HEP Activity in NTU and CosPA

Yee Bob Hsiung
National Taiwan University
1/8/2004

For ASHRA Collaboration Meeting at
University of Hawaii at Manoa, Honolulu

HEP/PA Projects at NTU

NTU-HEP Group started about 10 years ago, we now have:

- Belle @ KEK B -factory

  CP Violation and Rare Decays of B-meson

- KEK-E391A

  Direct CP Violation in K_L Decay (pi0 nu nubar)

- CMS @ CERN

  Looking for Higgs and new physics beyond SM

- NuTel

  An VHE neutrino Telescope R&D

Institution and Manpower

- NTU Physics and Institute of Astrophysics (a new Astro-Math building with ASIAA in 4 yrs)
- Faculty: George W.S. Hou, Minzu Wang, Paoti Chang, Yee B. Hsiung, Koji Ueno, Yeh Ping
- Postdoc: Simon Blyth, J. Hsu
- Engineer: Yuri Velikzhanin, Z. Gao, Y. Chi
- 7 Ph.D. students, several Master students and undergrads
- Plus 2 Theory postdocs and students

Funding Support

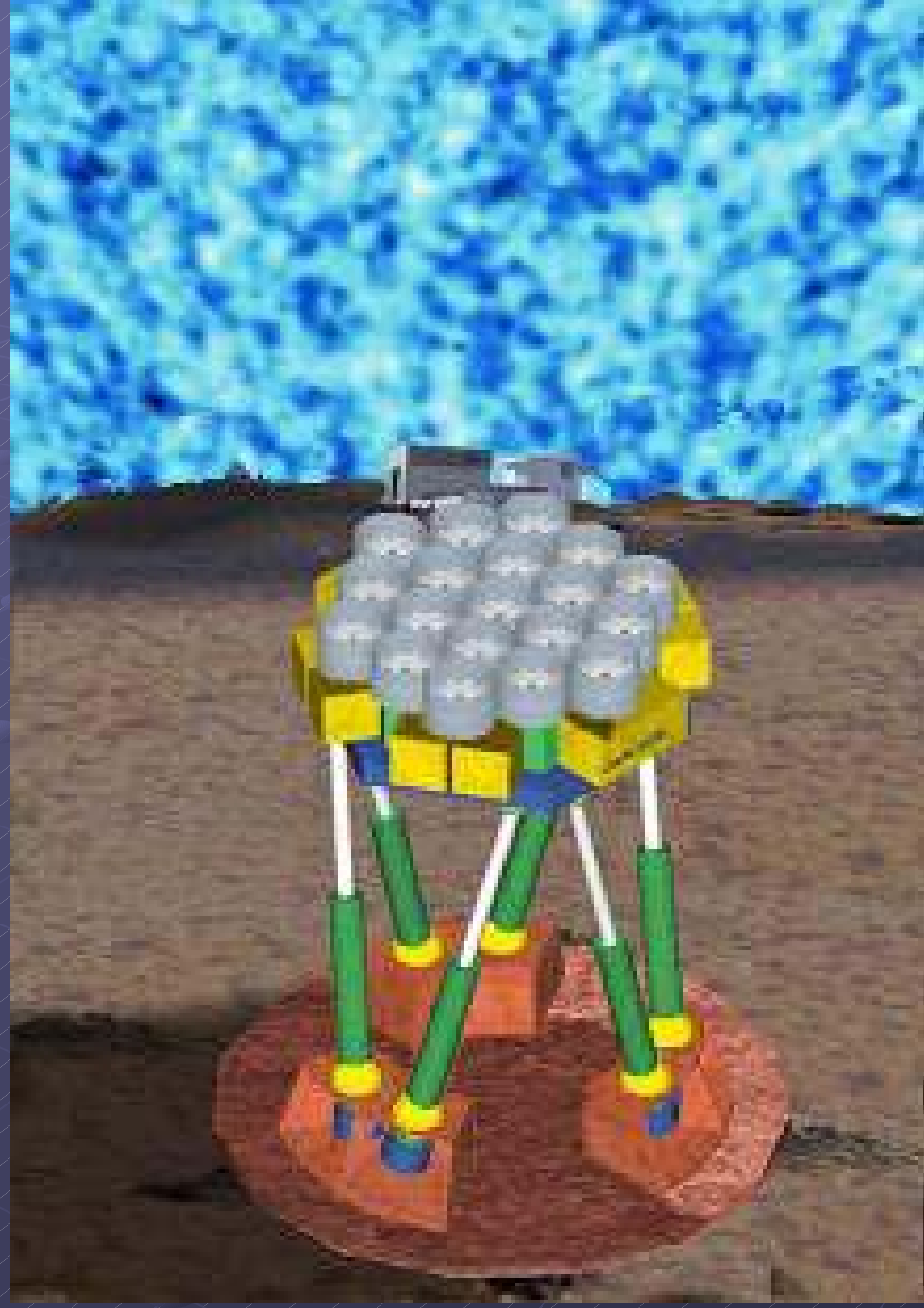
- National Science Council (NSC) – Regular proposals for Belle, CMS and E391A
- Ministry of Education (MOE) – Excellence Program for Cosmology and Particle Astrophysics (CosPA): CosPA-2 project for NuTel, Belle SVD2 upgrade, Dark Matter Search R&D

CosPA

- 4 yrs MOE Excellence Program
- 5 subprojects – AMiBA, NuTel, Theory, CFHT and Lulin Observatory
- 2nd 4 yr- CosPA continuation proposal submitted in 9/2003
- If approved, NuTel → ASHRA/NuTel

AMiBA
on Mauna Loa

The Array for Microwave Background Anisotropy
(ASIAA, NTUIAP)



Seeing AGN through Mountain

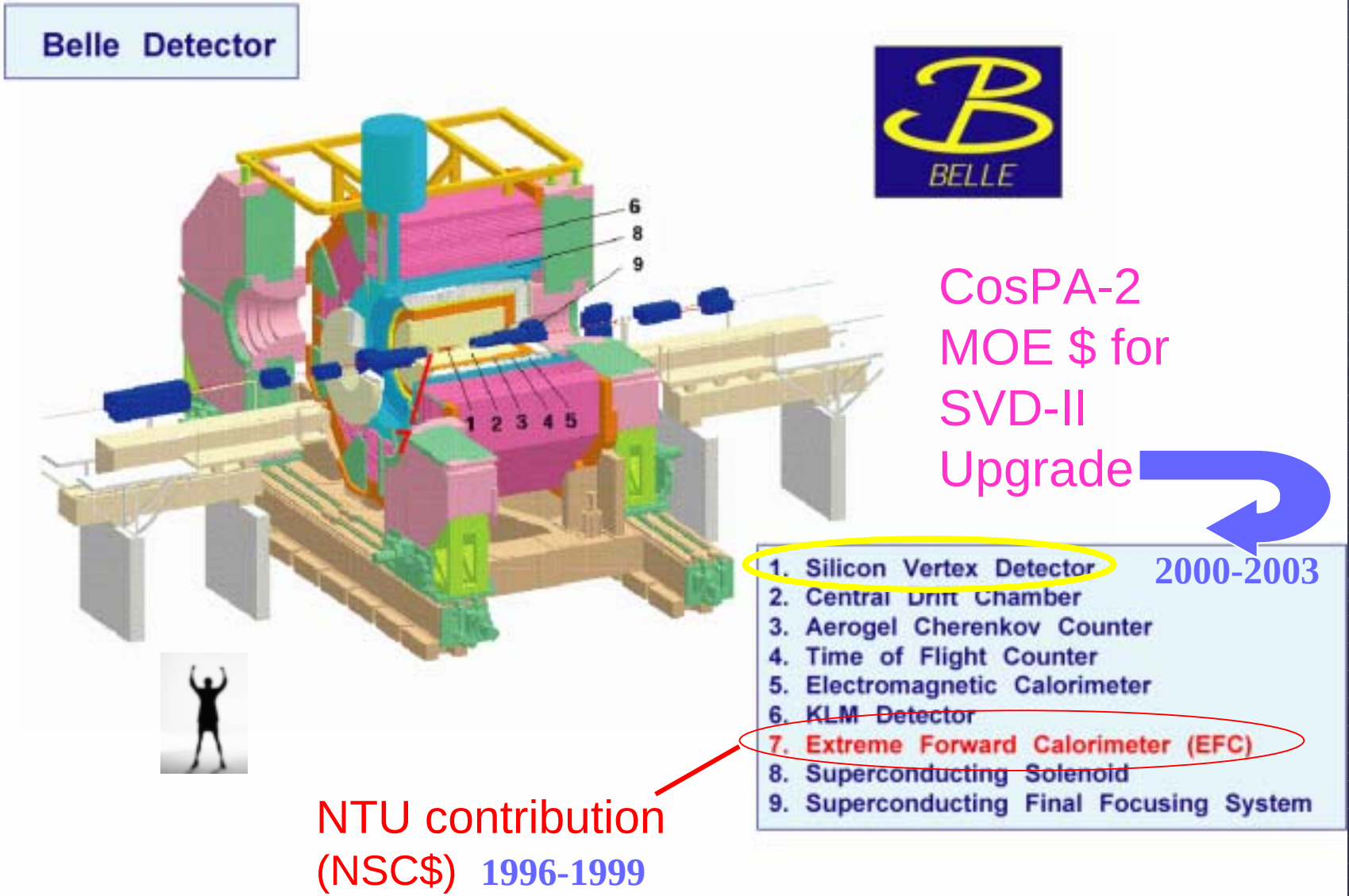
Very High Energy Neutrino Telescope

What have we done so far in Hardware

- Belle EFC detector – BGO, electronics and calibration
- Belle SVD-II upgrade – Trigger Timing Modules, Flex cables, SVD-II installation
- E391A – PMTs for photon veto system
- CMS – Preshower readout electronics Mother Boards
- Electronics/Optics for NuTel R&D (K. Ueno's talk)

Belle偵測器

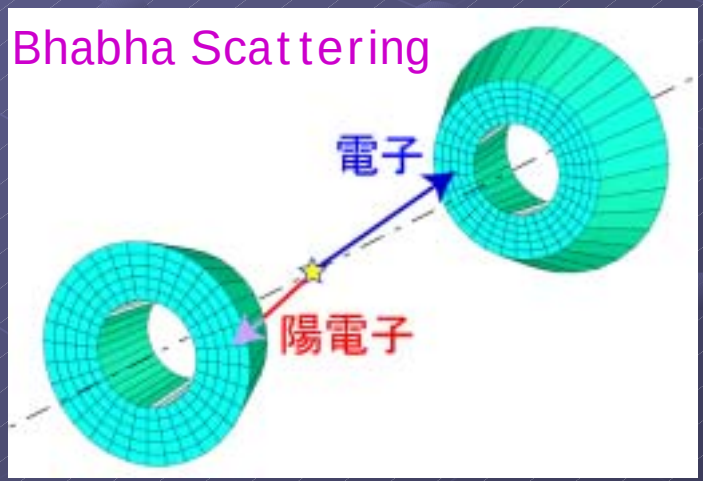
Belle (法語) ≈美人

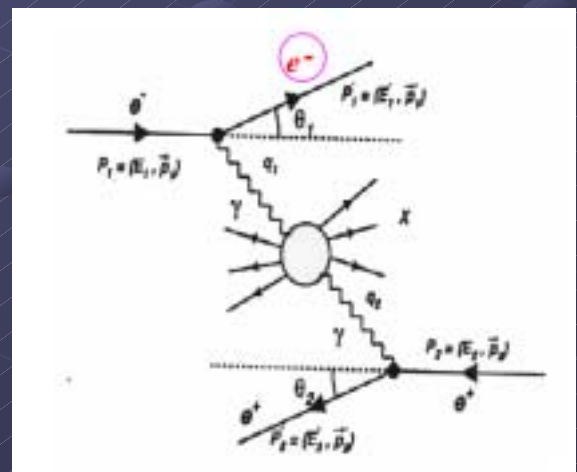


KEK (日本高能實驗室) 鳥瞰圖

Extreme Forward Calorimeter (EFC)

- A small-angle EM calorimeter (rad. hard pure BGO)
- Extend the Belle detecting angle from 17 ~ 150 degree to 6.4 ~ 173.4 degree
- Utility: *Instantaneous Luminosity*
  Beam Background Monitoring
  Tagger for Two-photon Physics



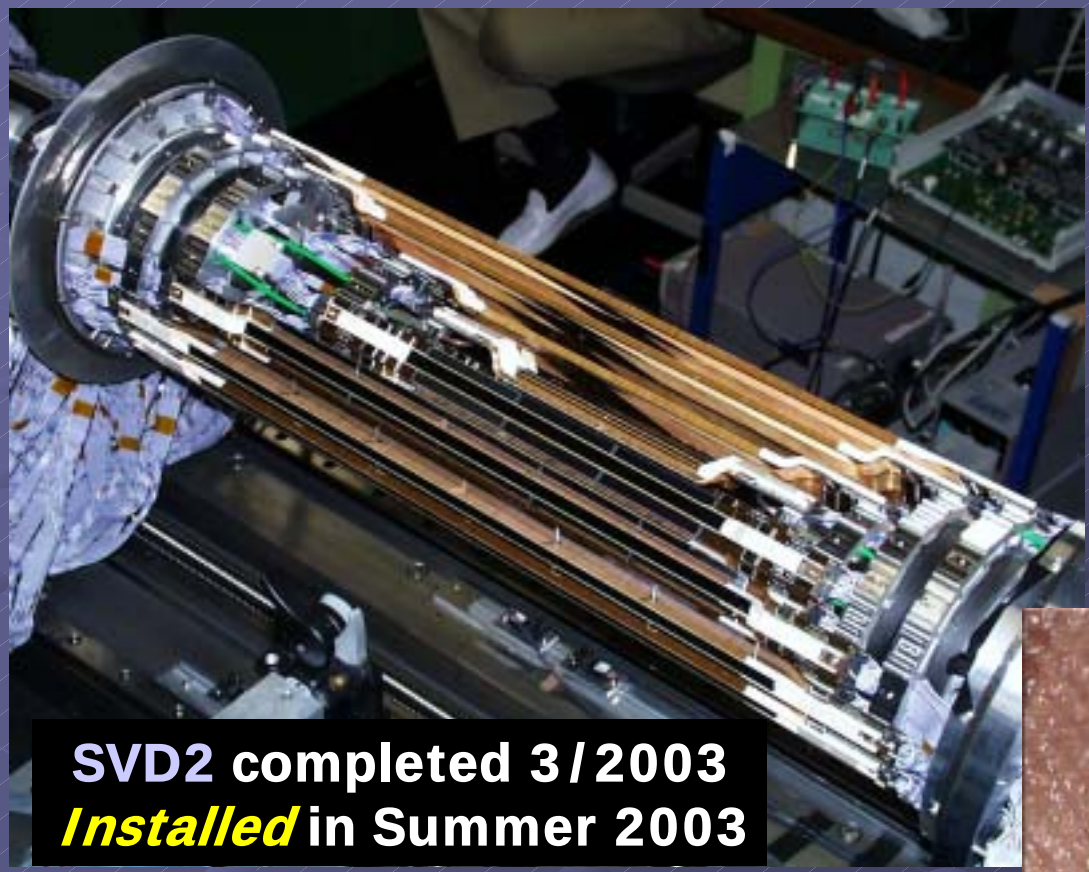


Single-tagged two-photon

EFC on the Cover Page

EFC saw First Bhabha events at B Factory!

Belle SVD2 Upgrade

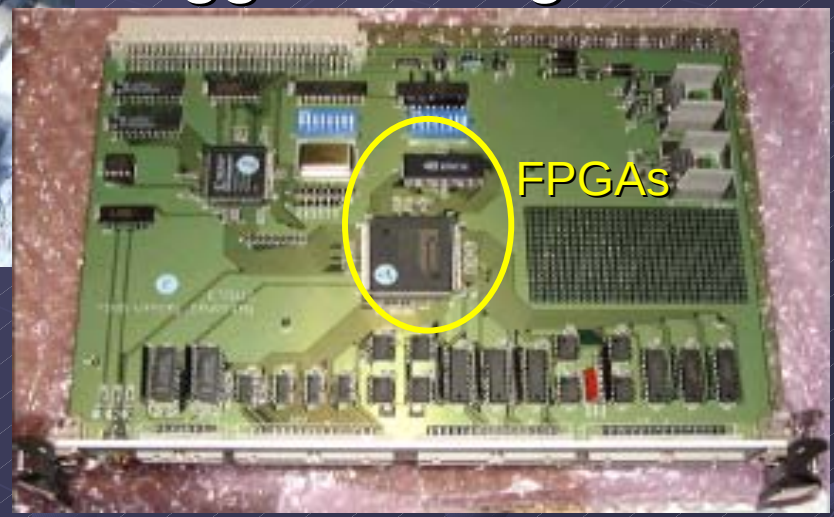


SVD2 completed 3/2003
***Installed* in Summer 2003**

From 3-layers of **SVD1 to**
4-layers + self-tracking

Collaborate w/
KEK,
Tokyo & Princeton
etc.

NTU Contribution: TTM
Trigger Timing Module



NTU Contribution: FLEX — Flexible PCB

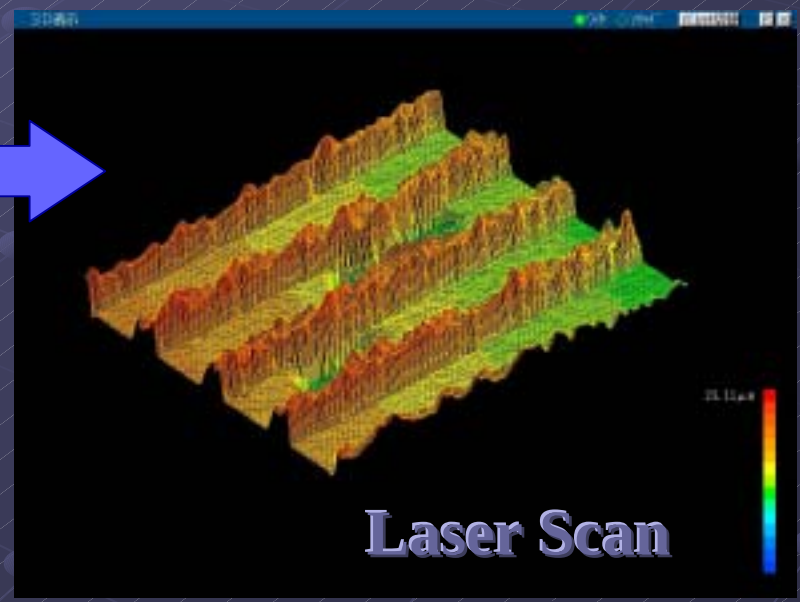
State of the Art!

500 lines in 2 cm

Smallest pitch in the world：

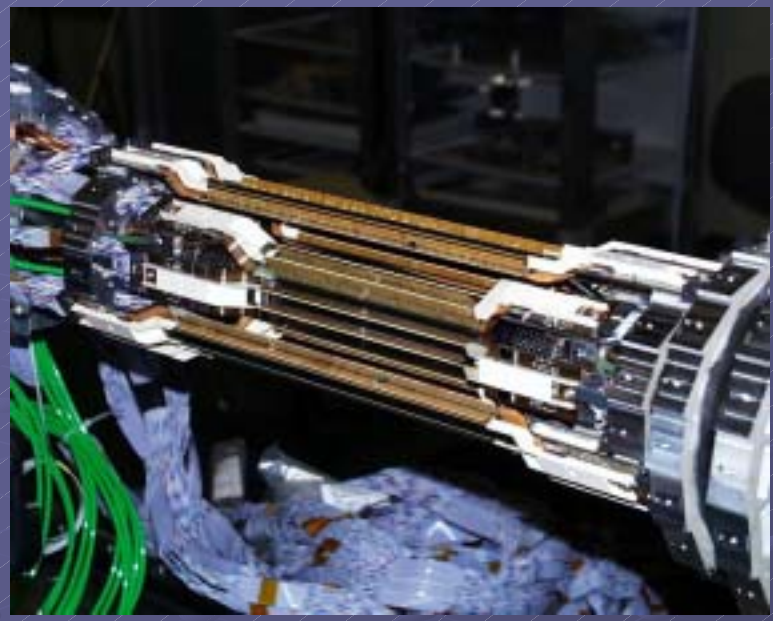
20 μm

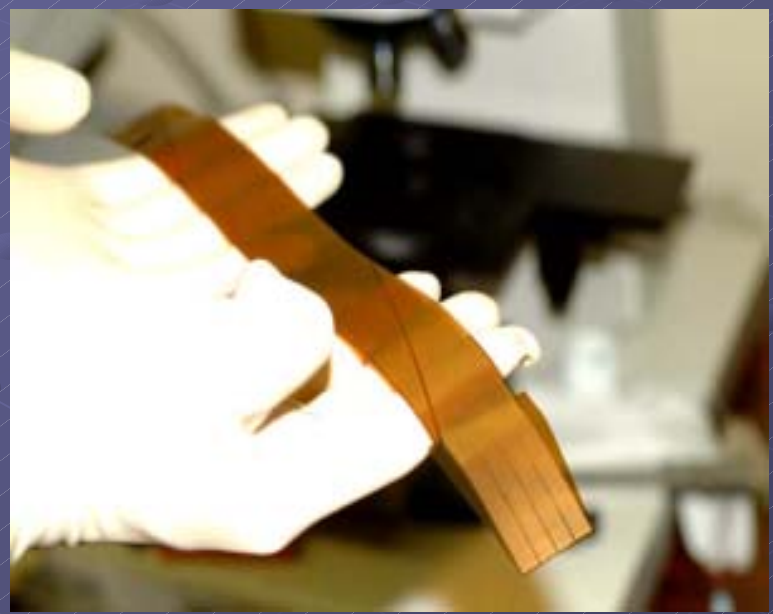
Finer than Mobile by 5 ~ 10 times



Laser microsurgery by NTU grad/tech
— Correct *Mass Production Defects*

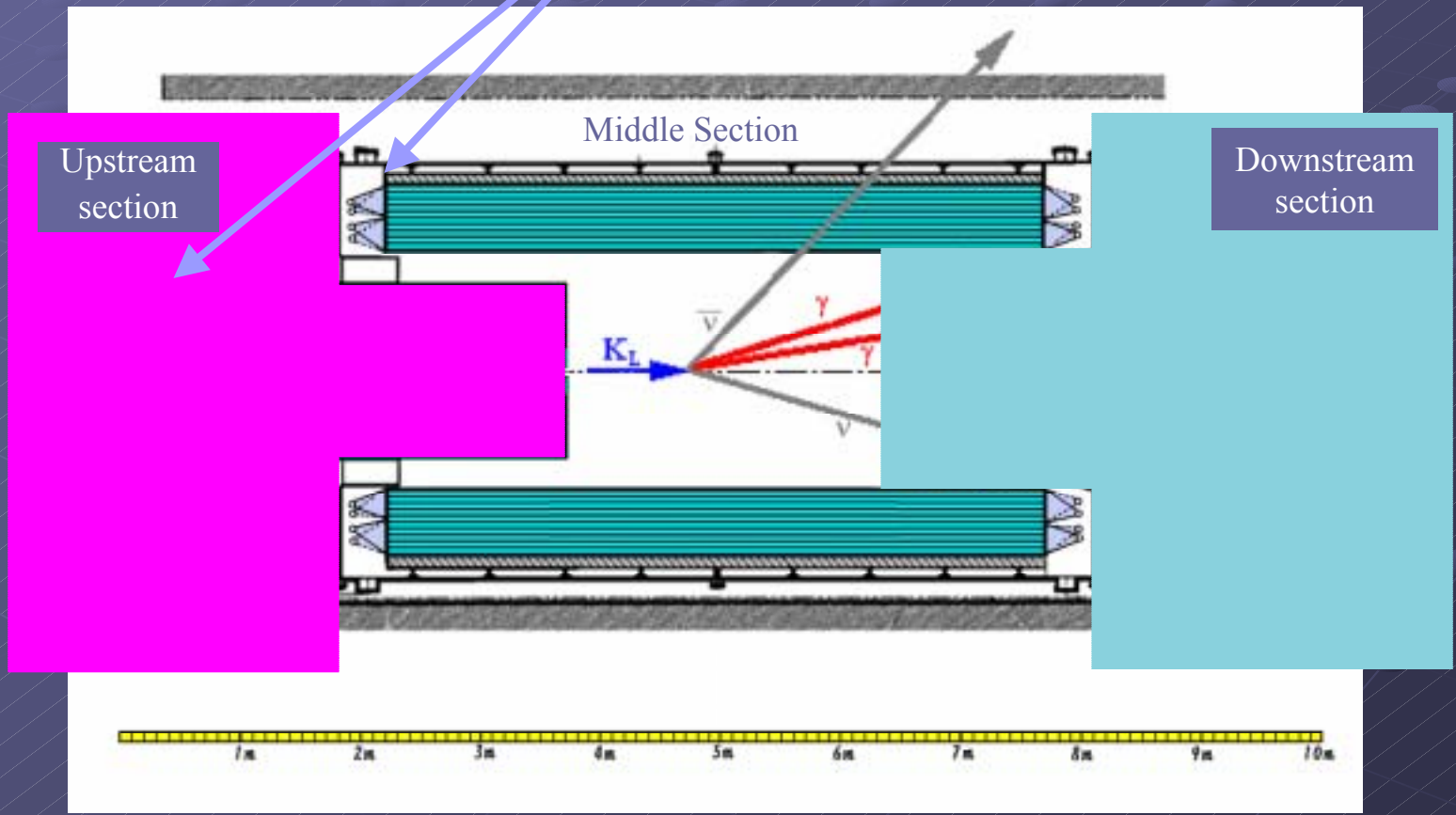
SVD2 & FLEX Assembly





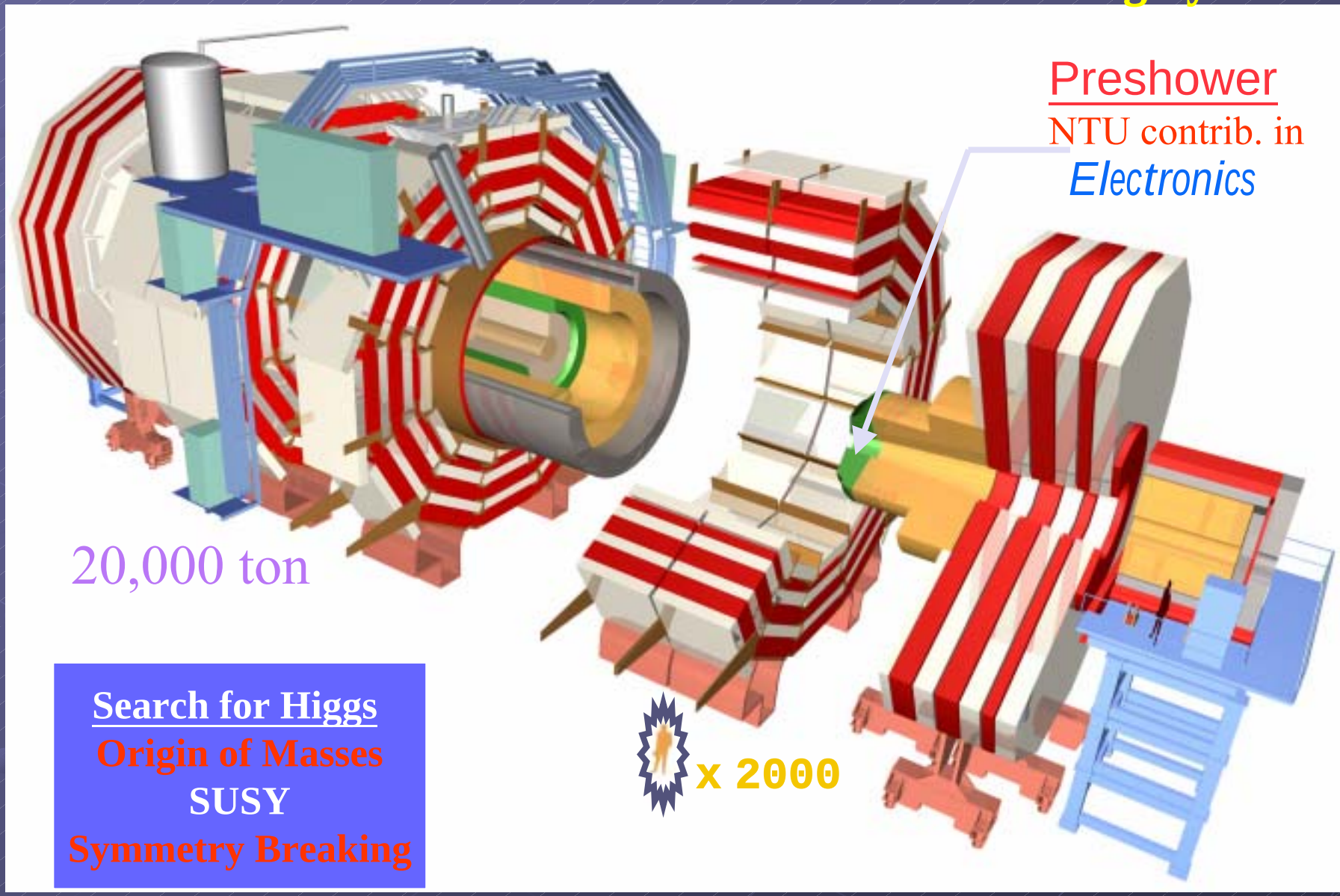
E391a Detector

NTU contribution: **PMTs** for photon veto system



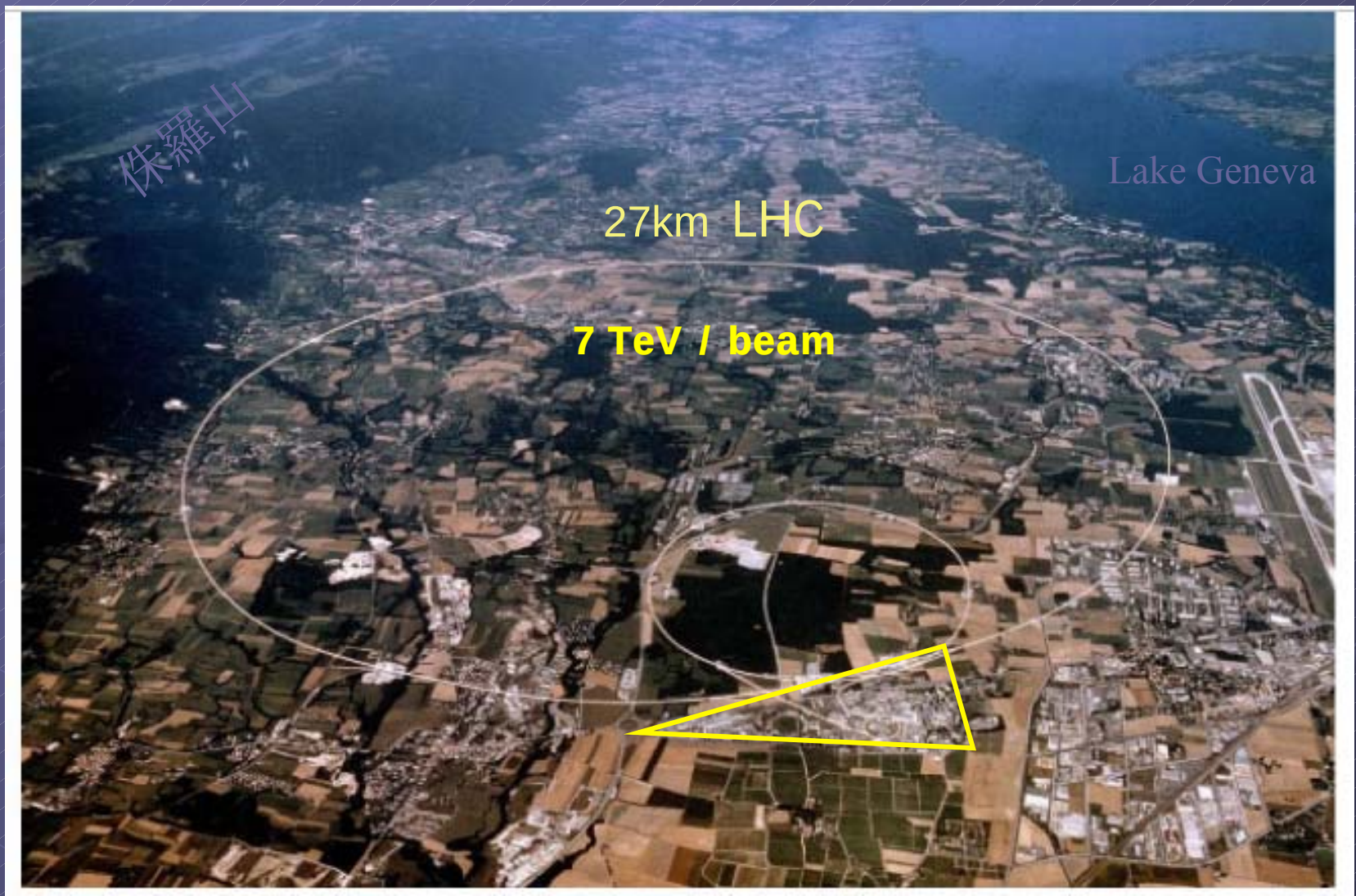
CMS Detector (at LHC@CERN)
(Compact Muon Solenoid)

Finishing by 2007



Search for Higgs
Origin of Masses
SUSY
Symmetry Breaking

LHC at CERN



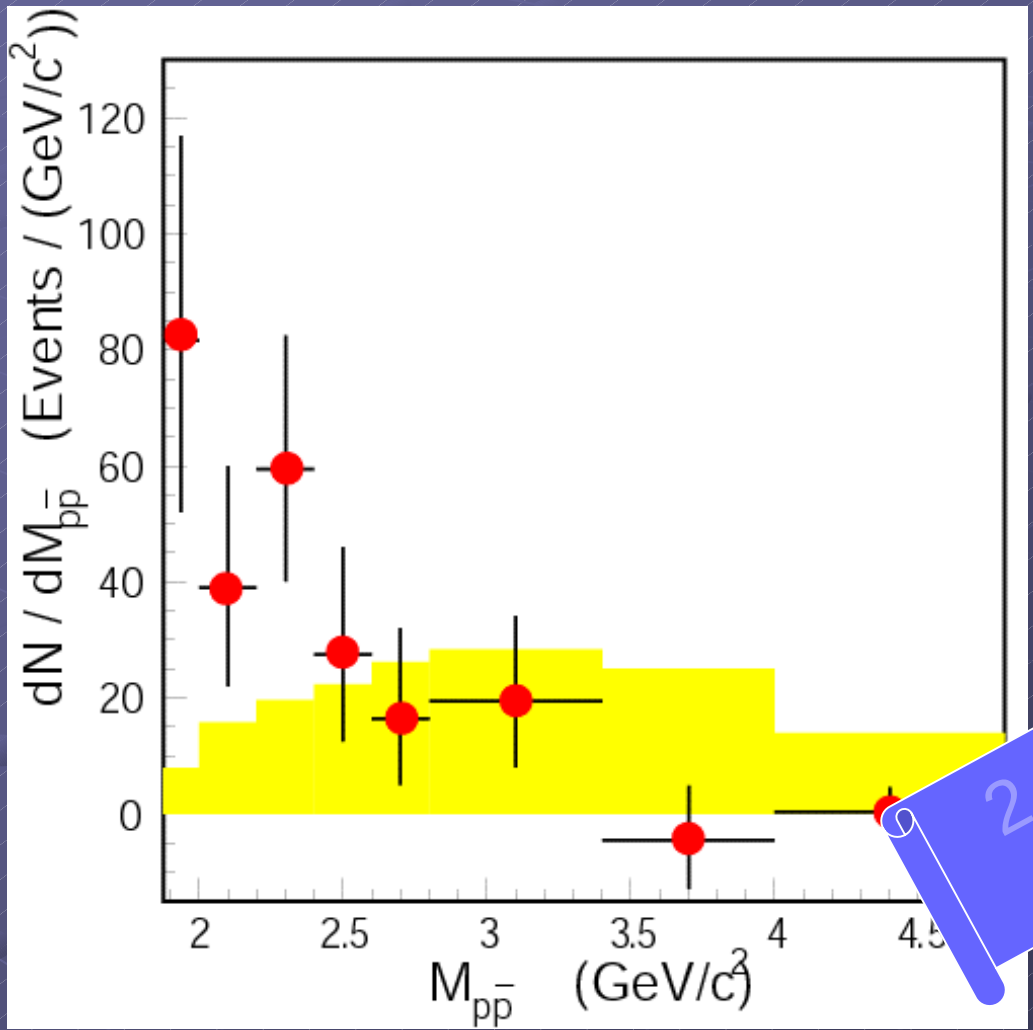
Analysis:
Enjoying New Physics Results

- CP-Violation and Rare Decays in B
- NuTel Simulations (M. Wang's talk)

T-Belle Physics Analysis 2000-2003

Subject	Journal	TW %	Taiwan Authors
1. $B \to \pi\pi$, $K\pi$	PRL	$\sim$ 50 %	P.T. Chang, K.F. Chen
2. $B \to \pi\pi$, $K\pi$ A_{CP}	PRD-RC	$\sim$ 50 %	P.T. Chang, K.F. Chen
3. $B \to \eta' K$	PLB	100 %	P.T. Chang, C.H.Wang, S.C. Hsu
4. $B \to D^0 h^0$ (4 modes)	PRL	100 %	R.S. Lu, H.C. Huang, K.F. Chen
5. $B \to p\overline{p}K$	PRL	100 %	M.Z. Wang, H.C. Huang, K.F. Chen
6. $B \to p\overline{p}$, $p\overline{\Lambda}$, $\Lambda\overline{\Lambda}$	PRD-RC	100 %	M.Z. Wang
7. $B \to \rho\pi$	PLB	50 %	Y. Chao, P.T. Chang
8. $B \to \omega K$	PRL	100 %	R.S. Lu
9. $B \to \eta' K$ CP	PLB	100 %	K.F. Chen, Y.B. Hsiung, P. Yeh
10. $B \to sq\overline{q}$ CP	PRD-RC	$\sim$ 50 %	K.F. Chen, Y.B. Hsiung
11. $B \to p\overline{\Lambda}\pi$	PRL sub.	100 %	Y.J. Lee, M.Z. Wang
12. $B \to \phi\phi K$	PRL sub.	100 %	H.C. Huang
13. $B \to s\overline{s}s$ CP	PRL sub.	$\sim$ 50%	K.F. Chen
14. $B \to \ell^+\ell^-$	[PRD]	100 %	M.C. Chang
15. $B \to p\overline{p}h$	[PRL]	100 %	Y.J. Lee, M.Z. Wang
16. $B \to \omega K$	[PRL]	100 %	C.H. Wang
17. $B \to \eta h$	[PRL]	100 %	H.C. Huang, S.W. Lin
18. $B \to \eta K^*$, $\eta' K^{(*)}$	[PRD]	100 %	C.H. Wang, P. Yeh, J. Schümann

Discovery of Rare Decays: $B^{\pm} \to p\bar{p}K^{\pm}$



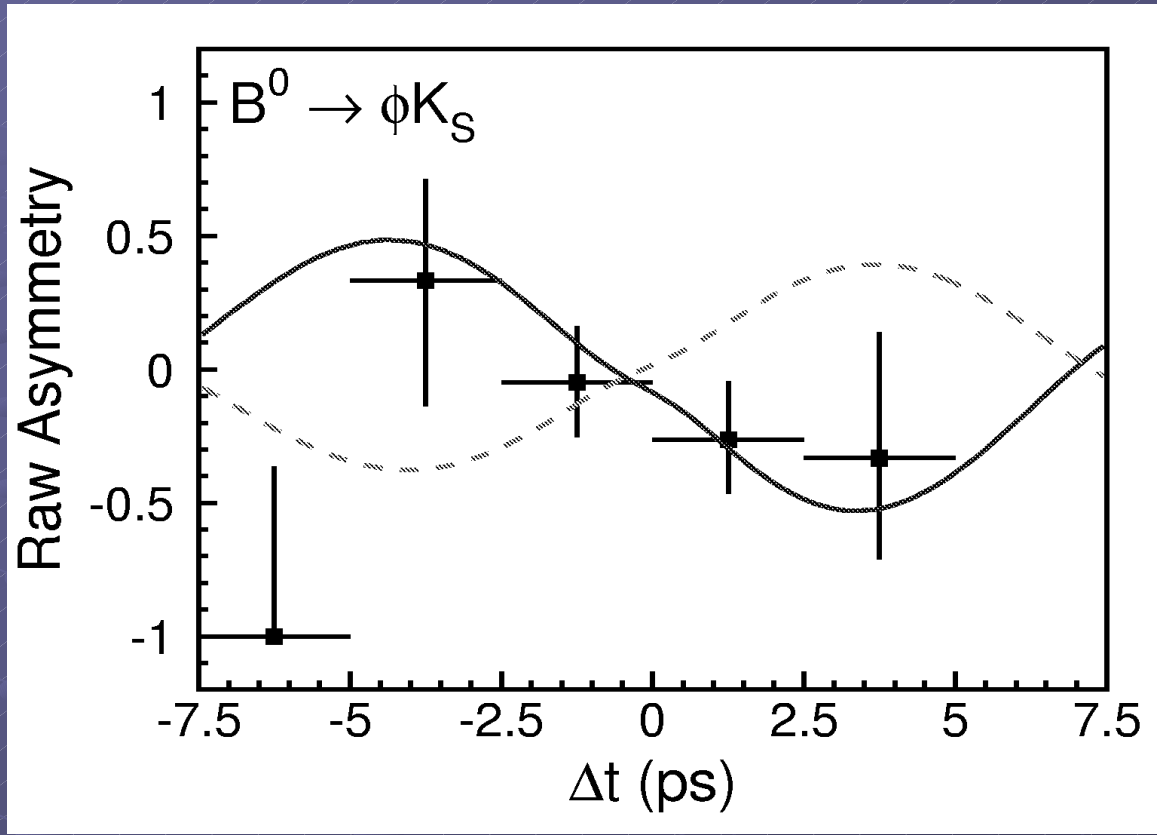
- New Rare Baryon Decays!
- Unexpected Spectrum
- May le
  V
  02 submitted
  PRL

2 More Papers Since
Many More to come

PRL **88**, 181803 (2002)

Belle 2003: CP Asymmetry in $B \rightarrow \varphi K_S$

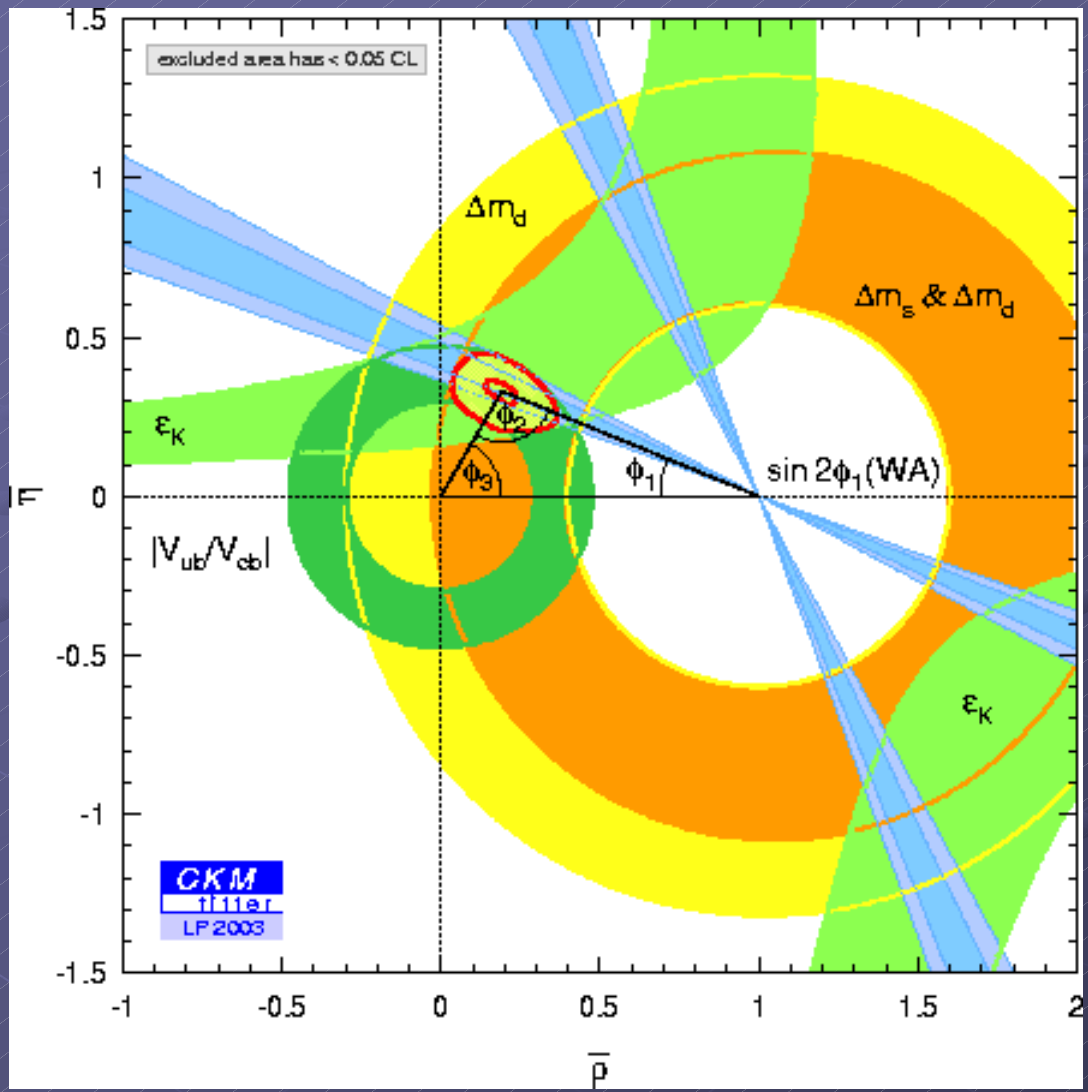
140 fb^{-1}



(A=-0.15±0.29±0.07)

Belle: $\sin 2\varphi_{1eff} = -0.96 \pm 0.50$ 3.5σ off

Current Belle and BaBar Results for sin(2φ1)

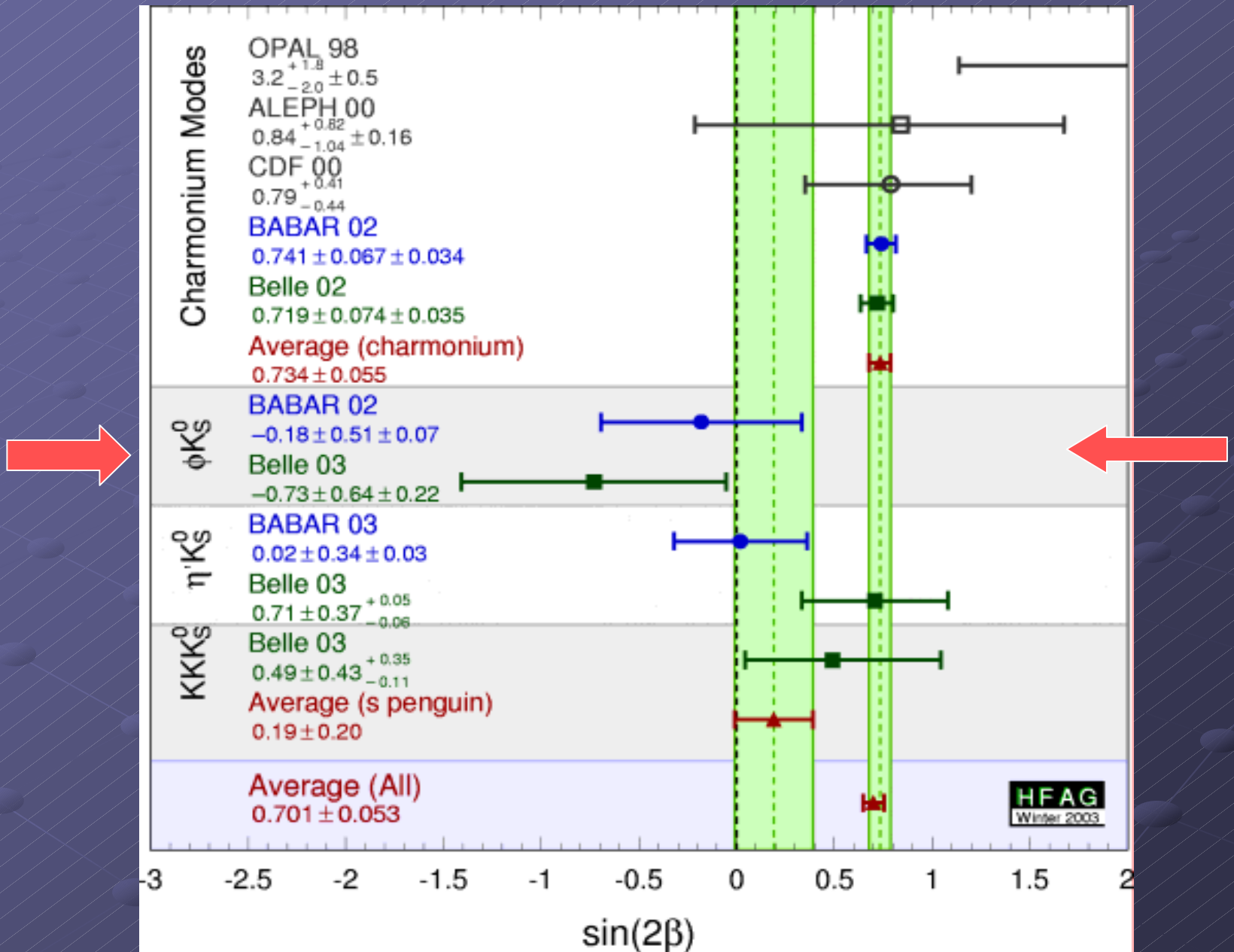


$\sin 2\phi_1$ (Belle 2003,140 fb^{-1}) $=0.733 \pm 0.057 \pm 0.028$

$\sin 2\phi_1$ (BaBar 2002, 81 fb^{-1}) $=0.741 \pm 0.067 \pm 0.033$

$\sin 2\phi_1$ (New 2003 World Av.) $=0.736 \pm 0.049$

2002 Status of new phases in b→s penguins



2002 Status of New Phases in $b \rightarrow s$ Penguins

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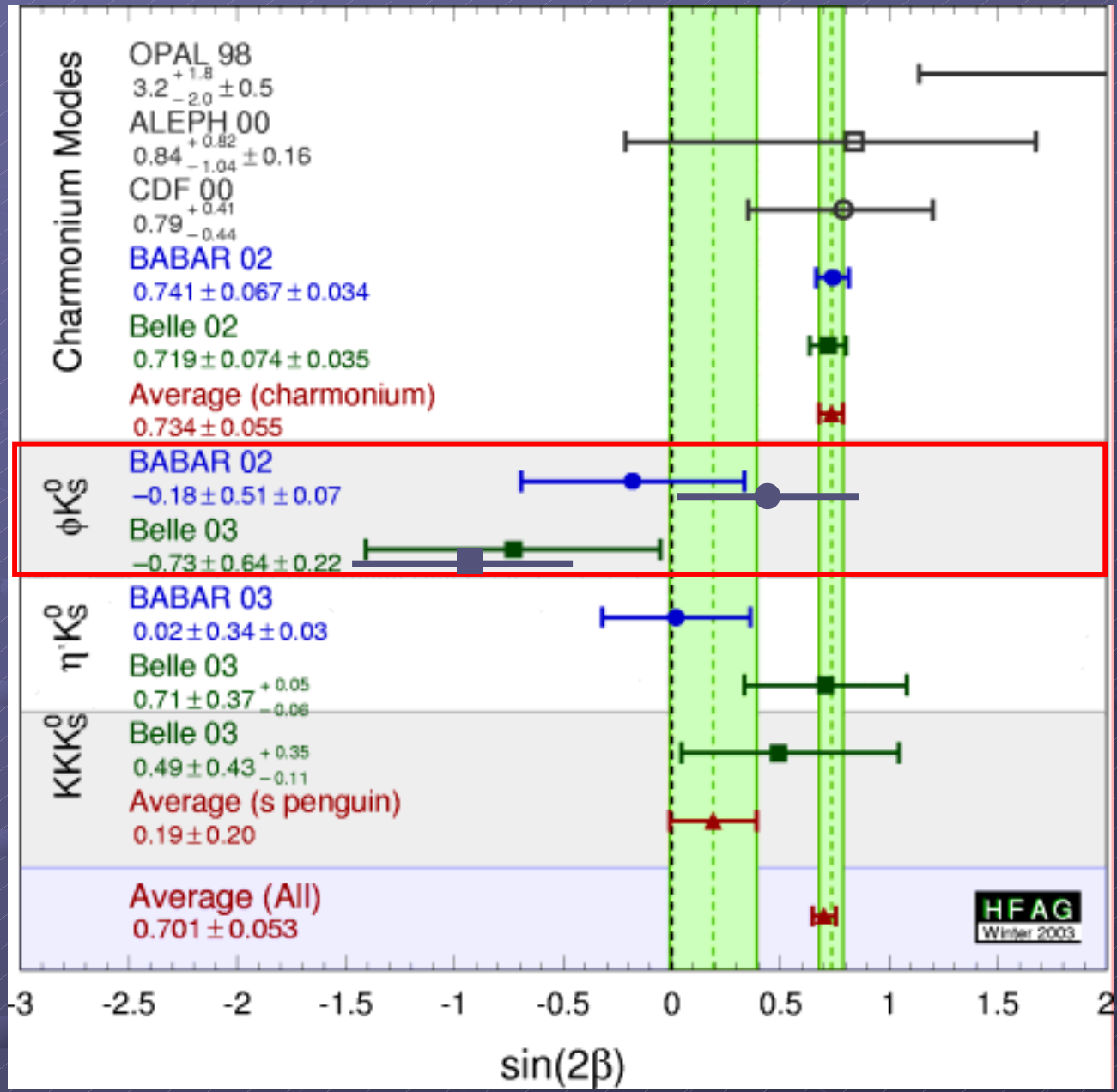
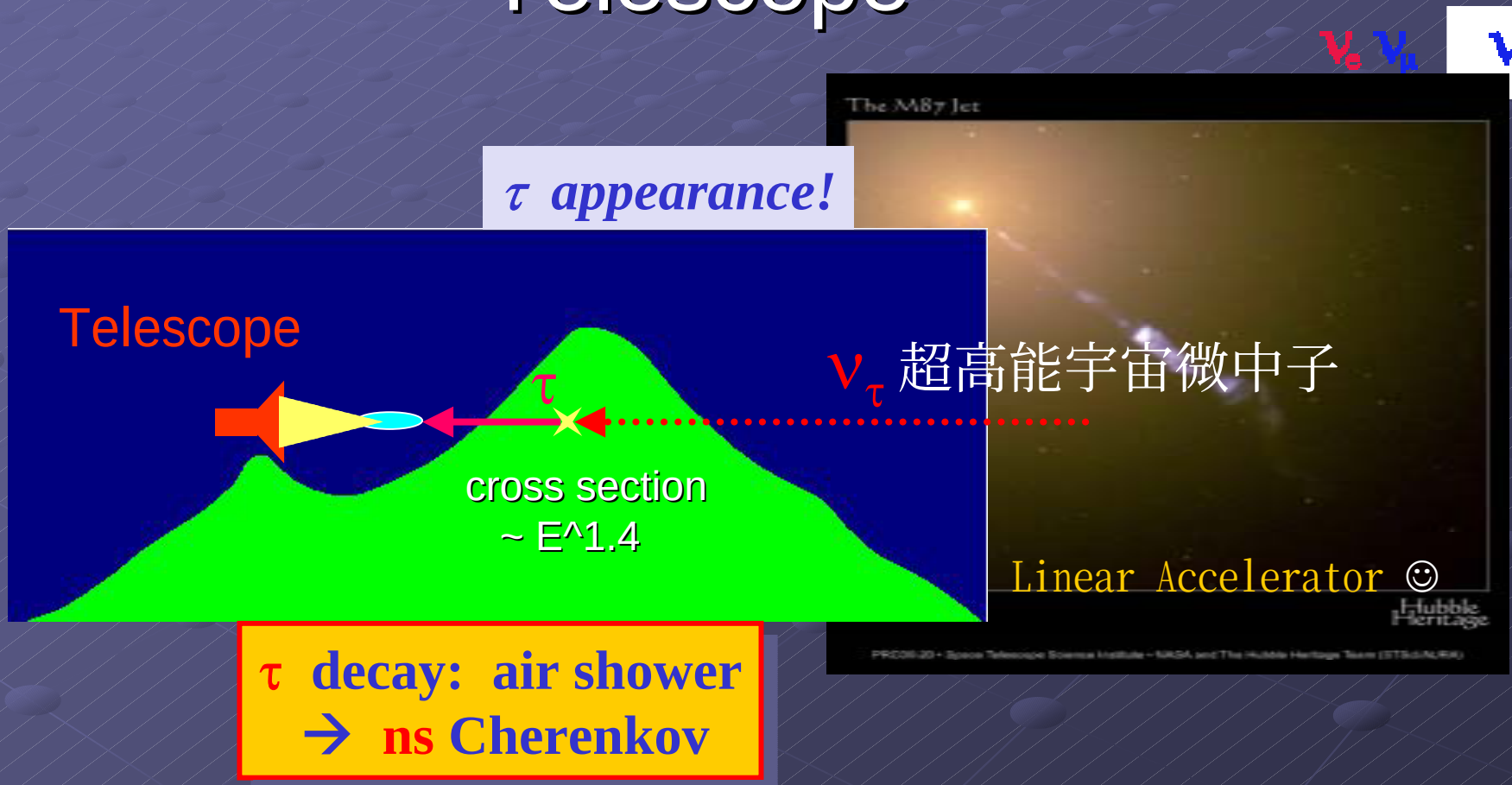


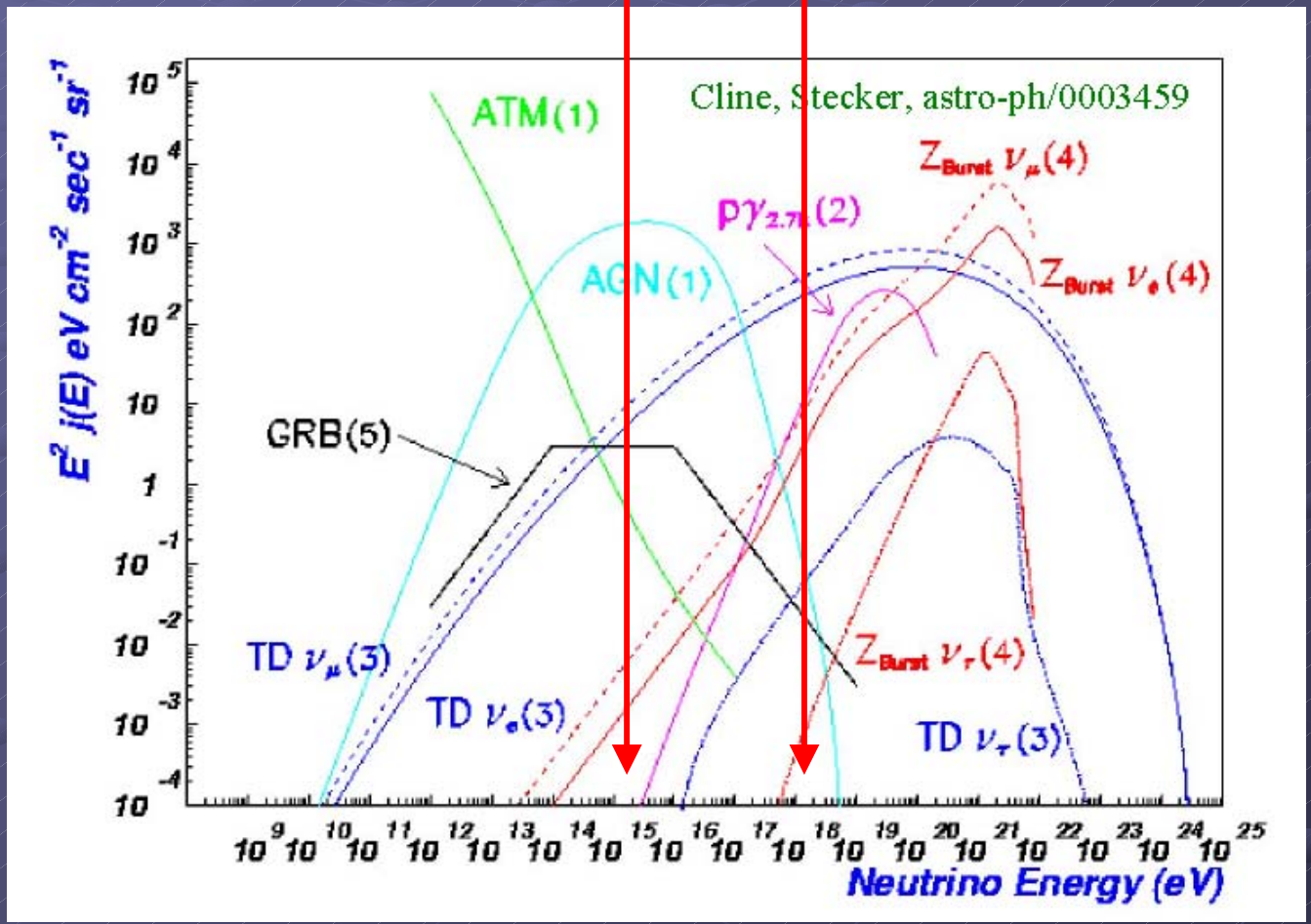
Who Would You Believe ?

Seeing AGN through Mountain
Ultra High Energy Neutrino Telescope



Window of Opportunity

Conventional ν Detector | **?** | **UHECR ν Detector**



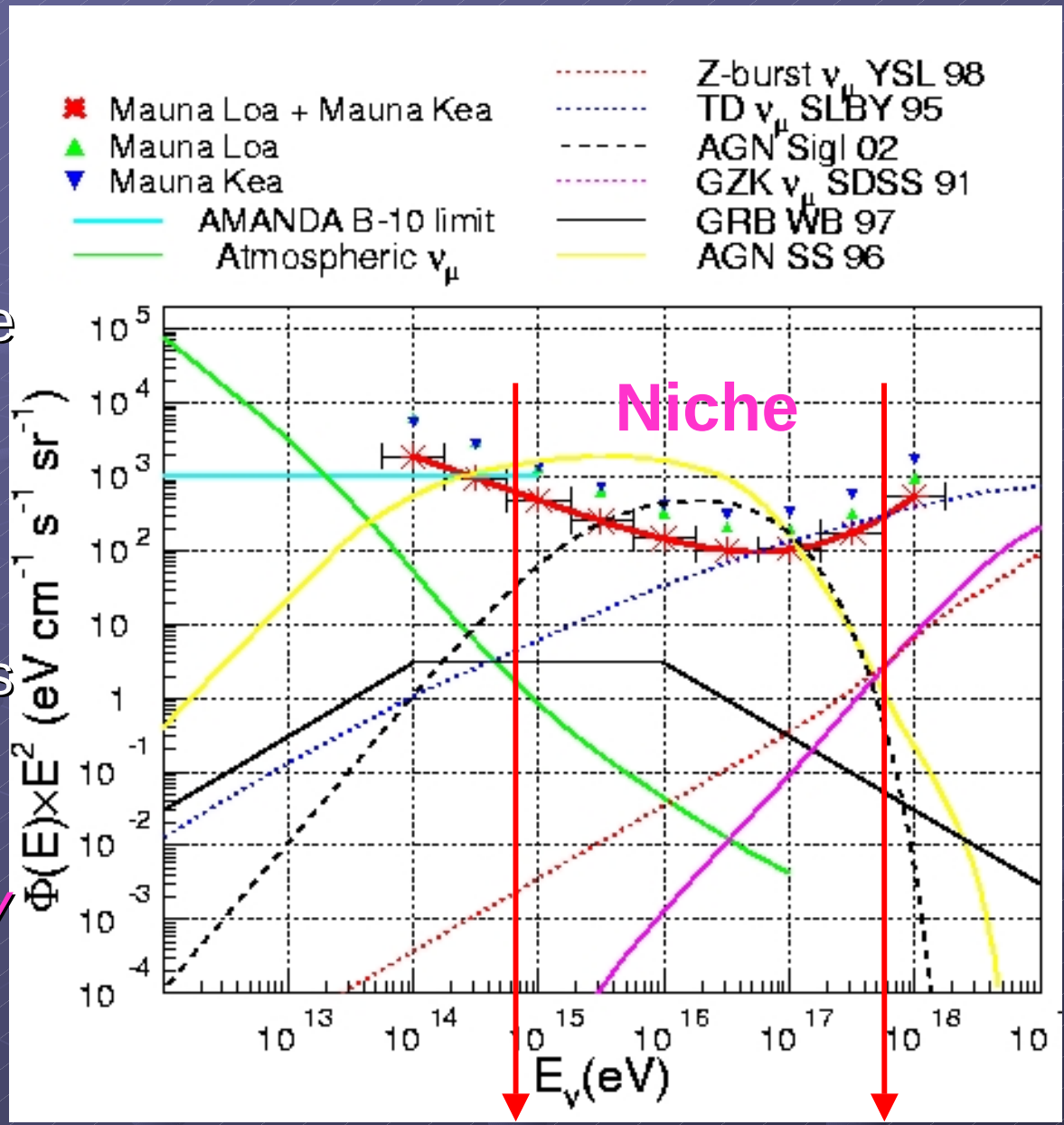
Sensitivity

- **Sensitivity** *defined* as Flux that produce **0.3 evts per year per 1/2 decade of energy**

→

- Explore MPR limits
- Similar limit as AMANDA-B10

  But *Higher Energy*
- What about Nearby Point Source ?



Study by Alfred Huang

Conclusion

- HEP experimental group in NTU started about 10 years ago by joining KEK-Belle
- We now have 4 teaching faculties, 2 research faculties, 2 postdocs, 3 engineers, 7 Ph.D. students, several master and undergrad students
- Experimental projects have also expanded from HEP into Astrophysics with new Institute of AP

- Belle -> Super B
- E391a -> JHF
- CMS
- NuTel -> ASHRA/NuTel -> ASHRA
- GLC?