

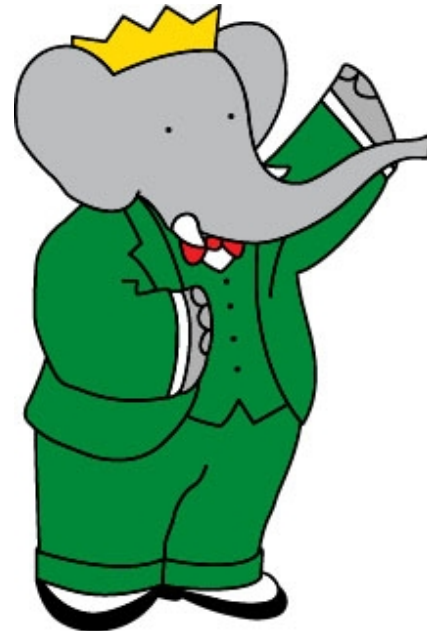
THE BABAR EXPERIMENT AT SMU

Prof. Steve Sekula

Presented at the Department Seminar
1/25/2010



SMUSM

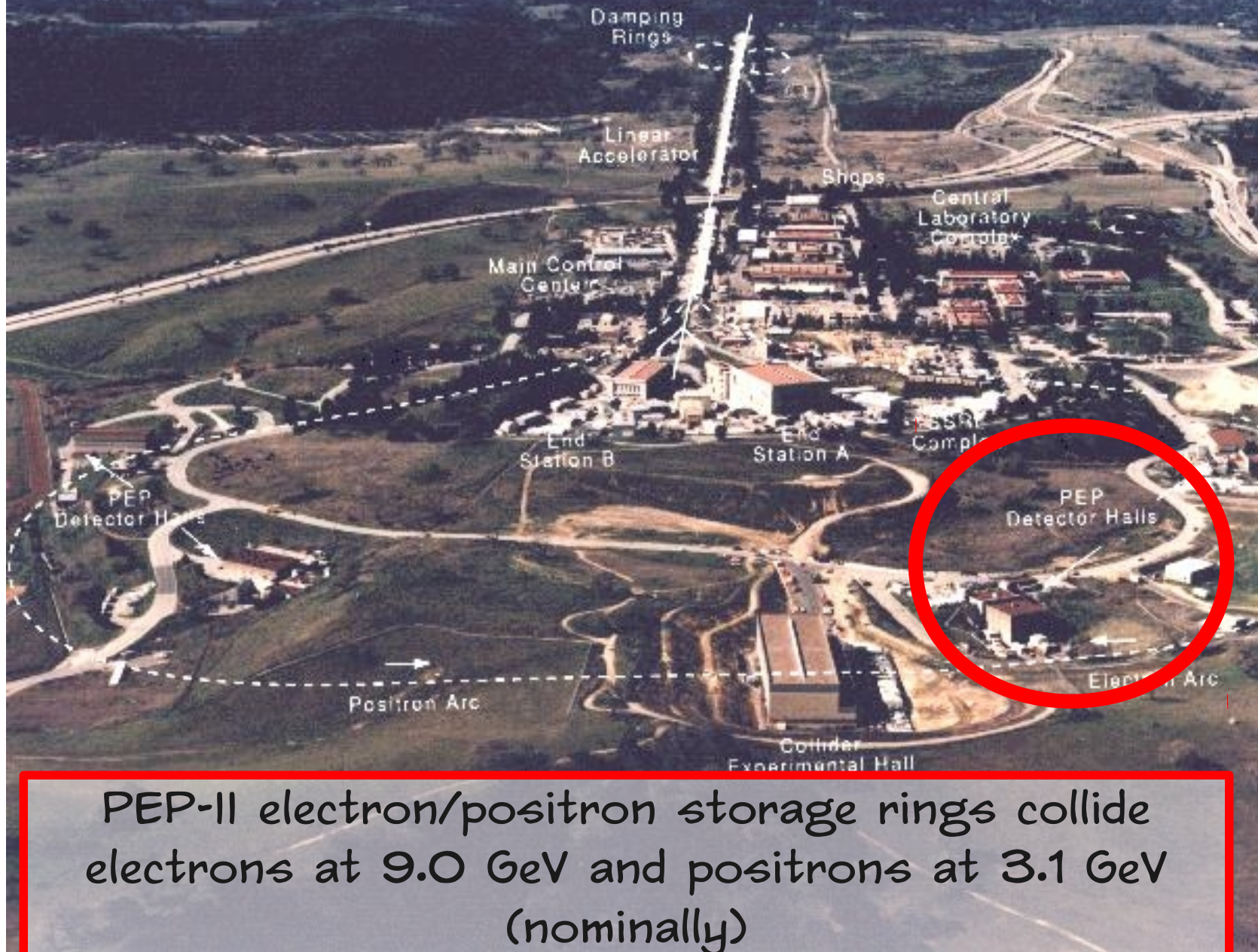


™ and © Nelvana, All Rights Reserved

OVERVIEW

- PEP-II collider and BaBar detector
- Physics at BaBar
- SMU BaBar Program

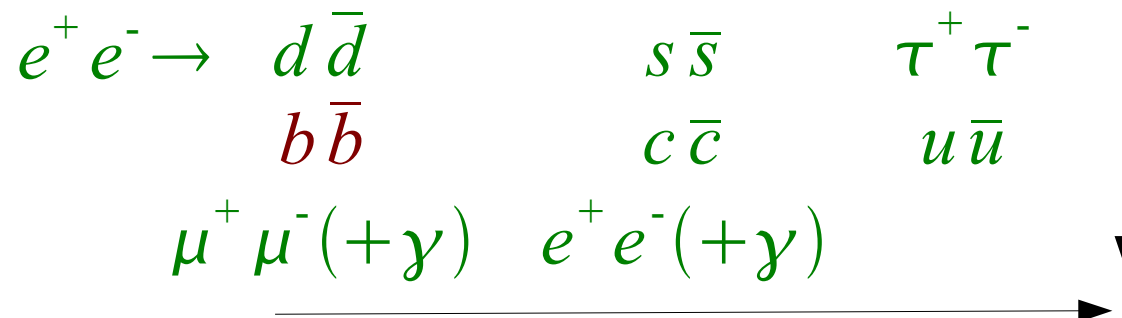
SLAC National Accelerator Laboratory (Palo Alto, CA, near Stanford University campus)



PEP-II electron/positron storage rings collide electrons at 9.0 GeV and positrons at 3.1 GeV (nominally)

COLLIDER PHYSICS

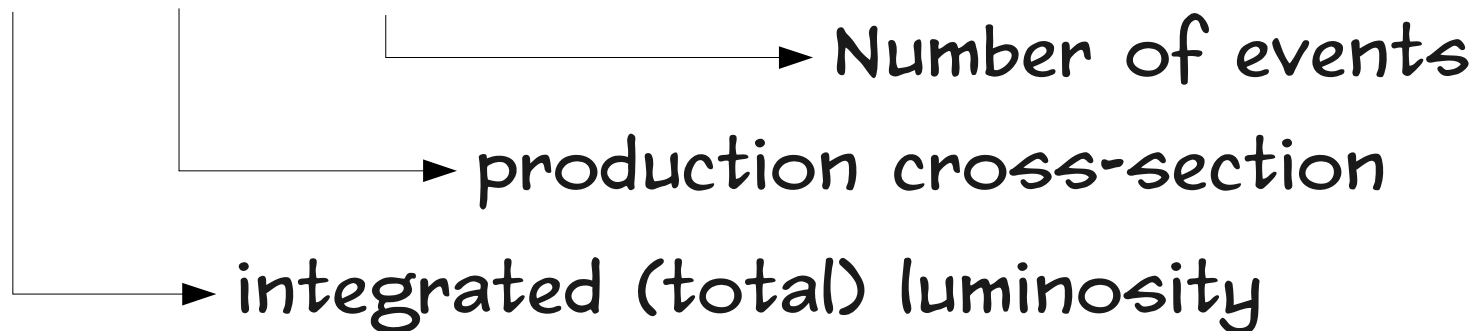
- Asymmetric-energy collider
 - Center-of-mass (CM) frame is NOT the same as the laboratory frame
 - CM system Lorentz-boosted in direction of electron beam ($\beta\gamma = 0.56$)
 - CM energy: nominally 10.58 GeV
- Many processes are accessible:



direction of arrows indicate increasing production cross-section.

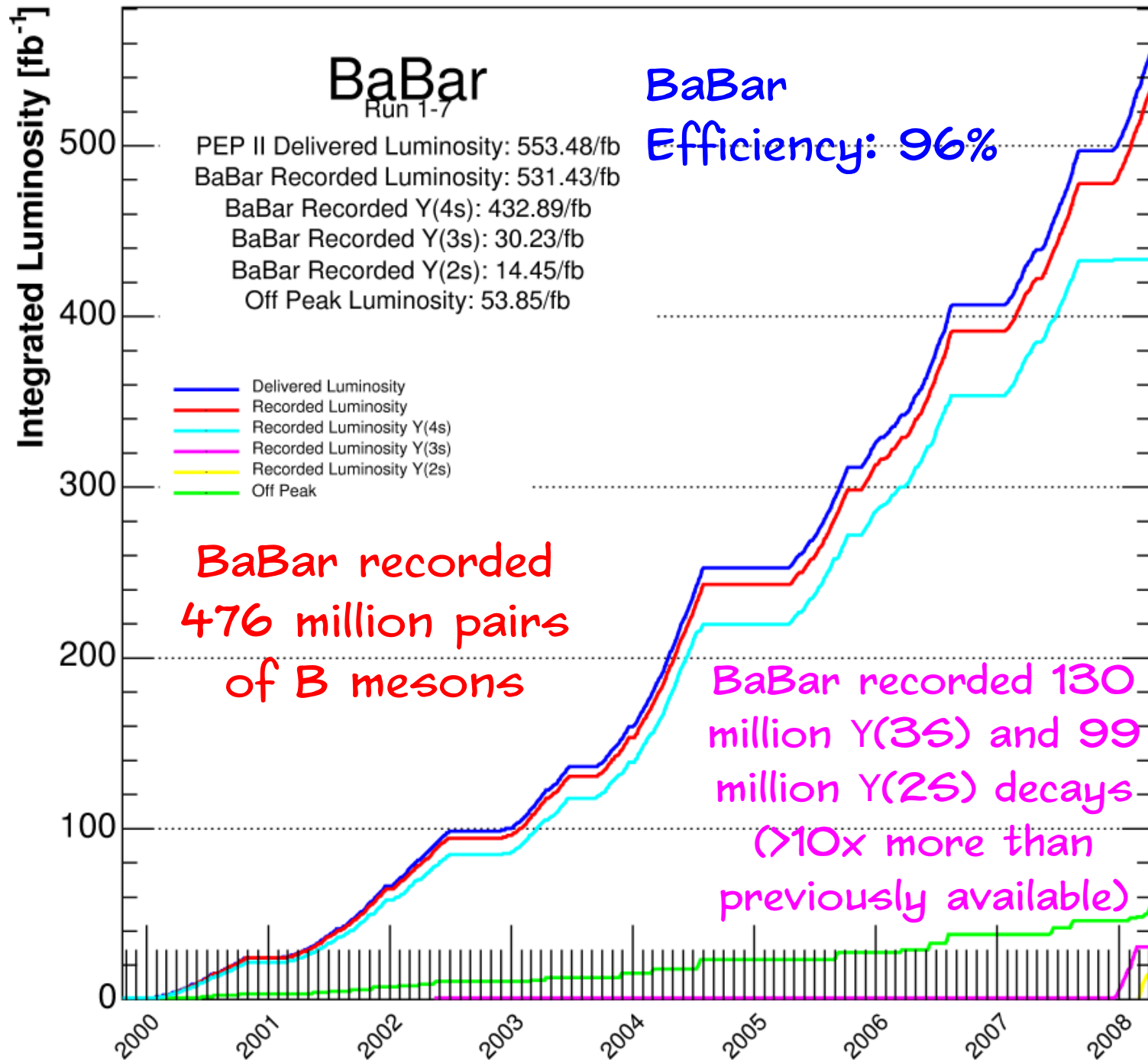
"B FACTORY"

$$L \times \sigma = N$$

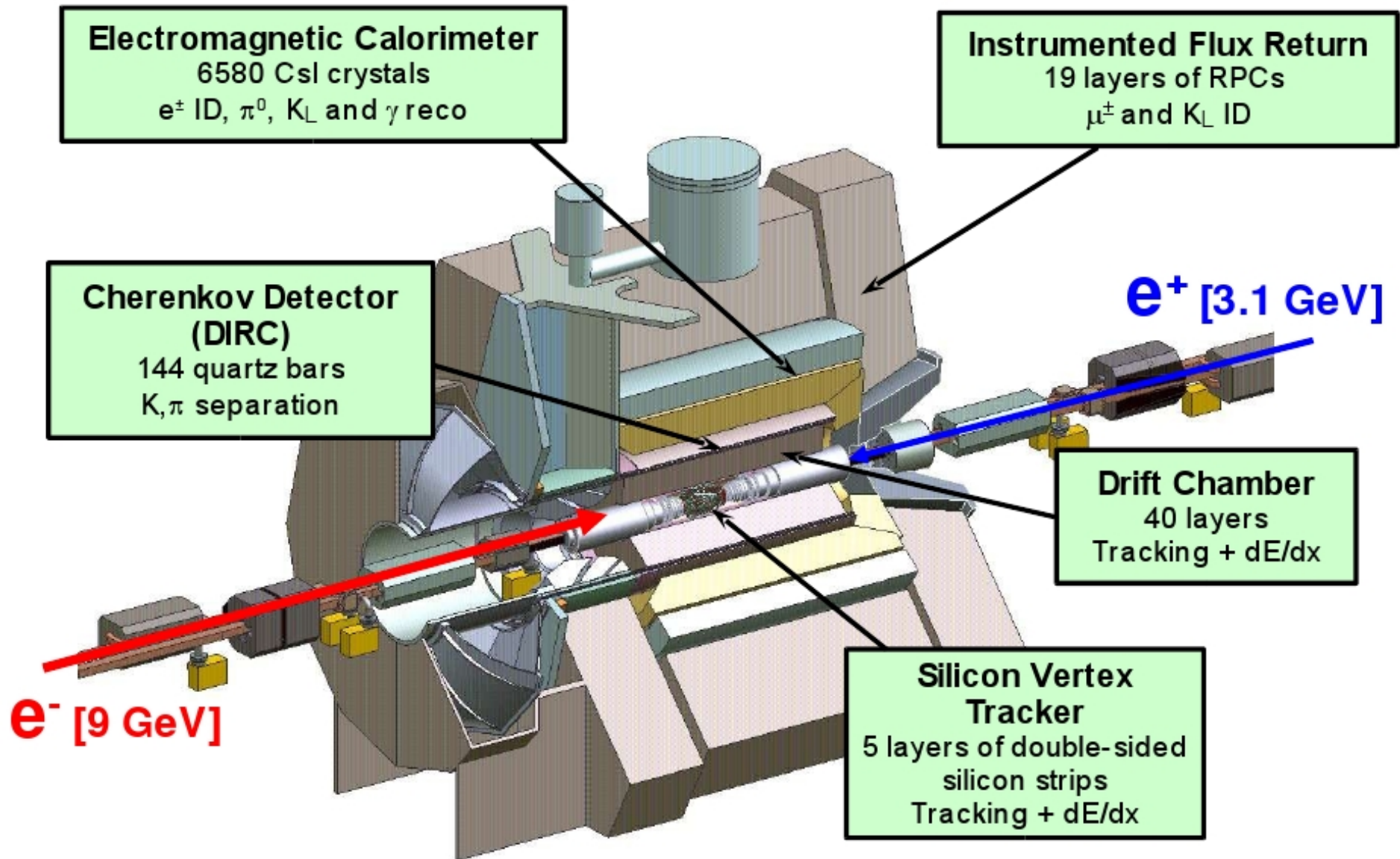


PEP-II was designed to collide e^+e^- at a high rate ($10^{33}-10^{34} \text{ cm}^{-2}\text{s}^{-1}$) for long periods of time

Design goal: produce the $\Upsilon(4S)$ resonance ($\sigma=10^{-9}$ barn), which decays promptly (>99% of the time) to either B^+B^- or B^0B^0 , so that rare B meson decay phenomena can be studied.



BaBar is a large acceptance experiment with excellent particle reconstruction and identification capability



BaBar at SMU

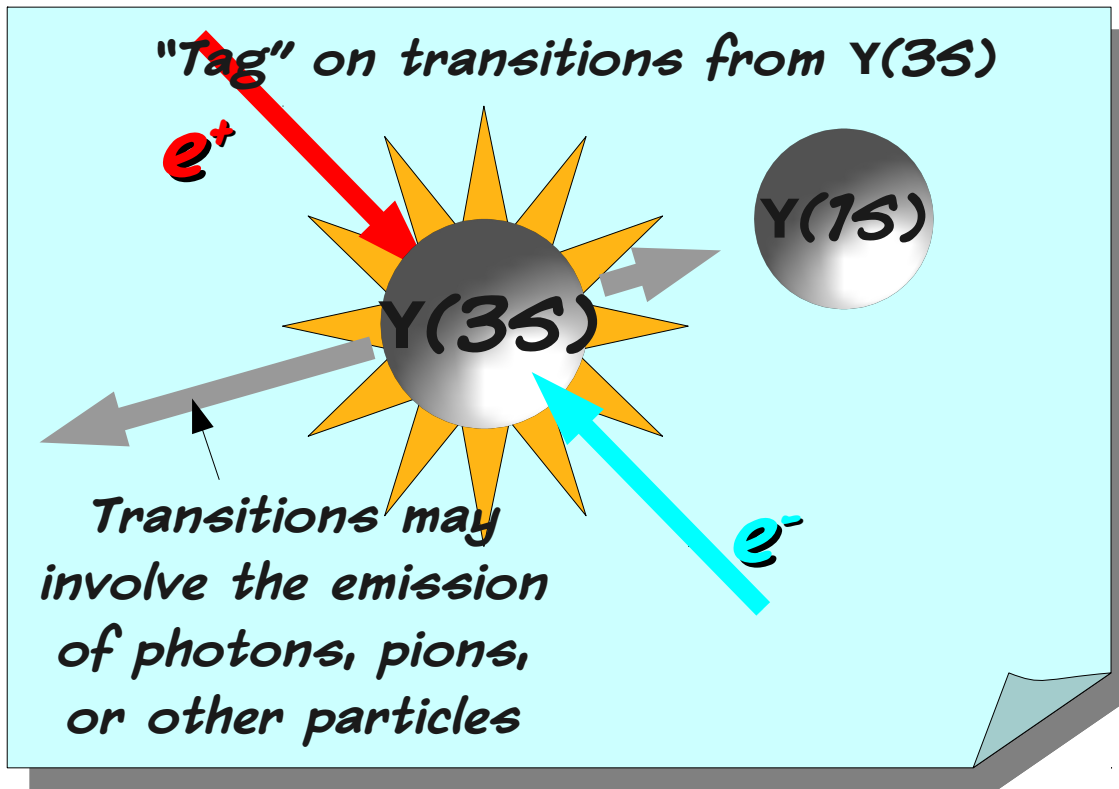
PHYSICS PROGRAM

- Studies of rare processes using $\Upsilon(3S)$ and $\Upsilon(2S)$ decays
- Search for new phenomena using B meson decay

LPSILON DECAYS

- A unique Upsilon sample!
 - >10x more Upsilon(3S)/(2S) mesons than any other experiment
 - processes that occur at the level of 10^{-6} - 10^{-7} are within reach
 - <50% of the final states of these mesons are known
- OPPORTUNITY for unique work
- OPPORTUNITY for discovery

PHYSICS IN THE RECOIL



Research opportunities:

- study and characterization of the physics of the transitions themselves
- employ the recoiling heavy Upsilon meson to search for new final-states of the Upsilon

This technique has been used for searches for low-mass dark matter in the final state of the Upsilon with sensitivities 10x better than any other experiment!

B MESON DECAYS

- Exotic final-states are windows into new principles of physics
 - e.g. $B \rightarrow 4l$ is predicted to occur in models of dark matter where the gauge forces are low in mass
 - complimentary to LHC studies aimed at searching for dark gauge bosons

SUMMARY

- BaBar offers
 - an immense data sample
 - opportunity for unique work
 - complimentary physics to LHC
- Benefits:
 - Ph.D. opportunity
 - Expect 1-2 papers from any of these topics
 - Experience with C++, Python, etc. and modern analysis techniques