International Neutrino Summer School

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History of INSS

- 2007: "Fermilab/KEK Neutrino Physics School", 55 students, spearheaded by Young-Kee Kim
  - Idea was to switch off with Hadron Collider Summer School at Fermilab
  - "Every other year" school would be at Fermilab, off years at KEK
  - Eventually this went to "every 3 years in the US", in coordination with NuFact summer schools, which had started in 2002
- INSS09: Fermilab, 94 students
- INSS10: Yokohama, ~70 students
- INSS11: Cartigny, Switzerland 34 students
  - Smaller size due to late change of venue
- INSS12: Virginia Tech, 75 students
- INSS13: Beijing, 87 students (52 from China, 35 from elsewhere)
- INSS14: St. Andrews, Scotland, 80 students
- INSS15: Sao Paolo, Brazil, 55 students
- INSS16: Quy Nhon, Vietnam, 33 students

History of NuFact Schools

- NuFact Summer Institute: 2002: Abingdon, near Oxford
  - Mix of accelerator physics, particle theory, particle experiment
- NuFact03: Shelter Island
- NuFact04: Tokyo Metropolitan University
- NuFact05: Anacapri, Italy
- NuFact06: Irvine, CA
- NuFact07: no school, INSS started
- NuFact08 School: Spain

What makes INSS Unique

- Broad program covers all major areas of neutrino physics
- Program involves many components
  - Formal Lectures
  - Problem sets that students must answer in groups
  - Students interact with lecturers and tutors during problem-solving sessions
  - Student presentations of the answers they derive
- Students are paired randomly in groups to work together; students with diverse backgrounds meet each other
- Also pair theorists and experimentalists
- Lecturers are asked to stay at school for full week

2016 School Demographics

- Of 33 students:
  - 19 from Asia
  - 7 from Europe
  - 7 from USA
- Of 33 students:
  - 10 women, 23 men
- Over 80% were experimentalists
- Mix of experiments represented:
  - Accelerator-based (10)
  - Reactor-based (6-8)
  - Neutrino-less double beta decay (few)
  - atmospheric/solar based experiments (few)

School Funding

- ICISE paid either half or full student registration fees for 12 students
- DOE (through FNAL) paid for full student registration fees for 7 students from US institutions
- ICISE paid full travel costs for all non-FNAL lecturers, and some travel costs for FNAL lecturers
- FNAL paid 10k$ towards 4 lecturer/organizer travel costs

Lessons Learned during Student Registration Process

- Recruiting strategy: sent out emails to many leaders in Asian HEP community (spokes of experiments, lab management, former collaborators, etc).
- In addition to the 33 students who attended, 25 students registered to attend but did not
  - 1 each from Egypt, Nepal, USA, 3 from Indonesia, and Poland
  - 4 from Vietnam, 7 from India, 5 from China
- May have been confusion over application for financial aid, only 19 applied for financial aid, of the no-shows, only 1 had applied for (and received) financial aid
- 4 students cancelled at the last minute
- Should have been more vigilant about this, especially, Vietnamese and Korean students

School Curriculum and Lecturers

- Neutrino Mass Models (4): ZhiZhong **Xing**
- Neutrino Phenomenology (4): Boris **Kayser**
- Neutrino Detectors (3): Masashi **Yokoyama**
- Accelerator Neutrino Experiments (3): Jeff **Hartnell**
- Neutrino Interactions (3): Kevin **McFarland**
- Direct Neutrino Mass and Neutrino-less Double Beta Decay Measurements (4): Susanne **Mertens**
- Solar and Atmospheric Neutrino Experiments (2): Jen **Raaf**
- Reactor Neutrino Experiments (2): Seon-Hee **Seo**
- Cosmology / High Energy Neutrino Astrophysics (2): Mary Hall **Reno**
- Future Efforts of the Field (2): Sandhya **Choubey**
- Short bonus lecture:
  - Neutrinos: Can We Tell 4 From 2 (Components)? Jean-Marie **Frère**

School Schedule

- Monday July 18 8AM - Friday July 29 11AM
- 8 Days of 3 lectures/day (1.25 hr/lecture)
  - 6 of those days also had 2.25 hr tutorial sessions
  - 1 of those days had 3.5hrs of student presentations
- Last Day: 2 lectures
- 2 half-day excursions, 1 per week
- 1 full day off in the middle
- Programming schedule on normal day:
  - 8AM start, 4:30PM end

Hospitality

- Very important factor in the schools is the ability of students to share meals with each other and with the lecturers
- Another implied ingredient is that the lecturers should be at the school
  - Every lecturer except one stayed for at least 5 school days, and a few stayed 11 days or more!
- For INSS2016 success students and lecturers shared most meals at both ICISE and at Seagull Hotel

Comments from Student Evaluations

- Responses: 17 replies out of 33 students
- Balance of Lecture and Tutorial time correct?
  - Mostly, but a few asked for longer tutorial sessions
- Most valuable part of the school:
  - Discussions with the lecturers and tutorial sessions
- Any topics we should have added?
  - More on ICECUBE experiment
  - Discussion of systematic uncertainties

- Were lectures at right level of difficulty?
  - Some of the mass model lectures were at too high a level
- Social events: (excursions, banquets, etc.) good, but should have had an ice-breaker at the beginning

Future of INSS

- Fermilab is interested in supporting this school at a more formal level through Neutrino Physics Center umbrella (http://npc.fnal.gov)
- Planning to host it in odd years
- School MUST continue to cycle through different geographical regions during even years!
- Next year's school chair: Anne Schukraft
  - She is working out advisory/planning committee(s) now, plans to ask chairs of previous schools to serve to maintain continuity
- Plan for venues in even years still undetermined