wrecked on the toll road driving to Ohare, I found myself behind them as we all flew off to teach...

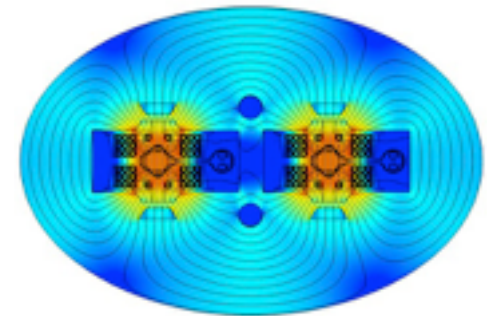
- When we had the scheme complete, we presented to the Fermilab Board. Wilson was furious because we had not given him a copy of our proposal ahead of time.
- Dave, Carlo, and I celebrated one night later that year, because we knew that somewhere, at one lab or the other, we would find the bosons.
- Then Carlo switched to CERN, and he and Daave found the bosons...
- Dave focused discussion on the next horizon for great discovery – the Death Hormone...
- And then there was Bataclan...

Years later, as we spun up ideas for future colliders, Dave and I gave vision talks at an International Accelerator Conference

- The conference was at KEK in Japan.
- I stayed at a ryokan – traditional Japanese guest house in a neighboring town – I went native.
- I took a bus from KEK back to the small town, then walked back to my ryokan.
- Passing along the street, I suddenly spotted Dave – in a McDonald's

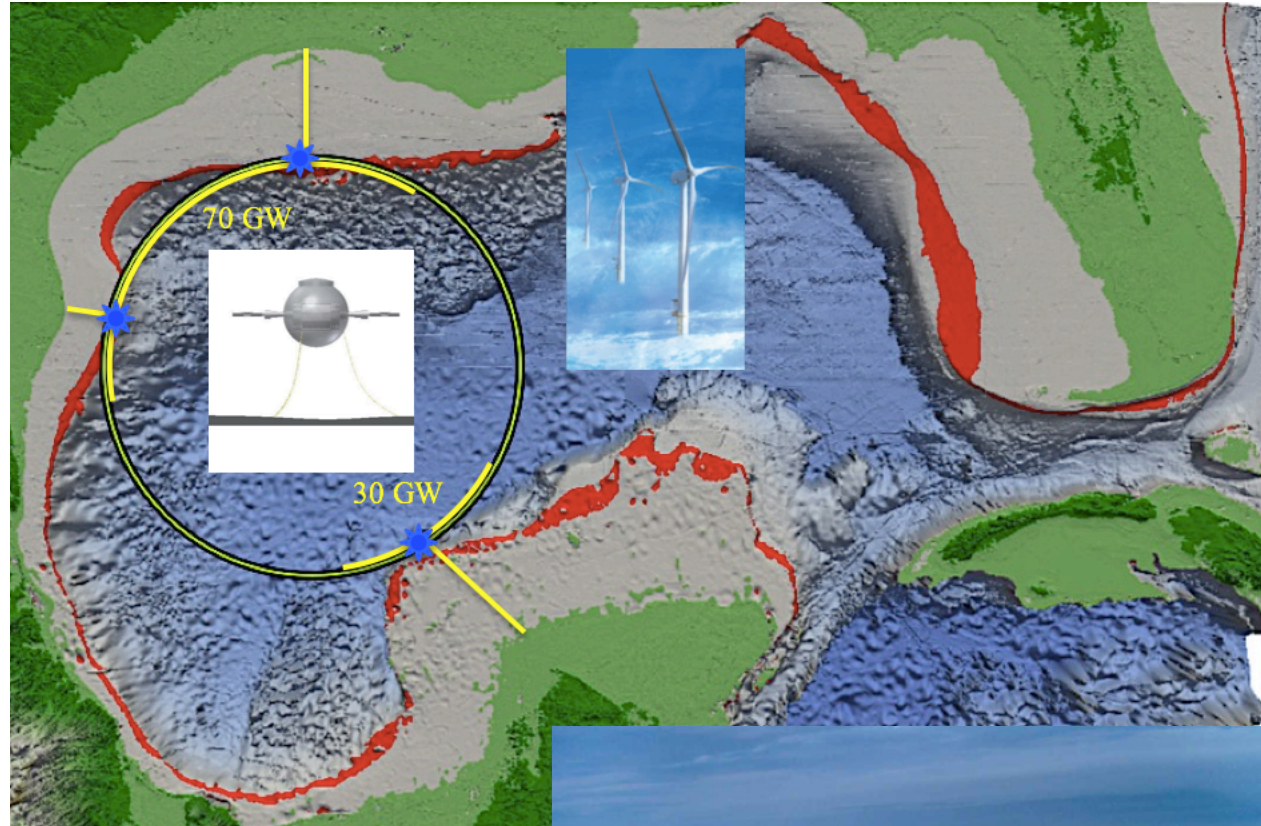
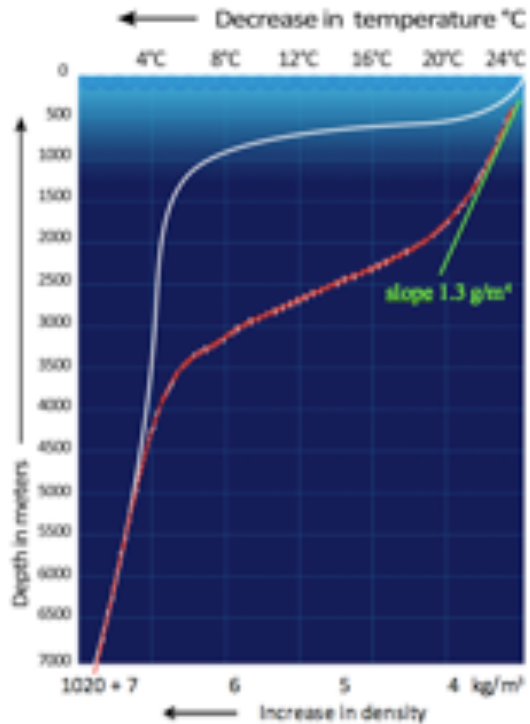
I wish Dave were here today

- He would love my latest crazy ideas...
- 100 TeV collisions that the world could afford:



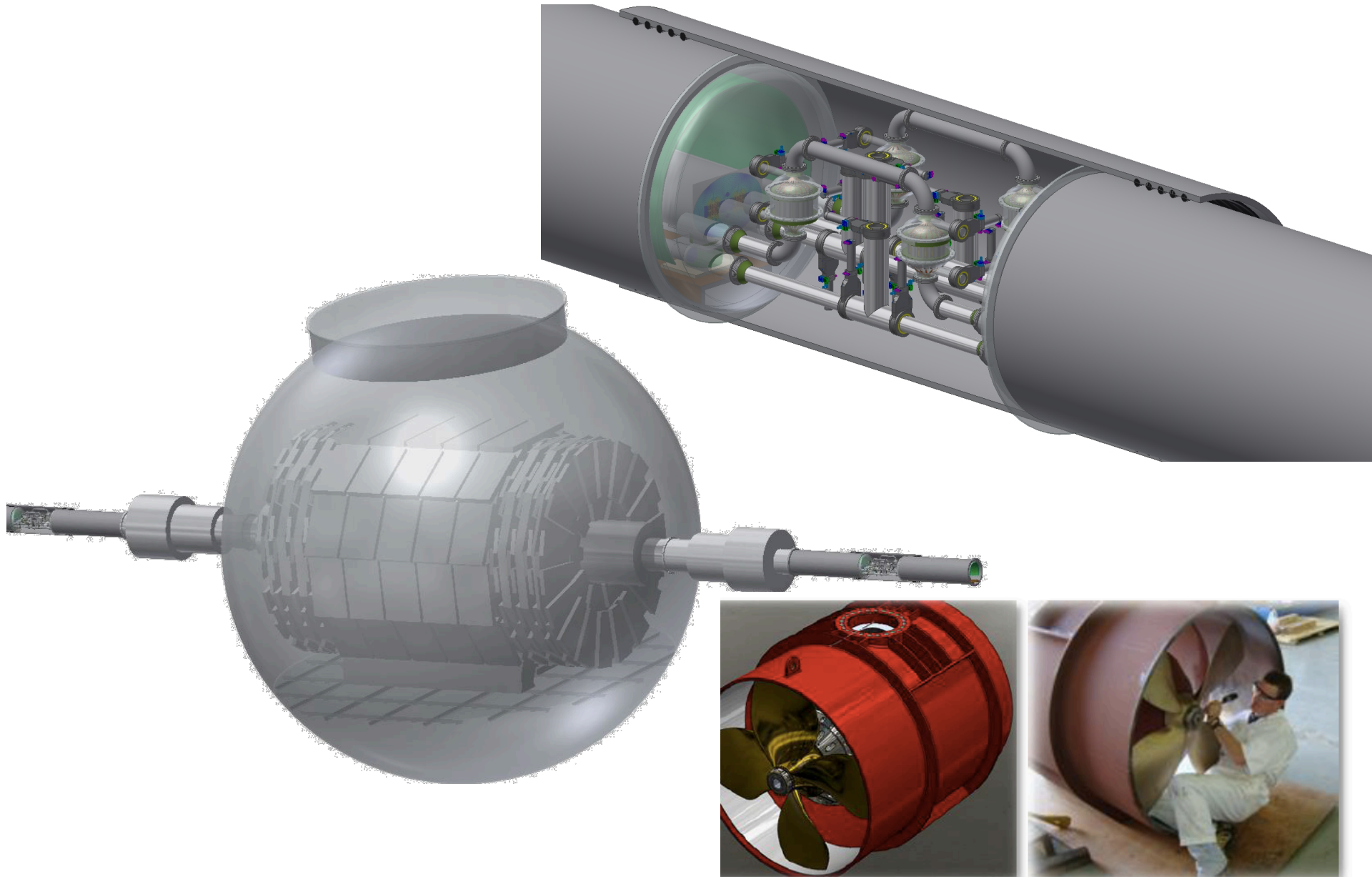
270 km tunnel
4.5 T dipole field
100 TeV collisions

500 TeV collisions in the sea...



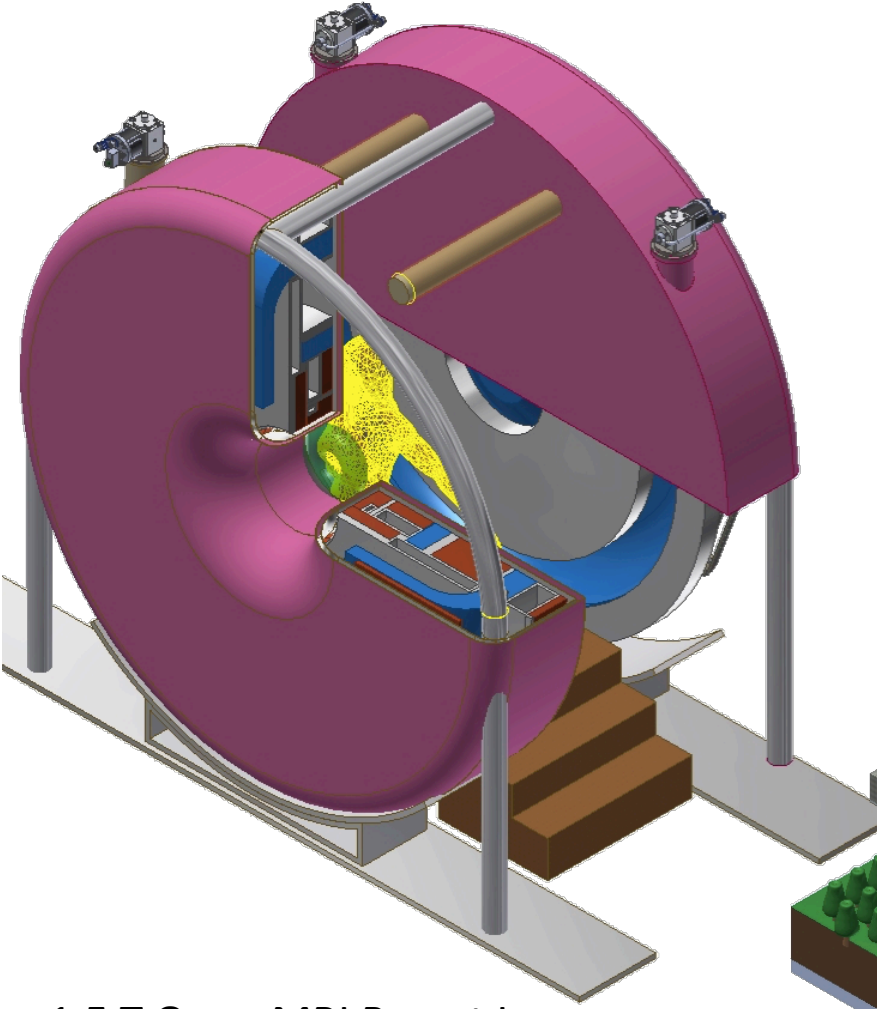
1900 km circumference
3.2 T dipole field
500 TeV collision energy
100 GW of electric power...

Just put the Sea in place of the Earth...



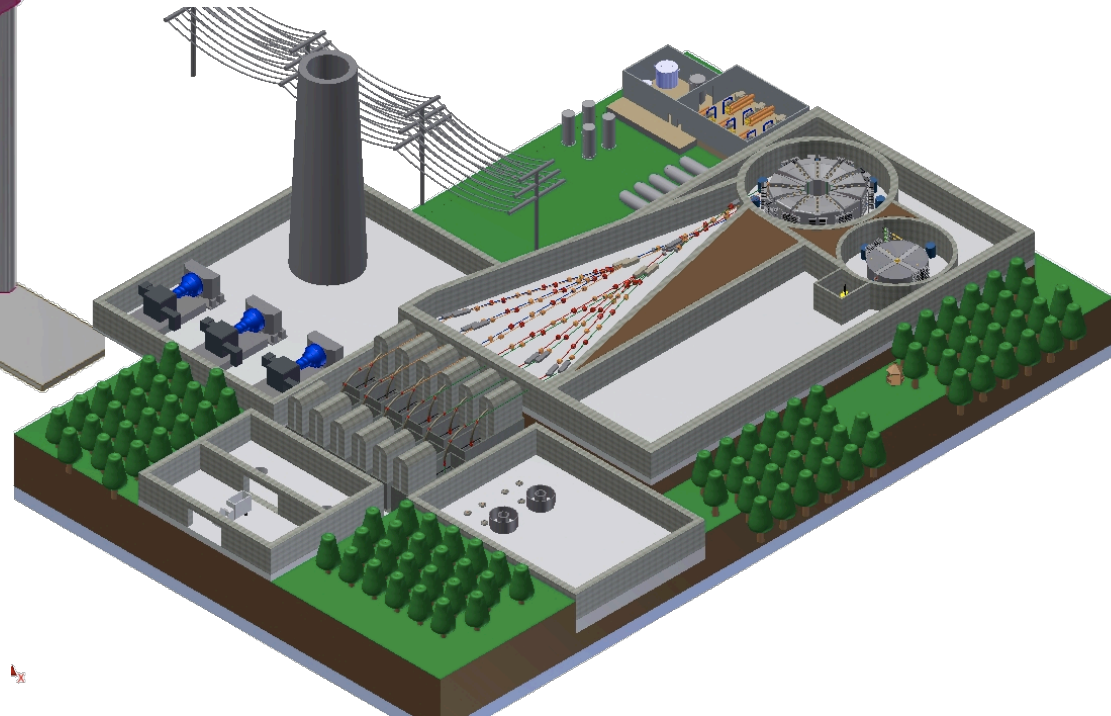
	LHC	Texas	CERN	Collider-in-the Sea	
circumference	27	270	90	1,900	Km
dipole field	8.3	4.5	15	3.2	T
collision energy	14	100	100	500	TeV
integrated luminosity	3	10	10	100	ab ⁻¹
physics reach (Z' using Ref. 16)	7.5	42	42	194	TeV
superconductor:	NbTi	NbTi	Nb ₃ Sn/NbTi	NbTi	
cross-section/bore	34	7.2	95/60	7.2	cm ²
2015 cost	0.6	1.7	23.1	12.3	B\$
tunnel: 2015 cost	1.0	1.6	4.2	?	B\$

Dave always enjoyed talking with me about practical uses of accelerator technology



1.5 T Open MRI Breast Imager
Affordable Well-Patient Screening
For early detection of breast cancer

Accelerator-Driven Subcritical Fission in a
Molten Salt Core
Destroy the nightmare transuranics in
spent nuclear fuel
Safe nuclear power for a millenium



- Beethoven was once a dance band leader
 - He composed lively dance tunes.
 - He led a small orchestral group to play in Vienna coffee houses.
 - One of his most popular was a simply, beautiful melody...
- Then he moved on to symphonies
 - He remembered his little melody, and used it as the recurring theme in one of the most beautiful symphonies of all time.
- Dave was my friend and my fellow musketeer in some great physics.
- *Dave ate physics in its many flavors.*
- *He enjoyed all the flavors.*

