



## Why are we here??



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## Why are we here??

If **E** = **mc**<sup>2</sup> true and all mirror symmetries unbroken:

- a) The Martians would rule the Earth
- b) I slept through that part of class
- c) We wouldn't be here
- d) The universe would be full of turtles



## Why are we here??

#### c) We wouldn't be here

Many, many unanswered questions





#### SSC ~ 20 years ago today... • Very ambitious... SUPERCONDUCTING SUPER COLLIDER LABORATORY Gary S. Varner NAME Boston Univ. AFFILIATION ED SI 1/95 SERIAL NUMBER EXPIRES **VIS00795** 40TeV vs 14 TeV (LHC)

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### **New/Immediate Projects**



### We need you! (for new measurements)



# ANITA3





#### **Physics Goals**

- Discovery experiment for "BZ" neutrinos, created by the so-called GZK process
- Uses the entire Antarctic continent as a detector!
- Best near-term chance to observe neutrinos from earliest universe
- 3<sup>rd</sup> (final) flight in December 2013



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## ANITA3 – ID Lab



# ANITA3

How rare is rare? If I have a 1km-size detector, how long would I have to wait to see 1 "GZK" event ?







- a) A couple of weeks
- b) A couple of years
- c) A couple of centuries
- d) Not since the last ice age
- e) Not in the lifetime of the universe

# **ANITA3**





### Askaryan Radio Array (ARA)



# ARA – ID Lab

### IRS, IRS2, IRS3 ASIC



#### **Our Developments**

- ANITA trigger/digitizer electronics  $\rightarrow$  to ARA
- "array crossing" waveform sampler (IRS)
- Built "testbed" almost 4 years ago....
- Finally deployed in January, taking data
- First "station" January 2012 needs work...











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### **Bremsstrahlung x-rays: UH FEL**

50MeV max. (40MeV typ.)



### Who invented the Free Electron Laser?



- a) John Madey
- b) Joe Blow
- c) Mittwellian Romney III
- d) Lord Kelvin
- e) Robert Byer
- f) Eugene Stanley



### a) Prof. John Madey He received the Robert R. Wilson prize last month



### TEDA –ID Lab – FEDDX, STURM2

cPCI crate (control room)



# Large Area Photodetector



### **Project goals**

- Photomultipliers still built on vacuum tube technology
- CRT  $\rightarrow$  flat panel screen transition
- Integrated readout electronics
- Necessary for next generation (large) detectors





**CHAMP** 



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### **Micro-channel plate**



#### For our 8" plates, how many holes?



- a) A few thousand
- b) A few million
- c) A few hundred million
- d) A few billion
- e) A few gazillion
- f) I never learned to count

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# Belle II – ID Lab



### iTOP – ID Lab





## Got fiber?



## How much data?

### High Luminosity B-factory

At  $L = 8 \times 10^{35} \text{ cm}^{-2}/\text{s}$ :

• Pipelined readout:

128k channels equiv., 40MHz x 2bytes



# Manpower needed...

- 1. KLM/iTOP CRT readout system (full quadrant test of muon system)
- iTOP beam test --> boards and board test plan
  [512 channel system = 4x 128ch]
- 3. 8" ceramic LAPPD PMT [72 channels]
- 4. xFEL Fermionics readout [64 channels]
- 5. mini-Time Cube [12x 64-channel tube readout minimum?]
- 6. fDIRC2 readout [14x 64-channel tubes]

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120 X-Stri

1855

3258

### Milestones and Opportunities

- Belle II iTOP/KLM by 2014, pixel upgrade thereafter
- Disruptive technology: LAPPD (Detector dev center ANL)
- ANITA 3<sup>rd</sup> Flight next year  $\rightarrow$  active R&D (ASICs, trigger...)
- New initiatives: ARA Test bed installed, year 2 & 3
- Great opportunities life cycle of a university
  - Jr./Sr. research projects (EE 399/499, PHYS 499)
  - Directed study/NASA Space Grant/REU (Japan/Antarctica)
  - Publications (NIM/IEEE/JINST ...)
  - Board/firmware/chip design (PHYS476)
  - Many designs in queue; IRS3B, STURM3, GRAPH...
    - Design, layout, simulation and test opportunities



