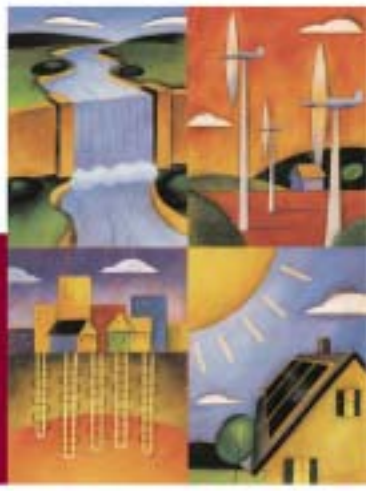
Florida Institute of Technology
College of Science and Liberal Arts
# Research News & Report 2003
Florida Institute of Technology — Melbourne, Florida



## In This Issue



## Modern-Day Ben Franklins Study Lightning

Dr. Joseph Dwyer of the Department of Physics and Space Sciences was the College of Science and Liberal Arts Science Lecturer for the 2003 spring term. Like a modern-day Ben Franklin, Dwyer spoke about the recent discovery of x-ray emission from lightning.

Everyone is familiar with the image of some hapless carton character being hit by lightning: as the lightning bolt strikes, for an instant, the skeleton of the victim becomes visible as if suddenly exposed to x-rays. For years, scientists have scoffed at this familiar image, because while lightning is very bright in visible light, it was not thought to produce x-rays or other kinds of energetic radiation. Usually the production of energetic radiation, i.e., x-rays, gamma-rays and fast electrons, is hampered by the presence of air and requires a vacuum like that found in outer space or inside an x-ray tube.

The recent discovery that intense bursts of energetic radiation occurs in rocket-triggered lightning was, therefore, quite surprising. The discovery was made using a Florida Tech instrument specifically designed and built to operate in the electromagnetically noisy environment near lightning. For this research, small rockets trailing a thin copper wire were launched into overhead thunderclouds, triggering lightning only 75 feet from the instrument.

The reason that lightning appears to flicker is that each flash is often made up of multiple return strokes. It was just before these return strokes, in intervals lasting only one ten-thousandths of a second, that very bright bursts of energetic radiation were detected.

Because triggered lightning is very similar to natural lightning, these results suggest that a similar phenomenon is occurring in natural lightning as well. Most models of lightning to not predict the production of energetic radiation, so these new results suggest that current understanding of how lightning works is not complete.

Dwyer and Dr. Hamid Rassoul, also from the physics and space sciences department, and others on their team will continue to learn how x-rays function as a part of the lightning.

# Bush Prepares for Andes Expedition

Dr. Mark Bush, associate professor of biological sciences, will be getting ready for an exciting expedition to help preserve a conservation hotspot. Bush received a $450,000 grant from the National Science Foundation (NSF) for climate control research in Peru. He will be traveling through remote neotropic sites in the Andes Mountains.

Bush says, "Where the Andes rise from the Amazon plain, the forests are identified as a biodiversity, as well as a conservation, hotspot, because of the threat from human land conversion. Of 25 such hotspots labeled by Conservation International, the region most at risk from future climate change is the neotropical Andes."

Professor Bush will be coordinating the project. He and his team of undergraduate and graduate students will be working in concert with other researchers from Northern Kentucky University and Wake Forest University. The team will document what is growing in the region and research how systems have responded to past climate changes. The study will help in the effort to develop conservation policies.

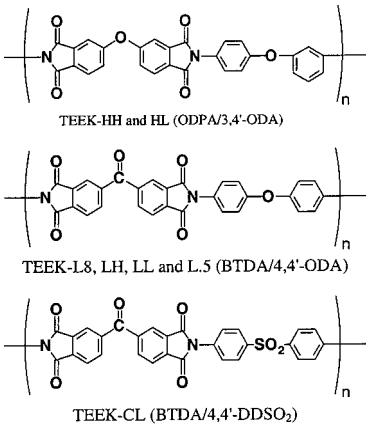
# Research With Polyimide Foams

Dean Gordon Nelson and Martha Williams, a senior polymer chemist and NASA-Kennedy Space Center staff member, have been studying the properties of NASA high temperature polyimide foams as part of Ms. Williams' doctoral program.

In this research, specific properties of three different, closely related polyimide foams (namely, TEEK-H, TEEK-L and TEEK-C) were comparatively studied: thermal, mechanical, surface, flammability and degradation properties. Foams have much higher surface areas than solid polymers and are a greater challenge to fire retard. Because of the intrinsic flame retardancy of aromatic polyimides, one has the ability to investigate the effects of changes in density, surface area and chemical structure on fire properties, physical and mechanical properties, and the degradation of foams that have not been previously reported. Data indicate that subtle differences in chemical structure result in large differences in surface area, which further results in large differences in heat release and other flammability properties as observed in radiant panel and cone calorimeter data.

Thermal stability and degradation studies indicate that the diamine rather than the dianhydride is the greater contributing factor to the thermal stability of polyimide foams. The degradation mechanisms follow that reported previously in the literature for polyimide films. X-ray photoelectron spectroscopy (XPS) analyses of oxygen-plasma-exposed samples indicate an overall oxidation of the foams and that the degradation mechanism follows that of thermal degradation. The mass loss data after oxygen plasma exposure indicate that chemical structure followed by density play the greatest role in atomic oxygen resistance. A weathering study gave further insight into the relationship of chemistry, density, and surface area effects. XPS, infrared (IR) and Raman spectroscopies, plus thermogravimetric (TGA) and thermomechanical (TMA) analysis, confirm that unlike the thermal and oxygen plasma exposures, the carbonyl linkage in the dianhydride of the TEEK-L series has the greater effect during weathering on the stability (lower) of the polymer, followed by density.

Data show that for these foams material choice will be governed by the application and the relative importance of specific performance properties. The TEEK-H series has better tensile and weathering performance. The TEEK-L series has better compression and Oxygen Index (OI) and Glow Wire performance. The TEEK-C series, because of the stabilizing $SO_2$ of the diamine linkage, has better thermal and oxygen plasma performance. Surface area and not density, as is usually thought, drives foam fire performance.

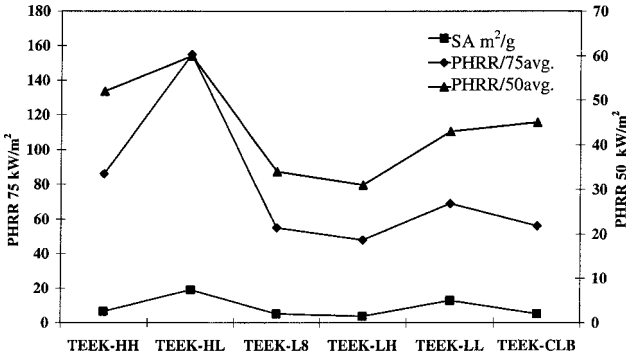



*Chemical Structures of Foams*

**TEEK Foams, Densities and Surface Areas**

| Sample Foam | Density g/cc | Surface Area $m^2/g$ |
|---|---|---|
| TEEK-HH | 0.08 | 6.5 |
| TEEK-HL | 0.032 | 19.1 |
| TEEK-L8 | 0.128 | 5.2 |
| TEEK-LH | 0.08 | 3.6 |
| TEEK-LL | 0.032 | 12.9 |
| TEEK-L.5 | 0.008 | N/A |
| TEEK-CL* | 0.032 | 5.0 |

*notes series with skin



## Studying How the Stars Age

Drs. Terry Oswalt and Matt Wood, both faculty in physics/space sciences, continue to find out how stars age. They are undertaking a three-year study under a $177,000 National Science Foundation grant.

The project focuses on normal stars in the Sun's neighborhood of the Milky Way Galaxy. Stars like the Sun often show signs of activity like sunspots, which affect the total energy radiated into space, as well as flares that, in the Sun's case, may disrupt communications on Earth. Stars tend to become less active as they age, but the process takes billions of years. Astronomers have known this for several decades, but the exact relationship between stellar activity and age has been hard to determine, because there are very few techniques to determine a star's given age.

The objects chosen for the NSF-sponsored study have dead stellar companions called white dwarf stars. White dwarfs are the slowly cooling remnants of nearly all previous generations of stars in the galaxy. The Sun will one day become such a cooling ember. Although white dwarfs no longer create their own energy, they are slowly cooling to the temperature of interstellar space in a very predictable way, which will aid the research.

Dr. Matt Wood

Dr. Terry Oswalt

## New Physical Sciences Building Ground Breaking

This was the year that the future home of CSLA's chemistry and physics/space sciences departments broke ground in a ceremonial display, marking the beginning of the new building's life. Excited students, faculty, staff and VIPS, including the Florida Tech mascots Pete and Penelope Panther, celebrated under festive tents and banners behind the current Olin buildings to launch the construction of the F.W. Olin Physical Sciences Building.

The Olin Physical Sciences Building has been made possible by the support of the F.W. Olin Foundation of Sarasota, Florida. The new complex will contain classrooms, laboratories and faculty offices, and the office of the Dean of the College of Science and Liberal Arts.

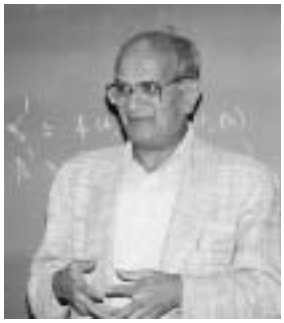
## CSLA Faculty Elected to Management Board

On April 4, 2003, the representatives of the non-CERN member states participating in the Compact Solenoid Muon (CMS) experiment elected Dr. Marc M. Baarmand of CSLA's Department of Physics and Space Sciences as their representative to the CMS management board. This board is charged with overseeing construction of the CMS detectors in time for 2007 start-date and within the budget of $500 million.

The CMS experiment is a large general-purpose particle detector under construction at the Large Hadron Collider (LHC) accelerator at the European Center for Particle Physics (CERN) in Geneva, Switzerland. More than 1,850 scientists from 150 universities and research institutions from 34 countries collaborate in study of high energy proton-proton collisions to answer some of the most fundamental questions of nature, such as the origin of mass and dominance of matter over antimatter in our universe. Florida Tech formally joined the CMS collaboration in June 2001.

## Series in Mathematical Analysis

Dr. V. Lakshmikantham, professor and head of the Department of Mathematical Sciences, and chair of the International Federation of Nonlinear Analysis; and Dr. S. Köksal, associate professor of mathematical sciences, have recently published *Volume 7: Monotone Flows and Rapid Convergence for Nonlinear Partial Differential Equations*. This volume describes the monotone iterative technique used to obtain montone approximate solutions that converge to the solution of nonlinear problems of partial differential equations of elliptic, parabolic and hyperbolic type. This, when combined with the quasilinearization method, offers rapid convergence of approximation to the solution and plays a valuable role in unifying a range of nonlinear problems. This monograph is divided into two parts: the first describes the general methodology, systemically utilizing the classic approach, while the second illustrates the development of the same basic ideas via the variational technique. The volume is a useful and timely reference resource for applied scientists, engineers and numerical analysts.



# Environmental Collaborative Research with Universities in Hungary

Dr. Virender K. Sharma, CSLA associate professor of chemistry, visited Hungary under the partnership program between Florida Institute of Technology and Budapest University of Technology and Economics (BUTE). During the one-month visit, Sharma presented his research on chemistry and environmental applications of high-valent oxy-irons, Fe(VI), Fe(V), and Fe(IV), at various universities in Hungary. Sharma's interaction with researchers sparked interest in the unusual oxidation states of iron in Hungary. These iron species are involved in many processes of biological, industrial and environmental importance. For example, Fe(VI) has environmental friendly multi-treatment properties and can potentially decontaminate mustard gas, cyanides and *E. coli*. Sharma's visit resulted in a collaboration with a number of researchers in Budapest and Veszprém.

Sharma with Professor György Pokol.

Dr. Sharma will be collaborating with Professor György Pokol at the Institute of General and Analytical Chemistry, BUTE, and exploring the process of Fe(VI) production on a large scale. He will also be working with Professor Zoltán Hommonnay from the chemistry department at Eötvös Loránd University (ELTE), Budapest, who has done pioneering work in Mossbauer Spectroscopy, and published 12 books and over 500 research articles. Sharma and his colleagues will be studying the mechanism of Fenton reaction. In addition, there will be collaboration with Professor A. Horváth, University of Kaposvar, Veszprém. This research will look at the fast kinetics laser spectroscopic technique, which is used to study the reaction of Fe(VI) with copper(I) complexes. The research will provide understanding of reaction mechanism between Fe(VI) and cyanides complexes; thus parameters for effective destruction of cyanides in gold mill wastewater.

During his visit to Europe, Professor Sharma was invited to give seminars at the Max-Planck Institute of Solid State Research, Stuttgart, Germany; Institute of Chemical Technology, Prague; and Heyrovsky Institute of Physical Chemistry, Prague, Czech Republic.

# CSLA's Panther Battalion

The Florida Tech ROTC Panther Battalion once again hosted the annual training exercise "Audie Murphy" at Camp Blanding in Starke, Florida. The exercise is named after WWII's most decorated soldier and Medal of Honor winner, Audie Murphy. The intent of the exercise is to prepare the junior-year cadets for their upcoming training and evaluation at Ft. Lewis, Washington, this coming summer. Cadets from Florida Tech were combined with cadets from five other universities from around Florida. In attendance were cadets and cadre from Emory-Riddle Aeronautical University, University of Florida, University of Central Florida, University of Tampa, and Florida International University. The field training exercise was planned, coordinated and executed by the senior-class cadets of the Panther Battalion. Cadet Captain John Barkley, a Florida Tech ROTC senior and future Air Defense Artillery Officer, worked diligently with fellow cadets and under the close supervision of Lt. Col. Thomas Tate and the ROTC staff. More than 200 cadets participated in the training.

The operation consisted of a three-day exercise that began on Friday night when cadets arrived from their schools and were assigned to their respective 12-person groups, called "squads." Their task for Friday night was to familiarize themselves with each other and begin to solidify their ability to work as a team in the few short hours before going to sleep. At 6:00 a.m. the next morning, they began the Situational Tactical Exercise lanes. Each had the opportunity to be in charge of the squad, receive a mission from a higher headquarters, formulate a plan, relay that plan to their fellow squad members, and then exercise leadership of the squad as it executed the plan and reacted to the changing circumstances on the ground. Missions ranged from reacting to enemy contact, to engaging with the media on the modern battlefield. After each lane, the cadets conducted a review of the previous leadership's strengths and areas in need of improvement, rotated leadership positions, and incorporated those lessons learned into their next mission. A senior cadet and a cadre member accompanied the squad and evaluated the squad leader's performance based on the principles of leadership. The cadets conducted missions throughout the day and late into the afternoon. That evening was reserved for clean up of equipment followed by tales of the day's highlights over pizza and soda.

By all accounts, the field training exercise was another success for the Panther Battalion. The cadets in attendance not only benefited from the leadership training, but in light of current events, they gained insight into the importance of preparing mentally and physically to deal with the stress of leadership in a less-than-ideal, if not hostile, environment.

# General Schwarzkopf Talks to Cadets

ROTC cadets from the Florida Tech Army ROTC Panther Battalion had the honor of participating in a charity dinner to benefit the Wuesthoff Medical Center. The black tie event was held at the Melbourne Civic Center and featured General (retired) Norman Schwarzkopf as the keynote speaker. The decorated commander of U.S. military forces during Operation Desert Storm and one of this century's most recognized and respected leaders, General Schwarzkopf delivered a dynamic and thought-provoking speech on leadership. The general spoke on the challenges of leading in contemporary America, where too often the drive for the bottom dollar and an end-justifies-the-means mentality can obscure a common sense, "do what's right" approach to leadership. He challenged the assembled local leaders from business, politics and society to rise to the challenge and lead their communities and organizations forward with integrity and honor. Delivering his message with a mix of authority and humor, he captured the attention and admiration of the entire audience.

All the cadets who participated in the event had the opportunity to personally meet and speak with the general. Upon completion of the speech, the cadets assembled for a parting photograph with General Schwarzkopf, who thanked them for their dedication and service to country, and encouraged them to be leaders and demonstrate integrity and honor in all that they do.

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## Science and Math Education

**Blenis, D.**, "What a BioBlast!" *Science and Technology Journal*, 8(1), 13, 2002.

**Gallo, M.** and Clark, C., "Effects of Calculator Use on Third-Grade Students' FCAT Scores," *Florida Educational Leadership,* 3(1), 54–59, 2002.

# CSLA Proposals Awarded

## Biological Sciences

**Bush, M.B.**, "Past and Present Vegetation of the Andean Flank, Peru/Bolivia," NSF, $450,000; "Vaughn-Jordan Foundation Award for Undergraduate Research in Botany," Vaughn-Jordan Foundation, $45,000; "REU Supplement to a Computer Guided Key to Neotropical Pollen," NSF, $12,500.

**Dhople, A.M.**, "Microbial Ecology of Indoor Air," Florida Solar Energy Center, $6,500.

**Helmstetter, C.E.**, "Cell Culture Development," MRI Ventures, $15,000.

**Lin, J.**, Rhyne, A.L. and Calman, B.G., "ABC (Aquaculture, Biology and Conservation) of Marine Ornamental Shrimp," National Sea Grant, $60,000.

**Shenker, J.M.**, "Quantitative Assessment of the Fish Fauna of Complex and Vulnerable Estuarine Habitats in Florida," Florida Non-Game Wildlife Contracted Projects Program, $34,500.

**Turingan, R.G.**, "Development of Feeding Mechanics and Prey Capture Performance in Marine Fish Larvae: A Novel Approach to Understanding a Major Bottleneck in Marine Ornamental Fish Culture," Florida Sea Grant (NOAA), $25,000.

**Tankersley, R.A.**, "Migratory Behavior of Larval Blue Crabs Following Release," NSF, Research Experience for Undergraduates, $12,750.

**Wells, G.N.**, "Ground Operations Support of ESA Payload on STS 107," European Space Agency (ESA), $682,576.

## Chemistry

**Baum, C.**, Gibson, T. and **Brown, A.**, "Fluorescence Detection of Hydrazines Utilizing Hydrogen Bonding," Flordia Space Grant Consortium, $29,995; "Development of Hydrazine Sensors," NASA/ASEE Faculty Fellowship Program, $12,000; **Baum, C.** and Gibson, T., "Remote Detection of TIC's Using Fluorescence and H-Bonding," Department of Defense, $124,998.

**Bologa, M.**, "Introducing NMR Spectroscopy into the Chemistry Curriculum," NSF-CCLI Adaptation and Implementation, $32,637.

**Brown, A.**, Gibson, T. and **Baum, C.**, "Cavitied Cyclophanes in Controlled Energy Release," Florida Solar Energy Center, $15,000.

**Novak, M.**, "Contract Synthesis Service," U.S. Army, open amount.

**Rokach, J.**, "Isoprostanes and Free-Radical Damage in Chronic Diseases," National Institute of Health, $973,000; "Chemistry of Eicosanoids," Cayman Chemical Company, $35,000.

## Physics and Space Sciences

**Baarmand, M.**, "CMS Project Funds for Construction of a Laser/LED Calibration System for the CMS Forward Hadron (HF) Calorimeters." U.S. CMS/Fermilab/DOE, $65,350.

**Baksay, L.**, "A Dual Purpose Superconducting Hydrogen and Electrical Power Transfer Line," Florida Solar Energy Center, $25,000; "Upgrade of Foster–Miller Track," Florida Space Grant Consortium, $19,567; "Quark Net," DOE/NSF, $18,212.68; Fellowship Grant, NASA, $12,000; USCMS Teacher Fellowship DOE $5,500; Support of FSI Office at Florida Tech, Florida Space Institute, $5,000.

**Clements, S.D.**, NASA–ASEE 2002 Summer Faculty Fellowship Program, National Aeronautics and Space Administration and The American Society for Engineering Education, $12,000.

**Dwyer, J.**, "Developing an Improved Energy Measurement for Space-Based Time-of Flight Mass Spectrometer," Florida Space Grant Consortium, $20,000; CAREER: "Experimental Research on the Runaway Breakdown of Air During Thunderstorms," NSF CAREER Program, $411,049; "CME Associated Energetic Particles: An In-Depth Comparison of Theory with Observations," NSF SHINE, $223,194; "Measuring Solar Cycle Variations of 3He in Energetic Particle Events," NASA NRA 01-OSS-01 SSS, $239,933; Principle investigator on NASA subcontract, University of Maryland, $19,400.

**Mantovani, J.**, "Study of the Electrostatic Properties of Martian Soil Simulant," Florida Space Grant Consortium, $3000.

**Oswalt, T.**, et al., "Five Nights Awarded on Cerro Tololo Interamerican 4-m Telescope in Chile," $10,000/night; "Calibrating Stellar Chromospheric Activity and the Galaxy's Dark Matter Content Using White Dwarf Cooling Times," NSF, $177,026.

**Rassoul, H.**, et al., "Measuring Solar Cycle Variations of $^3$He in Energetic Particle Events (Co-1)," NASA-SSS, $240,000; "CME Associated Energetic Particles: An In-Depth Comparison of Theory with Observations (Co-1)," NSF SHINE, $220,000.

**Wood, M.A.**, "Understanding Cataclysmic Variable Accretion Disk Dynamics and Viscosity," NSF Stellar Astronomy and Astrophysics, $62,800.

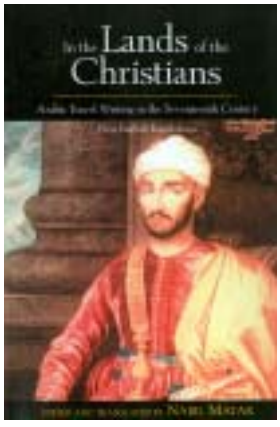
**Zhang, M.**, "CME Associated Energetic Particles: an In-depth Comparison of Theory with Observation," NSF SHINE, $223,000; "Ulysses Cosmic and Solar Particle Investigations (COSPIN): Efforts at the Florida Institute of Technology," JPL Ulysses project, $30,000.

## Science and Math Education

**Marcinkowski, T.**, "Status of Environmental Service Learning in Florida Grades 9–16," Florida Campus Compact Impact Grant, $20,000.

# New Scholarly Edition Published

Dr. Nabil Matar, professor of English and CSLA department head of humanities and communication, has recently edited and translated *In the Lands of the Christians*, published by Routledge Publishers. The scholarly edition presents the first English translations from Arabic of four Christian and Muslim writers who visited Western Europe and South America in the seventeenth century. In the words of William Dalrymple, author of *From the Holy Mountain: A Journey Among the Christians of the Middle East*, "Nabil Matar is a genius. Having written two of the most remarkable, original and important studies of Islamic-Christian relations to be published in the last twenty years, he has now surpassed even his own high standards with *In the Lands of the Christians*. At a time when Islam and Christianity appear to be heading for a major confrontation, Matar's work could not be more vital, or more timely."

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CSLA's Department of Chemistry hosted its annual prestigious A.H. Blatt Seminar. This spring's keynote speaker was Dr. Koji Nakanishi.

Dr. Nakanishi received his Ph.D. in chemistry from Nagoya University in 1954. He joined the faculty of Columbia University in 1969; became Centennial Professor of Chemistry in 1980; and was chair of Columbia's chemistry department from 1987 to 1990. His research encompasses isolation, structural and bioorganic studies of bioactive compounds, retinal proteins, interaction between ligands and neuroreceptors, and development of various spectroscopic methods, especially circular dichroic spectroscopy. He has published approximately 750 papers, and has authored, coauthored, or edited nine books on spectroscopy and natural products.

Professor Nakanishi has determined the structures of over 200 biologically active natural products, many of which are endogenous and/or the first member of a new class. These include ginkgolides from the ancient ginkgo tree, first insect molting hormones from plants, new nucleic acid bases, insect antifeedants, antibiotics, first meiosis inducing substance from starfish, crustacean molt inhibitors, shark repellents from fish, tunicate blood pigments, brevetoxins from red-tide dinoflagellates, philanthotoxin from a wasp, and the human eye pigment involved in macular degeneration.

As of 2002, approximately 425 students and postdoctoral fellows have done research with Professor Nakanishi and team of scientists. About 140 of his former colleagues now hold academic positions at universities all over the world.

## Congratulations to Award Winners

The Florida Tech Greek Community honored the following three faculty members—all from the College of Science and Liberal Arts—at the First Annual Greek Scholarship Faculty Awards Ceremony.

**Matthew Ruane** of the Department of Humanities and Communication for *Excellence in Teaching*

**Alan Brown** of the Department of Chemistry for *Outstanding Greek Faculty Adviser*

**Monica Baloga** of the Department of Chemistry for *Service to Students and the Florida Tech Community*


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