

Rapporteur Talk:

HE 1.1- Extensive Air Shower Observation
for Energy $< 10^{17}$ eV

HE 1.2 - Theory and Simulation (In atmosphere)

HE 1.5 - Instrumentation and New Projects
(excepting UHECR)

HE 3.1 - Hadron Interactions

By **Masato Takita**, ICRR, U. of Tokyo,
@ICRC2003, Tsukuba, August 7, 2003

[First Measurements with the ARGO-YBJ Detector](#)

Antonio Surdo for the ARGO-YBJ Collaboration

[Angular Distribution of EAS at \$N > 10^7\$ Particles](#)

Vladimir Ivanovich Yakovlev et al.

[Comparison of Some Parameters of EAS Initiated by Light and Heavy Nuclei in the Region of Energy Spectrum Break](#)

Vladimir Ivanovich Yakovlev et al.

[Analysis of Air Showers at the Trigger Threshold of KASCADE](#)

Andreas Haungs for the KASCADE Collaboration

[Analysis of Energy Distributions of Hadrons Registered in the Pamir Experiment](#)

Jan Malinowski et al.

[Test of a Hadronic Interaction Model by a Multidimensional Analysis of Lateral and Longitudinal Air-Shower Observables at KASCADE](#)

Markus Roth and A.F. Badea

[Investigation of the Muon Pseudorapidities in EAS with the Muon Tracking Detector of the KASCADE Experiment](#)

Janusz Zabierowski for the KASCADE Collaboration

[Muon Production Height from the Muon Tracking Detector in KASCADE](#)

Janusz Zabierowski for the KASCADE Collaboration

[Muon Density Measurements as Probe of the Muon Component of Air-Shower Simulations](#)

Andreas Haungs for the KASCADE-Grande Collaboration

[The Role of Measurements of Muon Arrival Time Distributions for the Mass Discrimination of High Energy EAS](#)

Iliana Magdalena Brancus for the KASCADE-Grande Collaboration

[Registration of Particles Delayed by 400 - 1000 Microsec after EAS](#)

Jacek Szabelski et al.

[EAS Muon Distributions and Primary Mass Composition from the GAMMA Installation](#)

Lawrence W. Jones et al.

[The Contradiction in the EAS Muon and Hadron Data beyond the CR Spectrum Break](#)

Sergey Borisovich Shaulov

[A Search for Very High Energy Muons \(\$E_\mu > 100\$ TeV\) in EAS around the Knee](#)

Valery Borisovich Petkov et al.

[Anomalously Delayed Particles in Extensive Air Shower Core According to Results of the New Plant](#)

Turlan Khamzinovich Sadykov et al.

[EAS High Energy Muon Component around the Knee: Simultaneous Surface and Underground Measurements at Baksan](#)

Valery Borisovich Petkov et al.

[The Modern Status of Anomalous Delayed Particles Effect in the "Knee" Region EAS According to the Data of Tien Shan Mountain Station](#)

Alexander P. Chubenko et al.

[A Halo Event Observed by Hybrid Experiment at Mt. Chacaltaya](#)

Norio Kawasumi et al.

[Observation of EAS Core with the Small Scintillation Detector at Taro](#)

Hiroshi Sakuyama et al.

[Comparison of Experimental Events with an Galo with Calculations on Model "Tien-Shan"](#)

Turlan Khamzinovich Sadykov et al.

HE1: Extensive Air Showers and UHE Cosmic Rays

HE 1.1 Air shower observation for energy $< 10^{17}$ eV

Presenter Index (HE 1.1)

[Coplanar Production of Pions at Energies above 10 PeV According to Pamir Experiment Data](#)

Alexander Sergeevich Borisov et al.

[Lateral Distribution Function of EAS Cherenkov Light: Experiment Quest and Corsika Simulation](#)

Andrea Chiavassa for the EAS-TOP Collaboration

[Use of Neural Networks to Measure the Muon Contents of EAS Signals in a Water Cherenkov Detector](#)

Luis Villasenor, Y. Jeronimo, and H. Salazar

[How Well Do We Know EAS Size Spectra?](#)

Gerd Schatz

[A Measurement of the Energy Spectrum of Unaccompanied Hadrons](#)

Joerg Rudolf Hoerandel for the KASCADE Collaboration

[Single Unaccompanied Hadrons in Milagro and Surviving Primary Cosmic Ray Protons](#)

Gaurang B. Yodh for the Milagro Collaboration

[Primary Proton Spectrum in the Knee Region Observed by the Tibet Hybrid Experiment](#)

Makio Shibata for the Tibet ASgamma Collaboration

[Proton Fraction in PCR Mass Composition at Energies of \$10^{15}\$ – \$10^{17}\$ eV \(Experiment "Pamir"\)](#)

Serguei Anatolievich Slavatinsky et al.

[The Proton, Helium and CNO Fluxes at \$E_{\nu}\$ ^a 100 TeV from the EAS-TOP \(Cherenkov\) and MACRO \(TeV Muon\) Data at the Gran Sasso Laboratories](#)

Mario E. Bertaina for the EAS-TOP and MACRO Collaborations

[Energy Spectrum of Cosmic Rays in the Knee Region and Studies of Different Components of Extensive Air Showers](#)

German V. Kulikov et al.

[Primary Cosmic Ray Mass Composition Studies and Muon Size Spectra of Extensive Air Showers](#)

German V. Kulikov et al.

[Composition of Cosmic Rays from Coincidences between Air Showers and Muons in the Soudan2 Detector](#)

Richard Gran, P. Border, and K. Ruddick

[The Energy Spectrum and the Chemical Composition of Primary Cosmic Rays with Energies from \$10^{14}\$ to \$10^{16}\$ eV](#)

Shoichi Ogio for the BASJE Collaboration

[Mass Composition of Primary Cosmic Ray below the "Knee" Deduced from Analysis of Energy Distribution of Hadrons Registered in the Pamir Experiment](#)

Jan Malinowski

[Energy Spectrum and Elemental Composition in the PeV Region](#)

Markus Roth and H. Ulrich

[The Energy Spectrum of All-Particle Cosmic Rays around the Knee Region Observed with the Tibet Air-Shower Array](#)

Shunsuke Ozawa for the Tibet ASgamma Collaboration

[Study of Cosmic Ray Primaries between \$10^{12}\$ and \$10^{16}\$ eV from EAS-TOP](#)

Gianni Navarra for the EAS-TOP Collaboration

[The Cosmic Ray Primary Composition in the Knee Region through the EAS Electromagnetic and Muon Measurements at EAS-TOP](#)

Gianni Navarra for the EAS-TOP Collaboration

[A Study of Nuclear Composition of Primary Cosmic Rays above 100 TeV](#)

Hideki Tanaka et al.

[The Chemical Composition of the Primary Cosmic Rays around the Knee Region by Measuring Lateral Distributions of Air Cherenkov Photons](#)

Hisao Tokuno for the BASJE Collaboration

HE1: Extensive Air Showers and UHE Cosmic Rays

HE 1.1 Air shower observation for energy < 10^{17} eV

Presenter Index (HE 1.1)

[Mass Composition and Energy Spectrum Studies of Primary Cosmic Rays in Energy Range 10TeV-10PeV Using Atmospheric Cerenkov Light Telescope](#)

Alexander L. Mishev, S.C. Mavrodiev, and J.N. Stamenov

[A Study of the Primary Composition at \$\sim 10^{14}\$ - \$10^{15}\$ eV with the GRAPES-2 Array at Ooty](#)

Suresh Chandra Tonwar et al.

[A New Measurement on the Energy Spectrum of Primary Cosmic Rays in the Energy Region \$10^{14}\$ - \$10^{16}\$ eV, with GRAPES-3 Experiment](#)

Sunil K. Gupta et al.

[Measurement of the Cosmic Ray Composition at the Knee with the SPASE-2/AMANDA-B10 Detectors](#)

Katherine Rawlins for the SPASE and AMANDA Collaborations

[The Enhancement of Cosmic Rays with Energies above 10 TeV Observed at Mt. Chacaltaya](#)

Osman H. Burgoa for the BASJE Collaboration

[Cosmic Ray Anisotropy with KASCADE](#)

Gernot Maier for the KASCADE Collaboration

[The Cosmic Ray Anisotropy between \$10^{14}\$ and \$10^{15}\$ eV](#)

Piera Luisa Ghia for the EAS-TOP Collaboration

[Measurement of Energy and Arrival Direction of Air Showers by Synchronized Compact Arrays](#)

Nobuaki Ochi for the LAAS Group

[Search for Large-Scale Coincidences of EAS in LAAS Experiment](#)

Nobuaki Ochi for the LAAS Group

[Search for Non-Random Features in Arrival Time Series of Air Showers Observed at Mt.Chacaltaya](#)

Nobuaki Ochi et al.

[Simulation Study on the Performance of Synchronized Compact Arrays within 1 Km Baseline](#)

Atsushi Iyono for the LAAS Group

[The Meteorological Effects of Cosmic Ray Intensity at Sea Level Observed at Multiple EAS Arrays in LAAS Experiments](#)

Atsushi Iyono for the LAAS Group

[Arrival Time Distribution by the New Observation System at Taro](#)

Hiroshi Sakuyama et al.

[Analysis of the Arrival Time of Serial Air Showers by Using Erlang Distribution and Poisson Distributon](#)

Hiroyuki Takada, N. Takahashi, and S. Kawaguchi

[Search for Sporadic Enhancements of UHECR and Correlations with Cosmic Phenomena in LAAS Experiment](#)

Isao Yamamoto for the LAAS Group

[Radar Echo Detection System of EAS Ionization Columns as Part of a LAAS Detector Array](#)

Isao Yamamoto for the LAAS Group

[The Array of Atmospheric Cherenkov Telescopes at Milagro to Study Cosmic Ray Composition](#)

Gaurang B. Yodh et al.

[First Results Obtained with Wide-Angle Cerenkov Light Telescope - BEO - p. Mussala](#)

Elisaveta Slavcheva Malamova et al.

[A New Possibility to Determine the Mass Composition around the Knee with EAS Observed in Altitude \(700 g.cm⁻²\)](#)

Lawrence W. Jones et al.

[Primary Cosmic-Ray Spectra in the Knee Region](#)

Samvel V. Ter-Antonyan and P.L. Biermann

[About EAS Inverse Problem](#)

Samvel V. Ter-Antonyan

[The Knee in the Energy Spectrum of Cosmic Rays in the Framework of the Poly-Gonato and Diffusion Models](#)

Joerg Rudolf Hoerandel, N.N. Kalmykov, and A.I. Pavlov

[Some Characteristics of Extensive Air Showers at Chacaltaya Observation Level](#)

Alexander L. Mishev and J.N. Stamenov

[A Selection of Different Cosmic Ray Primaries Using a New Selection Parameter Based on Cerenkov Light Registration](#)

Alexander L. Mishev and J.N. Stamenov

[The Primary Cosmic Ray All Nucleon Spectrum as Seen by ARGO-YBJ](#)

Eleonora De Marinis for the ARGO-YBJ Collaboration

[A Method to Reconstruct the Energy and Mass of Individual Primary Cosmic Ray Particles](#)

Igor Alexandrovich Lebedev and E.G. Boos

[Sensitivity of the ARGO-YBJ Strip Size Spectrum to Different Models of the Primary Cosmic Ray Composition in the Energy Range 10 ½ 500 TeV](#)

Giuseppe DiSciascio for the ARGO-YBJ Collaboration

[On the "Knee" in Primary Cosmic Ray Spectrum](#)

Yuri V. Stenkin

[The Cosmic-Ray Knee: Still a Mystery](#)

Frank Culver Jones, R. Streitmatter, and D. Kazanas

[New Approach to Cosmic Ray Phenomena Generated by VHE Particles above the Knee](#)

Anatoly Afanasievich Petrukhin

[Influence of Low-Energy Hadronic Interaction Programs on Air Shower Simulations with CORSIKA](#)

Ralph Engel et al.

[On Scaling of Inclusive Spectra of Charged Particles in Ultra-Relativistic Heavy Ion Collisions](#)

Arunava Bhadra

[Characteristics of Ultra-Heavy Cosmic Ray Nuclei in the PeV-EeV Energy Region](#)

David B. Kieda

[Radio Emission from EAS - Coherent Geosynchrotron Radiation](#)

Tim Huege and H. Falcke

[Explanation of the Knee in the Galactic Cosmic-Ray Spectrum](#)

Volodymyr Kryvdyk

[The Bell-Lucek Mechanism in SNRs and the "Knee" in the Cosmic Ray Spectrum](#)

Luke O'C. Drury, E. van der Swaluw, and O. Carroll

[On the Pulsar Origin of the Knee](#)

Arunava Bhadra

[The Knee in Galactic Cosmic Ray Spectrum and Variety in Supernovae](#)

Lyubov G. Sveshnikova

HE1: Extensive Air Showers and UHE Cosmic Rays
HE 1.2 Theory and simulations (including origins of knee)

Presenter Index (HE 1.2)

[Particle Acceleration Due to Electrostatic Shock Wave Driven by Counterstreaming Pair Plasmas](#)

Shinji Saito, J.I. Sakai, and T. Haruki

[Advective Diffusion Propagation Model for Galactic Cosmic Rays above \$10^{12}\$ eV](#)

Shoichi Ogio and F. Kakimoto

[The Residence Time of Cosmic Rays in the Galactic Disk at Energies around the Knee](#)

Antonio Codino and F. Plouin

[Analysis of Emulsion Chambers in Tibet Hybrid Experiment Using the Image Scanner](#)

Makio Shibata for the Tibet ASgamma Collaboration

[Analog Read-Out of the RPCs in the ARGO-YBJ Experiment](#)

Michele Iacovacci for the ARGO-YBJ Collaboration

[The Detector Control System for the ARGO-YBJ Experiment](#)

Paolo Camarri for the ARGO-YBJ Collaboration

[ARGO-YBJ Computing Model, Data Analysis and Hardware/Software Architecture of the Processing Farm](#)

Paola Celio for the ARGO-YBJ Collaboration

[The Trigger System of the ARGO-YBJ Detector](#)

Antonio Surdo for the ARGO-YBJ Collaboration

[The Online System of the ARGO Experiment](#)

Huihai He for the ARGO Collaboration

[Development of Resistive Plate Counter for the Extended Mini-Array Experiment at Gauhati University](#)

Subhash Chandra Rajbongshi et al.

[Shower Reconstruction Performance of KASCADE-Grande](#)

Gernot Maier for the KASCADE-Grande Collaboration

[Wide Area Small Air Shower Detection System Linked by Internet](#)

Yoshiki Teramoto et al.

[Multiplicity Spectrum of NM64 Neutron Supermonitor and Hadron Energy Spectrum at Mountain Level](#)

Alexander P. Chubenko et al.

[The Wide Range Front-End Electronics for Readout Amplitude Date of the Ionization Calorimeter](#)

Turlan Khamzinovich Sadykov et al.

[Delayed Scintillator Pulses Observed with an EAS Array](#)

Harri K. Arvela and A.-M. Elo

[Depth Distribution of the Maxima of Extensive Air Shower](#)

James H. Adams, Jr. for the EUSO Collaboration

[The Surface Detector Trigger for the Auger Observatory](#)

Zbigniew Szadkowski for the Pierre Auger Collaboration

[A Proposal of a Single Chip Surface Detector Trigger Based on Altera Cyclone™ Family](#)

Zbigniew Szadkowski

[Calibration and Monitoring of the Pierre Auger Surface Detectors](#)

Xavier Bertou for the Pierre Auger Collaboration

[Study of Long Term Stability of the Pierre-Auger Surface Detector Using Muon Events](#)

Tohru Ohnuki et al.

[Production Test System and Results on Large PMTs for Pierre-Auger Surface Detectors](#)

Katsushi Arisaka et al.

[The Pierre Auger Surface Detector Led Flashers and Their Use for Monitoring and Calibration](#)

Tiina Suomijarvi for the Pierre Auger Collaboration

[Photon Yields from Dry Air Excited by Electrons](#)

Keizo Kobayakawa et al.

[Measurements of Diffuse Night Sky Background](#)

Osvaldo Catalano et al.

[AIRFLY: Air Fluorescence Induced by Electrons in a Wide Energy Range](#)

Paolo Privitera et al.

[New Photon Yields Measurement in Air and Its Effect on the Energy Estimation of Ultra-High Energy Cosmic Rays](#)

Naoto Sakaki et al.

[An Experiment to Measure the Air Fluorescence Yield in Electromagnetic Showers](#)

Petra H. Huentemeyer for the FLASH Collaboration

[Measurements of the UV Nocturnal Atmospheric Background in the 300-400 nm Wavelength Band with the Experiment BaBy during a Transmediterranean Balloon Flight](#)

Andrea Santangelo et al.

[Study of the Fluorescence Yield for Electrons between 0.5 - 2.2 MeV](#)

Ernesto Kemp et al.

[Study on Wavelength Shifters and Multilayer Half-Mirror for High-OE PMT](#)

Masahiro Takeda for the EUSO Collaboration

[Mobile ACE - New Approach to Reduce Systematic Errors in the Absolute Energy by Fluorescence Detectors](#)

Katsushi Arisaka

[Checking the Pointing Accuracy of Air Fluorescence Detectors with Star Light](#)

Stefan Westerhoff for the HiRes Collaboration

[Evaluation of Flat Microchannel Plate Photomultipliers for Use in a Portable Air Fluorescence Detector](#)

S. BenZvi and J. Martin

[APF Light Sources for the Auger Southern Observatory](#)

John A.J. Matthews for the Pierre Auger Collaboration

[Atmospheric Monitoring for the Telescope Array Experiment](#)

Michiyuki Chikawa et al.

[Atmospheric Effects on the Development and the Fluorescence Detection of Extensive Air Showers](#)

Markus Risse et al.

[The Influence of the Global Atmospheric Properties on the Detection of UHECR by EUSO on Board of the ISS](#)

Didier Lebrun for the EUSO Collaboration

[Environmental Testing of the Front-End Electronics for the Auger Observatory Surface Detector](#)

James Dominic Chye for the Pierre Auger Collaboration

[Statistical Calibration and Background Measurements of the Auger Fluorescence Detector](#)

Hartmut E.H. Gemmeke, M. Kleifges, and A. Menshikov

[The Slow Control System of the Auger Fluorescence Detectors](#)

Hartmut E.H. Gemmeke et al.

[A Novel Approach in Detecting the UHECR Using EAS Telescopes Notch Optical Filters Combining Optimum Sensitivity for Cherenkov and Fluorescence Contributions](#)

Emmanuel D. Fokitis et al.

[Tracking Stars with the Fluorescence Detector of the Pierre Auger Observatory](#)

Daniel V. Camin et al.

[Portable, Single-Mirror, Air Fluorescence Detector](#)

Robertsen A. Riehle et al.

[The Absolute Calibration of the HiRes Detectors](#)

John N. Matthews for the HiRes Collaboration

[A New Technique Producing Double-Sided Spherical Fresnel Lens Segments Assembled to Large Aperture Lenses](#)

Hitoshi Ohmori for the EUSO Collaboration

[A Ground-Based UV Light Source for the EUSO Mission](#)

James H. Adams, Jr.

[The Focal Surface of EUSO Telescope](#)

Hirohiko M. Shimizu for the EUSO Collaboration

[The Light of the Night Sky in EUSO: Duty Cycle and Background](#)

Didier Lebrun et al.

[Development of Multi-Anode Photomultipliers for the EUSO Focal Surface Detector](#)

Naoto Sakaki for the EUSO Collaboration

[Wide-Angle Optical Telescope for the EUSO Experiments](#)

Lloyd W. Hillman for the EUSO Collaboration

[The Housing of the EUSO Photo-Detector Sensors](#)

Marco Pallavicini for the EUSO Collaboration

[Simulation and Data Analysis for EUSO](#)

Giacomo D'Ali Staiti for the EUSO Collaboration

[A PCI Based Data Acquisition System for Ground Array Detectors with Wireless Synchronization through GPS](#)

Mario Pimenta et al.

[The Euso Electronics](#)

Marco Pallavicini et al.

[EUSO Analog Front End Electronics](#)

Dy-Holm Koang for the EUSO Collaboration

[EUSO Analog Front End Electronics and Calibrations](#)

Dy-Holm Koang for the EUSO Collaboration

[ASHRA Trigger and Readout Pixel Sensors](#)

Makoto Sasaki et al.

[Simulation of Ice Cherenkov Detectors for IceTop](#)

Todor S. Stanev for the IceCube Collaboration

[LOPES - Detecting Radio Emission from Cosmic Ray Air Showers](#)

Andreas Horneffer et al.

[Complex EAS Array for Super-High Energy Cosmic Ray Research](#)

German V. Kulikov et al.

[Perspectives of the ATHLET Installation at the Tien Shan](#)

Rauf A. Mukhamedshin et al.

[Antarctic Balloon Measurements of UHE CR \(SPHERE Experiment\)](#)

Sergey Borisovich Shaulov et al.

[The KASCADE-Grande Experiment](#)

Andreas Haungs for the KASCADE-Grande Collaboration

[EUSO \(the Extreme Universe Space Observatory\) - Scientific Objectives -](#)

Masahiro Teshima for the EUSO Collaboration

[The Extreme Universe Space Observatory \(EUSO\) Mission in the Context of ESA](#)

Jean Clavel et al.

[AGASA Results and EUSO](#)

Motohiko Nagano for the EUSO Collaboration

[The EUSO Instrument Onboard the International Space Station](#)

Osvaldo Catalano on behalf of the EUSO Collaboration

[EUSO Operations: Flight and Ground](#)

Maria Catarina Espirito Santo for the EUSO Collaboration

[The EUSO Science Operations and Data Centre](#)

Maria Catarina Espirito Santo for the EUSO Collaboration

[EUSO in the Context of ESA Human Spaceflight Directorate](#)

Andrea Santangelo et al.

[The ULTRA Experiment: A Supporting Activity for the Euso Project](#)

Piero Vallania et al.

[The Scientific Baseline to Have an Atmosphere Sounding System Coupled to the EUSO Detector](#)

Giacomo D'Ali Staiti for the EUSO Collaboration

[TUS/KLYPVE Space Telescopes - Simulation of Performance](#)

Dmitry Vadimovich Naumov et al.

[Tracking Mirror for Measurement of Extreme Energy Cosmic Rays from Space](#)

Il H. Park, G.K. Garipov, and B.A. Krenov

[Downward Neutrino Induced EAS with EUSO Detector](#)

Sergio Bottai for the EUSO Collaboration

[IceTop: The Surface Component of IceCube](#)

Thomas K. Gaisser for the IceCube Collaboration

[Hadroproduction in Proton Carbon Collisions at the NA49 Experiment](#)

Giles Barr for the NA49 Collaboration (carbon run)

[On the Problem of High Transverse Momenta in the Interactions of Hadrons at Energies about \$10^{16}\$ eV](#)

Jan Malinowski

[Status of the HARP Experiment at CERN](#)

Simon A.M. Robbins for the HARP Collaboration

[The Accelerator Data - Cosmic Ray Monte Carlo Interface; An Update](#)

Lawrence W. Jones

[A Measurement Technique of p-Air Inelastic Cross-Section above \$10^{18}\$ eV](#)

Konstantin V. Belov for the HiRes Collaboration

[Air Shower Fluctuations and the Measurement of the Proton-Air Cross Section](#)

Jaime Alvarez-Muniz et al.

[How Fast Is the Growth of Total Cross Section at High Energies?](#)

Fazal Aleem et al.

[Note on the Energy Distribution of Produced Particles in Multiple Particle Production](#)

Akinori Ohsawa and M. Tamada

[Comments on Centauro Events](#)

Akinori Ohsawa for the Chacaltaya Emulsion Chamber Collaboration

[Centauro I: Finding the Answer](#)

Vladimir V. Kopenkin and Y. Fujimoto

[Observation of Penetrating Shower-Clusters in Chacaltaya Two-Storey Emulsion Chambers](#)

Masanobu Tamada

[Investigation of Geometrical Structures in the Hadronic Shower Core](#)

Joerg Rudolf Hoerandel for the KASCADE Collaboration

[Remarkable Events in the Knee Region and Abnormal Behaviour in EAS Data](#)

Jean-Noel Capdevielle et al.

[TARGET 2.2 - A Hadronic Interaction Model for Studying Inclusive Muon and Neutrino Fluxes](#)

Ralph Engel et al.

[Nature of 100 TeV Hadronic Interactions in the Forward Region Seen from Muon Data of the L3+C Experiment](#)

Qing-Qi Zhu on behalf of the L3 Collaboration

[Fractionally Charged Particles in Cosmic Rays? Reevaluation of the Data](#)

George Bashindzhagyan

[Non-Extensivity Parameter in Thermodynamical Model of Hadronic Interactions](#)

Izabela Kurp and T. Wibig

[Collective Behaviour in Nuclear Interactions and Shower Development](#)

Ricardo Vazquez et al.

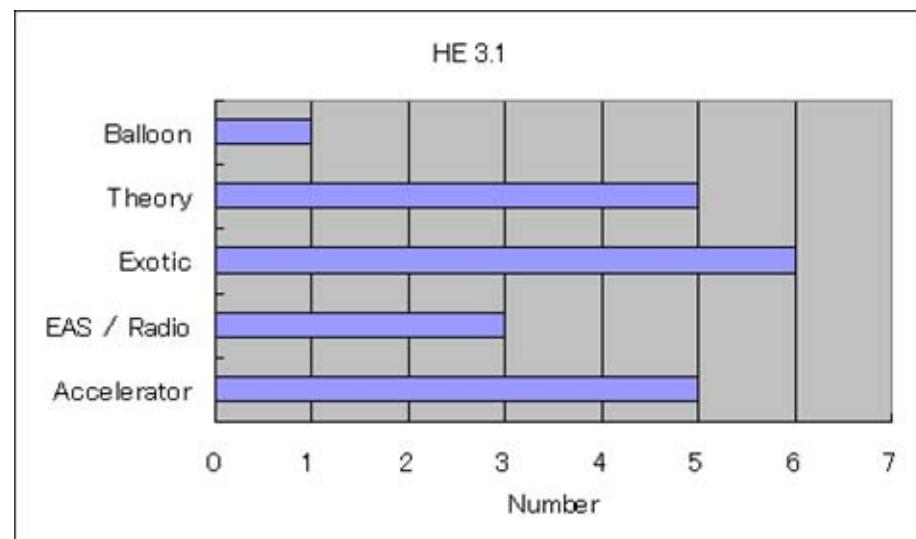
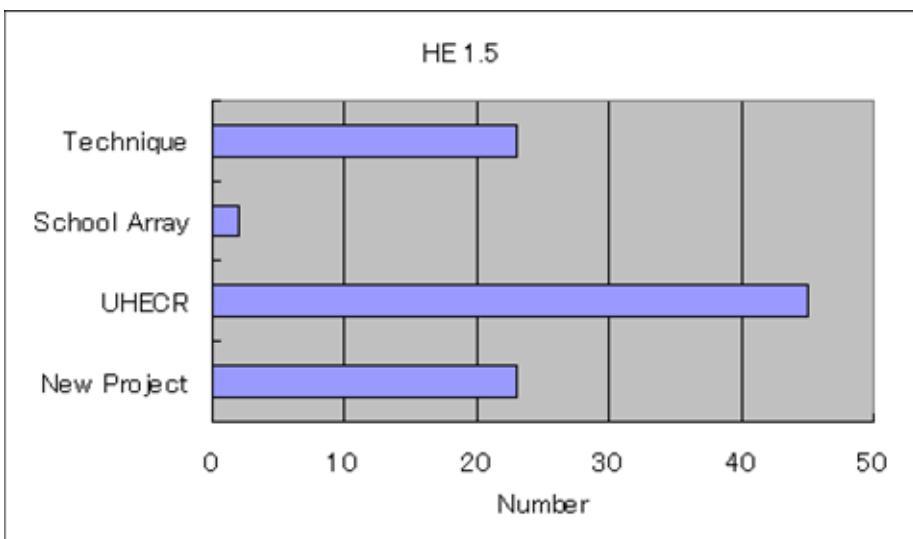
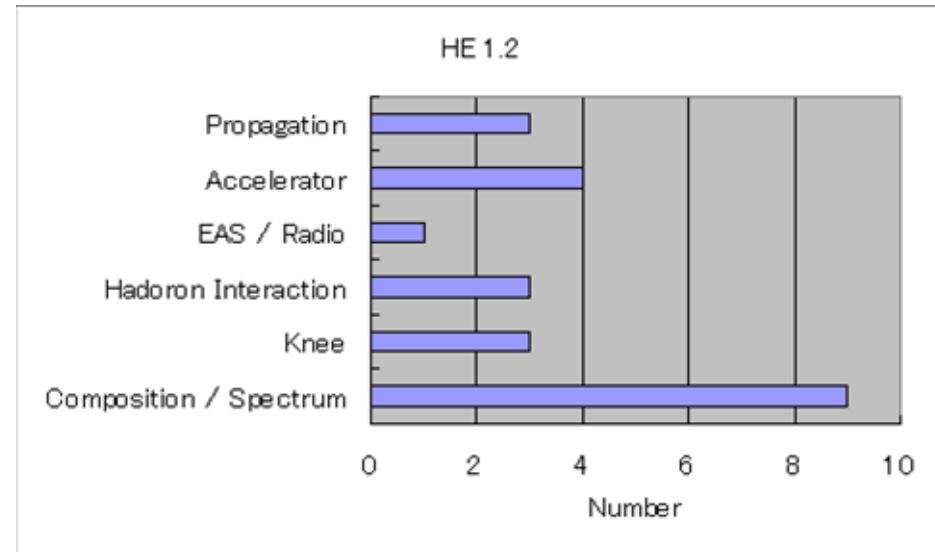
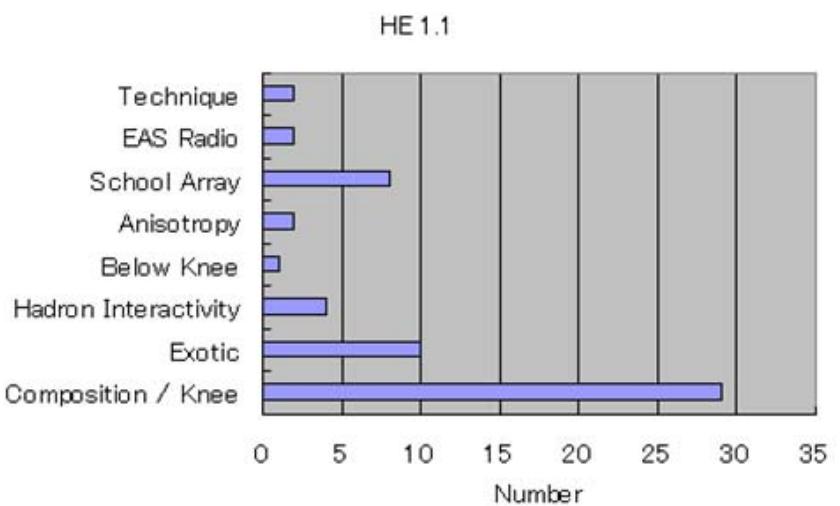
[Extrapolation of Interaction Models above LHC Energies and Fast Simulation Procedures for Giant EAS](#)

Jean-Noel Capdevielle, F. Cohen, and K. Sanosyan

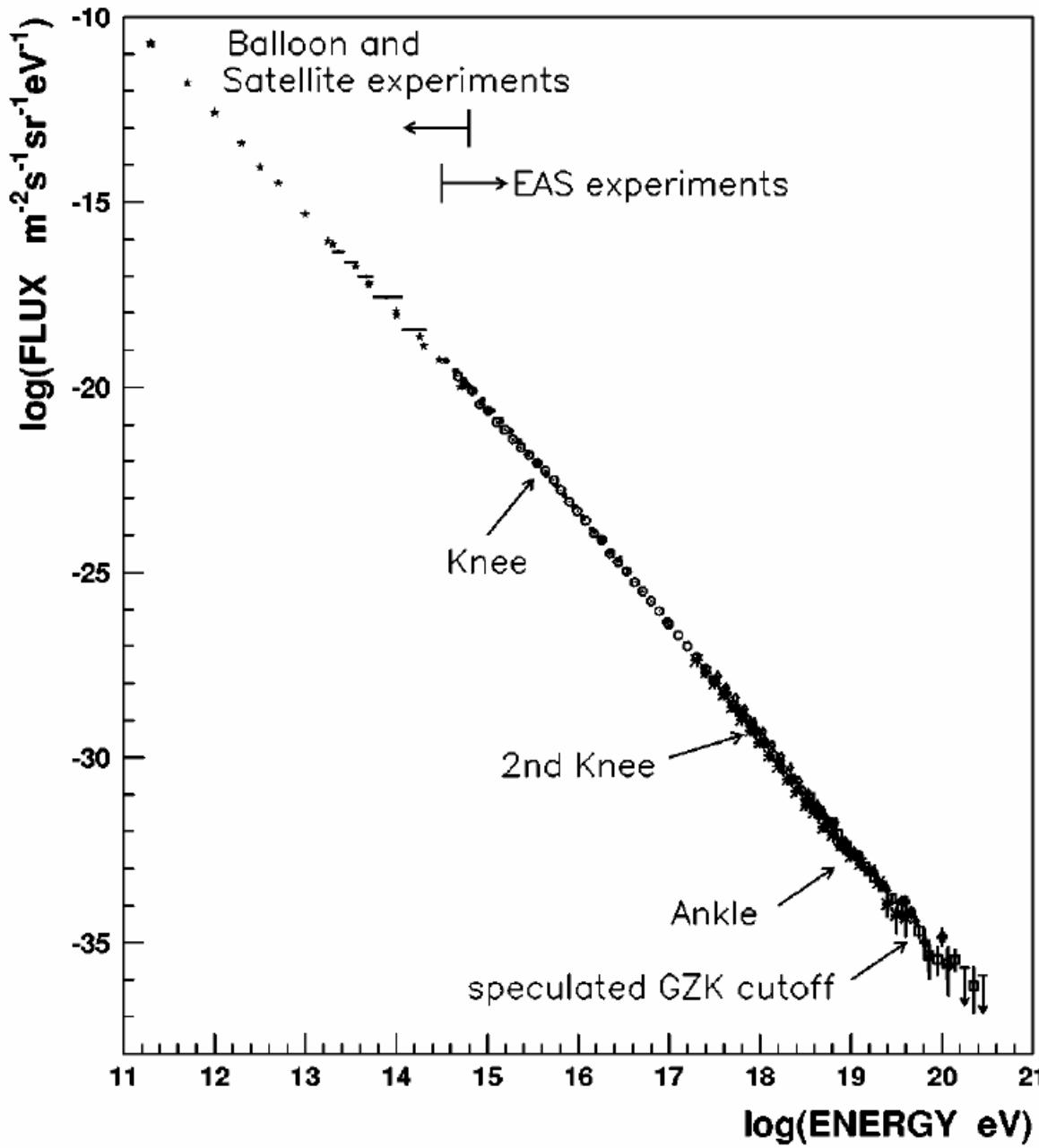
[Composition of Cosmic Ray Particles in the Atmosphere as Measured by the CAPRICE98 Balloon Borne Apparatus](#)

Emiliano Mocchiutti for the WiZard/CAPRICE Collaboration

STATISTICS (BREAK DOWN)

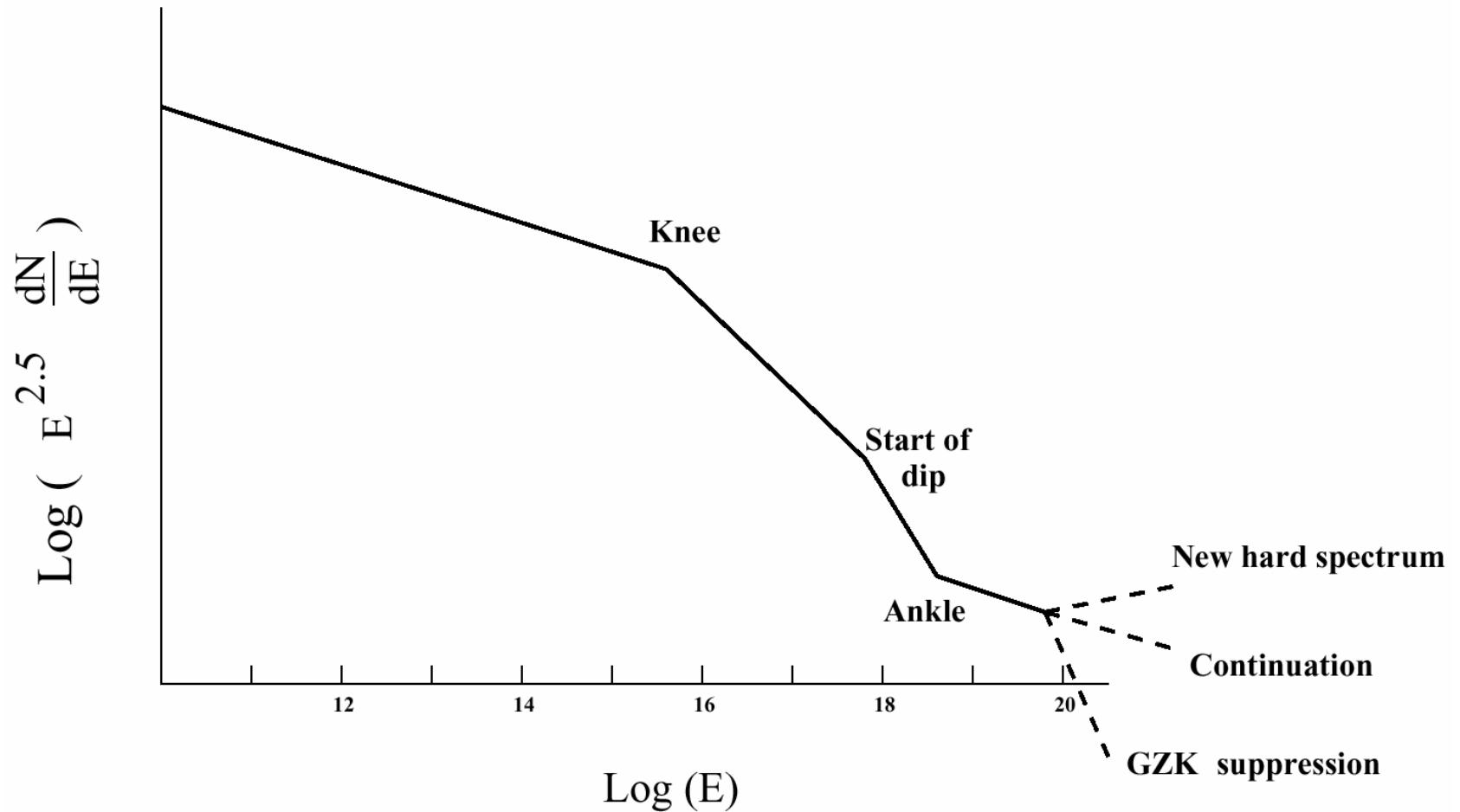


Cosmic Ray Energy Spectrum



M.Nagano, A.A.Watson (2000)

Cosmic Ray Energy Spectrum



Sommers (ICRC2001)

Primary Cosmic Radiation and Extensive Air Showers.

B. PETERS

Institute for Theoretical Physics, University of Copenhagen - Copenhagen

(ricevuto il 19 Agosto 1961)

Summary. — The hypothesis, that separate sources of cosmic ray particles of widely differing strength predominate in different energy regions, has been examined. In particular the following questions are discussed: Can such separate sources dominate neighbouring energy intervals of the primary particle spectrum without introducing appreciable changes in slope or discontinuities in the size-frequency distribution of air showers? Can such separate contributions, if they exist, nevertheless be distinguished experimentally with existing techniques? Do available data on extensive air showers provide evidence for or against the hypothesis? It appears that, if such separate sources existed and even if they differed in strength by factors as large as thousand, no significant departure from smoothness in the size-frequency relation of air showers would

B.Peters (1961)

One of Ancient Predictions

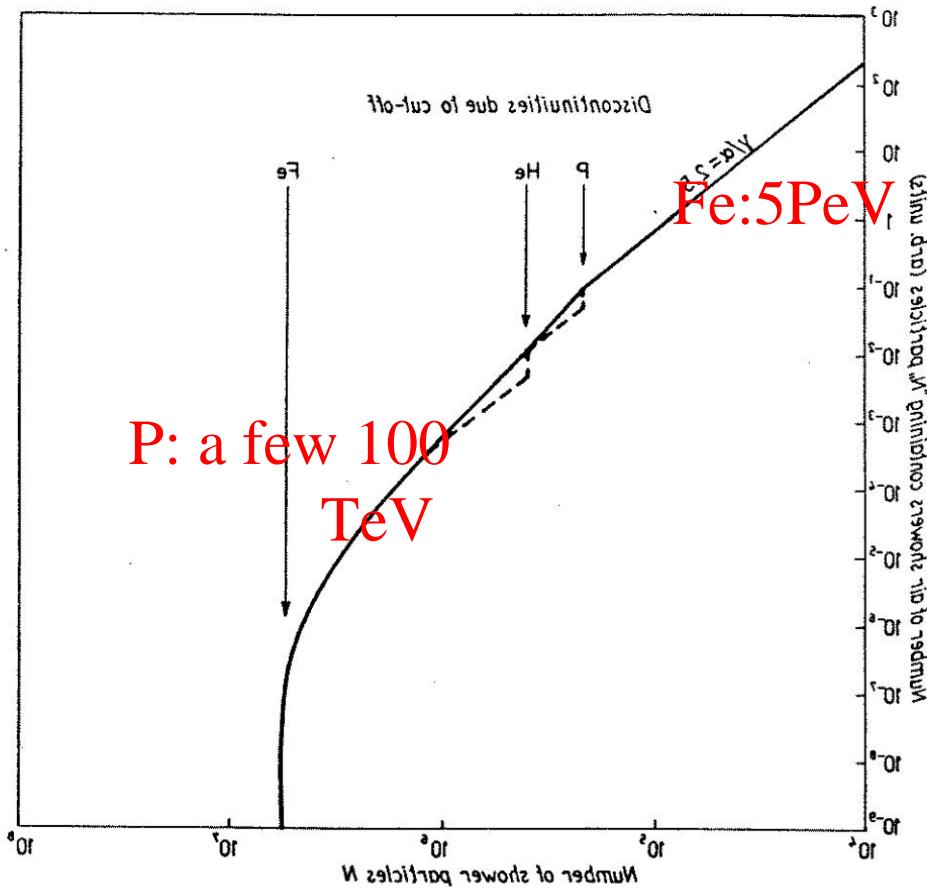
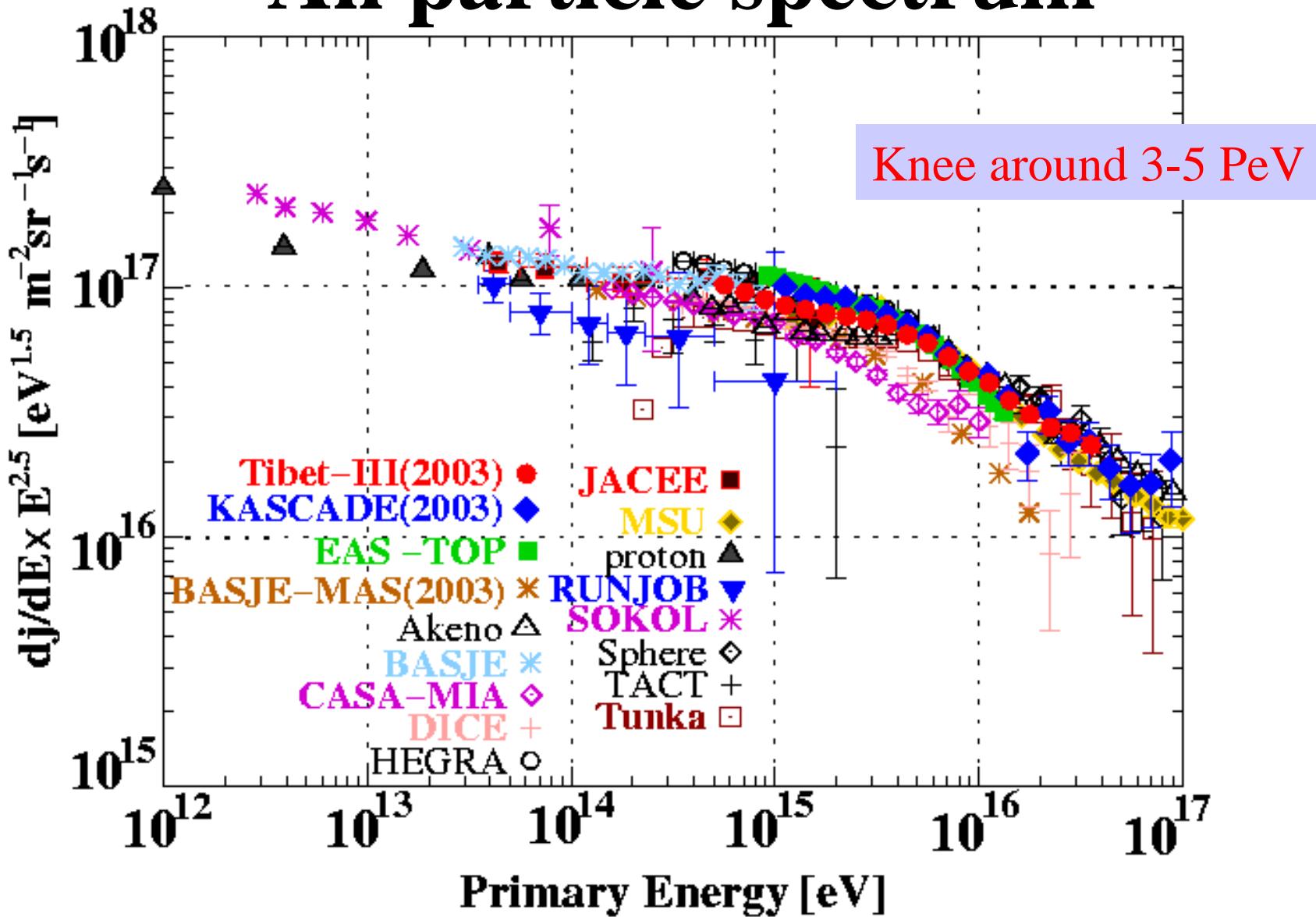


Fig. I. — The curve represents the distribution of shower particles at different stages of development of air showers at mountain altitude in atmospheric air. This distribution results from a primary rapidly moving nuclei (Fe) and secondary electrons (e⁻) with $\gamma = 1.62$; 3) a sharp cut-off at a certain depth d (rigidity corresponding to protons with about 10^{18} eV). The distribution in the shower corresponds to an assumed deficiency of ${}^3\text{H}$, ${}^3\text{He}$, ${}^7\text{Li}$, ${}^7\text{Be}$ and ${}^8\text{B}$ in the primary beam.

Experiment	site		g/cm ²	e	μ	h	∇C
AKENO	Japan (35.5N, 138.5E)		930	○	1 GeV		
BLANCA	Utah(40.2N,112.8W)		870	○			○
CASA-MIA	Utah (40.2N,112.8W)		870	○	800 MeV		
DICE			860	○	800 MeV		○
EAS-Top	Italy (42.5N,13.6E)		820	○	1 GeV		
HEGRA	La Palma (28.8N,17.9W)		790	○			○
KASCADE (electrons/muons)	Germany (49.N, 8.E)		1022	○	230 MeV		
KASCADE (hadrons/muons)			1022		230 MeV	50 GeV	
KASCADE (neural network)			1022	○	230 MeV		
MSU			1020	○			
Mt. Norikura	Japan		735	○			
Tibet	Tibet (30.1N,90.5E)		606	○			
Tunka-13			680				○
Yakutsk (low energy)			1020				○

All particle spectrum

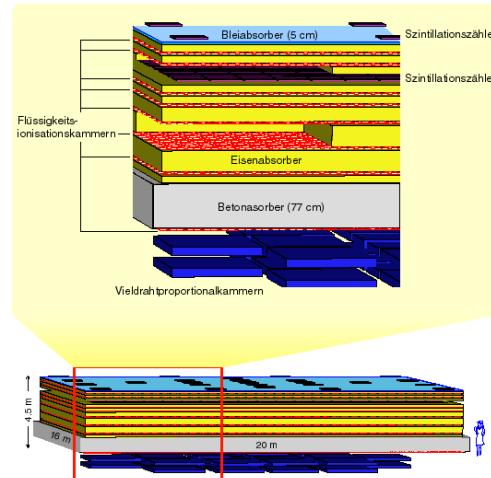


KASCADE



e/μ

Hadron



KASCADE UH SPECTRUM

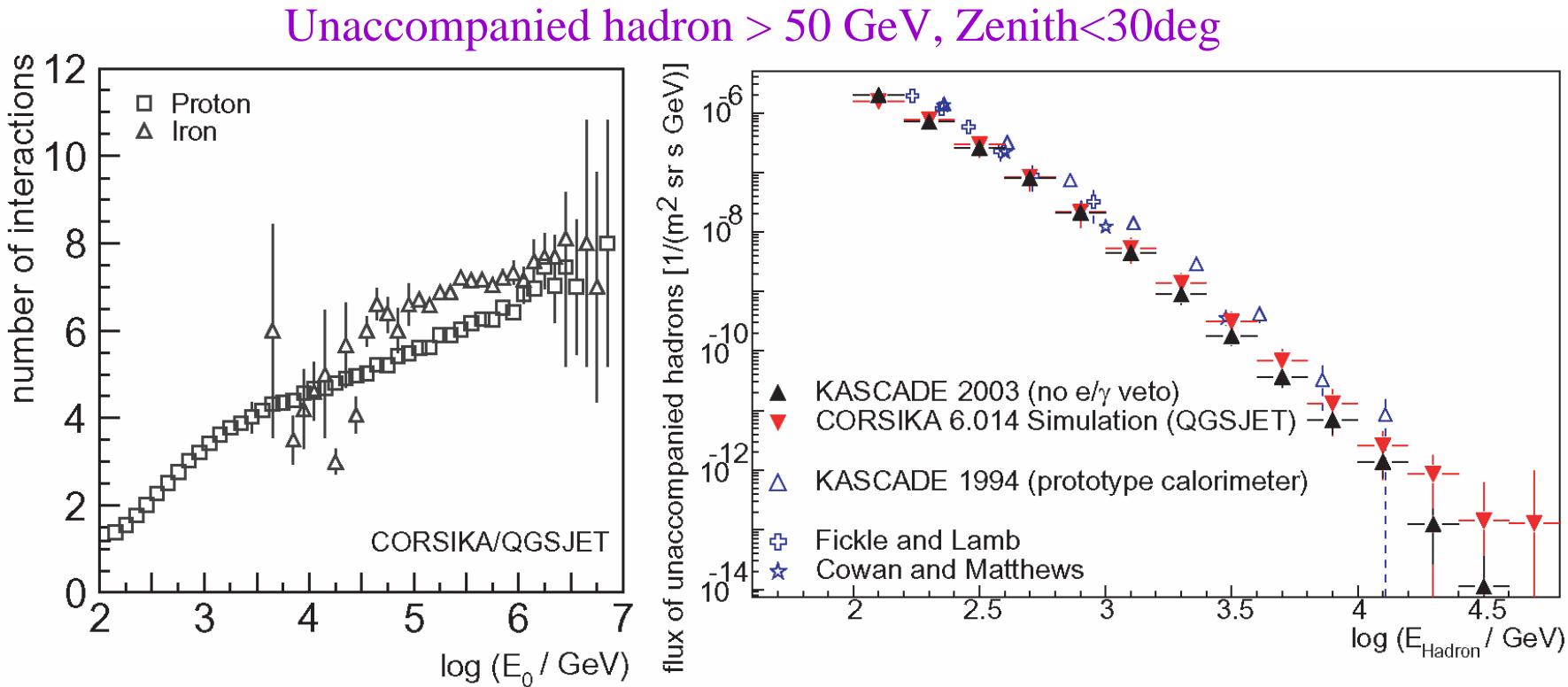


Fig. 1. Left: Number of interactions versus hadron energy at ground level. Right: Flux of unaccompanied hadrons at ground level.

KASCADE Proton Spectrum (UH)

Strong model dependence & systematic errors under study!

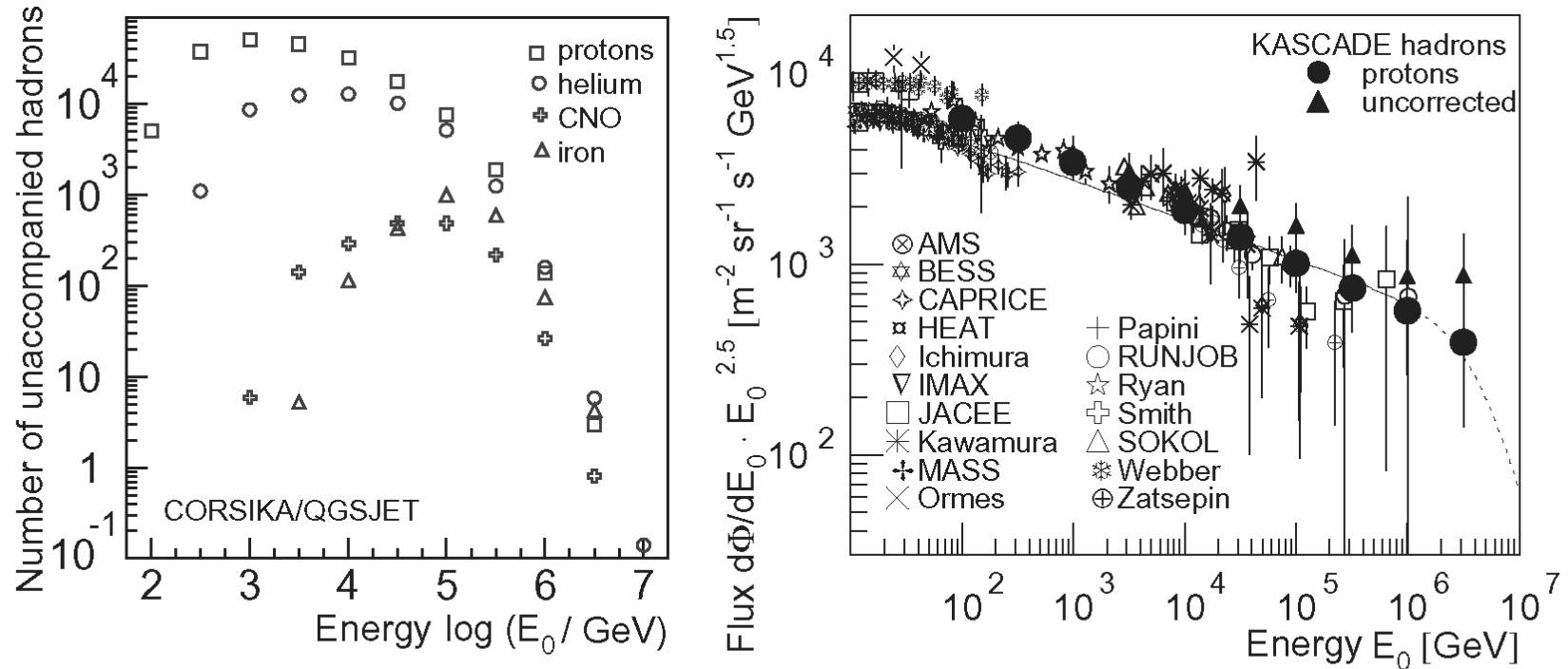


Fig. 3. Left: Number of unaccompanied hadrons versus primary energy for different elemental groups. Right: Primary proton flux reconstructed from unaccompanied hadrons compared to results of direct measurements, for references see [6]. The line represents a fit to the measurements [6].

S

KASCADE Ne vs. N μ

HE 1.1-18 *Markus Roth and H. Ulrich*

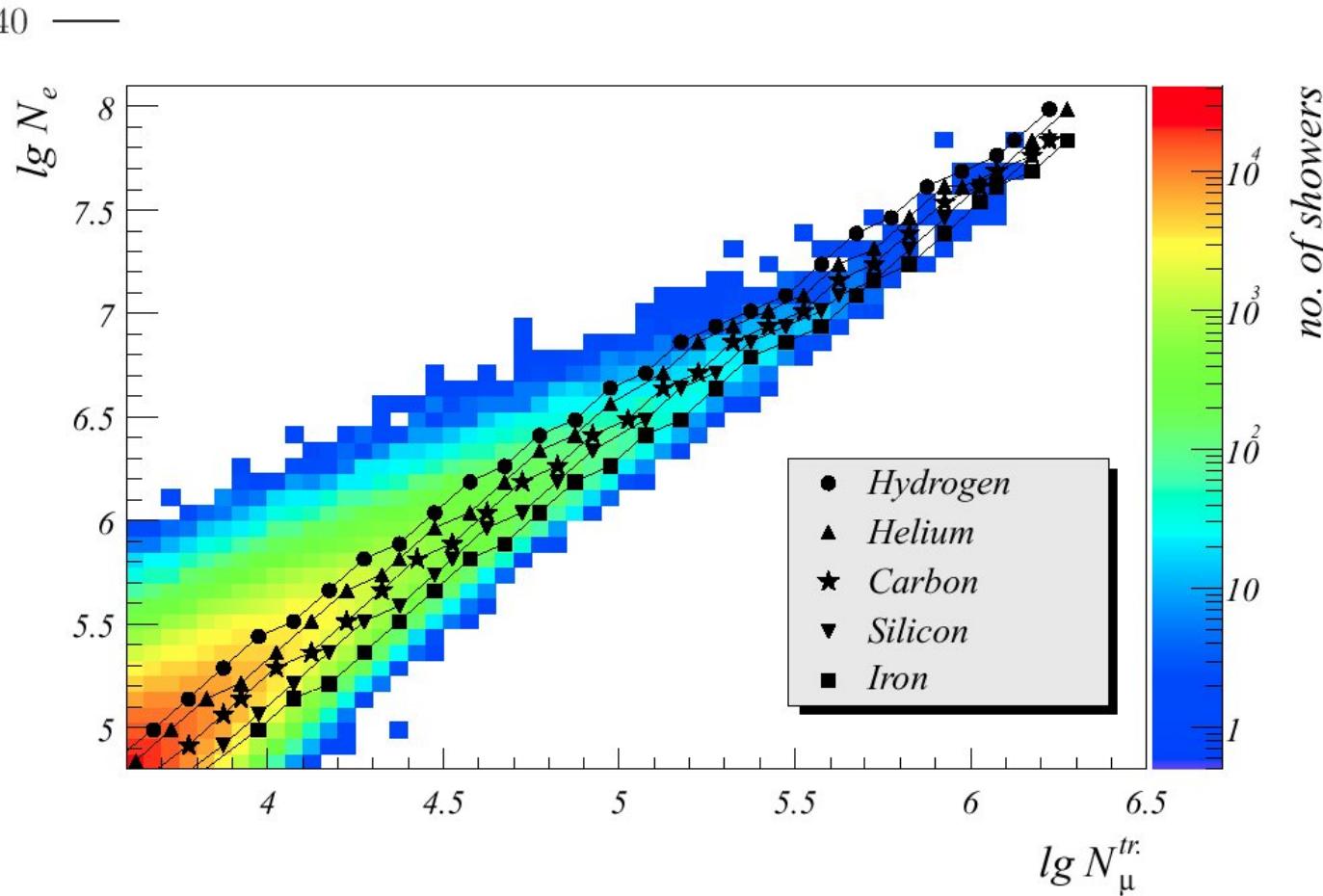


Fig. 1. The two-dimensional shower size spectrum of $lg N_e$ and $lg N_{\mu}^{tr}$. The zenith angle range of the showers is $[0^\circ, 18^\circ]$.

Caveat: MC does not reproduce the data ($\chi^2/\text{d.o.f} \sim 170/100$)

KASCADE PROTON SPECTRUM (Ne vs. N μ)

Caveat: DATA vs MC (Ne vs. N μ) difference under study 141

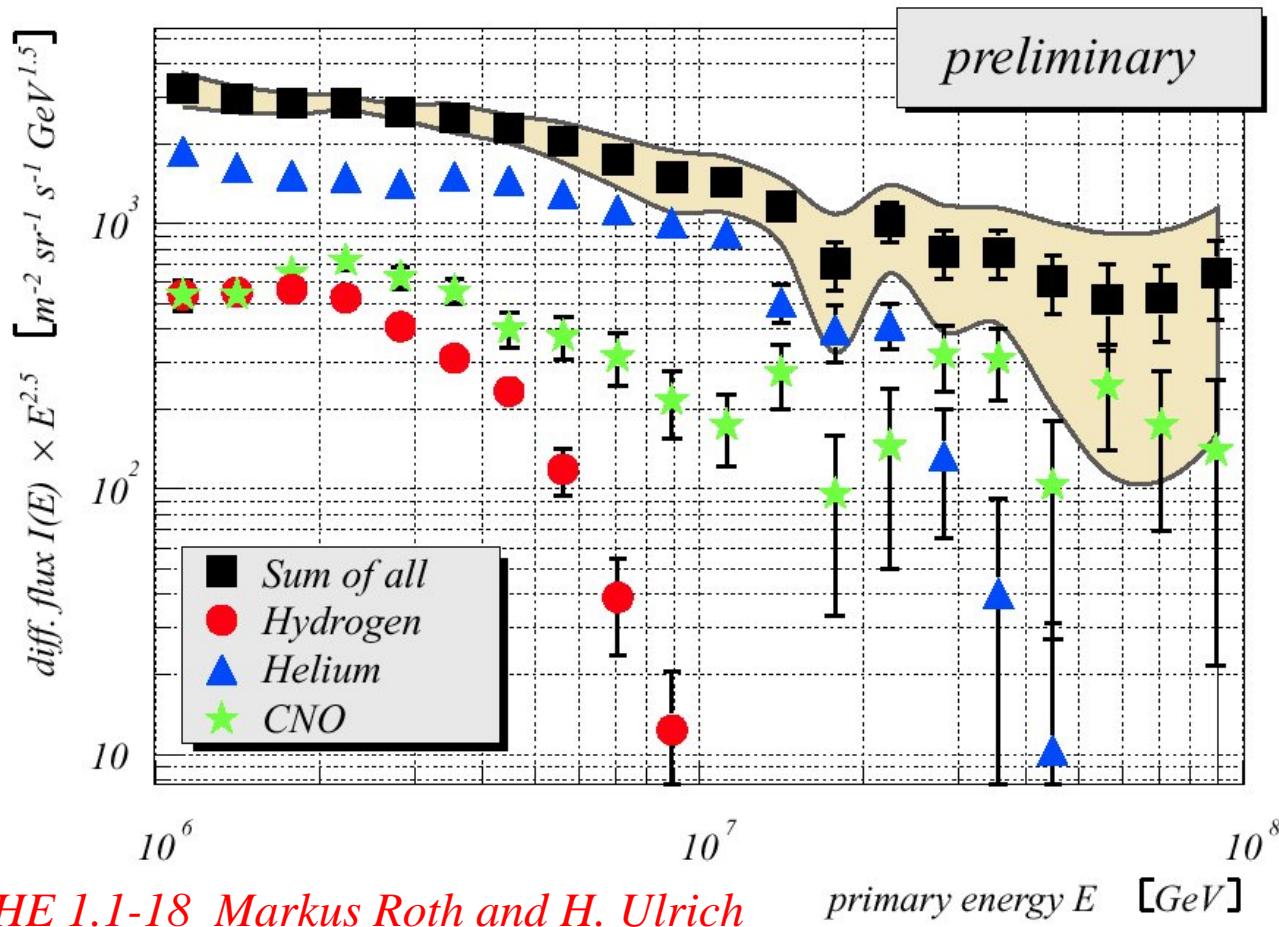


Fig. 2. Result of the Gold unfolding procedure. The given error bars reflect the statistical errors due to the measurement and simulation. The all-particle spectrum as well as the spectra for light elements are displayed. Systematic errors for the all-particle spectrum due to the applied method are indicated by the shaded area.

KASCADE Ne vs. N μ

HE 1.1-18 Markus Roth and H. Ulrich

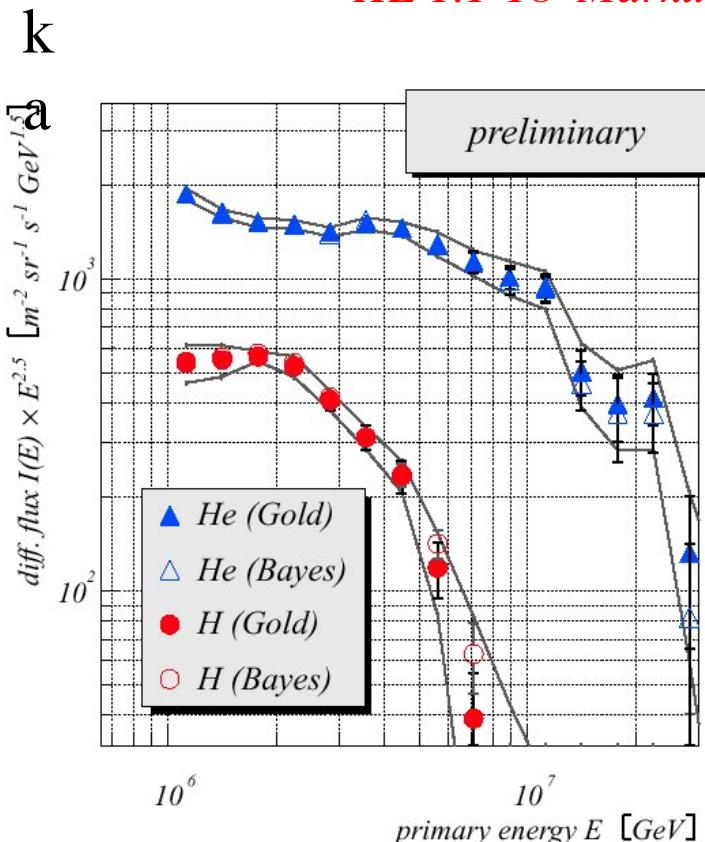


Fig. 3. Comparison of the deconvoluted H and He spectra using Bayesian [2] and Gold [3] unfolding. The solid lines mark the systematic uncertainty of the Gold algorithm.

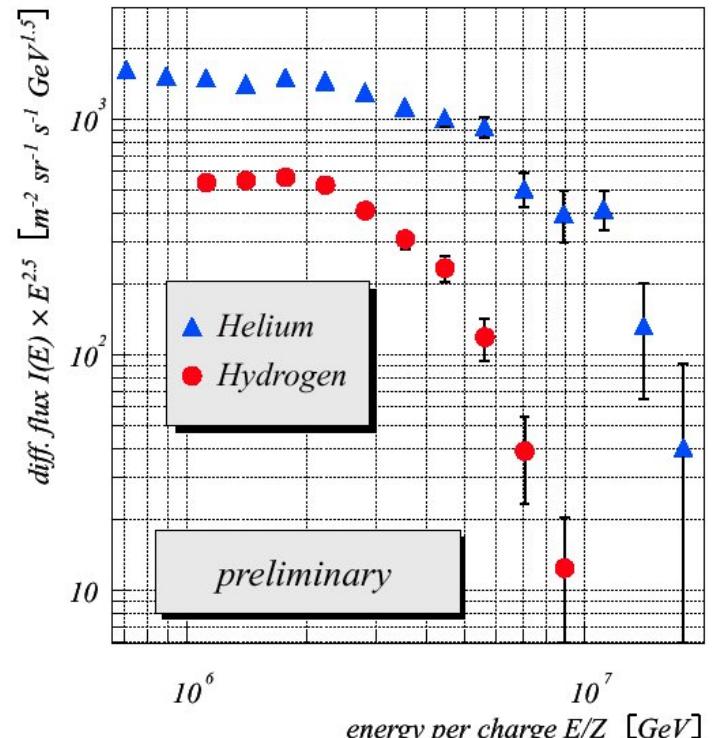
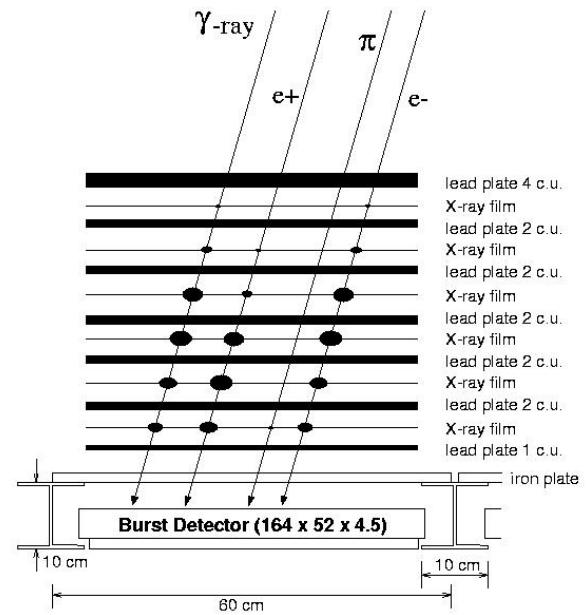


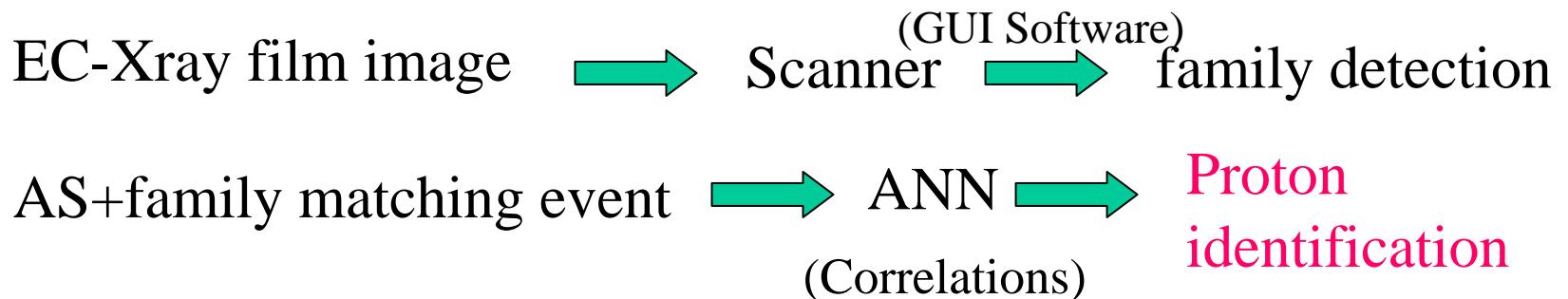
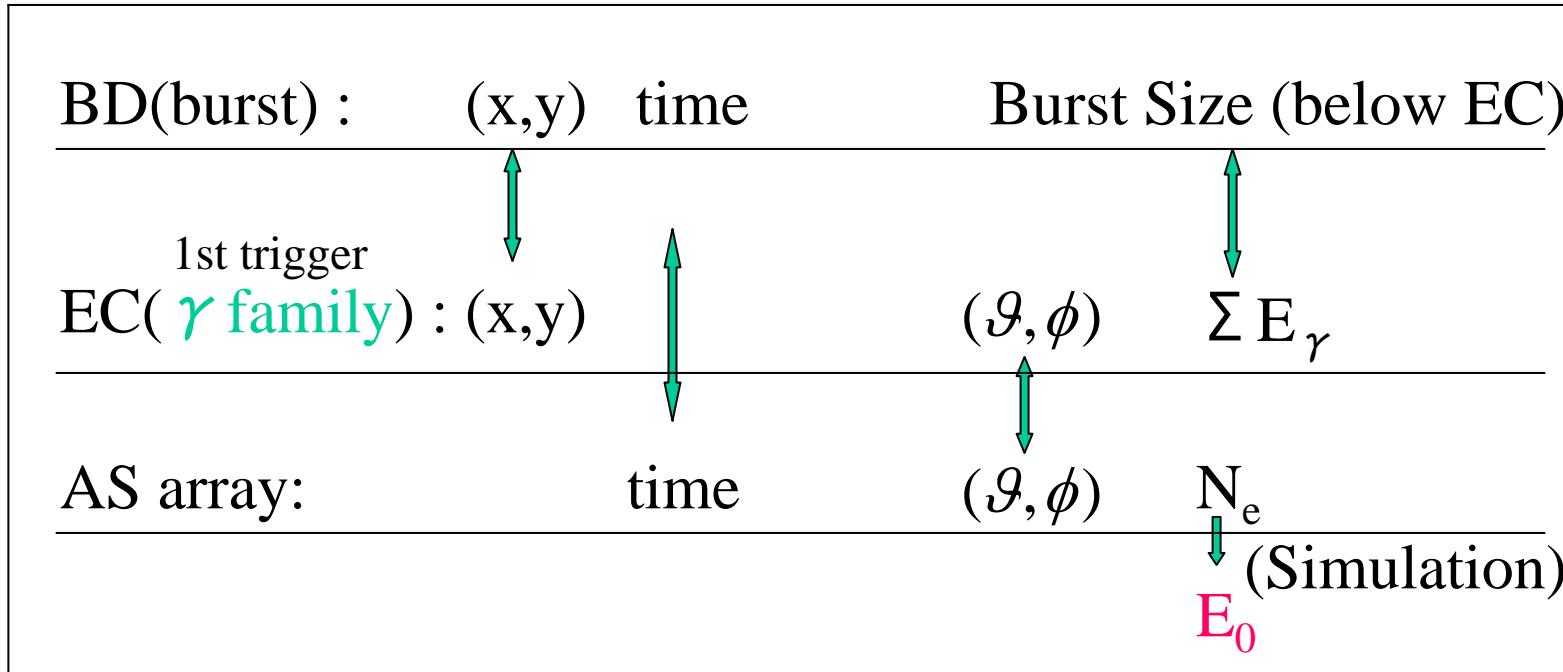
Fig. 4. Individual spectra as a function of the rigidity $R \propto E/Z$. The knee positions of the H and He spectra are nearly at the same position.

TIBET



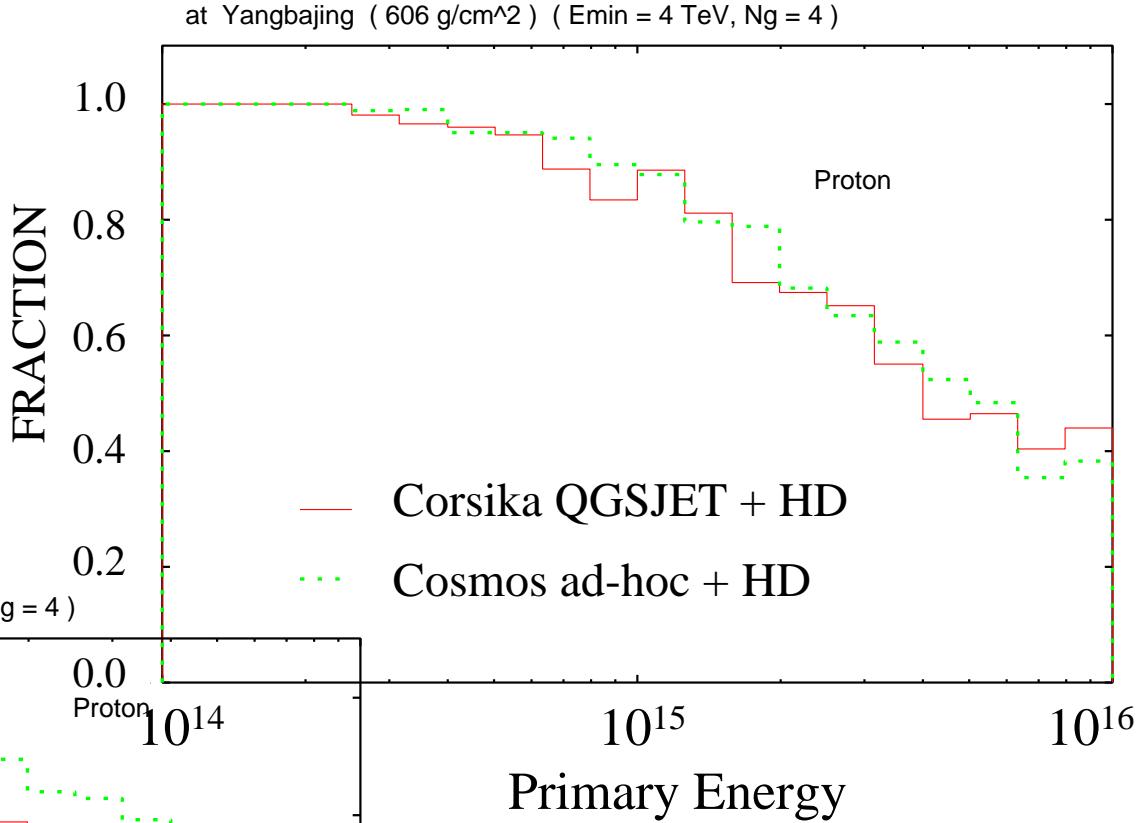
How to obtain proton spectrum?

Hybrid system



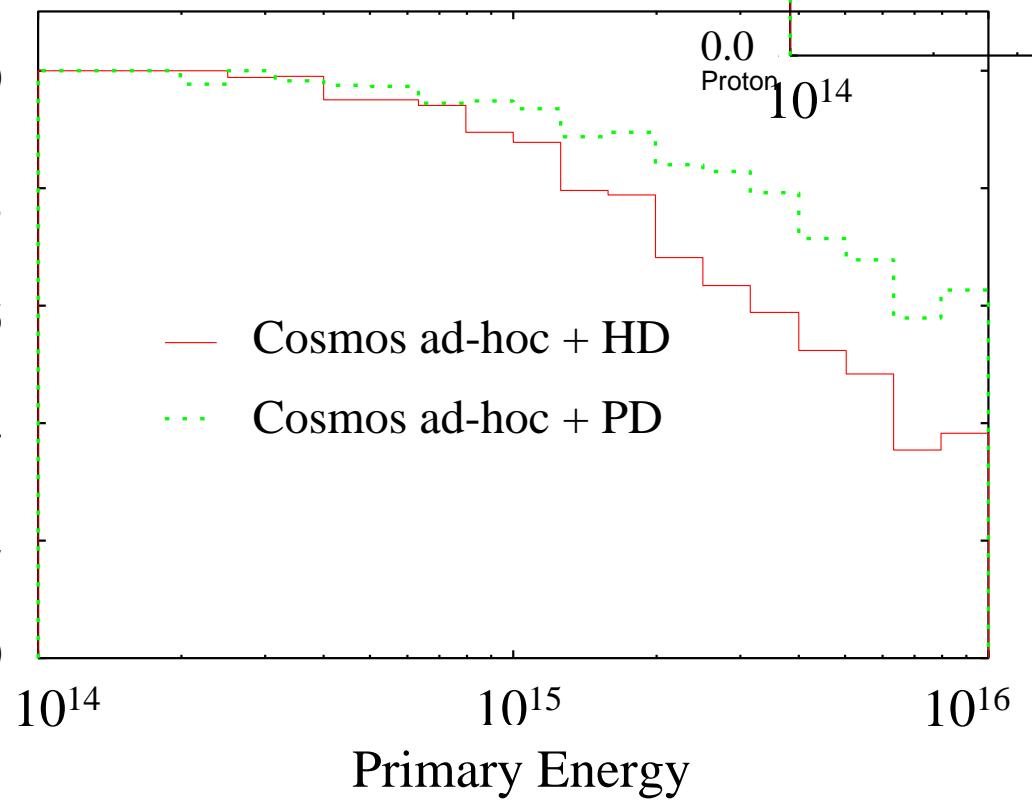
ϵ p-tag by ECC

at Yangbajing (606 g/cm²) (Emin = 4 TeV, Ng = 4)



FRACTION

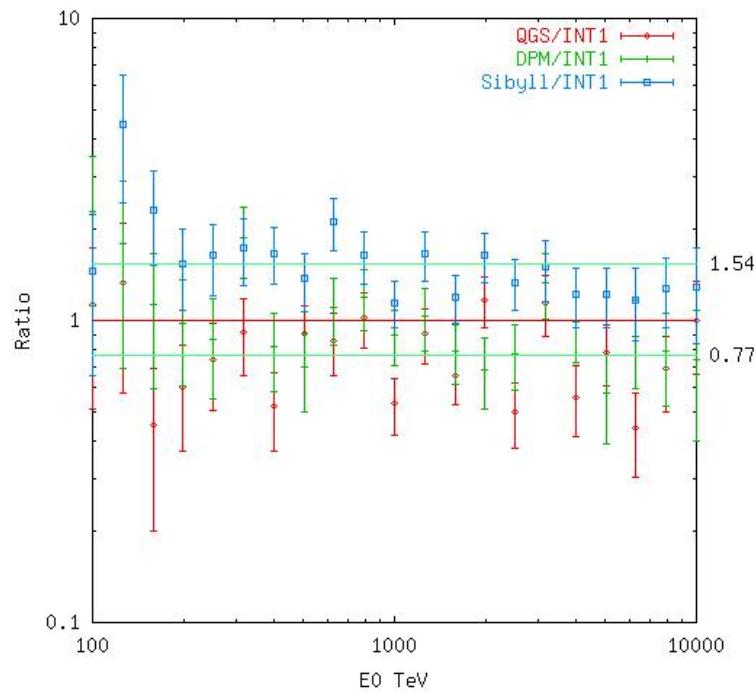
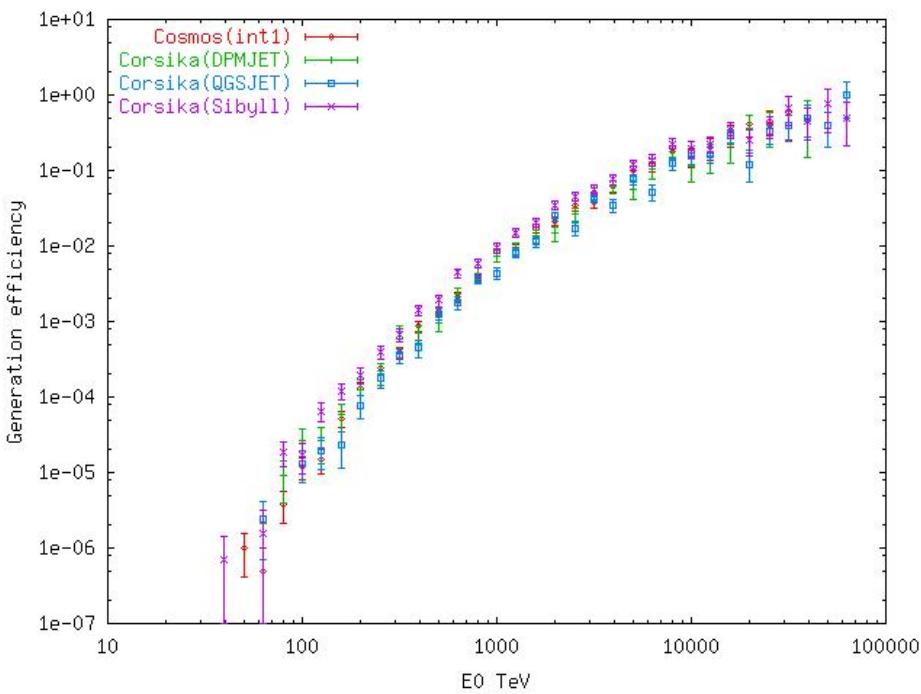
at Yangbajing (606 g/cm²) (Emin = 4 TeV, Ng = 4)



From Shibata Makio

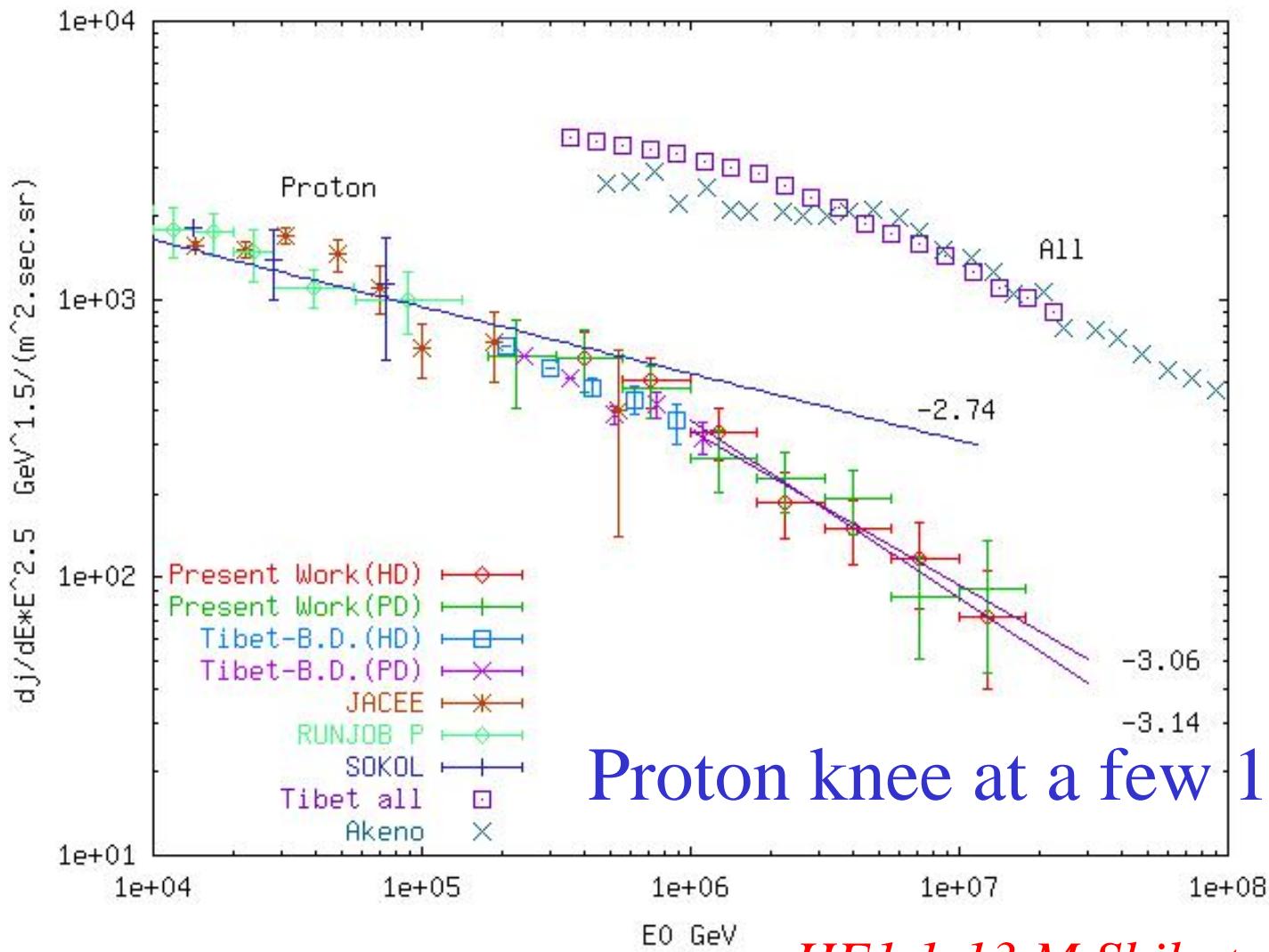
Tibet Proton Spectrum

Efficiency of family generation by protons



HE1.1-13 M.Shibata

Tibet Proton spectrum



HE1.1-13 M.Shibata

Summary (Tibet Proton)

Steepening of the proton energy spectrum in
the knee region is observed.

power index= -3.14 ± 0.10 (HD analysis)

-3.06 ± 0.09 (PD analysis)

Comparison with direct measurement suggests the
break point of protons exists at a few 100 TeV.
The knee of all particle spectrum (3-5PeV) can be
interpreted as produced by iron($Z=26$) component.

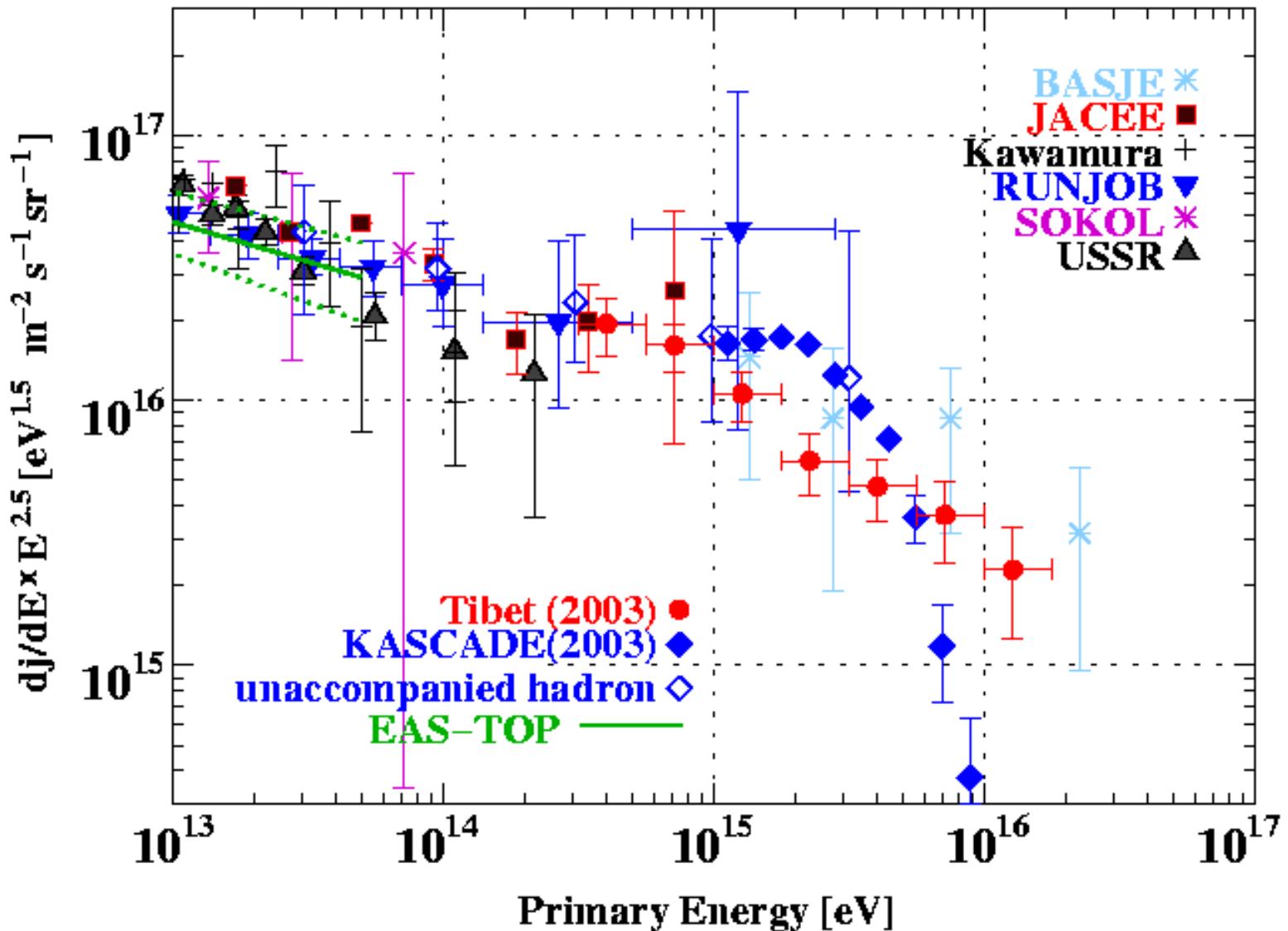
Tibet Proton Spectrum

Systematic errors

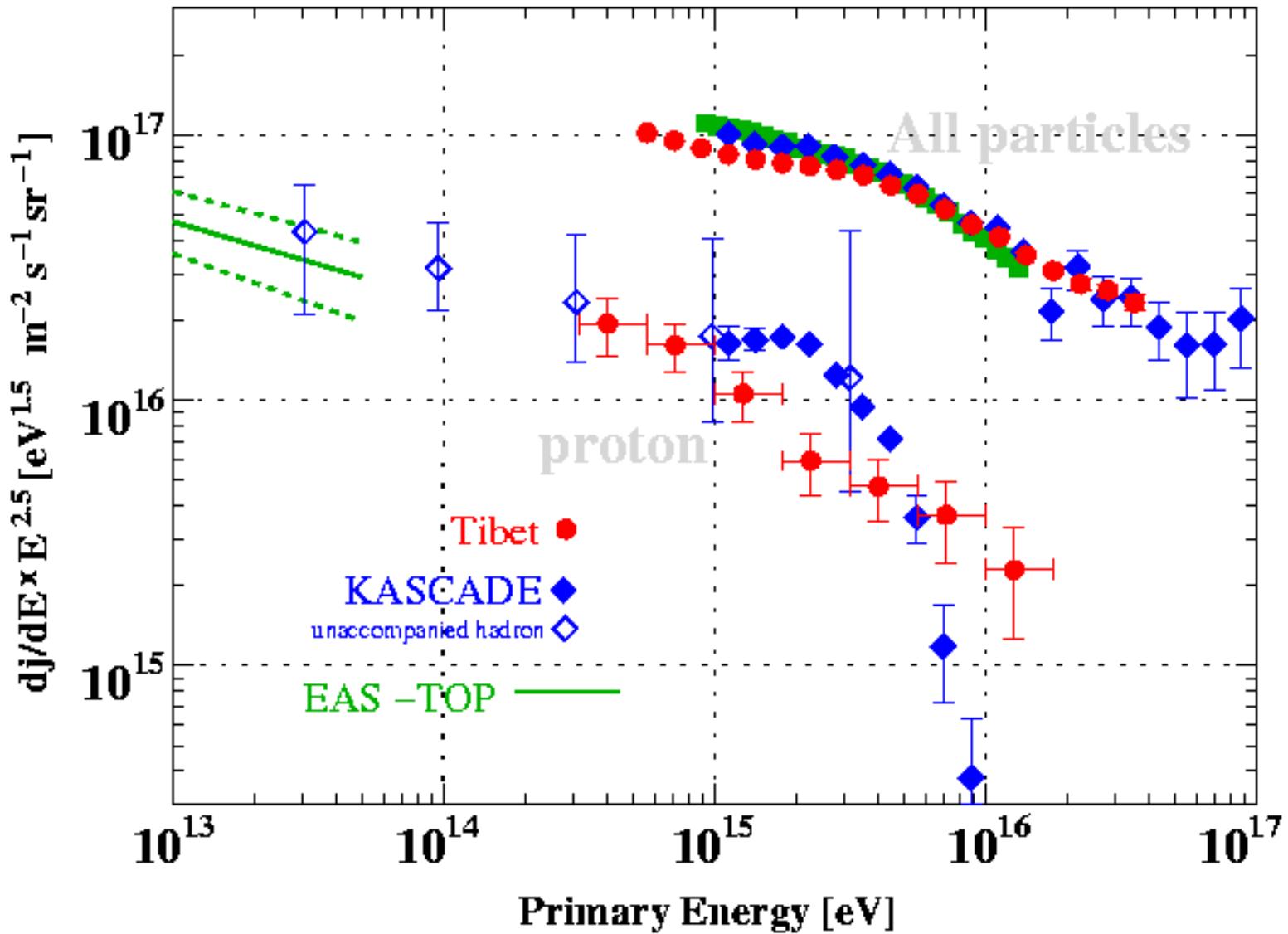
Absolute flux by interaction model 20 %
(however, no effect on power index)

HE1.1-13:M.Shibata

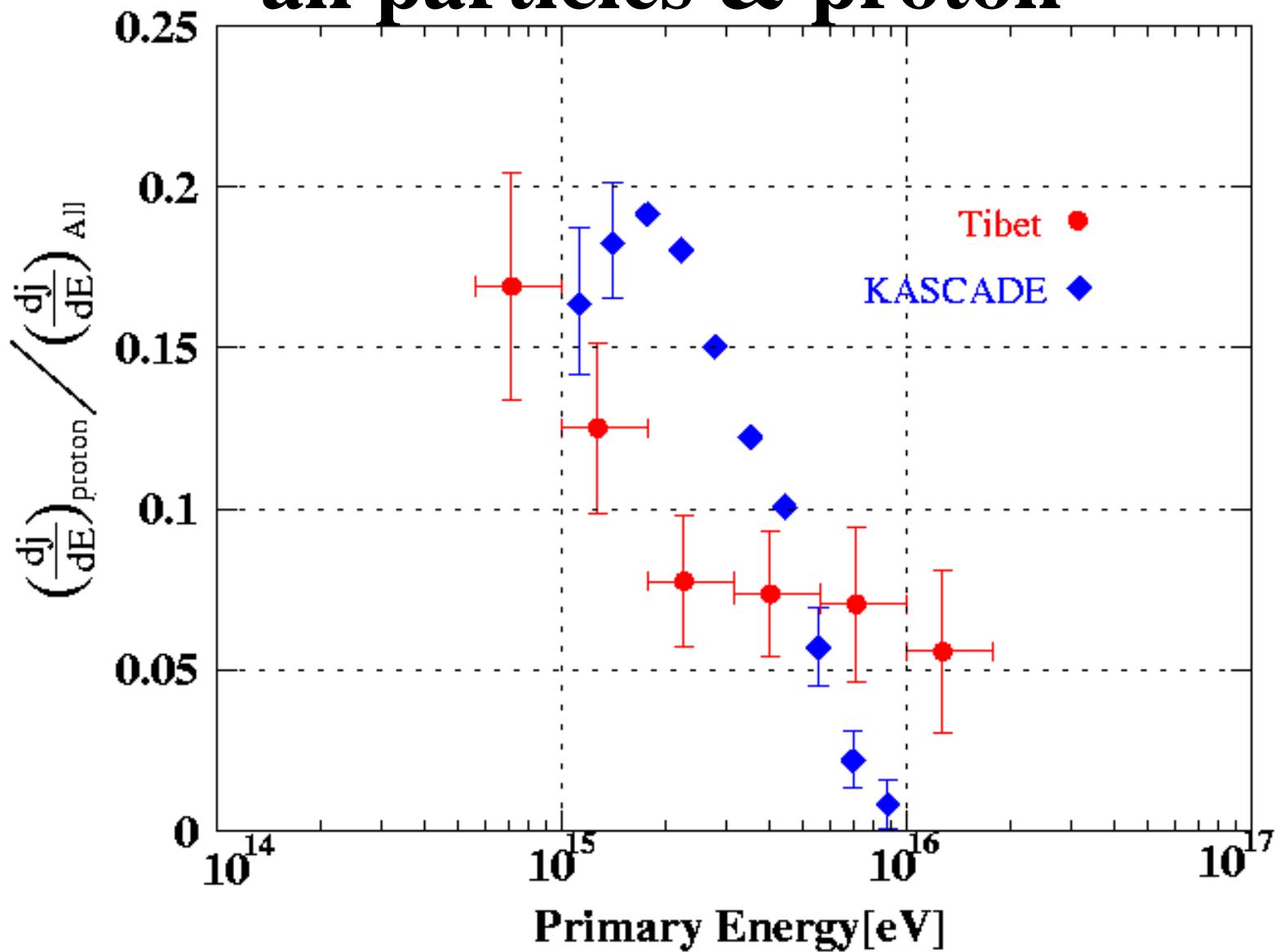
Proton spectrum



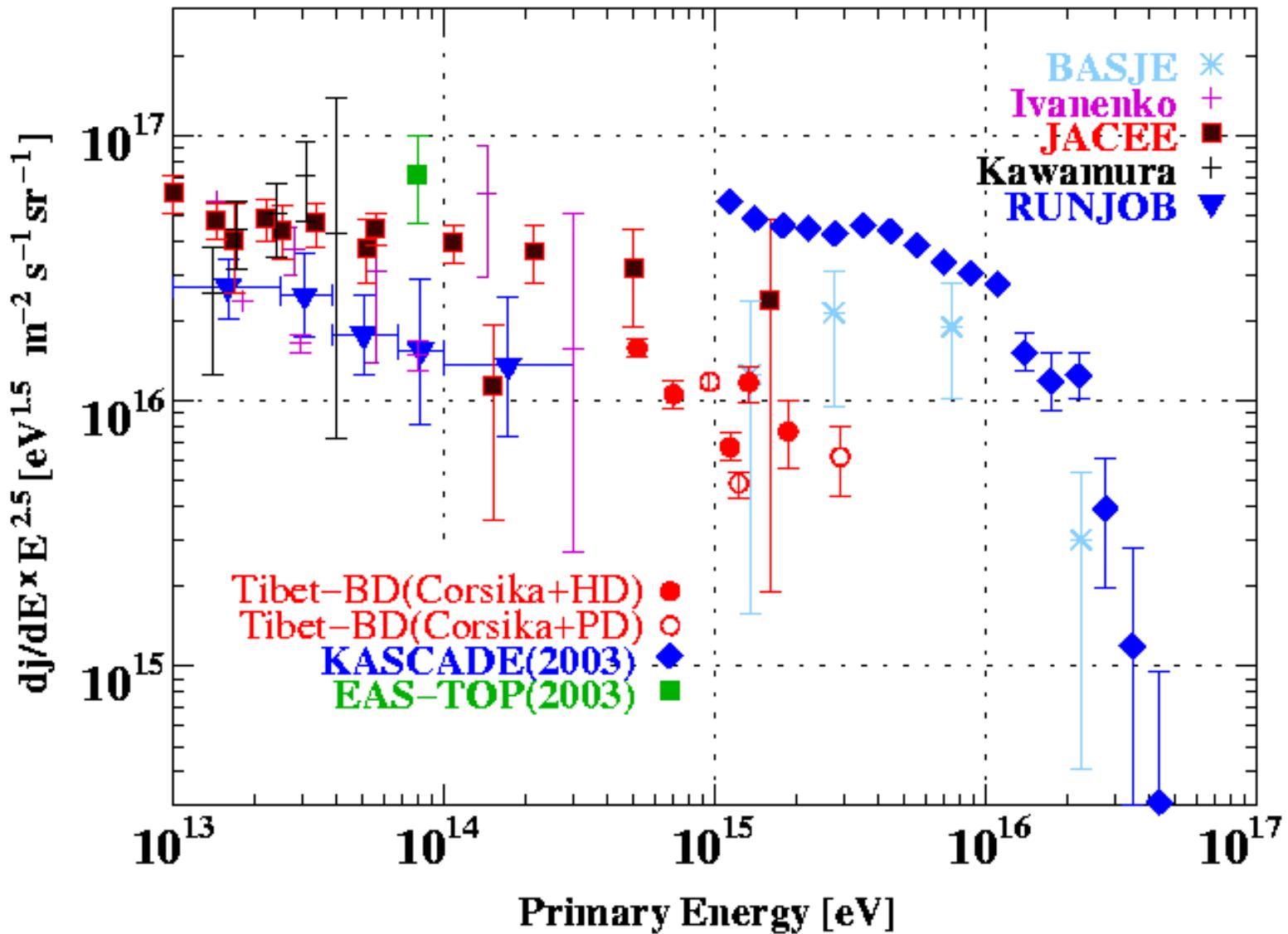
All particles & Proton



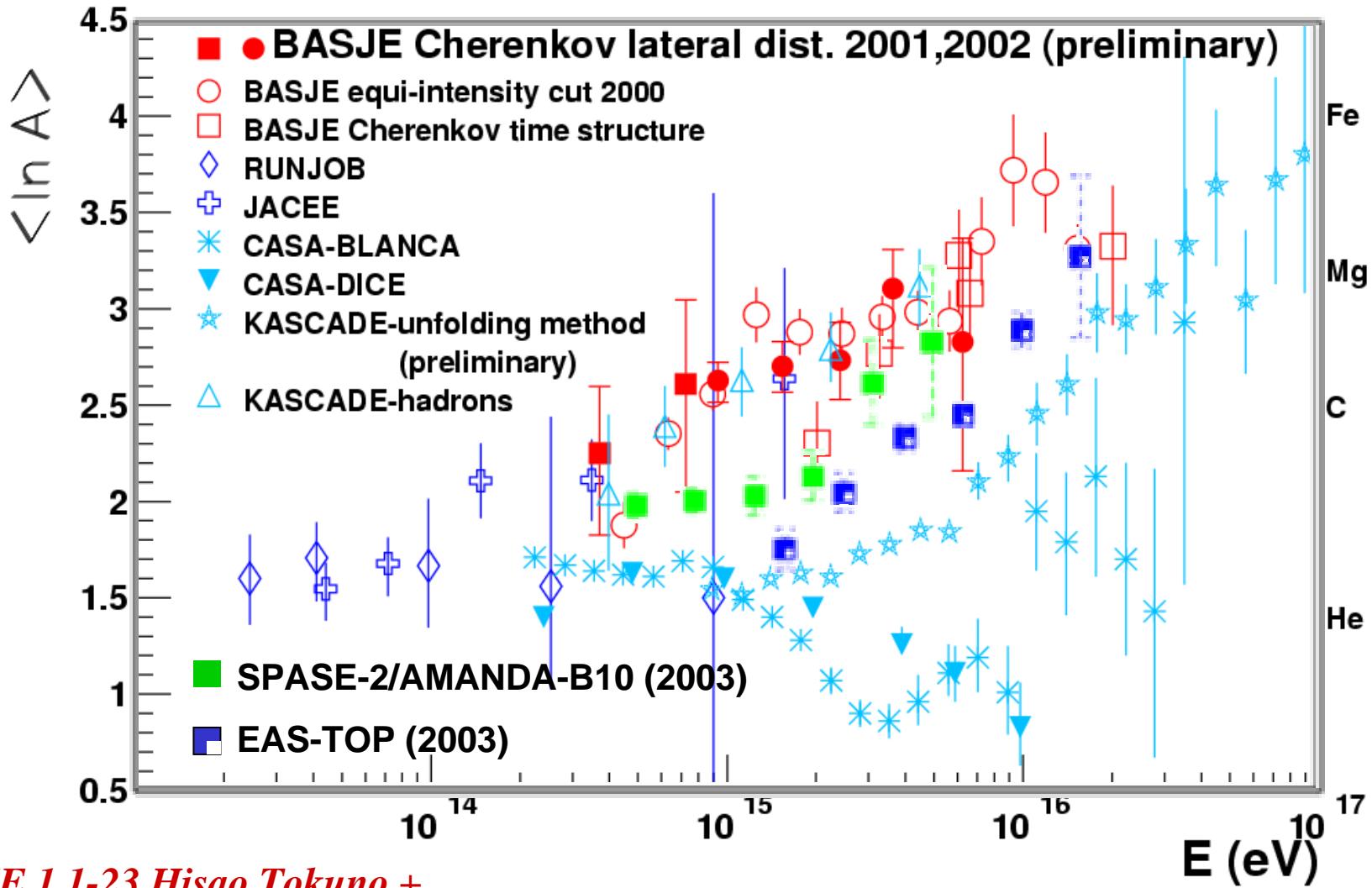
Comparison with all particles & proton



Helium spectrum



Cosmic Ray Composition $\langle \ln A \rangle$



HE 1.1-23 Hisao Tokuno +

HE 1.1-25 Katherine Rawlins for the SPASE and the AMANDA Collaboration

HE 1.1-21 Gianni Navarra for the EAS-TOP Collaboration

KASCADE Anisotropy (1)

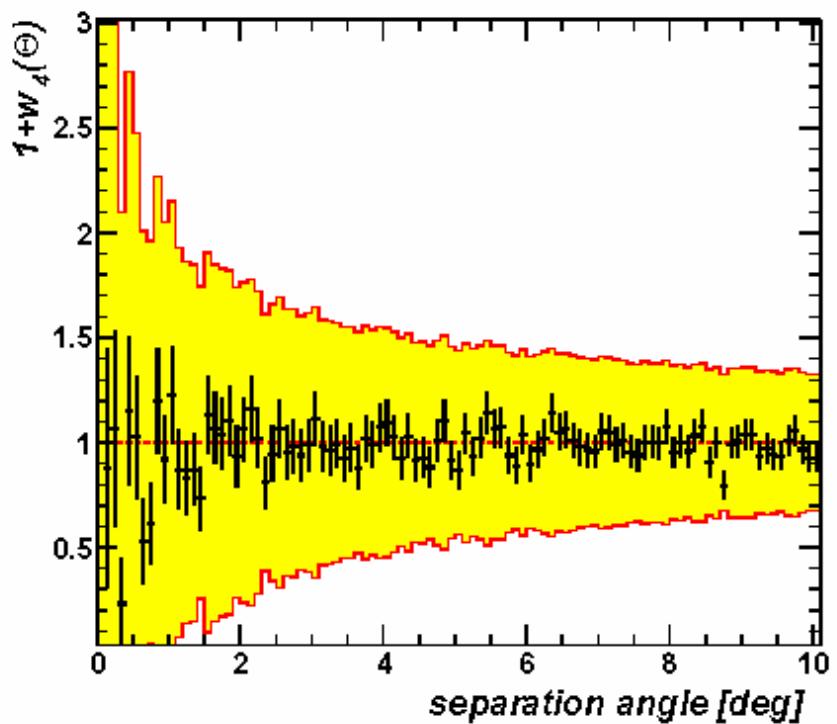
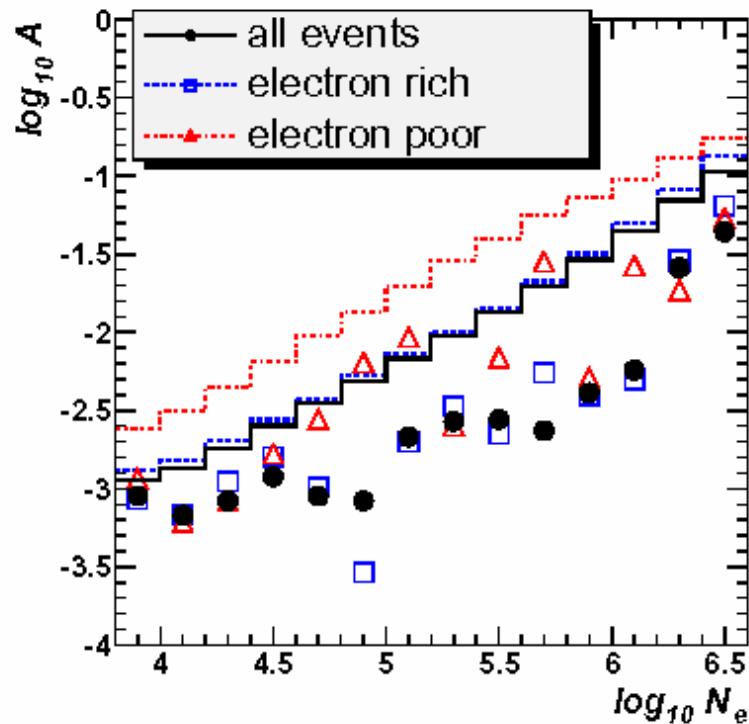


Fig. 1. Left: Rayleigh amplitudes. Right: autocorrelation of the 1000 largest showers.

KASCADE Anisotropy (2)

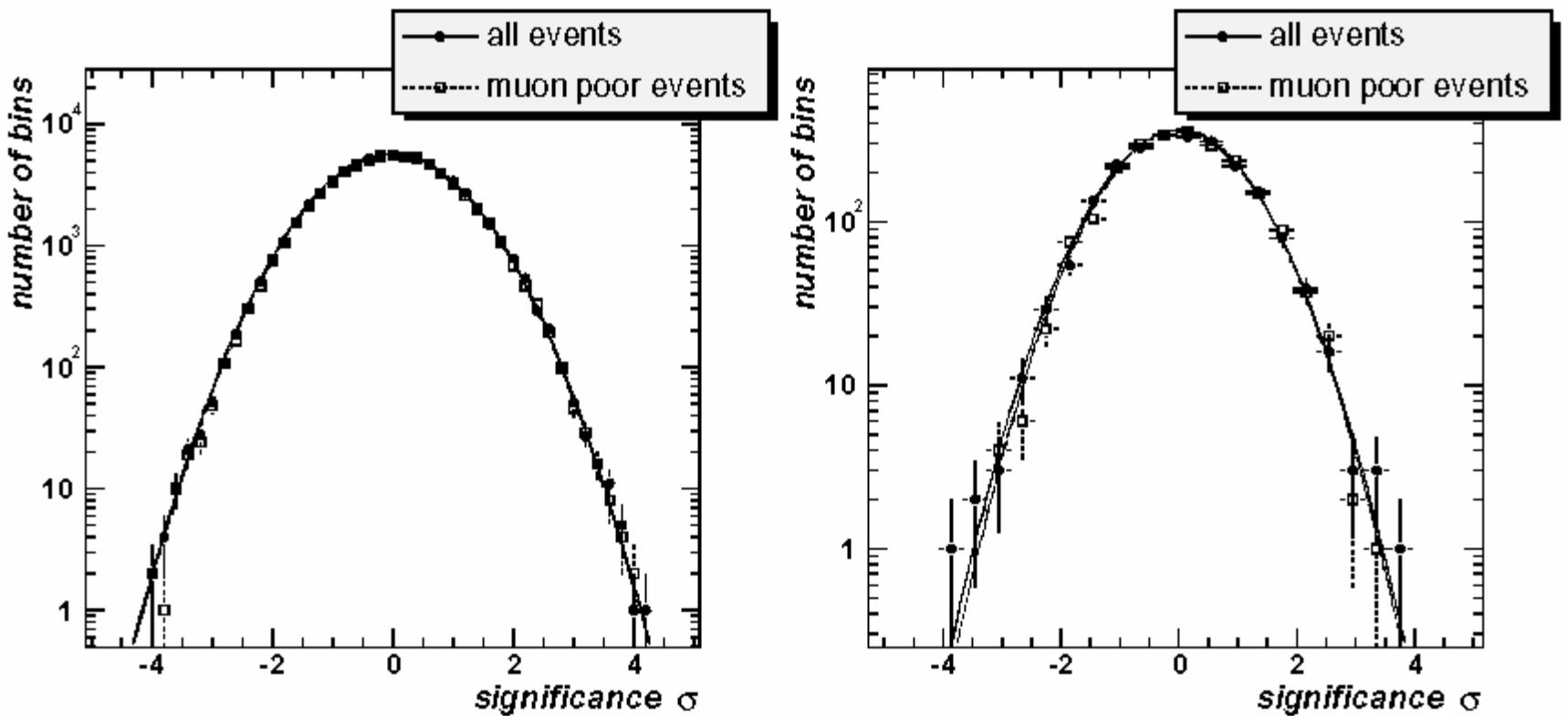
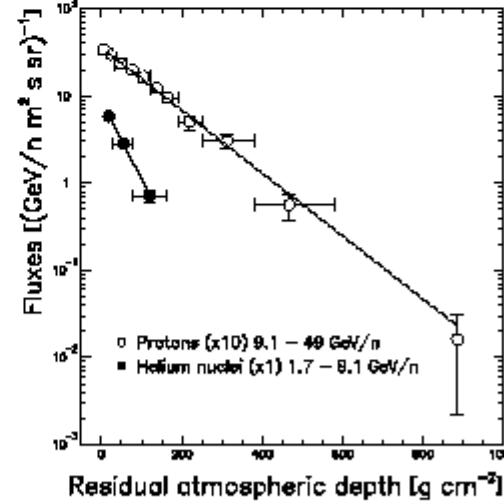
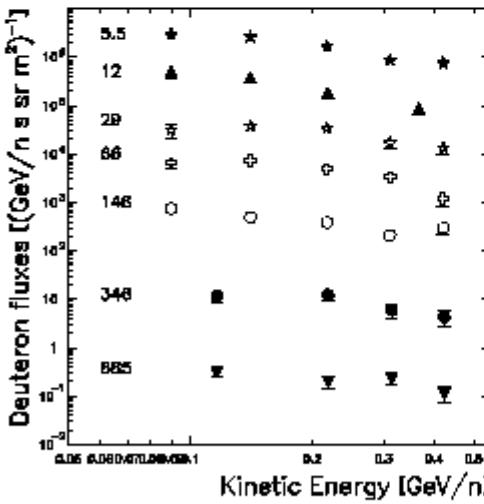
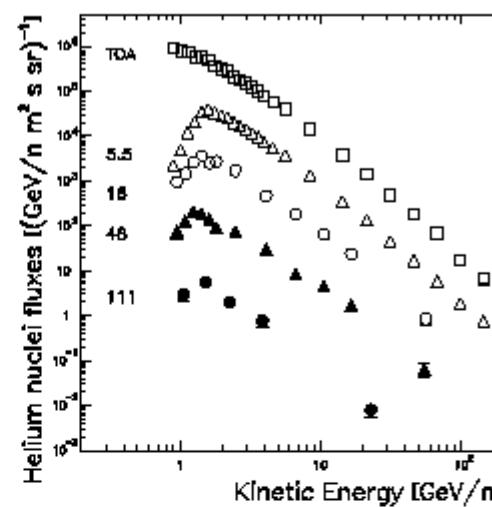
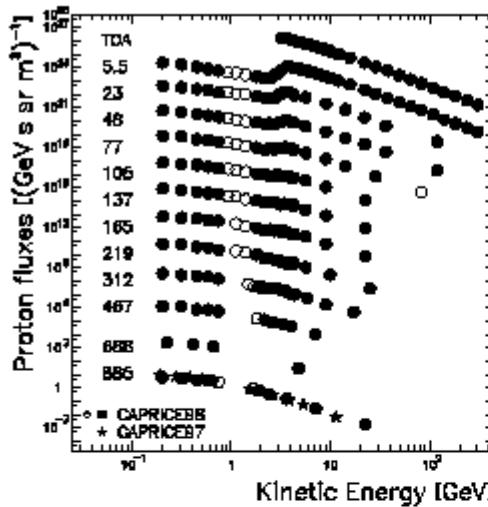


Fig. 2. Significance distribution of the visible sky of KASCADE (left) and of the sky inside a band of 6° around the galactic plane (right).

Caprice98 (for tuning MC)



e^- spectra

e^+ spectra

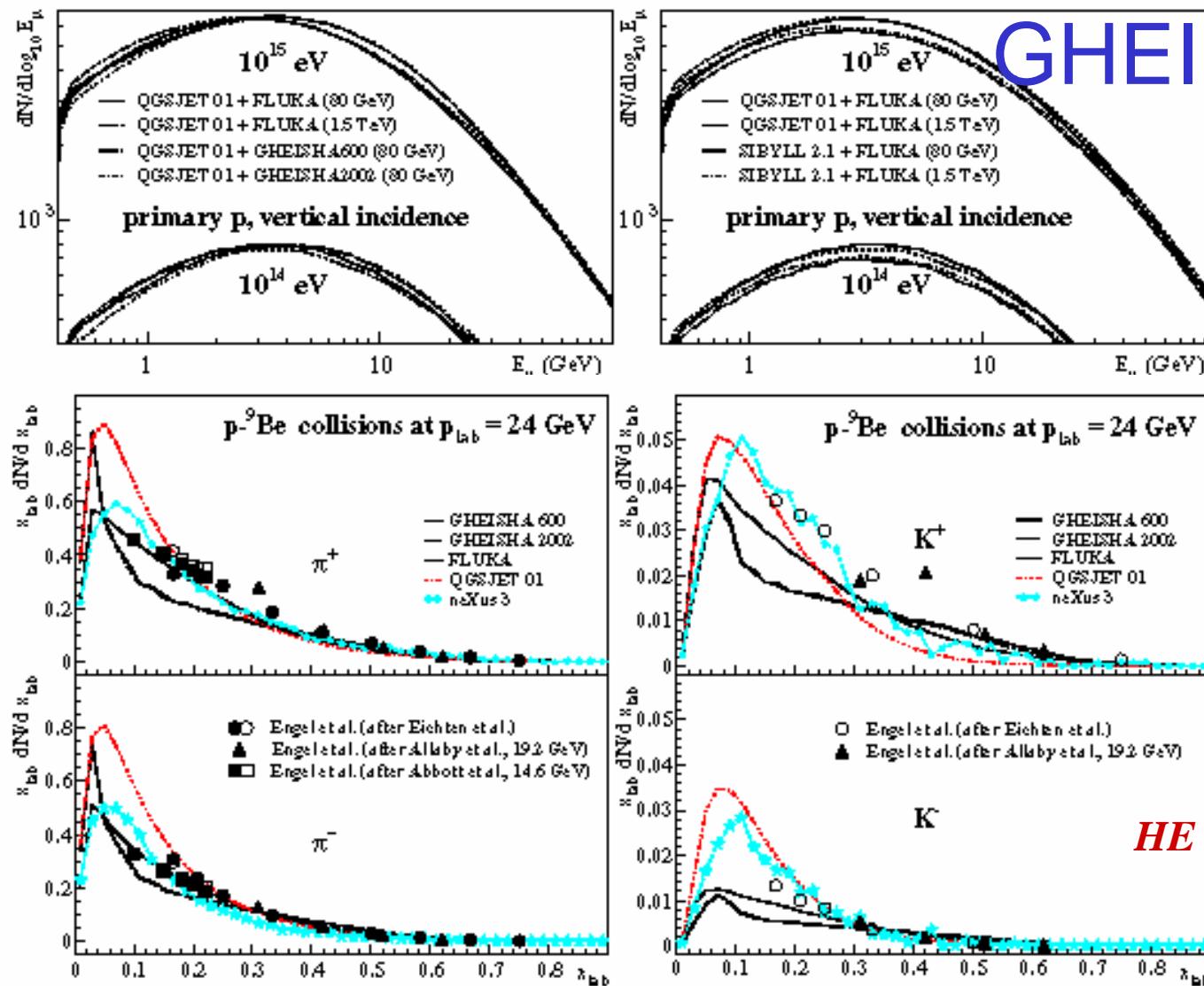
covered by a single experiment

Fig. 1. From the upper left clockwise: the proton spectra, the helium nuclei spectra, the proton and helium nuclei fluxes as function of the atmospheric depth and the deuteron spectra. Spectra are scaled as described in the text, the average residual atmospheric depth is reported and expressed in g/cm^2 .

HE3.1-9: E.Mocchiutti et al.

FLUKA - recommended

**GHEISHA – wrong
in LE part**



HE 1.2-5 Ralph Engel et al.

Fig. 1. Distribution of secondary particle momenta $z_{\text{lab}} = p_{\text{tot}}/p_{\text{beam}}$ in $p - {}^9\text{Be}$ collisions at $p_{\text{lab}} = 24 \text{ GeV}$. Left: Pions. Right: Kaons. The experimental data points were derived [8] from the measurements of [6, 2, 1].

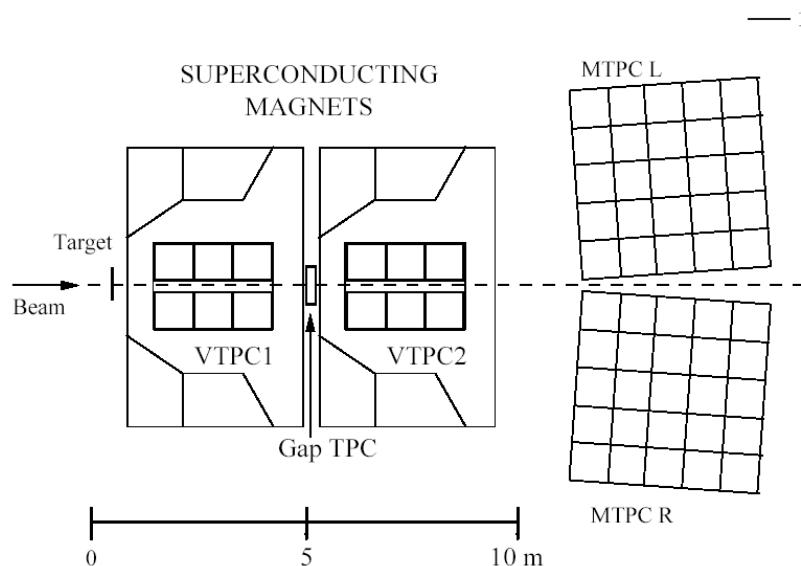
Motivation and outline

- TARGET 3D (old version: 2.1, current version: 2.4)
 - very flexible and tunable hadronic interaction model
 - simple and fast Monte Carlo code
 - optimization for inclusive muon/neutrino fluxes
- event generation structure and recent improvements
- comparison to data
- application: L3+C muon flux

Forthcoming New DATA

Being analyzed-> results soon

NA49 at CERN



HARP at CERN

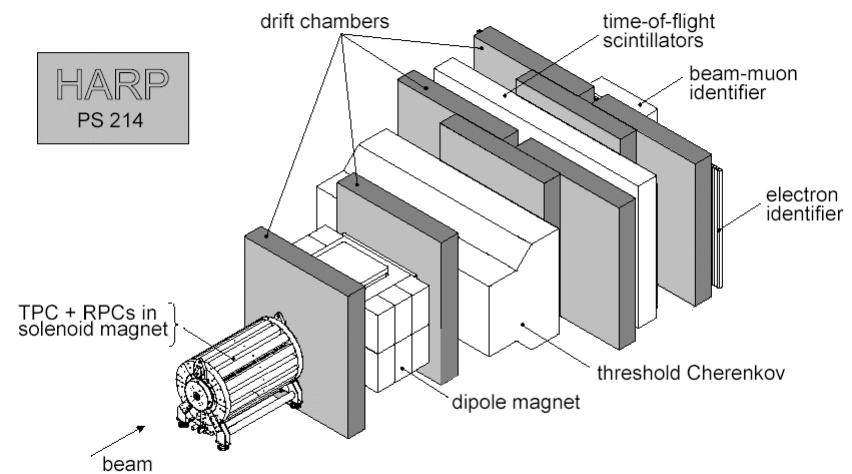


Fig. 1. Schematic of the components of the detector

Fig. 1. Schematic layout of the main components of the NA49 experiment used in the hadroproduction measurement.

Future Experiments

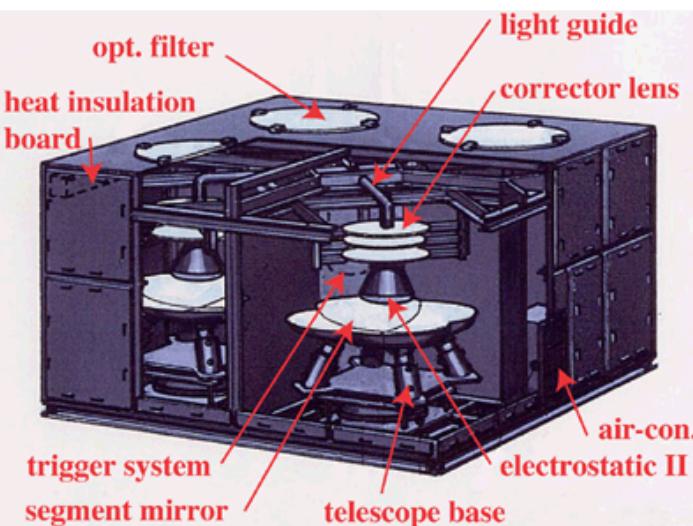
Experiment	site	Depth (g/cm ²)	Energy (eV)	e	μ (GeV)	h (GeV)	\check{C}	year
ARGO-YBJ	Tibet (30.1N,90.5E)	606	<10 ¹²	○				2005 -
ASHRA-1	Hawaii (--,--)	600?	10 ¹² - 10 ²⁰				○	2005 -
ICE-TOP	Antarctic (--,--)	?	>300TeV	○				200?-
KASCADE-Grande	Germany (49.N, 8.E)	1022	10 ¹⁵ – 10 ¹⁷	○	230 490 800 2400	50		Jul.2003 -



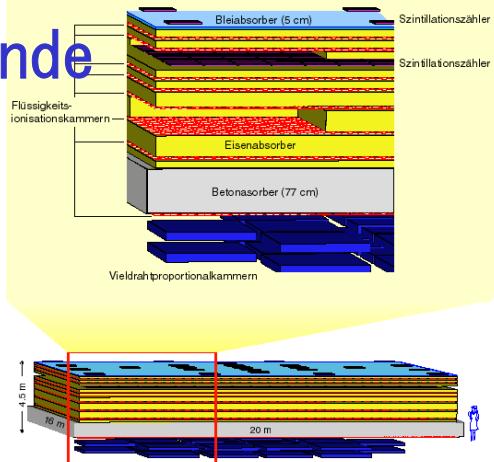
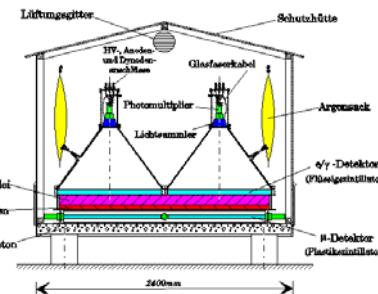
ARGO-YBJ



ASHRA



KASCADE-Grande



ICE-TOP



Conclusions

- Lots of Interesting & Exciting Presentations, among them,
All-particle Spectrum Consistent between Tibet & KASCADE

Tibet Knee:

Protons at a few 100 TeV &

Fe at 3-5 PeV (~all particles' knee)

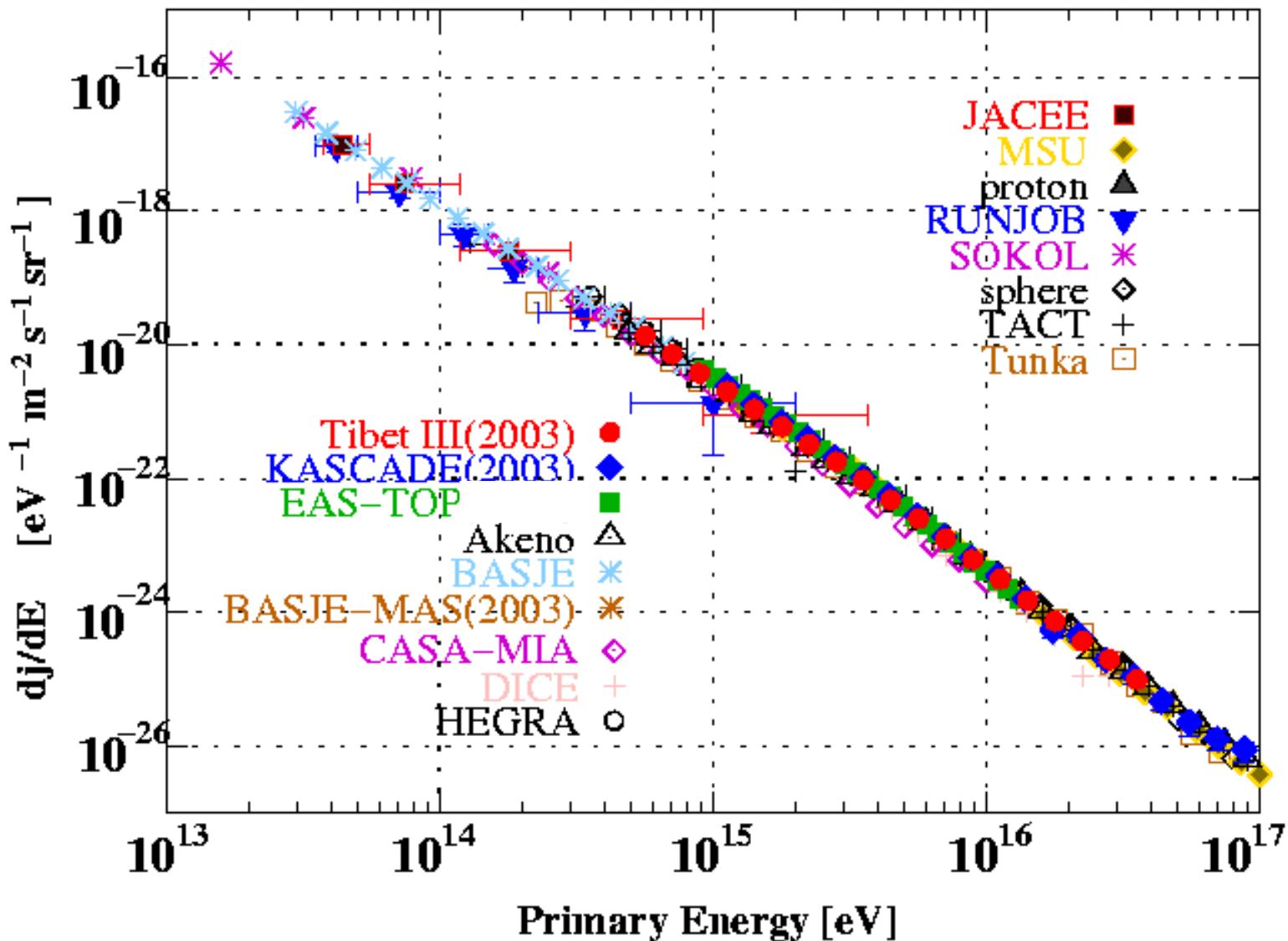
KASCADE Knee:

Protons at 3-5 PeV &

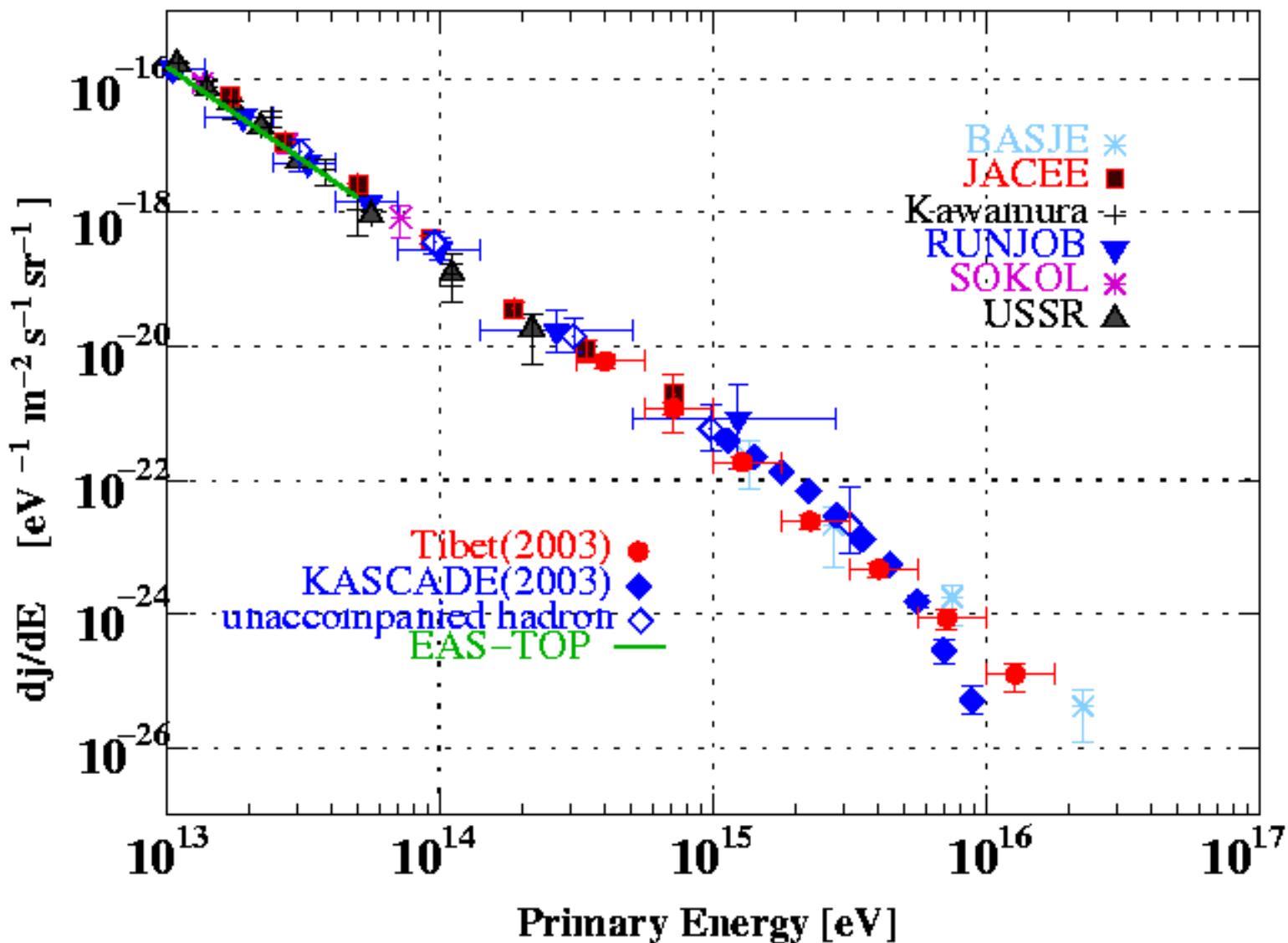
Fe (NOT FOUND YET) at $\sim 10^{17}$ eV(KASCADE-
Grande)

- FLUKA Recommended for L.E. Hadron Interaction Model
in stead of GHEISHA.
- Looking forward to Exciting New Results at ICRC2005.

All particle spectrum



Proton spectrum



Helium spectrum

