High Energy Physics at Hawaii

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ASHRA Workshop

January 8, 2004

(Based on presentations to DOE)

UH News in 2003

- **Kirill Melnikov wins OJI**
  - **2nd Hawaii OJI in two years (Peter Gorham was 1st).**
- **Hirotaka Sugawara joined our group**
  - **Dai Ho Chun Chair (but will return to Japan)**
- **1st results from KamLAND**
  - **LMA solution favored**
- **Hint of new physics from Belle**
  - **$\sin 2\phi_1(B \rightarrow \phi K_S) \neq \sin 2\phi_1(B \rightarrow J/\psi K_S)$?**
- **Anita-lite mission launched**

Our strategy is unchanged:

- **Do excellent science**
- **Use 1st-rate facilities**
- **Maximize our impact**

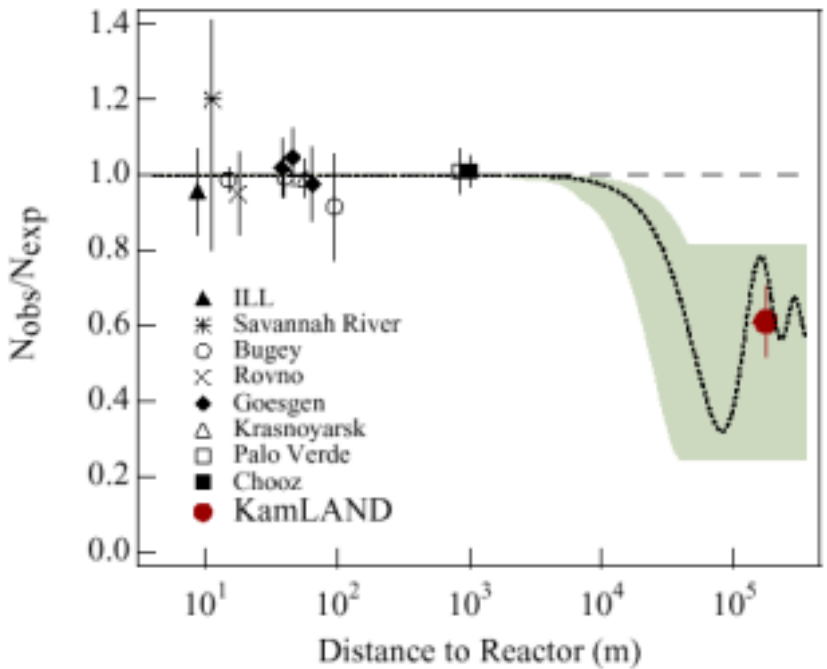
Currently important HEP areas

- Solar neutrino problem
  - KamLAND
- Ultra-high energy cosmic rays
  - GLUE, ANITA, SALSA
- CPV in B-meson system
  - Belle
- ν oscillations/ν mass
  - Super-K / K2K / KamLAND
- Precision tests of SM
  - Higher-order QCD calculations
  - R measurements from BES
- Searches for SUSY
  - Plans for GLC

Hawaii plays an important role in each of these areas

Neutrino oscillations

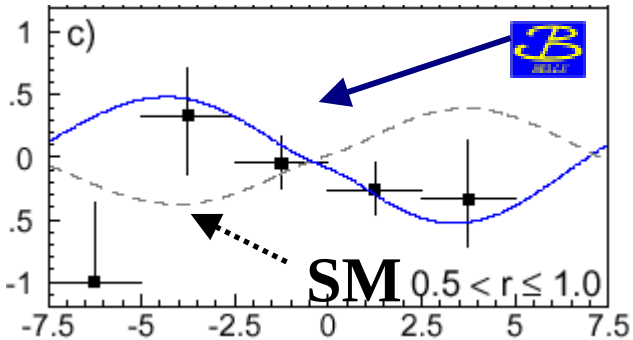
- **KamLAND selects the LMA solution!!!**



(discussed in JGL's talk)

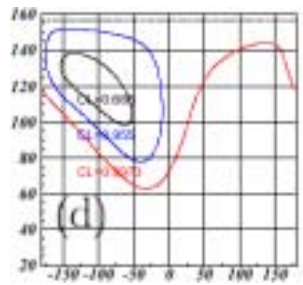
B-meson physics with Belle

- **New physics in B→φ K_S?**
  - **1st reported by Browder @LP03**



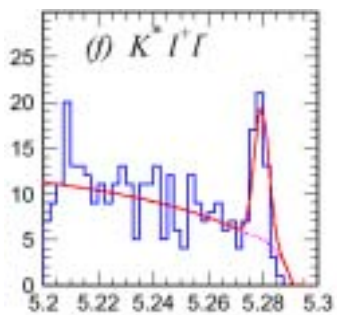
- **ϕ_2 (α) results from in B→$\pi^+\pi^-$**
  - **1st measurements**

ϕ_2

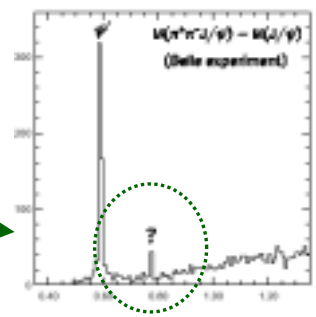


δ

- **EW penguin (K* l^+l^-)**
  - **1st observation**



- **new charmonium-like state discovered**
  - **follow-up to η_c' discovery in 2002**



Other Belle highlights: 2002-03

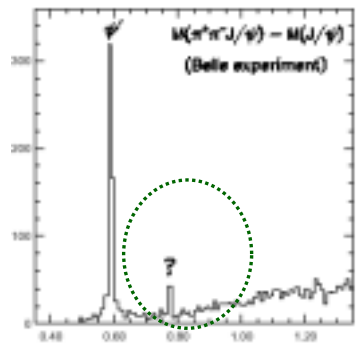
- 1st measurement of ϕ_3 ($B \rightarrow KD^0$ Dalitz plot)
- Measurement of Br($B \rightarrow \pi^0\pi^0$)
- 1st radiative charm decay $D \rightarrow \phi\gamma$
- Observation of DsJ in B Decays……..

Belle has submitted/published 79 papers (39 since August 2002)

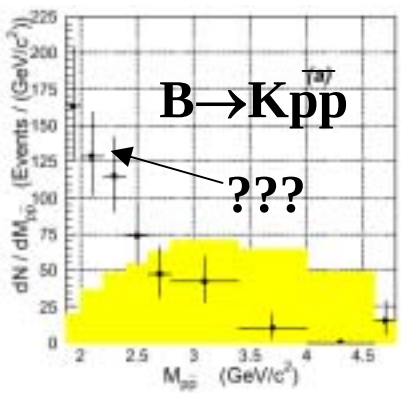
Dec 21-30, 2003 issue of Phys Rev Letters (5 Belle papers)

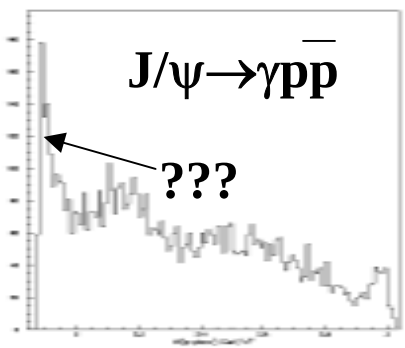
New particles in Belle & BES

- New state in $B \rightarrow K\, \pi^+\pi^- J/\psi$
  - $M_{\pi\pi J/\psi} = 3872$ MeV $(= M_D + M_{D^*})$
  - inconsistent with a $c\bar{c}$ state



- Low mass $p\bar{p}$ enhancement in
  - $J/\psi \rightarrow \gamma\, \bar{p}p$ (BES)
  - $B \rightarrow p\bar{p}\, h$ (Belle)





Papers primarily from Hawaii group

- **New charmonium-like state**
  - **(hep-ex/0309032) S.-K. Choi, S.L. Olsen et al.,(accepted by PRL)**
- **$B \rightarrow D_{CP} K$**
  - **(hep-ex/0304032) S.K. Swain, T.E. Browder et al., (accepted by PRD)**
- **$B \leftrightarrow B$ mixing with $B \rightarrow D^* \pi$ (partial recon)**
  - **PRD 67 092004 (2003) Y.H. Zheng, T.E. Browder et al.,**
- **$B \rightarrow \eta_c K^*$ 1st observation**
  - **PRL 90, 071801 (2003) F. Fang, et al.,**
- **$B \rightarrow hh$**
  - **PRD 66, 092002 (2002) B.C.K. Casey, et al.,**
- **η_c' discovery**
  - **PRL 89, 102001 (2002) S.-K. Choi, S.L. Olsen, et al.,**
- **$B \rightarrow ppK$ 1st observation (PRL --- F. Fang)**
- **A_{CP} for $B \rightarrow h^+h^-$ (PRD --- B. Casey)**
- **$B- \rightarrow K_1(1270)$ J/ψ (PRL --- S.-K. Choi, S.L. Olsen))**

Hawaii service in Belle

- **TOF system** (essential for all CPV studies)
  - Calibration: Mike Jones
  - Reconstruction: Mike Peters
- **Tracking** (essential to all analyses)
  - Kalman filter (fitting): Karim Trabelsi
  - $K_S \rightarrow \pi+\pi-$ selection: Fang Fang
- **Trigger**
  - Level 0: Hulya Guler
  - Level 1.5 (SVD-CDC matching): Kirika Uchida
- **Background simulations** (for SVD upgrade)
  - Spent particles: Karim Trabelsi
  - Synchrotron radiation: Sanjay Swain
- **MC**
  - generator tuning: Rolf Seuster
  - Event generation: Eric Dodson

Hawaii service in Belle (cont'd)

- **Utilities**
  - Run-by-run CM energy calibration: Sanjay Swain
  - N(BB) determination: Sanjay Swain
  - General event selection criteria: Brendan Casey
- **SVD upgrade**
  - Electronics: Gary Varner
  - Opto-Mechanical: Marc Rosen
  - Software: Karim Trabelsi & Kirika Uchida
- **Upgrades**
  - DAQ: Gary Varner & Yang Heng Zheng
  - Pixels: Fang Fang
- **Administrative**
  - Analysis coordinator: Tom Browder
  - Co-spokesperson: S. Olsen

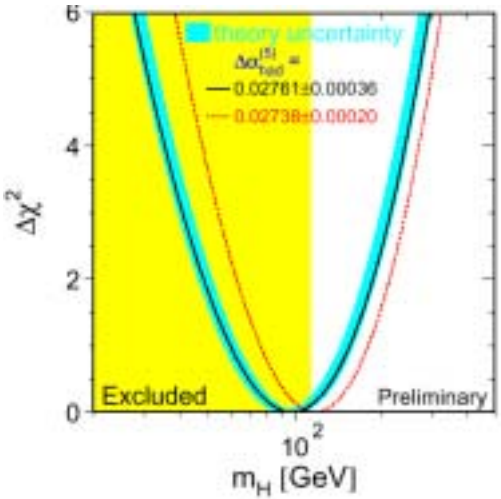
Other analyses underway

- **CPV in $B \rightarrow D^{*}\rho$ (Trabelsi & Peters)**
- **CPV in $B \rightarrow \eta_c K_S$ (Fang)**
- **CPV in $B \rightarrow D_{CP}K$ (Swain, Kent)**
- **Charm fragmentation (Seuster)**
- **$B \rightarrow K\pi\pi$ J/ψ & $B \rightarrow K\pi\pi\psi'$ (Guler)**
- **Search for $^1h_{c1}$ (i.e. $^1P_{c1}$ cc state) (Fang)**
- **$B \rightarrow \eta'(980)X_S$ (Uchida)**
- **New particle searches (Olsen)**
- **…**

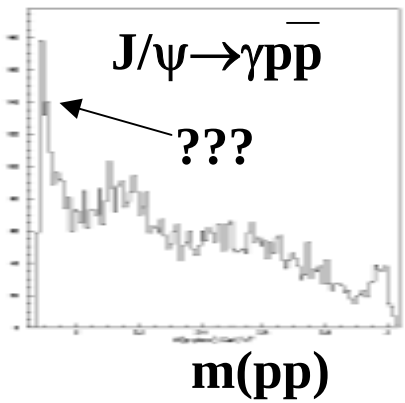
R-scan and J/ψ & ψ' physics (BES)

(Prof F. Harris,Dr Z.J Guo, Prof S.L. Olsen, Dr G. Varner)

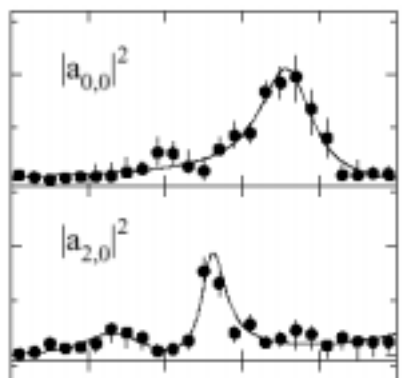
- **Completed R-scan analysis**
  - **M_{Higgs}up by ≈50%**



- **baryonium state?**
  - **PRL 91 022001 (2003)**

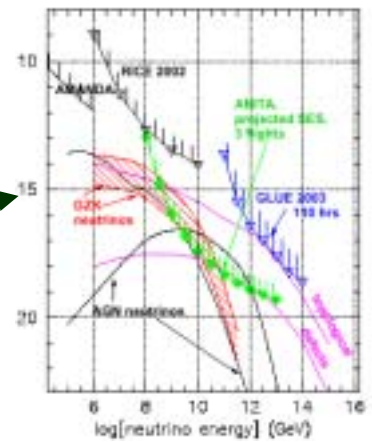


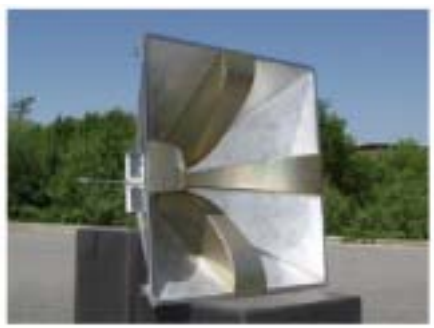
- **J^{PC} of the f(1710)**
  - **it's 0^{++} hep-ex/0307058 (accepted by PRD)**



New directions for HEP

- **Radio detection of UHE cosmic ν's**
  - **Askaryan effect verified over 4 orders of magnitude**
  - **New limits on diffuse UHE cosmic ν's**
  - **ANITA lite launched in 2003**

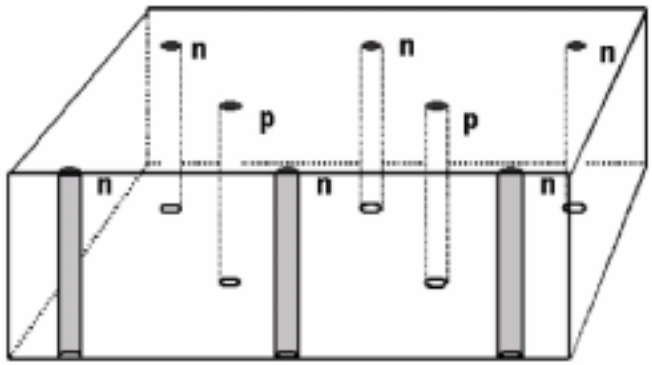




(discussed in JGL's talk)

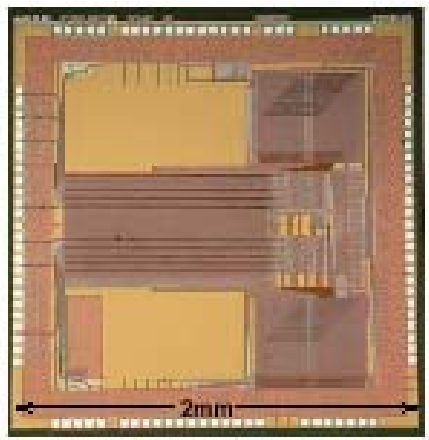
New types of detectors/electronics

- **3-dim pixel detectors for LHC/NLC**



- **DAQ electronics for ANITA & Belle**

STRAW Chip for RF antenna Array readout



(G. Varner et al.)

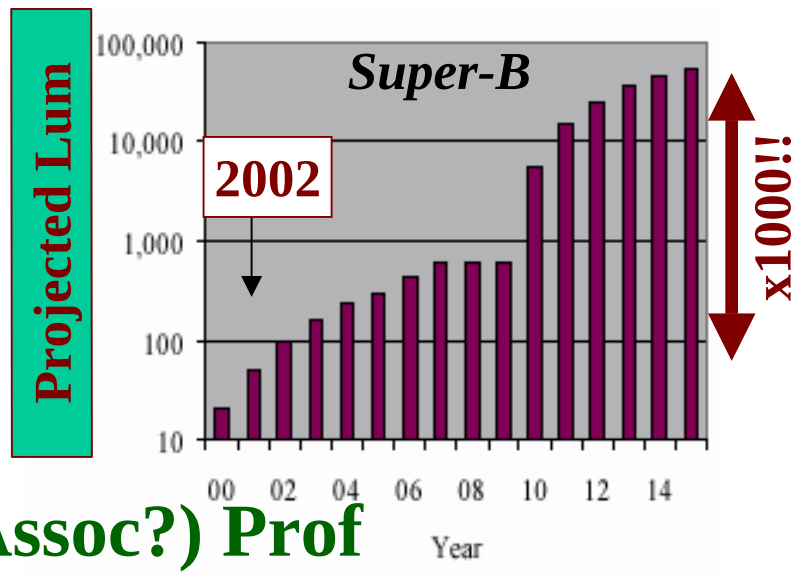
Impact

- **GLUE/ FORTE /ANITA / SalSa / …**
  - **initiator / spokesperson: Gorham**
- **Belle**
  - **co-spokesperson: Olsen analysis coord: Browder**
  - **~largest non-KEK group in Belle**
  - **~10 of Belle's 1st 70 papers were ~100% Hawaii efforts (plus many Hawaii contributions to the others)**
- **BES**
  - **cospokesperson: Harris R-scan PhD stdnt: Kong**
- **Super-K / KamLAND**
  - **council: Learned / upmu leader: Matsuno**
  - **KamLAND calibration: Gorham / Gullian**

Further future

- **Gorham is launching a new field of UHE CR detection**

- **Browder is a leader in the quest for Super B-factories (workshop Jan 19-22)**
- **Harris is co-leader of the BESIII/BEPC initiative**



- **We hope to recruit an Asst (Assoc?) Prof**

Faculty/Staff

- **State supported: (11 faculty)**
  - **Learned, Matsuno, Peters, Sugawara (full 11 month salaries)**
  - **Browder, Gorham, Harris, Melnikov, Olsen, Tata, Pakvasa**
- **DOE supported: (2 faculty)**
  - **Jones & Parker**
- **Research Associates (9; 6 DOE-supported)**
  - **Ferrandis, Guillian, Guo, Herbert, Lehtinen, Link, Mitov, Seuster, Trabelsi**
- **Graduate students (10)**
- **Technical Support (~2.5 FTE's)**
  - **Ibaraki, Rosen, Varner**

University support

- faculty salaries
  - Learned, Matsuno,Peters& Sugawara 100%
- reduced teaching loads
  - 0 for Matsuno, ~50% for Olsen
- high-quality lab space
- start-up funds
- off-campus overhead
  - 0% overhead for postdocs
- department machine shop
  - 2 full-time machinists
- ~ 50% of our computing system

Saltstack CR expt

Fishnet PC farm

Summary

- **Fore-front scientific program**
  - **Solar-ν; ν-oscil/ν-mass; CPV; SM tests; UHE cosmics; new particles**
- **Talented & productive team**
  - **Responsible for important papers/analyses**
- **High impact**
  - **Responsible for major initiatives; leaders in our collaborations**
- **Innovative**
  - **3-dim pixels; radio detection of UHE showers; …**
- **Well supported by the University**
  - **Salary support + equipment + reasonable overhead rates**
- **Promising future**
  - **Browder, Gorham & Melnikov are emerging HEP leaders**