

IDEAS ON LONG-TERM OBSERVATIONS WITH SMALL CHERENKOV TELESCOPES

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OUTLINE

- INTRODUCTION
- THE NEED FOR DEEP OBSERVATIONS OF VARIABLE SOURCES
- USE OF SMALL TELESCOPES
- EXAMPLES: THE CROATEA PROJECT, THE WHIPPLE TELESCOPE
- CONCLUSIONS

INTRODUCTION

- THE CURRENT SITUATION: WITH THE NEW CLASS OF LARGE CHERENKOV TELESCOPES (CANGAROO, HESS, MAGIC, VERITAS) GROUND-BASED γ -RAY ASTRONOMY HAS ENTERED A VERY PRODUCTIVE PHASE.
- THE PRESSURE FOR OBSERVATION OF MANY CANDIDATE SOURCES IS VERY HIGH (SOURCE HOPPING)
- NOT ENOUGH LARGE TELESCOPES !!
- NO CHANCE TO MAKE DEEP OBSERVATIONS OF, SAY, 200-300 h /YEAR
- SIMILAR SITUATION AS IN ASTRONOMY WITH LARGE TELESCOPES
- REMINDER: TECHNOLOGY OF CHERENKOV TELESCOPES IS RAPIDLY DEVELOPING. TELESCOPES NEED AN UPDATE ALREADY AFTER 3-4 YEARS AFTER 6-8 YEARS OBSOLETE
- ARE THE SMALLER TELESCOPES OF LAST GENERATION STILL GOOD FOR SOMETHING?

THE CASE OF VARIABLE SOURCES: AGNS

(ALL) OBSERVED AGNS SHOW STRONG VARIABILITY
ALL AGNS ARE DISCOVERED DURING HIGH FLARING ACTIVITY
NEVERTHELESS. FLARING IS GENERALLY RARE

- THE LARGE TELESCOPES CANNOT SPEND IDLE TIME TO WAIT UNTIL SOURCE BECOMES ACTIVE

A KEY QUESTION: HADRONIC PRODUCTION OF γ s?

SMOKING GUN: COINCIDENCE OBSERVATIONS WITH NEUTRINOS

- RXTE NOT SENSITIVE ENOUGH
MAINLY RESPONDING TO ELECTRON ACCELERATION
- WHAT ABOUT HADRONIC ACTIVITY OF GAMMA SOURCES?
EXAMPLE 'ORPHAN FLARES' OF 1ES1959 ??
- SATELLITES: ALSO NO FAST RESPONSE
EGRET DID HARDLY SEE MKN 501: NO SIGNAL BEFORE 1997
AFTER THE LONG FLARING ACTIVITY IN 1997 ONLY A 5 SIGMA CLAIM
GLAST WILL BE BETTER BUT NOT GOOD ENOUGH (-> SENSITIVITY CURVE)

SIMPLE RATE CALCULATION + SHORT FLARE DURATIONS +
ACCIDENTAL RATE CALCULATION OF ν RATES AT ICECUBE SHOW
A NEED TO MAKE LONGTERM MONITORING OF PROMIZING
CANDIDATES

STUDY COINCIDENCES LATER

(alerts from Amanda II/Icecube very likely too late for CTs))

THE REFURBISHED CTS OF LAST GENERATION COULD BE OF HELP

CROATEA

Cosmic Ray Observatory At The Eastern Adriatic

Initially based on 2 HEGRA Telescopes,

use of old camera and readout electronics

plans for improvements:

new cameras (smaller pixels, hemispherical PMTs or G-aps)

+ new 2-GHz FADCs (switched capacitor arrays)

+ larger mirror size ($\sim 14 \text{ m}^2$)



THRESHOLD: ≈ 300 GEV (14 m² mirror, higher QE pmts or G-APDs)

Simple coincidence trigger in case of 512 nsec deep switched capacitor array-

-> no extra delay of signal needed

-> low trigger rate -> simple readout

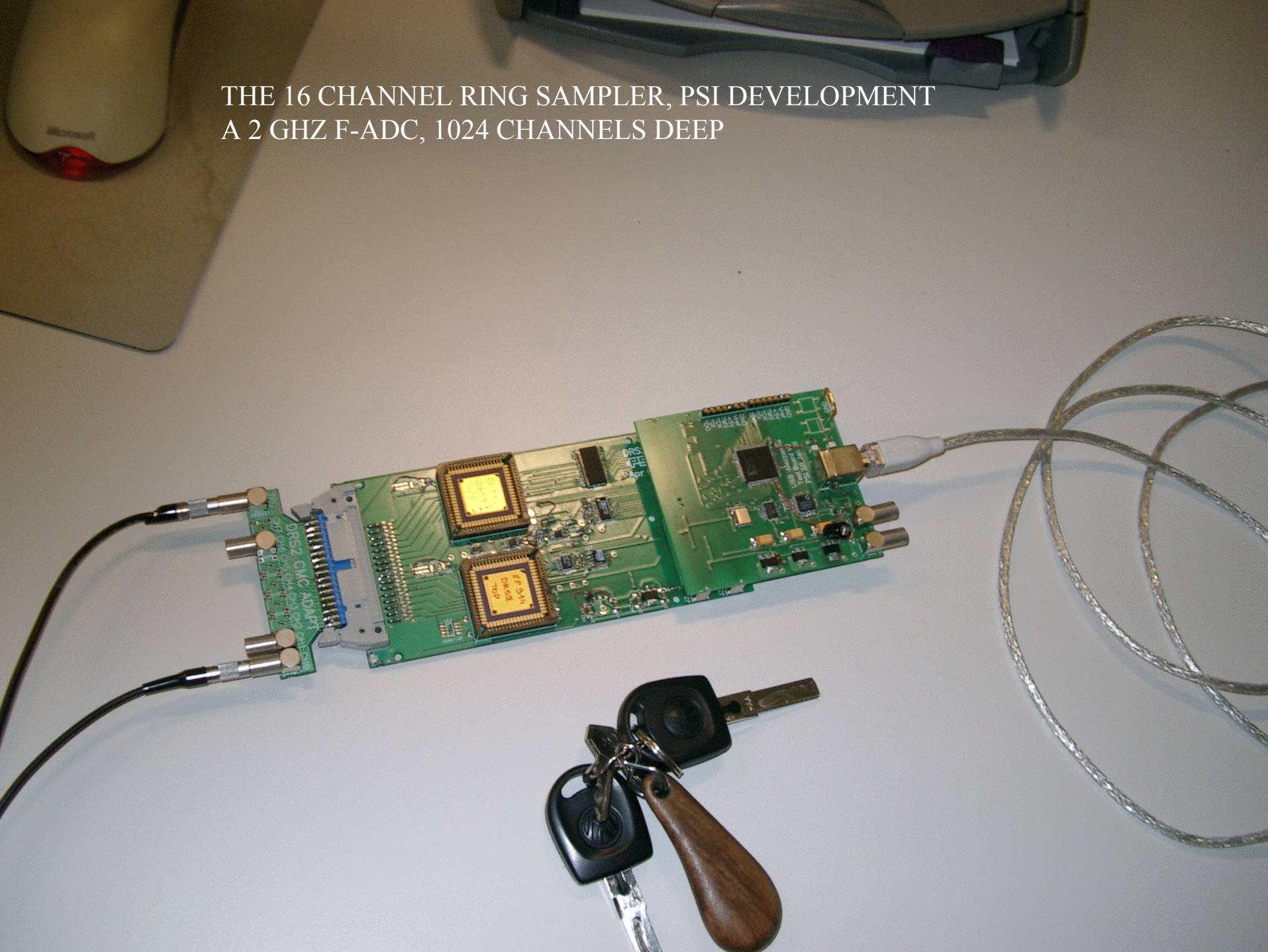
Observation during moon light (for strong sources) ≈ 1.6 - 1.7 times ‘on source’

-> possible to observe selected sources up to 300-350 h/year

‘Online reconstruction’

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

THE 16 CHANNEL RING SAMPLER, PSI DEVELOPMENT
A 2 GHZ F-ADC, 1024 CHANNELS DEEP



CROATEA

Cosmic Ray Observatory At The Eastern Adriatic

PEOPLE

- University of Split

Z. Antunovic, I. Puljak, N. Godinovic, I. Soric, M. Dzelalija, D. Polic

- Rudjer Boskovic Institute, Zagreb

K. Pisk, D. Hrupec, I. Slaus, D. Miljanic, M. Koncul

- UC Davis, USA (D. Ferenc)

- Others invited (international)

- CROATIAN GROUPS APPLIED FOR FP6-HEAP, TURNED DOWN->FP7?

CROATEA

Location Candidates



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THE MAIN GOALS:

MONITOR A FEW OF THE STRONGEST AGNS (MKN 501, MKN421, 1ES 1959, 1ES 2344..., LOW z) FOR > 200 H/YEAR

CRAB FOR CALIBRATION

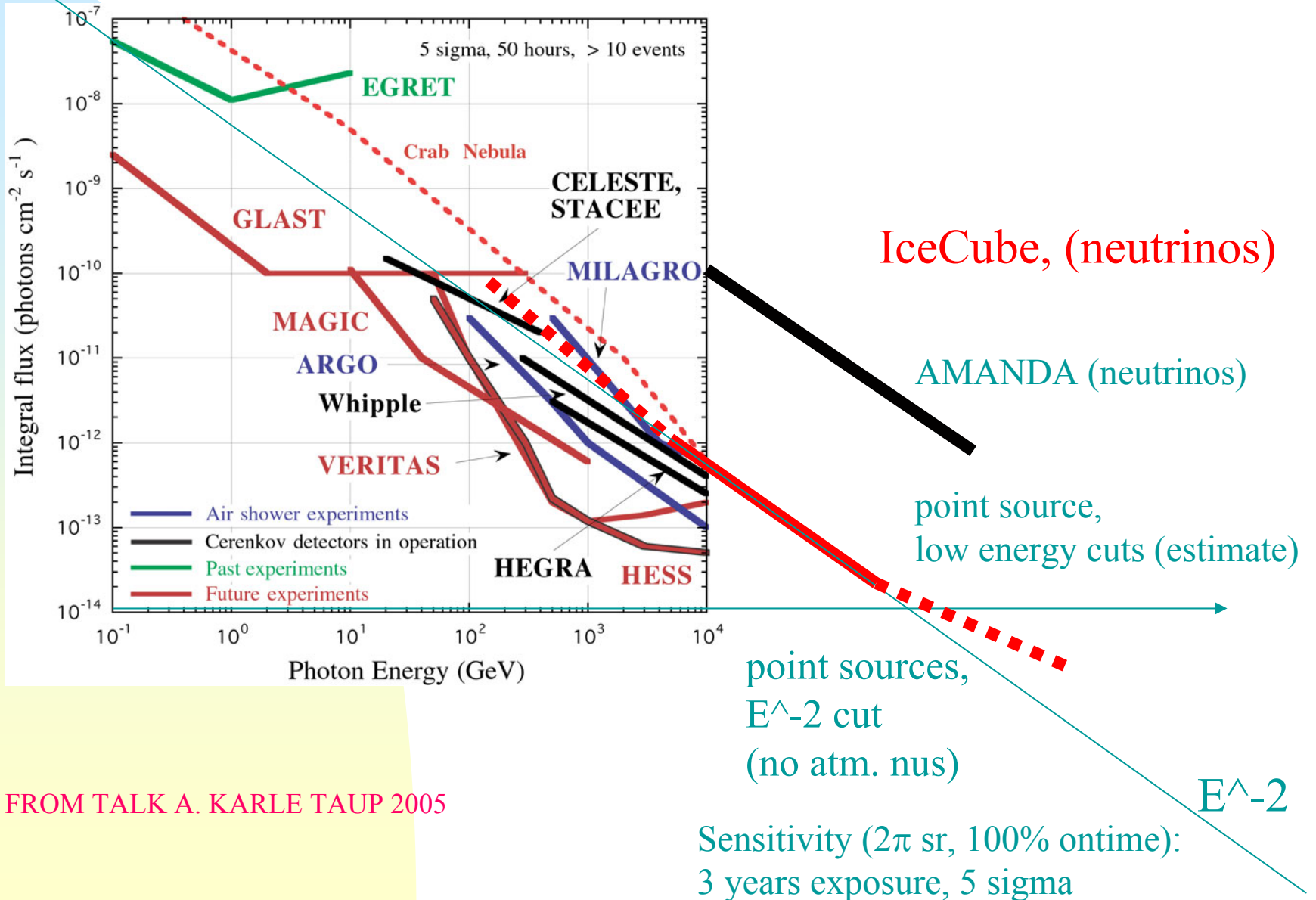
SEMIROBOTIC OPERATION

-> ALERTS FOR CANGAROO, HESS, MAGIC, VERITAS

-> COMBINED ANALYSIS WITH THE AMANDA II, ICECUBE DATA TO SEARCH FOR COINCIDENCES OF STRONG γ ACTIVITY AND NEUTRINOS

CROSS ANALYSIS WITH RXTE TO DETECT POSSIBLE HIGH γ ACTIVITY/LOW X-RAY ACTIVITY

Gamma ray detector and neutrino sensitivities



FROM TALK A. KARLE TAUP 2005

THE VERITAS COLLABORATION FOLLOWS A SIMILAR STRATEGY WITH THE OLD WHIPPLE TELESCOPE

Time offset against Croatea: ≈ 8 hours

-> nearly 12 h /day source coverage for best conditions

A northern network to monitor AGNs around the clock?

BYPRODUCTS

- EXCELLENT TRAINING GROUND FOR YOUNG PEOPLE
- TESTBEDS FOR NEW IDEAS, NEW CONCEPTS, PARTICULARLY IN PHOTSENSORS AND READOUT ELECTRONICS

CONCLUSIONS

- THE NEW LARGE CTS ARE MUCH TOO PRECIOUS FOR LONGTERM MONITORING OF SPECIFIC SOURCES
- THE USE OF REFURBISHED CTS OF LAST GENERATION IS WELL SUITED FOR LONGTERM MONITORING OF FLARING AGNS OF LOW REDSHIFT
- THE MAIN MOTIVATION: COMBINED OBSERVATION OF γ and ν FLARING SOURCES TO SOLVE HADRONIC PRODUCTION OF γ s IN THESE VHE SOURCES
- THE ICECUBE EXPERIMENT COMBINED WITH A (NETWORK OF) NORTHERN CT(S) IS A GOOD EXAMPLE OD A MULTIMESSENGER STUDY