

**ISU SYMPOSIUM 2012  
SPECIAL  
Sustainability of  
Space Activities**

**[www.isunet.edu/annualsymposium](http://www.isunet.edu/annualsymposium)**

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# Space Sustainability the ISU Way

by Tereza Pultarova

International, Intercultural and Interdisciplinary - the 3Is of the International Space University - is also the philosophy behind the ISU's annual Symposium. This year's Symposium, the 16<sup>th</sup> since inception, will once again bring together lawyers, economists, engineers, scientists, and other space professionals to discuss a common theme: sustainability of space activities. The Space Safety Magazine paid a visit to the Symposium Organizing Chair, Professor John Farrow, to learn more about the upcoming event.

Sitting in his office surrounded by his favorite satellite models, Prof. Farrow reveals how the idea to create a conference on the grounds of ISU emerged. Although not a faculty member at the time, he knows the story well. The birth of the ISU Masters program in 1995 brought together George Haskell, ISU Vice-President at the time, and Michael Rycroft, a key supporter of the Masters program. "They decided to introduce an international Symposium, which would form part of the students' timetable," explains Prof. Farrow, "the Symposium was intended to attract an international audience

**“Space debris is a very topical issue, and a very important one”**

to explore a chosen theme.”

The theme of space sustainability comes from involvement with the working group “*Long Term Sustainability of Outer Space Activities*,” created two years ago within the United Nations Committee on Peaceful Uses of the Outer Space (UN COPUOS). “In the context of space activities, sustainability means sustainable use of outer space for peaceful purposes for the benefit of all countries,” explains Prof. Farrow, “It covers things like threats from orbital debris, space weather, deliberate events such as anti-satellite attacks as well as cyber attacks on spacecraft or potential threats that are in space.” These subjects form the backbone of the Symposium session topics.

The issue of space debris and hazards related to uncontrolled space objects has recently received widespread attention. With the reentry of UARS and ROSAT in September

and October 2011, and with the reentry of the stranded Phobos-Grunt probe expected by early 2012, space threats are becoming a significant public concern. “It is a very topical issue, and a very important one,” says Prof. Farrow, “we looked at space security in a very broad sense four years ago,” he explains.

“Coincidentally at that time, just a few days before we held the Symposium on *Space for a Safe and Secure World*, there was an in orbit collision between two satellites which gave rise to a huge increase of debris in orbit. Since then, the subject of debris has become even more a matter of interest.”

The organization of a Symposium is a long and complex process: “we try to vary the topics from one year to another in order to give some variety,” explains Prof. Farrow. “It is also important to us that the topics should be of general interest, and that they have an academic content for our students,” he says. Sometimes the process is trickier than one might expect: “in the past we’ve been in the situation that we had to change our topic and even the date of our Symposium in order not to clash with another conference that would steal most of our participants,” he says. According to Prof. Farrow, there is something that sets the ISU Symposium apart: “There is a degree of uniqueness about what we do. Living up to ISU’s 3Is philosophy, we try to bring everybody into the same room – the engineers, lawyers, economists – each contributing to and sharing the same common topic,” he says. “The unique feature of our conference is that the great majority of our sessions are held in plenary,” he adds, “everybody shares, contributes to the ensuing discussion either in the conference center itself, over lunch or during other social activities we organize in Strasbourg, a very beautiful and ancient city that definitely helps to attract more people to our symposia.”



John Farrow, Organizing Chair of the annual ISU Symposium since 2005. Credits: Shripathi Hadigal Rao

# A Year of Debris

by Megan Kane

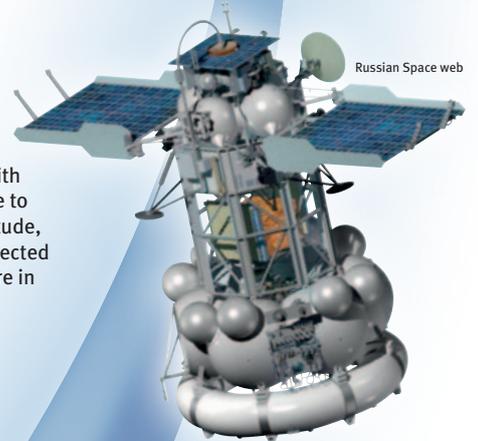
Infographic by Kristhian Mason

The Space community has considered space debris a serious threat to space operations, but only recently has the public become aware of the magnitude of threat. The reentry of large space stations, like Skylab on July 1979 or Mir on March 2001, were of course headline news, but ordinary debris have not been thoroughly considered – until now. While only one person has reportedly been hit by a piece of debris returning to Earth, millions learned that there is the potential to be hit by falling debris on a regular basis, as spent rocket stages, satellites, and other space objects fall to Earth every week. The public at large was mainly unaware of this, until two massive satellites came down within weeks of one another – one largely anticipated, one not. And while the year 2011 is reaching its end, the failure of the Russian Phobos-Grunt probe, carrying 10 tons of hydrazine and a capsule of radioactive cobalt, will be a dangerous and controversial opening to a new year in space debris.

# 2012

### November Phobos-Grunt Reentry

On November 13<sup>th</sup>, the Russian Martian probe Phobos-Grunt stalled in LEO with its tank filled with 10 tons of hydrazine. Due to its current mass and altitude, the 14.6 ton probe is expected to reenter the atmosphere in mid-January

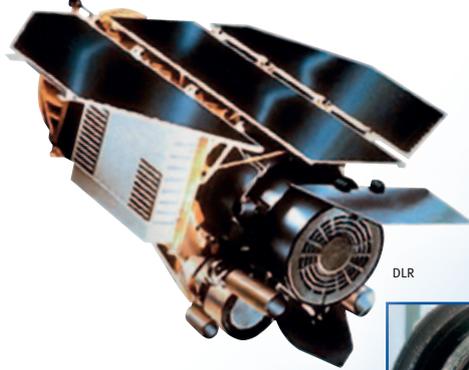


Russian Space web

### October ROSAT Reentry

ROSAT, with its massive mirror, reentered Earth's atmosphere over the Bay of Bengal on the 23<sup>rd</sup> of October after 21 years in orbit.

(DLR)



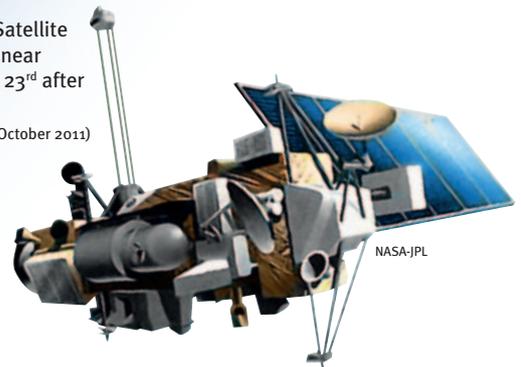
DLR



### September UARS Reentry

The 6 ton NASA Upper Atmosphere Research Satellite (UARS) fell to the Earth near midnight of September 23<sup>rd</sup> after 20 years in orbit.

(Orbital Debris News V15 Iss4, October 2011)

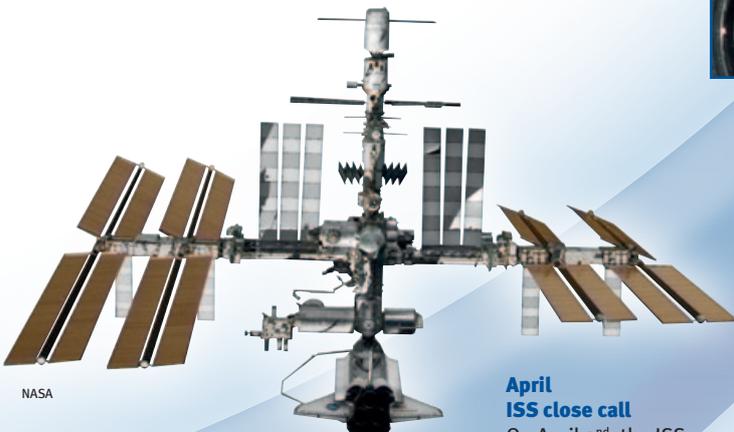


NASA-JPL

### April ISS close call

On April 2<sup>nd</sup>, the ISS performed the 12<sup>th</sup> avoidance maneuver since the start of its life, the 5<sup>th</sup> maneuver in the last 2.5 years.

(Orbital Debris News V15 Iss3, July 2011)



NASA

# 2011

# Familiar Faces

by Merryl Azriel

The 16<sup>th</sup> ISU Symposium will consist of six sessions covering the topics of International Perspectives, Space Debris, Space Weather, Other Threats (cyber attacks, anti-satellite weapons, and space militarization), Cooperative Approaches to Improvement, and Looking Forward. Several ISU supporters will be presenting their work in February: here are highlights from a few of them.

**Michael Rycroft** of CAESAR Consultancy, a regular lecturer at ISU and resident faculty member from 1995 to 1999, will be discussing the limitations of space weather forecasting today and what the future holds for forecasting not only in near-Earth, but around the Moon and Mars as well.

**Norma Crosby**, Chair of the ESA Space Weather Working Team, attended the SSP in 1992 and served as Assistant SSP Director in 2000. She will be presenting in Session 3: Space Weather, along with Michael Rycroft.

**Jim Burke**, JPL retiree, The Planetary Society representative, and long time supporter of ISU will be discussing ways to avoid a situation in which a disaster results in loss of communication between Earth and the existing satellite network. Along

with collaborator **Angela Peura**, George Washington University, he will recommend usage of low technology elements to provide robustness and redundancy that can safeguard existing communications and control systems. They will be presenting in Session 6: Looking Forward and Outward.

**Reinhold Ewald**, ESA astronaut and regular ISU lecturer will support the need for a long term human orbital outpost, such as the ISS, for the sustainability of Space utilization. Together with fellow veteran ESA astronaut **Christer Fuglesang**, Ewald will discuss how the success of ISS has been enabled by its international nature, which provides sustained political support, redundancy, and complementarity, a combination that cannot be achieved by any single actor. Ewald and Fuglesang also see potential for ISS to serve as a planetary mission analog in next generation space mission research. They will present in Session 4: Other Threats to Space Activities.

**Ram Levi**, ISU Space Studies Program (SSP) 2011 graduate and founder of Space Security Facebook page, is currently a research fellow at Yuval Ne'eman Workshop for Science, Technology and Security at Tel Aviv University, along with collaborator

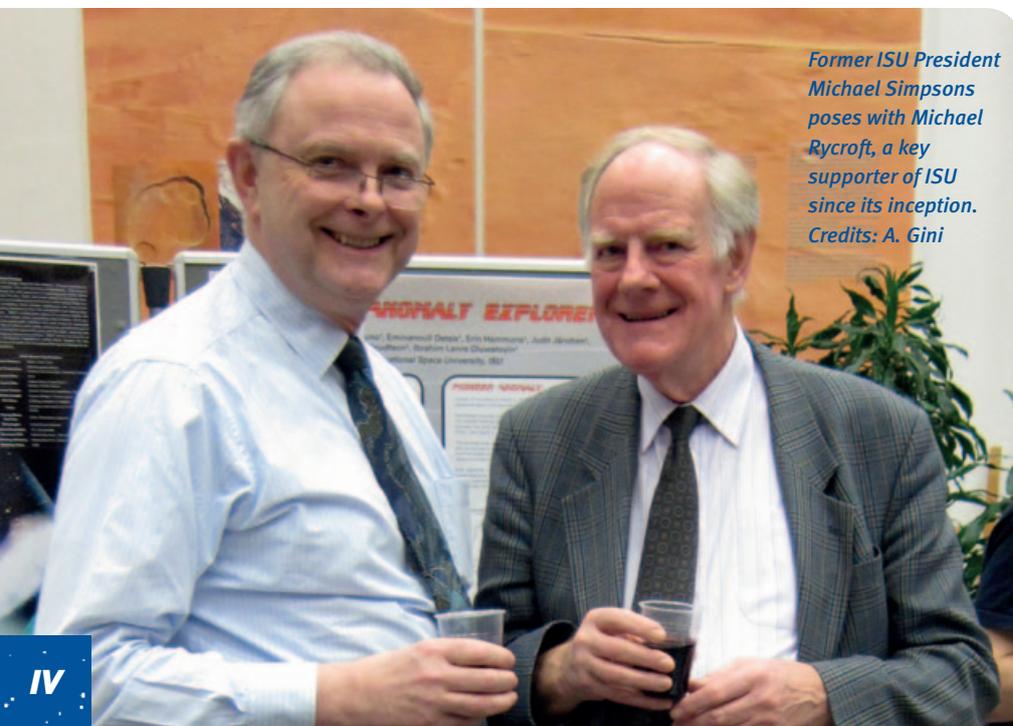
**Tal Dekel**. They will address potential cyber attack vectors on satellites and ground stations, review cyber attack case studies and present options for mitigation and avoidance of such vulnerabilities. Their talk will be presented in Session 4: Other Threats to Space Activities. Levi and Dekel will present a poster proposing a National Space Resilience Index to fill gaps in existing indices and provide a holistic view of recoverability of national space resources in case of a disruptive event.

**Jeffrey Apeldoorn**, ISU SSP 2009 graduate now working at OHB-System AG, will present in Session 2: Space Debris, along with an international research team on space mission protection. Strategies discussed will include spacecraft shielding, spacecraft self-protection, mission optimization and redundancy, and options for maintenance and repair of damaged craft. These strategies will be illustrated utilizing specific satellite case studies.

**David Kendall**, Chair of the Inter-Agency Debris Committee and Director of Science in the Canadian Space Agency (CSA), will be Chairing the first Space Debris session. Kendall is a former chair of the ISU Academic Council and served as SSP Director in 1999.

**Joe Pelton**, Vice President of the International Space Safety Foundation, is a former Dean of ISU. He will be speaking in Session 5: Cooperative Approaches to Improved Space Sustainability on space debris remediation efforts. He will propose creation of a monetary fund, paid into by space actors, and paid out to licensed operators authorized to remove Space debris on behalf of current and former Space actors.

**Kai-Uwe Schrogl**, head of ESA Policies Department and former Director of ESPI, will be chairing Session 5. Schrogl is a regular lecturer at ISU and frequently chairs symposia sessions. He is an expert on space traffic management and situational awareness programs.



*Former ISU President Michael Simpson poses with Michael Rycroft, a key supporter of ISU since its inception. Credits: A. Gini*



Poster session from ISU Symposium 2007  
Credits: ISU

# New Players

by Merryl Azriel

**M**any more faces, familiar and otherwise, will be presenting their research at the Symposium poster session, which will span the three days of the Symposium. Among these will be three current ISU students – Megan Kane, Christopher Johnson, and Jeffrey Osborne.

**Megan Kane**, a returned US Peace Corps volunteer with an abiding interest in space debris, will present “*Space Debris: A Commercial Opportunity*.” “This is an aspect of the space debris issue that has typically been overlooked,” said Megan. “The commercial sector is becoming more influential and active in the space

sector and they will want to protect their investments. It poses some interesting possibilities.”

**Christopher Johnson** and **Jeffrey Osborne** will be representing a larger team from ISU SSP 2011 with the topic “*An Interdisciplinary Approach to Human-Robot Cooperation in Mars Exploration*.” “Sustainable space development will have to intelligently balance the flexibility and ingenuity of humans, with robust and sophisticated robotic systems,” says Jeffrey, “I am looking forward to connecting with others who are passionate about long-term space development and to see

what tools and methods they are pursuing to achieve this.” Christopher Johnson, a lawyer by profession, is particularly looking forward to the Symposium’s policy discussions. “Space sustainability issues are governed by soft law – and are likely to continue in that vein,” said Christopher, “This creates opportunities for development of creative legal tools. There should be some interesting dialogues.”

See these and more speakers at the 16<sup>th</sup> annual ISU Symposium beginning February 21, 2012.

The full program is available at [www.isunet.edu/annualsymposium](http://www.isunet.edu/annualsymposium)

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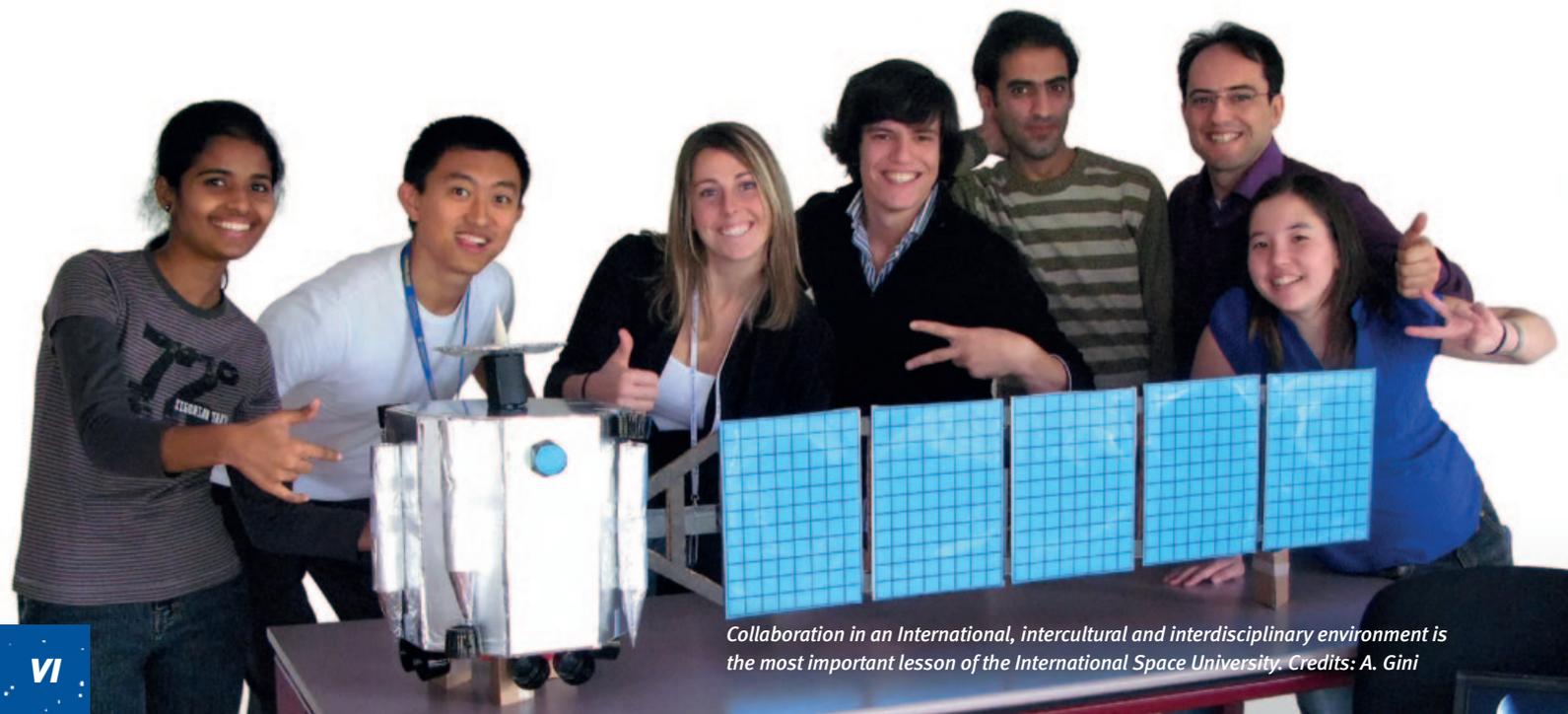
# 25 Years of International Space University

by Tereza Pultarova

It's been almost 25 years since Peter Diamandis, Todd Hawley, and Robert Richards founded the International Space University. Since then, more than 3200 students from over 100 countries have graduated there, and had a chance to start or improve their career in the space business. Based in the suburbs of the beautiful ancient Alsatian city of Strasbourg, ISU is a higher education institute aimed at providing education and training for future leaders of the space industry. The school presents a rather unique approach. During the one year Masters program or the 9 week summer Space Studies Program, students have the opportunity not just to learn about the space industry, but also to experience what the space sector is really about: an international endeavor that requires cooperation of people with different backgrounds, coming from different cultures and speaking different languages. Lawyers, engineers, natural scientists, and economists have to learn to talk to each other, and it is not always easy to overcome the differences in background, method, and mindset. Cultural differences

can be subtle and unpredictable, as what in one culture is considered funny may be regarded as offensive in another. Also, overcoming the language barrier requires a lot of effort when for example a Chinese engineer needs to solve a problem together with a Canadian counterpart. The ISU program is designed to be Intercultural, International and Interdisciplinary, a 3I philosophy that is the essence of the institute. This approach forces humanists to struggle to design a satellite orbit, scientists to put together a business plan, and aerospace engineers to find their way out of legal clauses. The ultimate lesson is that every difficult task is manageable, if you have a team to rely on whenever you feel lost. This experience is priceless: no great space exploration mission would have been accomplished without the enthusiastic cooperation of many people who, just like ISU students, have sometimes felt lost. The microgravity laboratory, the satellite tracking station, the professional-caliber telescope, and the concurrent design facility all provide opportunities to broaden

one's horizons with cooperative hands-on activities. Rocket competitions, robotics workshops, and a number of cultural events – an inseparable part of ISU's student life – are the additional ingredients that bring fun into the experience. And whether one wants to become an astronaut, join the future mission to Mars, start a commercial space flight company, or focus on remote sensing applications to improve life on Earth, everyone believes that space is an ever inspiring domain that opens our eyes and widens our horizons. "The first universities helped to bring mankind out of the Dark Ages and into the Renaissance," said Arthur C. Clark, the legendary science-fiction writer and first chancellor of ISU. "They demonstrated a potential to unshackle the minds and spirits of the people of their time. The International Space University may well become an essential cornerstone in leading humanity ahead in space and on Earth in the century to come." This same belief is what creates a connection among all the space enthusiasts who share the intense, varied, and challenging experience of the ISU program.



*Collaboration in an International, intercultural and interdisciplinary environment is the most important lesson of the International Space University. Credits: A. Gini*

# SSP 2012 Tackles Space Debris

by Merryl Azriel

The Space Studies Program (SSP) is an intensive nine week program designed to teach an intercultural, international, and interdisciplinary approach to the space sector. Held in a different city each year – Strasbourg, Barcelona, and Beijing just to mention a few – SSP2012 will be hosted by the Florida Institute of Technology at their Melbourne campus in partnership with the Kennedy Space Center in Florida USA. An important part of the SSP curriculum is the Team Project, a comprehensive research project, developed over 4 weeks, covering a contemporary interdisciplinary problem. Of this year’s four team projects, one will explore the issue of space debris, with a focus on mitigation and removal. We met Angie Buckley, ISU Dean, Vice President for Academic Affairs and Director of the SSP, to discuss the upcoming SSP and the ISU Symposium. “The SSP Team Project is a study of space debris in general – mitigation, elimination, and prevention, a holistic view of space debris,” said Dr. Buckley. The affinity with this year’s Symposium is fortunate, yet accidental: SSP Team Projects are in fact selected eighteen months in advance: “For this particular Team Project it seems most à propos, timely, and lucky,” says Dr. Buckley, “we will collect whatever information we can from the symposium and make sure that it gets incorporated in the documentation sent to Florida to be used in the Space Debris Team Project.”

The SSP addresses topics in a team environment: thirty to forty participants analyze the problem of the day, research the literature for the current state of the art, and develop a unique solution, often in the form of commercial initiative. Group composition is the most varied: “Young professionals, old professionals, midlevel managers, senior managers, senior engineers,” says Dr. Buckley, “some participants are already working in the space industry, while others are looking for a career change.” Dr. Buckley was one of the former when she attended SSP in 1993: “I was

*“I want people to leave with a greater understanding of the problem and motivation to do something about it”*

working at NASA as an engineer,” she recalls, “I saw SSP as a great opportunity to study business and management applied to space without a lot of risk.” A desire to expand their horizons and to refocus their careers seems to be a common trait among SSP attendees: “that’s what most of our participants are coming for,” explains Dr. Buckley, “to get an experience in an international, intercultural environment, but also to broaden the range of disciplines with which they’re familiar.” SSP Team Projects have covered a whole host of topics in the past. Remote sensing applications, robotics, tele-medicine, disaster management, and space traffic management have all been addressed at some point in the SSP’s 25 year history. “I was trying to think of subjects we haven’t looked at,” said Dr. Buckley, “If you go look at the list of former SSP topics it’s pretty amazing: when we get Team Project proposals, the Academic Council has to go back and look to see not if we’ve addressed the topic, but when was the last time we addressed this topic to make sure it’s fresh.”

It turns out SSP Team Projects are not just academic: “When I was an SSP student, our Team Project was called GEOWARN, a global emergency observation network,” says Dr. Buckley, “It actually got funded for a couple of years: I think NASA put well over a million dollars into it,” she says. According to Dr. Buckley, It was one of the first times a concerted effort was made to apply space assets to this problem, “Now it’s routine: you have a forest fire and JPL provides data to the firefighters; there’s a flood, you get remote sensing images to the people on the ground fairly rapidly now.”

ISU Team Projects tend to be forward-looking: “It’s fun to go back over the years and see that in many cases things are unfolding just the way we had predicted,” says Dr. Buckley. Hopefully the symposium will prove to be just as effective. “I want all the people who come to leave with a greater understanding of the problem and motivation to actually go out and do something about it,” Dr. Buckley concludes, “that would be a huge accomplishment.”



Angie Buckley, ISU Dean, Vice President for Academic Affairs and Director of the SSP. Credits: Shripathi Hadigal Rao

# Close Calls on the ISS

by Megan Kane



International Space Station. Credits: NASA

In the past 11 years, the International Space Station has been approached many times by fragmented space debris. Sometimes debris have not come close enough to call for precautionary measures, like in November 2011, when the ISS was approached by pieces of the Fengyun 1C satellite, which was destroyed in China's 2007 anti-satellite test. However, five approaches have been deemed threatening and resulted in avoidance maneuvers. Two incidents required retreat of the crew into the Soyuz capsules.

**27 August 2008**

Avoidance maneuver due to fragment from Cosmos 2421 spacecraft.

**12 March 2009**

Retreat to Soyuz Capsules due to fragment of U.S. Delta 2 third stage.

**22 March 2009**

Avoidance maneuver due to fragment of a Chinese launch vehicle stage.

**18 July 2009**

Avoidance maneuver due to fragment of a Russian launch vehicle stage.

**26 October 2010**

Avoidance maneuver due to fragment of NASA's UARS spacecraft.

**2 April 2011**

Avoidance maneuver due to fragment of Cosmos 2251.

**28 June 2011**

Retreat to the Soyuz capsules from unidentified debris fragment.

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*in Melbourne, Florida USA*

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