

# International collaboration in high energy physics experiments

- ❖ **All large high energy physics experiments today are strongly international.**
- ❖ **A necessary condition for successful collaboration is a clear mandate from strategic planning panels that the science case is compelling. This mandate exists for the ILC.**

We deeply appreciate the long history of US-Japan collaboration in many important areas of science.

## The character of high energy experiments:

Major high energy physics experiments world wide have become highly international – collaborations in Japan, CERN, Germany, US (Fermilab, SLAC) all have about 50% of collaborators from the non-host region.

These collaborations are large – from 100's to 1000's of physicists. The ILC experiments are expected to be of similar size.

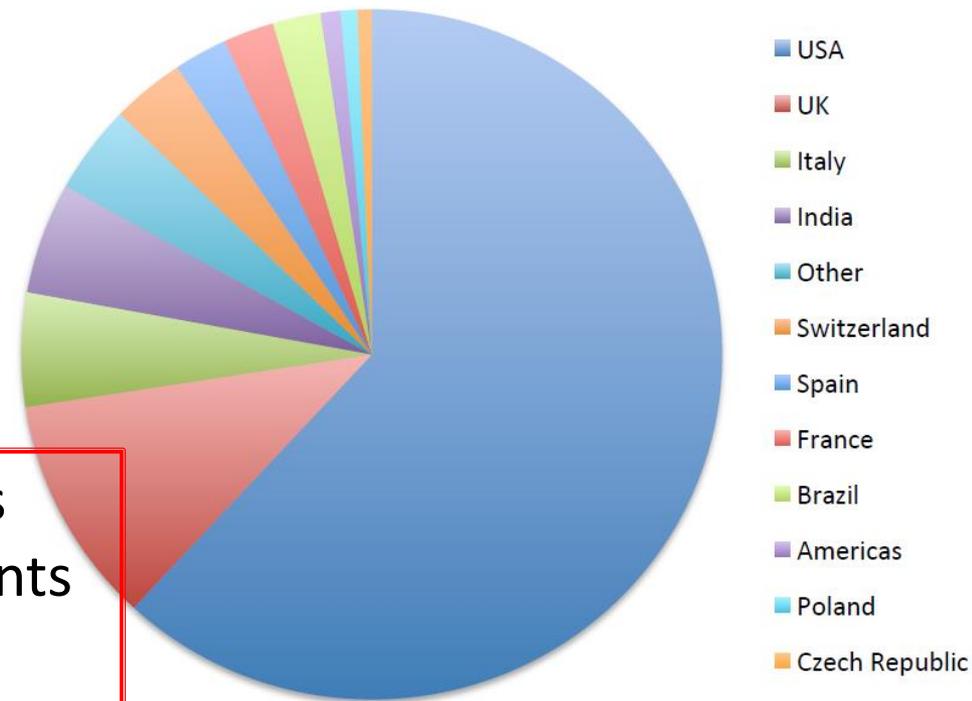
Modern particle detectors are large and complex. They weigh 1000's of tonnes, >50 meters on a side, have millions of electronic channels and produce petabytes of data yearly.

## Why large collaborations?

- ❖ Each detector has 10's of subdetectors, each with dedicated teams for design, building, testing, installation, operation.
- ❖ The electronics for reading out signals are highly complex and custom-built by teams of engineers and physicists.
- ❖ Operating the detector requires crews of physicists working around the clock, every day.
- ❖ Custom software and computing systems are required to select events, collect data, calibrate it, archive it for analyses.
- ❖ The science goals are very broad; 100's of separate analyses, each involving 5-10 physicists for many months.

## A recent example:

The Deep Underground Neutrino Experiment (DUNE) was initiated at Fermilab in Jan. 2015, seeded mainly by U.S. scientists. By April 2015, an international collaboration had formed with 769 collaborators, already with 40% foreign participants. The non-U.S. participation will grow.



This rapid internationalization was enabled by the strong endorsements from regional strategic planning studies (next slide).

## Endorsements for DUNE:

2014 HEPAP (U.S.) Recommendation: “Form a new international collaboration to design and execute a highly capable Long-Baseline Neutrino Facility hosted by the U.S. (This) is the highest-priority (U.S.-based) large project in its timeframe. “

2013 European Strategy Recommendation: “Rapid progress in neutrino oscillation physics, with significant European involvement, has established a strong scientific case. CERN should develop a neutrino programme to pave the way for a substantial European role in future long-baseline experiments. Europe should explore the possibility of major participation in leading neutrino projects in the US and Japan.”

Such endorsements, coupled with broad support from the scientific community, were absolutely essential for launching DUNE.

## Support for ILC:

Over 2500 physicists worldwide signed the document  
*“Understanding Matter, Energy, Space and Time: The Case for the  
 $e^+e^-$  Linear Collider”*

Several strategic planning documents in Japan have articulated the highest priority need for the ILC, and the desire to host it in Japan.

2014 HEPAP (U.S.) Report: “The ILC is the most mature in its design and readiness for construction. The ILC would greatly increase the sensitivity to the Higgs boson interactions, with particles in the dark sector, and with other new physics.”

(The U.S. should) “play a world-leading role in the ILC experimental program and provide critical expertise and components to the accelerator, should this exciting scientific opportunity be realized in Japan.”

## Support for ILC

2013 European Strategy Recommendation: “There is a strong scientific case for an electron-positron collider that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be upgraded. The initiative from the Japanese particle physics community to host the ILC in Japan is most welcome, and European groups are eager to participate. Europe looks forward to a proposal from Japan to discuss a possible participation.”

Given these strong endorsements of the scientific promise and technical readiness of the ILC, together with the precedents for forming successful collaborations, we expect large and enthusiastic engagement by the international community for a Japan-hosted ILC.

## A personal comment:

Large HEP experiments are extraordinary examples of close cooperation among people from different countries and cultures.

Through daily meetings and close cooperation on small projects, people learn to understand and respect the ideas of others, and to work collaboratively.

It is common to see young physicists from Pakistan and India, China and Japan, or Ukraine and Russia working together. This personal aspect of international collaboration often has long term impacts. When individuals return home to positions of responsibility, they understand the different cultures and often know their counterparts in other countries well.

**❖ Particle physics is a paradigm for successful global cooperation.**



If you build it, they will come ...

I am Paul Grannis of Stony Brook University. I was the original leader and current co-leader of the DZero experiment at Fermilab which grew from 70 US physicists in 1983 to a collaboration of over 600 people from 21 nations.