NuTel History

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National Taiwan University

ASHRA-1 Workshop
1/8, 2004 @ U. Hawaii

表五-1. 計畫預期進度表(總計畫及分

1.本表作為進度控制及檢討之依據。

2.工作項目：請視計畫性質及需要自行訂定。預定進度以季為單位並以 Bar Chart 標示。

My worry since early 2001 ...

CosPA-2 Items

序號	工作項目	第一年 (88年 7月) 2000				第二年 (89年 7月) 2001				第三年 (90年 7月) 2002				第四年 (91年 7月) 2003				備註
		第一季	第二季	第三季	第四季	第一季	第二季	第三季	第四季	第一季	第二季	第三季	第四季	第一季	第二季	第三季	第四季	
SVD2	參與 SVD1.1 系統組裝測試	■																
SVD2	[redacted]				■		■											
SVD2	軟性印刷電路板設計、生產、組裝、測試		■	■	■	■	■	■	■									
SVD2	建立 SVD 位置校正及衰變點重建之軟體	■	■	■	■													
SVD2	設計生產測試 SVD 前端電子線路板		■	■	■	■	■	■	■									
SVD2	[redacted]前端矽微條探測器之設計製作組裝測試	■	■	■	■	■	■	■	■									
BPC	JLC BPC 物理功用性評估	■	■	■	■													
BPC	BPC 材料選擇及其配合系統評估				■	■	■	■										
BPC	設計製作 BPC 之前端電子線路及後端讀出系統						■	■	■	■	■	■	■	■	■	■	■	
BPC	BPC 原型製作，打靶測試，及提出技術設計報告											■	■	■	■	■	■	
BPC	BPC 觸發系統及監測系統研發														■	■	■	
CDM	尋找 CDM 之物理研析	■	■	■	■													
CDM	架設 CsI 探測器之地點選取	■	■	■	■													
CDM	低噪訊前端電子電路研發	■	■	■	■	■	■											
CDM	CsI 原型探測器之設計、組裝測試	■	■	■	■	■	■											
CDM	完成 CDM 之可行性評估							■	■									

Finished

Closed

?

Change Approved 5/2002
MOE Mid-Course Review

表五-1

1.本表作

2.工作項目：請視計畫

分項計畫名稱 / 工作項目 \ 季次	第一年 (88年 7月) 2000				第二年 (89年 7月) 2001				第三年 (90年 7月) 2002				第四年 (91年 7月) 2003				備註
	第一季	第二季	第三季	第四季	第一季	第二季	第三季	第四季	第一季	第二季	第三季	第四季	第一季	第二季	第三季	第四季	
SVD2 參與 SVD1.1 系統組裝測試	■																
SVD2 [redacted]				■		■											
SVD2 軟性印刷電路板設計、生產、組裝、測試		■	■	■	■	■	■	■									
SVD2 建立 SVD 位置校正及衰變點重建之軟體	■	■	■	■													
SVD2 設計生產測試 SVD 前端電子線路板		■	■	■	■	■	■	■									
SVD2 [redacted]前端矽微條探測器之設計製作組裝測試	■	■	■	■	■	■	■	■									
NuTel BPC JLC BPC 物理功用性評估	■	■	■	■													
NuTel BPC BPC 材料選擇及其配合系統評估				■	■	■	■										
NuTel BPC 設計製作 BPC 之前端電子線路及後端讀出系統						■	■	■	■	■	■	■	■	■	■	■	
NuTel BPC BPC 原型製作，打靶測試，及提出技術設計報告											■	■	■	■	■	■	
NuTel BPC BPC 觸發系統及監測系統研發														■	■	■	
CDM 尋找 CDM 之物理研析	■	■	■	■													
CDM 架設 CsI 探測器之地點選取	■	■	■	■													
CDM 低噪訊前端電子電路研發	■	■	■	■	■	■											
CDM CsI 原型探測器之設計、組裝測試	■	■	■	■	■	■											
CDM 完成 CDM 之可行性評估							■	■									

Finished

Closed

VHE Neutrino Telescope

I. Backdrop:

CosPA-2 Project Evolution

Mid-course Review: Particle → Particle Astrophysics

Recall **Big Picture** of **CosPA-2** Objectives:

1. **To Gain** Strength in Mainstream HEP
   - Belle SVD2: **Flex/TTM** ⟸ **On Track & Winding Down**
   - JLC: Build **BPC Prototype** ⟸ **Too Early** ⇝ [CMS Instead]
2. **To Venture** into Genuine **Particle Astrophysics**
   - Feasibility Study: **CDM R&D** ⟸ **Successful but Closed**

▷ Original Focus for 4/2002 – 3/2004: **BPC Prototype** for JLC
— No Longer Plausible because of Delayed JLC Schedule —

▷ Not Plausible to Switch to or Continue on **CDM Search** w/ CsI Crystals
— Because { KIMS Would Dominate [in Site, $, and Manpower]
Improbability of Success [Against CDMS, DAMA, CRESST . . .]

Soul Searching since *before Summer 2001* . . . . . .

1. **Mainstream HEP:** Strength Attained! ✓
   ▷ Taiwan-Belle Well Established 2001; Further Strengthened by **CosPA-2**
   ▷ Course Well Set: Belle ⟹ CMS (2007–) [⟹ JLC (2010?–)]
2. **Genuine Particle Astrophysics** ⇝ **Time to Enter**

Use CosPA-2 to Move Into PA! **But How?**

What I learned 8/2001

▸ Vannucci Visit to NTU

- Earth Center Opaque for E > 10^{14} eV ν *!?*
- Mountain-Valley ν_τ Detection Concept

I asked whether he already had funding …

after - checking literature (e.g. Fargion)

- passing thru PIs

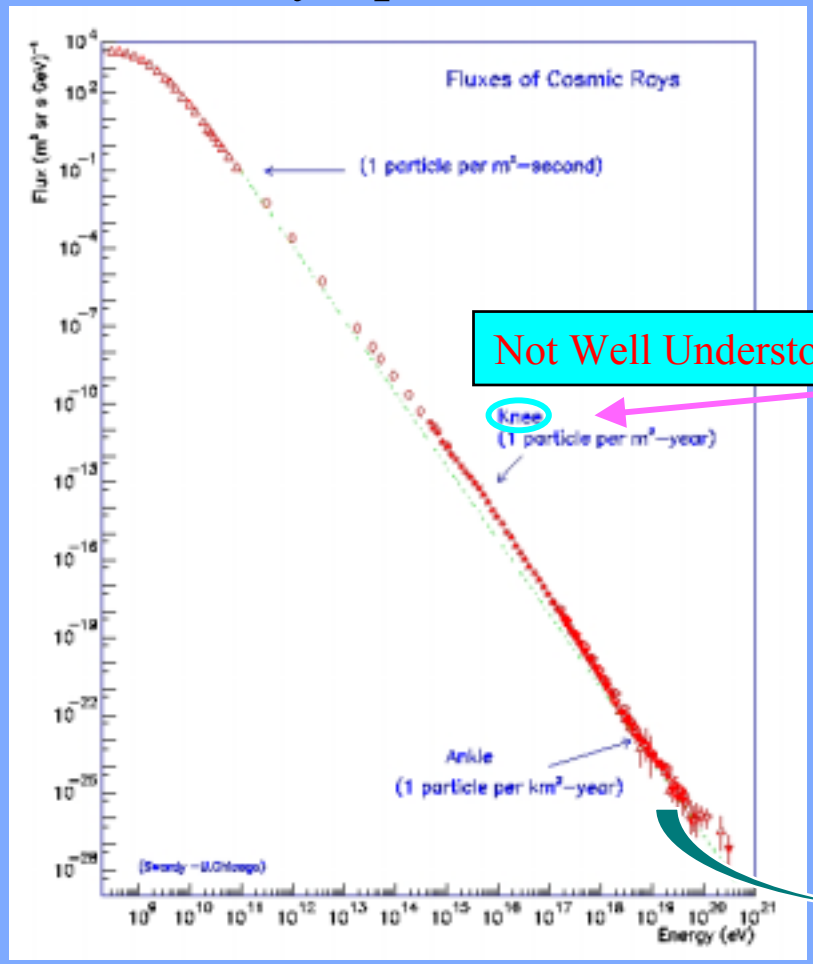
I hired Alfred Huang in Fall (start simulations)

(had to convince him ...)

Hawaii Site also came out from Vannucci visit …

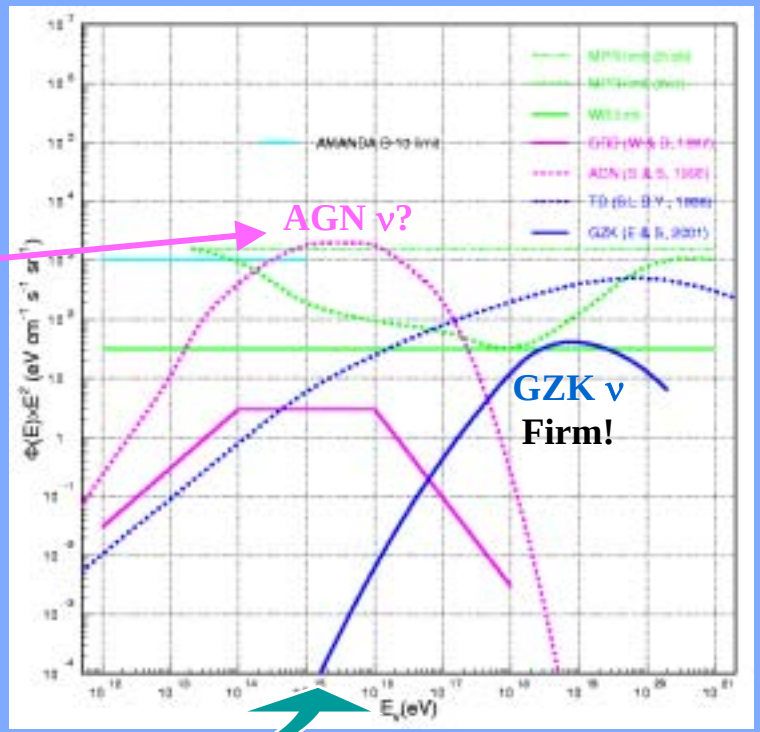
Cosmic/Astro Neutrinos

Cosmic Ray Spectrum



$CR + X \rightarrow \pi^{\pm} \rightarrow e^{\pm} + 2\nu_{\mu} + \nu_{e}$

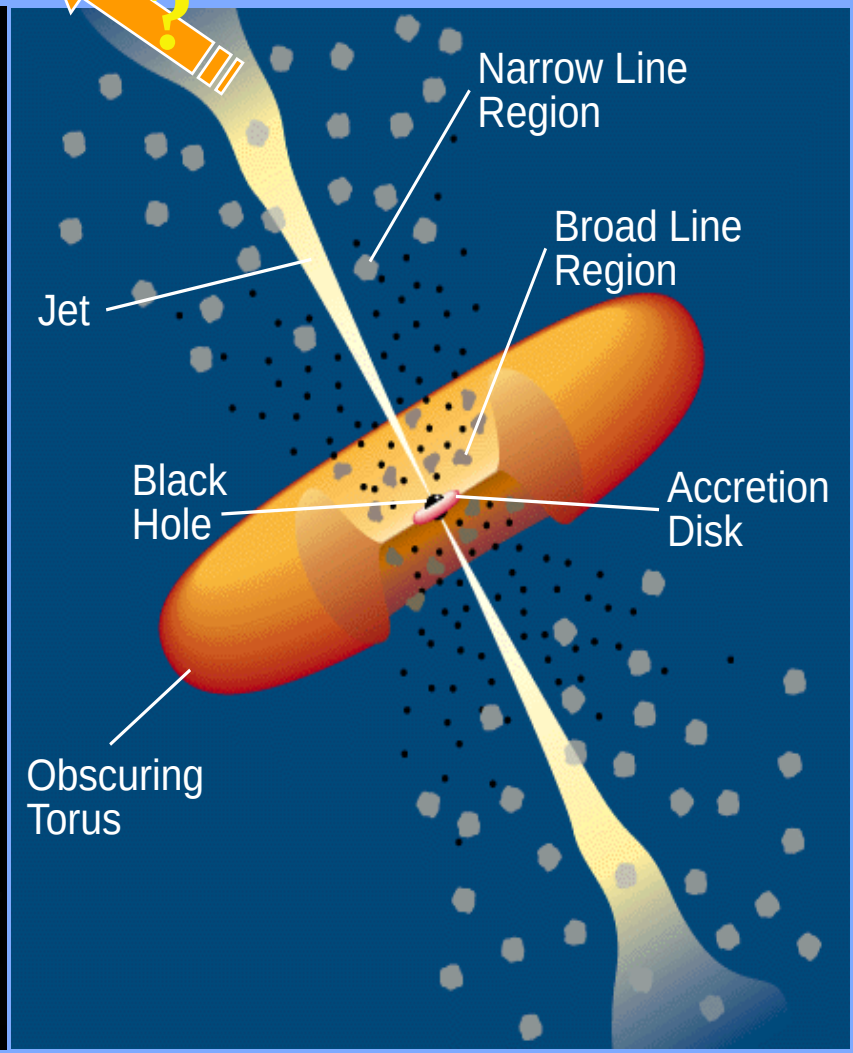
Not Well Understood



$UHECR + \gamma_{CMB} \rightarrow N + \pi \rightarrow GZK\ \nu$

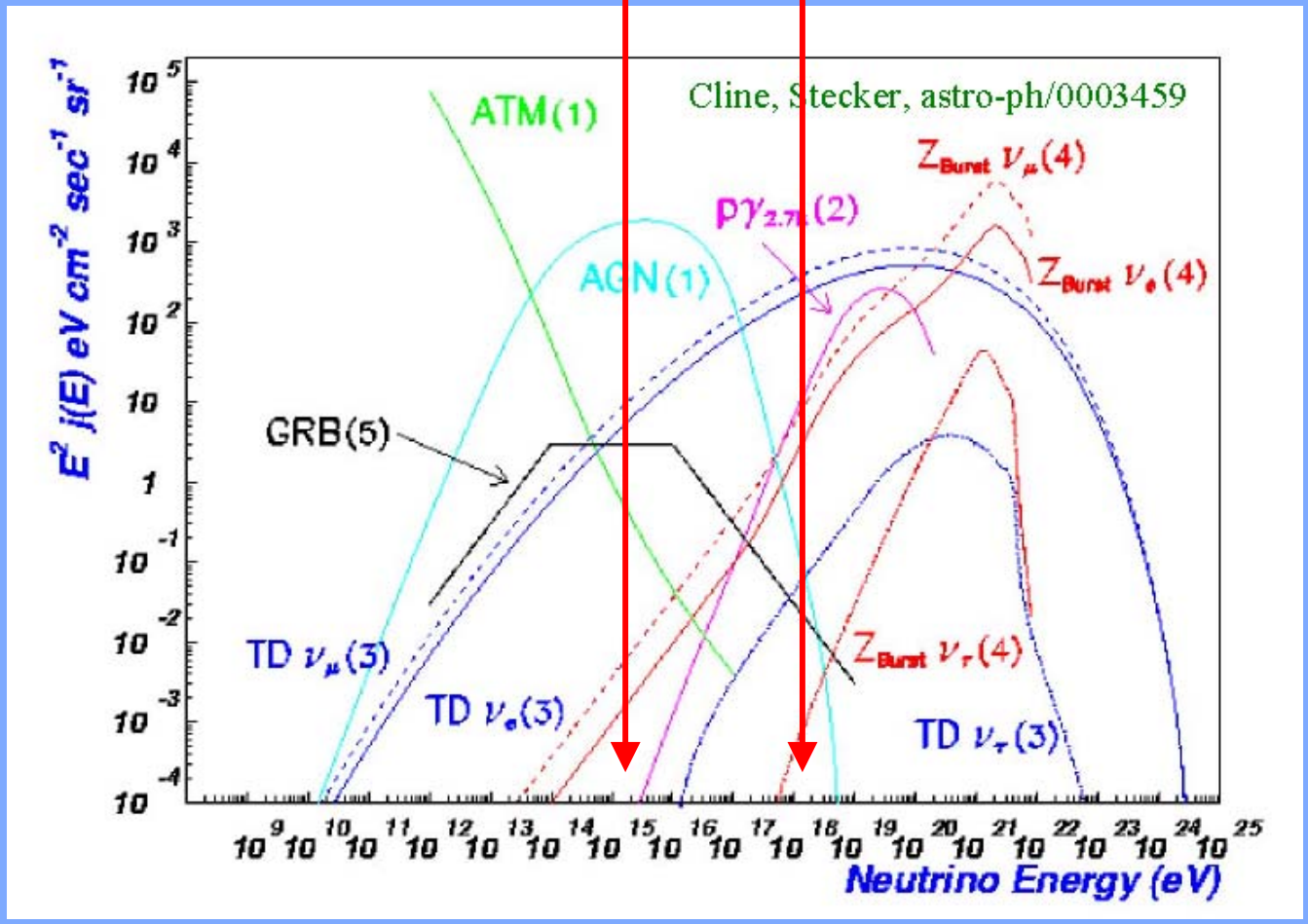
Protons?

AGN Jets, CRs and $\nu_\mu \rightarrow \nu_\tau$?

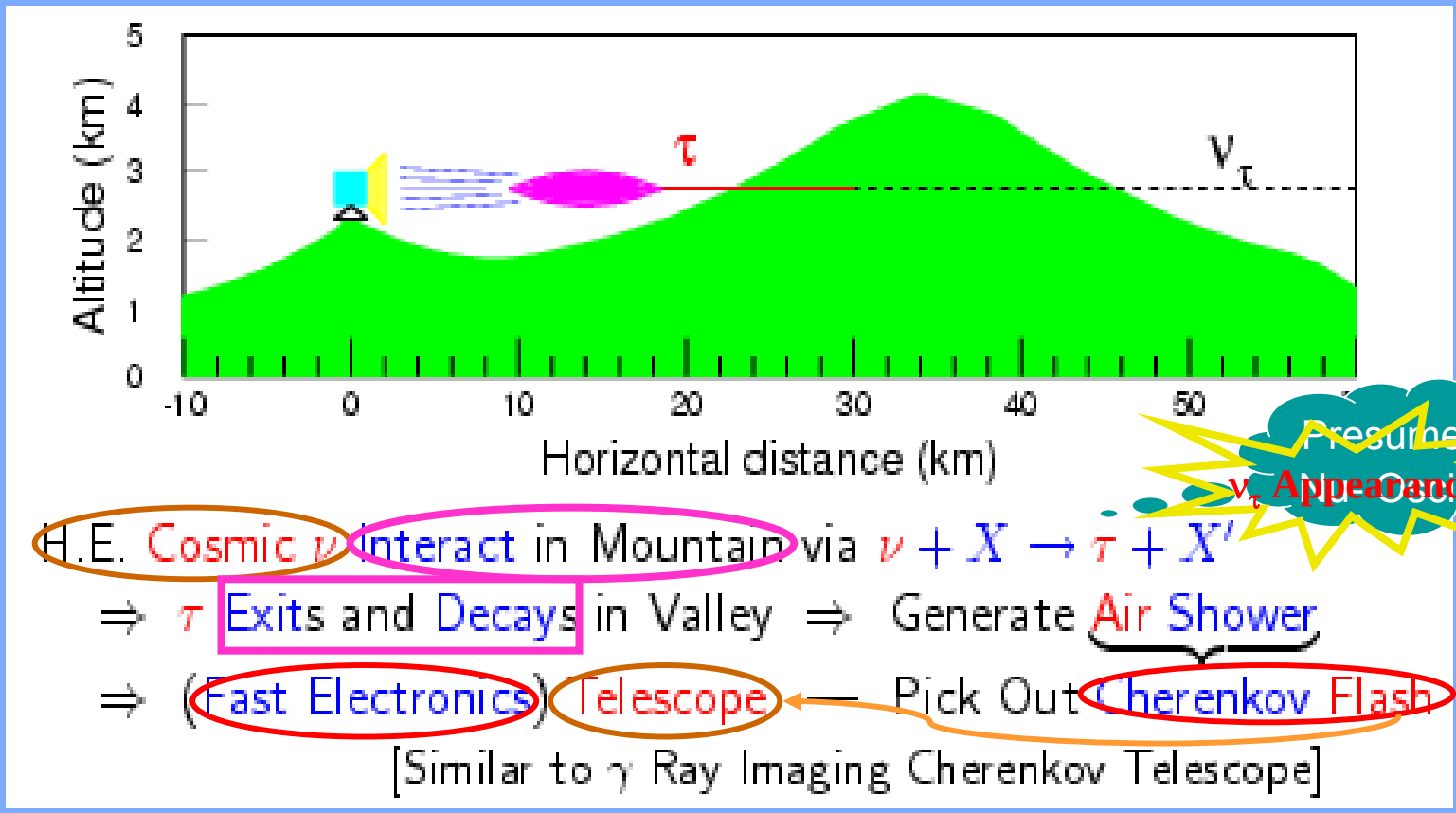


Window of Opportunity

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



Alternative, or Niche: Mountain/Valley ν-*Tel*



N.B. e —— Shower in Mountain

μ —— Pass thru Valley with Little Interaction

Hawaii Big Island as Site: happened as *gotcha*

- Courtesy visit to CosPA-1 (Fred Lo)
  - Stood in front of Hawaii map
  - ***Snap***: Big Mountains w/ 40 km sep.
  - Hawaii is known good Astro Site
- Mt. Hualalai: M. Alfred Huang

  Good view of Mauna Loa

  Situated at dryer west side

  Mauna Loa provide long base line

  ~ 90 km wide and 4 km high

NuTel Milestones

- Summer 2001: Pick up idea through Vannucci visit;
  prelim. check & eye on Hawaii Big Island
- 12/2001 NCTS Workshop on Astroparticle Physics, Kenting, Taiwan
  - Concept & Early Feasibility Study Presented *(F. Halzen was there)*
- 3/2002 1st VHE Neutrino Telescope Workshop, **Taipei**
  - 4 Institutions show intention to join

- 8/2002 2nd VHENTW, **Hawaii**
  - Cerenkov vs. Fluorescence; Visit Mt. Hualalai
- 1/2003 3rd VHENTW, **Palermo**
  - Decide on Cerenkov and Discuss detector configuration

International Workshops — Towards Collaboration

Very High Energy Neutrino Telescope Workshop

Palermo	O. Catalano ◀
Hawaii	J. Learned ◀

The Se… …Workshop

International Organizing Committee

Orvaldo Catalano (Palermo, Italy)
Pisin Chen (SLAC, USA)
Giancarlo Cusumano (Palermo, Italy)
Masaki Fukushima (ICRR, Japan)
Francis Halzen (Wisconsin, USA)
Paschy W.Y. Hwang (NTU, Taiwan)
John G. Learned (Hawaii, USA)
Kwok-Yung Lo (ASIAA, Taiwan)
Luciano Moscoso (Saclay, France)
Pierre Sokolsky (Utah, USA)
Francois Vannucci (Paris, France)
Alan A. Watson (Leeds, UK)

Local Organizing Committee

Kingman Cheung (NCTS)
Wei-Shu Hou (Chair, NTU)
Mingshiang Huang (Scientific Secretary, NTU)
Guey-Lin Lin (Co-chair, NCTU)
Koji Ueno (NTU)

Sponsored by CosPA Project, National Taiwan University
and co-sponsored by the National Center for Theoretical Science.

http://hep1.phys.ntu.edu.tw/VHENTW/

Hualalai Site Visit

Top of Mt. Hualalai
(altitude 2.5km)

Panoramic view
on Hualalai

pre-Prototype Telescope

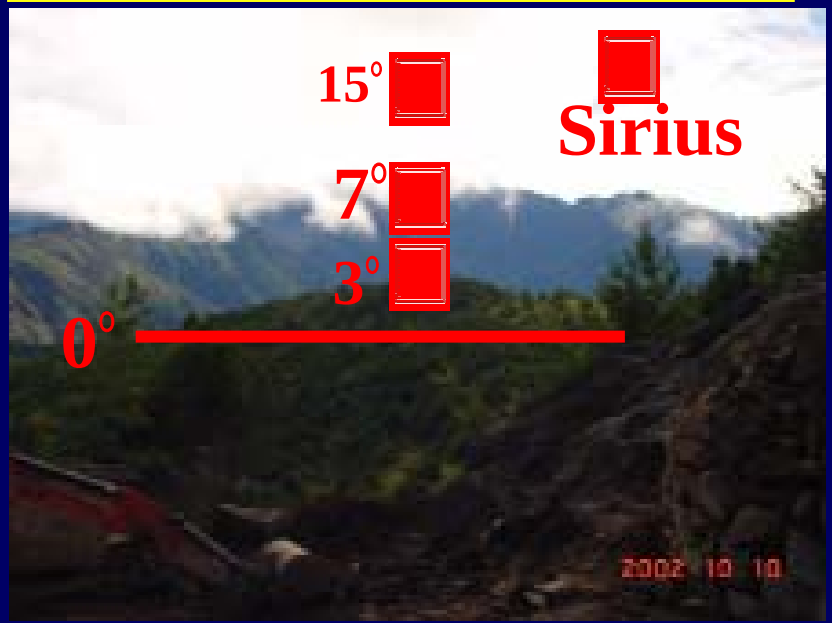
- Purpose:
  - Proof of Concept
  - Measure Background
- Telescope
  - Commercial Fresnel Lens
    (NTK-F300, f30cm, size=30cm,
    pitch=0.5mm, PMMA UV),
  - UV Filter (BG3)
  - Hamamatsu 4x4 (H6568) MAPMT
  - Readout Electronics: Preamp, Receiver, Trigger, ADC and DAQ

Built within a few months

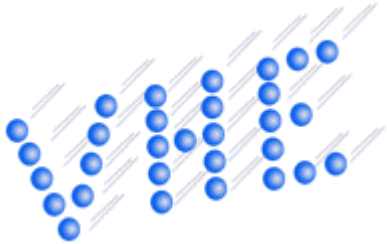
Field Test at Lulin Observatory (2900m)

10/10/2002

3 elevation angles: 3°, 7°, 15°
2 conditions: w/o BG3 filter



玉山
(Jade Mt.)
E



The *Third*
Very High Energy Neutrino Telescope Workshop

Organizing Commitees
Scientific Programme
General information

Palermo **(Sicily)**
9-10 January 2003

International Organizing Committee (IOC)

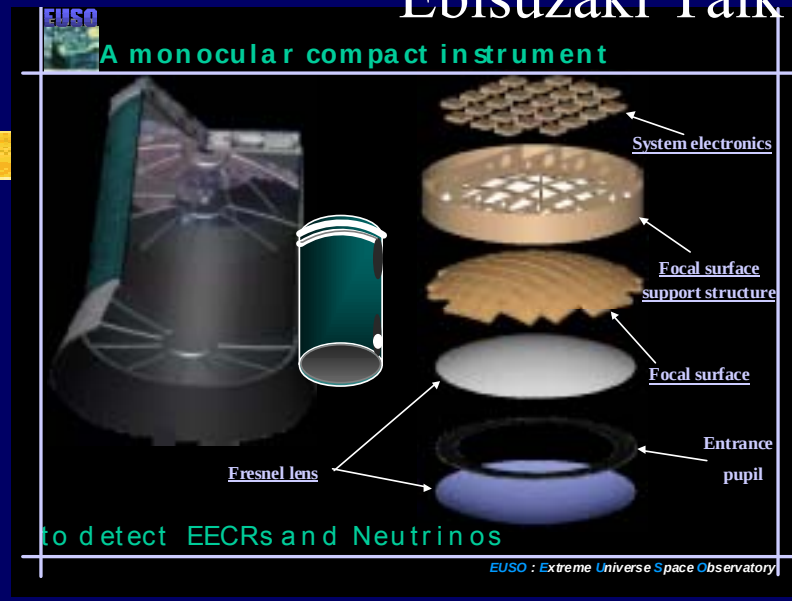
Francois Vannucci (Paris, France)
Guey-Lin Lin (Taipei, Taiwan)
Minghuey A. Huang (Taipei, Taiwan)
John G. Learned (**Hawaii**, USA)
Osvaldo Catalano (**Palermo**, Italy)
Yee Bob Hsiung (Taipei, Taiwan)
Bruno Sacco (Palermo, Italy)
Giancarlo Cusumano (Palermo, Italy)
Teresa Mineo (Palermo, Italy)
Nino La Barbera (Palermo, Italy)
Wei-Shu Hou (**Taipei**, Taiwan)
Said Bouaissi (Paris, France)
Francois Vannucci (**Paris**, France)

Local Organizing Committee
(IASF, CNR, Palermo, Italy)

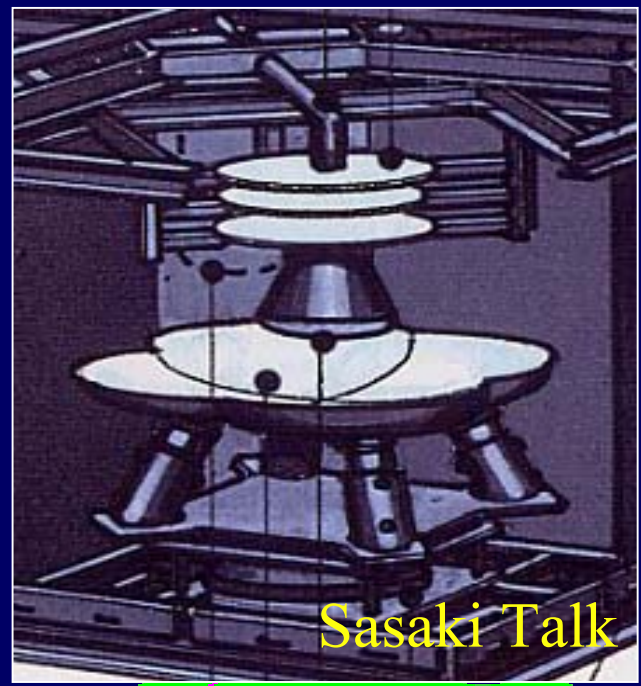
Giancarlo CUSUMANO
Fabio D'ANNA
Antonino LA BARBERA
Teresa MINEO

Optical System

Ebisuzaki Talk



- MAPMT (8×8) Array in Focal Plane
- Technical Difficulty:
  - Odd Shape FOV 12°×120°
    Difficult to Cover by Single Mirror/Lens
  - F Value!
- Options:
  - EUSO : 60° Fresnel Lens
    [40 cm Prototype]
  - ASHRA: 50° Modified Baker-Nunn
    Full Prototype Under Constructuon



Sasaki Talk

NuTel **Collaboration**

- Italy: IASF, CNR, Palermo
  - *N. La Barbera, O. Catalano, G. Cusumano, T. Mineo, B. Sacco*
- France: Paris, France
  F. Vannucci, S. Bouaissi
- USA: Hawaii
  J.G. Learned
- Japan: ICRR
  M. Sasaki [Fall 2003]
- Taiwan:
  - **NCTS/CosPA3**
  - *G.L. Lin, H. Athar, …*

NTUHEP/CosPA2

PIs: *W.S. Hou & Y.B. Hsiung*

Hardware Team:

K. Ueno	(Faculty)
Y.K. Chi	(Electronics)
Y.S. Velikzhanin	(Electronics)
M.W.C. Lin	(Technician)

Simulation Team:

M.Z. Wang	(Faculty)
P. Yeh	(Faculty)
H.C. Huang	(Postdoc)
C.C. Hsu	(Ph.D. student)

NLHU

M.A. Huang	(Faculty)

Formed in Spring 2002

NuTel Milestones

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- 1/2003 3rd VHENTW, **Palermo**
  - Decide on Cerenkov and Discuss detector configuration
- 2/2003 **NuTel** chosen as project name [vs. **TauWatch**]
- 3/2003 Agree on Wide FOV
- 7/2003 Three Posters at ICRC2003
- 9/2003 File NuTel/ASHRA plan as **CosPA-2 Continuation**
- 11/2003 Agreement on ASHRA Telescope Optics

Conclusion and Outlook

- Optimal Range for Detecting ν_τ
  by Conversion in Mountain/Earth is **10^{15} to 10^{18} eV**
  - Conversion Efficiency High
    Energy Resolution Reasonable

- **Niche** btwn Conventional ν Detectors [IceCube…]
  and UHECR ν Detectors [Auger…]

→ **Uniqueness** makes Project Attractive!

See Evt: Pin Down AGN Mech. & Test $\nu_\mu \rightarrow \nu_\tau$ Appearance

Astro **Particle**

Great Chance to Initiate First Experiment

CosPA-2 Direction for Next Two+ Years

2002 Physics Nobel

KUNGL. VETENSKAPSAKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

Raymond Davis Jr
Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, USA, and

Masatoshi Koshiba 小柴昌俊
International Center for Elementary Parti ics, University of Tokyo, Japan

"for pioneering contributio ophysics, in particular for the detection of cosmic

and the other ha

Riccard oni
Ass niversities Inc., Washington DC, USA

pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources".

Quest for Genuine Cosmic and VHE Neutrinos ...