



Ra 32 News

Team Members to Exhibit Ra IV in China!

FedEx picked up a rather unusual package here at the college Thursday morning, June 6. Ra IV is being shipped to Shanghai, China, to participate in a technology exhibition. The Chinese Society of Automotive Engineers and EDS are the sponsors of the event. EDS is our team's largest corporate donor, and recently recognized Principia with an Engineering Excellence Award in April.

The Chinese Solar Challenge, as it has unofficially been dubbed, will consist of 12 days of travel from Shanghai to Beijing. The participants—Principia, the University of Missouri-Rolla, and the first Chinese solar car—will be transported by trailer along the route and stop at several universities for public demonstrations. The event is motivated by EDS' desire to display the technological achievements of their academic partners, and by an increasing interest in solar power among the Chinese people.

Originally planned to coincide with the Beijing auto show, held in early June, the event was postponed to August 3rd – 13th. Due to conflicting interests with the University of Michigan's solar car, EDS representatives approached Principia to travel in their stead. This invitation to travel to China on an all-expenses-paid trip is a tribute to our team's dependability, which was demonstrated again in our hasty preparation for the event. Having confirmed our travel mid-May, we had only three weeks to prepare our car for international shipment.

Faculty advisor Steve Shedd supervised the building of the specialized crate needed to ship our solar car and equipment. We worked countless hours over a two-week span to complete the crate, which was designed to shipping requirements for both China and Australia, since we plan to reuse it for our trip to WSC 2003. Special considerations for our cargo included built in chocks, a shelf for the body lined with contoured foam, and a separate area for tools.

Beyond crate construction, logistical issues presented a few roadblocks. Since our gallium-



Ra IV packed inside the crate ready to leave for China. The body and chassis are packed separately for maximum protection during shipping. Photo by Steve Shedd.

arsenide solar cells are classified by the Department of Commerce as dual-use articles (having both civilian and military applications), shipping the technology to China initially posed a serious problem. Many hours were spent researching export law to determine what was needed to obtain a license for their export. At one point it appeared as if The Principia would have to be registered as a legal exporter of unclassified defense articles! Fortunately, the team was finally able to obtain a temporary license exception because the cells are only going to be in China briefly for demonstration purposes. The car will share a shipping container with Rolla's car.

Representing the team in China will be Stephen Shedd (faculty advisor), Cindy Shedd (resident counselor), John Broere (pit chief and electrical), Chris Churchill (chassis), Alison Wiegand (body), and Matt F (team leader). The group will depart from St. Louis July 31st and return August 18th to remain on campus for the summer, joining other team members in the construction of Ra V. We are sincerely grateful for the opportunities that have come our way to represent Principia – first across the US, and now on the other side of the globe.

By Robyn Goacher

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Ra IV Finishes Strong at Heartland Park



Ra IV racing down the track at Heartland Park. In Topeka, Kansas. Photo by Formula Sun HQ.

Ra IV – Principia’s fourth solar car – ended its racing career with a fantastic race at this year’s Formula Sun Grand Prix. Held at Heartland Park in Topeka, Kansas, the 3 day closed course contest featured 12 teams. Principia finished fourth, placing behind three cars that finished ahead of us in ASC 2001, and ahead of every entry that placed behind us in that race.

The object of the event was simple: drive as many laps around the track as possible in 3 days. Ra IV has competed in two other closed track races before – one in May of 2001 at Heartland Park, and one last June at the Gingerman Raceway in Kalamazoo, Michigan.

Though perhaps not as glamorous or as advertised as the road races, the track races can be every bit as demanding in their own right. A road race thoroughly tests a team and their vehicle at all levels – from adapting to rapidly varying terrain and road conditions, to working out the strategy and logistics of finding the best spot to stop each night. Track races do not have these strategic or logistical challenges, but are more difficult for the driver, and in some ways are harder on the car itself. Drivers must be more alert due to close quarters with competing vehicles. Tight corners taken repeatedly at a good clip cause extensive tire wear, and are quite trying on the suspension.

Going into the first day of the racing we were unsure how well the already ageing Ra IV would perform. The battery pack had lost considerable capacity over the previous six months, and the solar array’s output was somewhat of an unknown. Despite everything, Ra IV and Principia drivers Kevin Pratt, Chris Churchill, Joe Ritter, and Ryan McFall all performed very well.

Over the course of the competition Ra IV stopped only once for a popped tire, and pitted only a few short times each day for driver changes and quick inspections. This was an amazing feat. During closed course contests, teams will

typically blow out tires routinely, and spend several periods in the pit for repairs. Our car’s reliability saved us much time, a fact for which we are grateful.

We owe our success both to the reliability of the car and to the support of the whole team. After the first day, electrical wizards John Broere and Ryan McFall sacrificed sleep to make vital modifications to the car’s electrical systems, returning array output to its proper levels. Several team members were positioned as lookout throughout the event, commanding an expansive view of the track. Linked by radio, they could alert the driver to obstacles or passing cars. These watchers were very helpful, as Principia often knew about incidents even before the officials, alerting them and other teams to spinouts, crashes, and potential hazards.

We saw the race as a two-sided opportunity. First, it was an opportunity to do our best – to express our purpose, and the qualities and abilities native to the team. Our second goal was to get new team members acclimated to race conditions. Over the four days we were in Topeka eighteen Principians participated, including five new members.

As with every Formula Sun competition, we were impressed by the dedication and cooperative spirit of all the teams present. At least one team was racing during finals week!

By Chris Churchill and Matt F

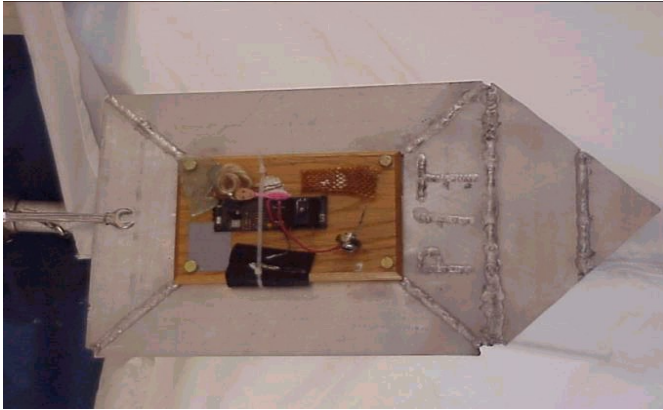
While the event itself did not actually begin until Monday,



The grandstands location. Forrest Bless is in the lookout position scanning the track, while Matt F is doing strategy and monitoring Ra IV’s telemetry data via the laptop. Photo by Ryan McFall.

Racing in Topeka

May 13th, the Saturday before marked the start of the team’s transition into “race mode.” That morning we picked up a U-Haul, and spent the remainder of the day packing our equipment into it. Unlike Ra IV’s previous races we packed fairly sparingly, being confident the kinks were worked out of the car, and that there was no need to bring everything



The pit award turned on its side. The shield and wrench (hangar) were Principia's additions. *Photo by Formula Sun HQ.*

of the car, and there was no need to bring everything plus the kitchen sink. Brett Darkin, a videographer who has volunteered to make a documentary on the team, arrived Sunday and followed the team through Formula Sun.

To race in the grand prix each solar car must pass "scrutineering"—an inspection in which officials scrutinize the engineering of the vehicle, ensuring it conforms to all race and safety regulations. Ra IV set a record for the Principia team by completing scrutineering in three and a half hours, finishing the last of the inspections before lunch. Following the close of scrutineering, all of the cars were invited to participate in the sprint competition. The sprint was a quarter mile drag to determine the starting order for the three day contest. The car with the shortest time—in this case from the University of Minnesota—was to receive pole position. Principia reached a top speed of 41.9 mph for the sprint, and qualified for fifth position with a time of 29.8 seconds.

We began racing at 8:00 am Wednesday morning under sunny skies, with lead driver Kevin Pratt starting for the team. For much of the morning we maintained the second place position behind the University of Minnesota. University of Missouri at Rolla passed us after a few hours, as did Kansas State University, so our day's total of 131 laps landed us in fourth, the position we retained throughout the rest of the race. That first day the solar array was performing about forty percent below normal output, and so electrical gurus Ryan McFall and John Broere spent the better part of the night making modifications and repairs to restore its power.

The team woke up Thursday morning to thunderstorms and gale force winds. One of the tents blew over, and a van had to be moved to shelter our campsite, which was already under a protective pavillion. The rain stopped as the morning progressed, and Ra IV took the track at 8:16 am, taking it a bit more slowly because of the cloud cover. The sun began to peek through before long, and by mid-day cloud formations were focusing the sun's rays on portions of the track, shining with perhaps twenty percent more intensity than is normal in cloudless conditions. With the array back up to full power, we were seeing over 1700

the array back up to full power, we were seeing over 1700 watts from it at some points—an amazing number for a solar car. By the end of the day Principia had completed 255 laps, keeping in a solid forth. University of Missouri-Rolla led with 300 laps.

Friday, the final day of racing, began wet and dreary and cold, with cloud cover hiding the sun's light. We put out on the track at 8:03 am poking along slowly, and gradually sped up as conditions improved. By 10:00 am the clouds had dispersed, and the strategy group told the driver to step it up to a good clip. By mid-afternoon Ra IV was told to increase speed even further, to a rate we maintained until the end of the race. Our final lap count was 372, translating into a distance of 781.2 miles, and giving Ra IV a total mileage of over 3500. University of Missouri-Rolla won the three day competition with an outstanding run of 444 laps. Rolla and Principia were neighbors in the pits, and have enjoyed a relationship for some time now—we enjoyed their success.

After the end of the race, teams lined up to participate in the pit crew competition, in which six members of each team raced to see how fast they could accomplish a simultaneous driver and tire change. Principia won the competition last time it was held, and so kept the trophy until this event. By tradition, each winner places an item of significance onto the trophy/plaque. Because the plaque proper was almost completely covered with other team's items, our crew decided to surmount the wooden plaque onto an aluminum shield we welded together, giving future winners more area to attach their additions. The honor to add to this trophy has now fallen to Kansas State University, to whom Principia finished second in the competition.

All in all, this Formula Sun Grand Prix was an amazing time for the team. The car raced well, the team performed well, and we learned much, taught each other a thing or two, and came away with a wonderful experience. Having zoomed through Topeka, we look forward to finishing our next car and *racing* it. We would like to thank all of our supporters for making this project possible. Your help is invaluable. Thank you!

By Matt F



Team members Chris Churchill, John Broere, and Kevin Pratt stand around Ra IV's chassis in the pit. *Photo by Formula Sun HQ.*

Thoughts from an Alumnus

Having been a member of the first solar car team (Sunrayce '95), I can attest to the fact that the skills practiced in building and racing a solar car are unique among the lessons learned at Principia. When I attended Prin, engineering was not a large focus of the science track. While science is about learning what the universe is telling us, engineering is about putting whatever knowledge learned to practical use -- helping society.

The solar car team offered me a chance to move from the theoretical learning of the classes, to the practical learning of the solar car. We practiced everything from machining to electrical design, from suspension work to fiberglass molding. What better way to educate the whole man than with a project that mixes science, engineering, project management, advertising, design, and a host of other skills?

The students of the solar car team have come a long way in the 8 years since I was a member of the team. The solar car team has brought prestige to Principia, and admiration from much larger universities (who don't do as well in the race). We barely managed to produce a working car, which unfortunately

did not qualify for the Sunrayce. Now, however, Principia's solar car is competing in races all around the world. Congratulations on a terrific job.

Seth Hieronymus, Principia College '98

News In Brief

**The team is pleased to announce that we have secured a batch of high performance solar cells for Ra V. We acquired the lot of about 3000 cell assemblies at a greatly reduced price from Emcore. The cell assemblies, or CICs, include Tecstar TEC1 triple-junction cells made for space satellites, but not suitable for space applications due to some minor mechanical defects. Preliminary tests of a sample indicate the cells perform as well as or better than promised by the manufacturer. More information will be in the next newsletter.

**From August 26th until the start of the new school year, team members will be gathering on campus for the team's two week pre-fall workshop. Time will be spent making progress on the construction of Ra V, including work on the suspension, battery box, body, and electrical sub-systems.

<p>Adopt -A-Trailer Donation: \$15000</p>	<p>Ra 32 Club Donation: \$1000</p>	<p>Adopt-A-Cell Donation: \$500</p>	<p>Adopt-A-Battery Donation: \$100</p>
<p>Rewards:</p> <ul style="list-style-type: none"> Your name or organization's name on Ra V* Your name or organization's name on our race trailer Subscription to Ra News Receive two blue/gold race shirts (more negotiable) 	<p>Rewards:</p> <ul style="list-style-type: none"> Your name or organization's name on our race trailer Subscription to Ra News Receive a blue and gold race shirt 	<p>Rewards:</p> <ul style="list-style-type: none"> Adopts one solar cell Subscription to Ra News Receive 2 T-shirts 	<p>Rewards:</p> <ul style="list-style-type: none"> Adopts one battery cell Subscription to Ra News Receive a T-shirt

Please address contributions to:
Fundraising Chairman
Principia Solar Car Project
Elsah, IL 62028

E-mail: solar@prin.edu Web-site: www.prin.edu/solar
Please make checks payable to: Principia Solar Car Project

All contributions are gratefully accepted and tax-deductible to our 501(c)(3) educational organization.
Please include a corporate matching form if your employer participates in such a program.

*Space on Ra V will be extremely limited and is not guaranteed