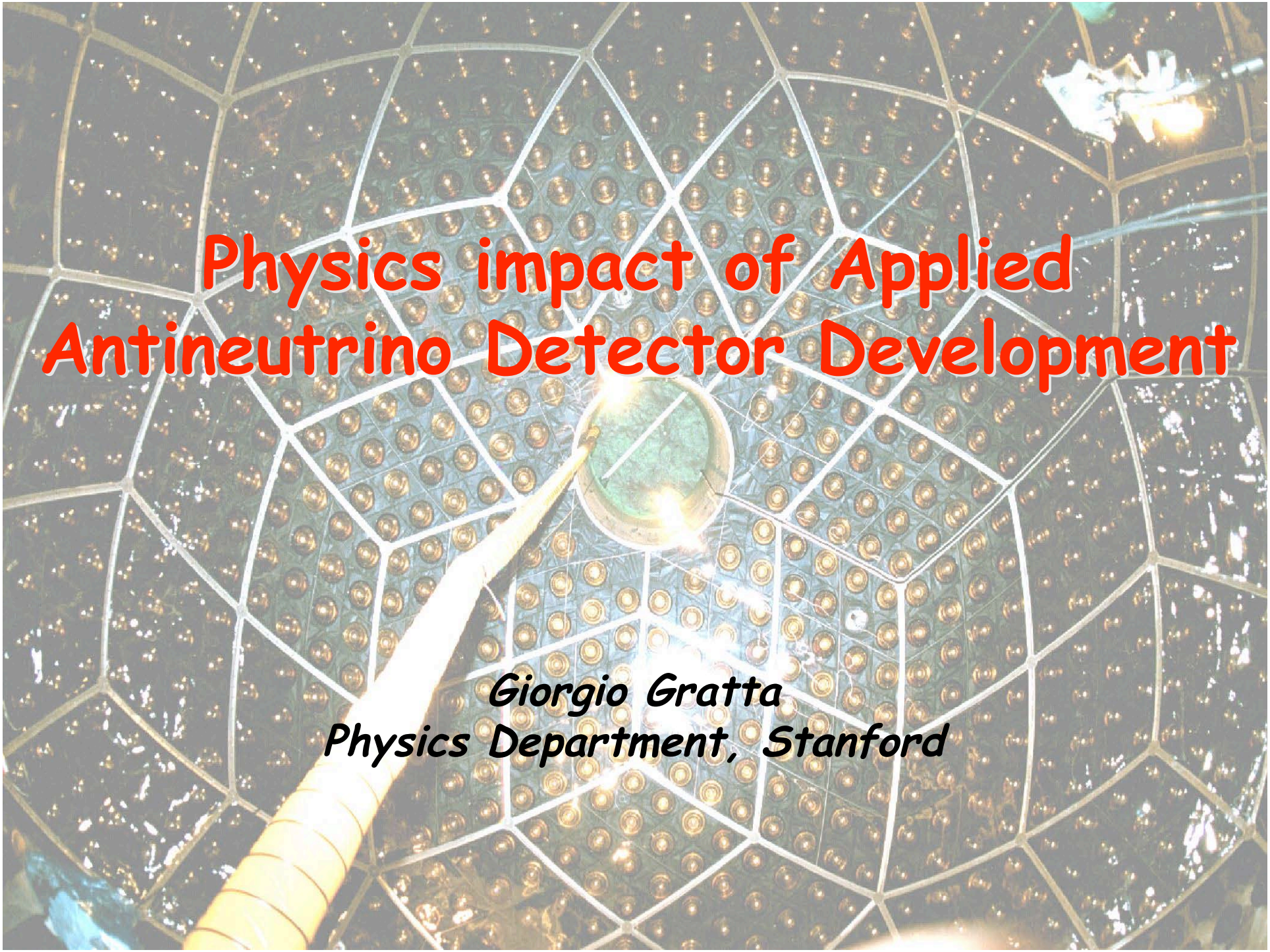

Physics impact of Applied Antineutrino Detector Development

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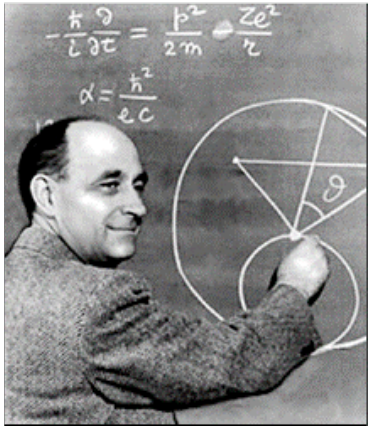
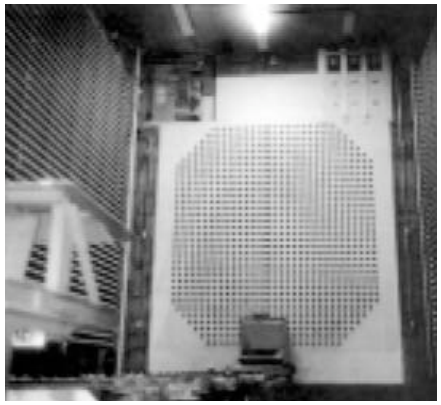
Bragging rights
Synergy/collaboration
Compact detectors
No/light shielding is good
Very large detectors
Reliable/stable detectors

Neutrinos have a rich history of synergies between pure science and technology

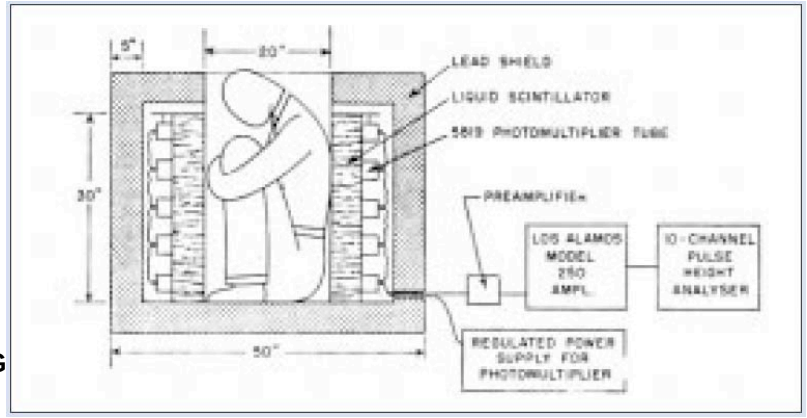


Pure science
Leads to
(bomb) technology



(bomb) technology
leads to scientific
discovery

science instrument
leads to (medical)
technology



Bragging rights

- Quite unusual to have transition from pure science applications to applications this fast
- Should used with the public, Congress and the funding agencies as an example of how fast this transition can occur
- Should make the point of how even rather esoteric topics in science (i.e. neutrinos) can unexpectedly bring applications

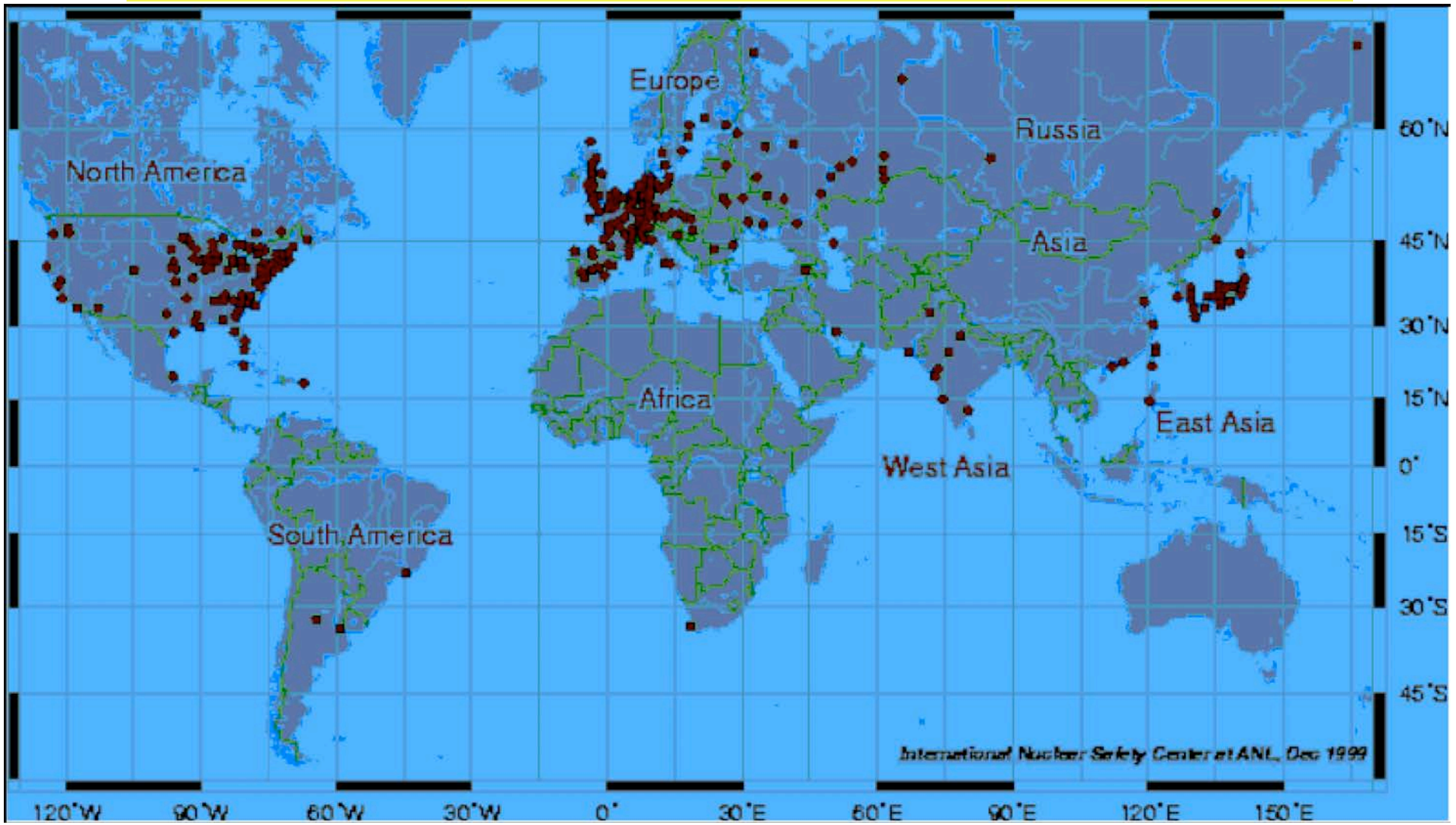
The HEP/NP community
needs to learn that
applied physics
is good !

There is no shame
in finding that
our work can produce
tangible results,
…sometimes
remarkably fast !

Synergy/collaboration: Some future detectors for neutrino science and non-proliferation may share interests: here are some themes

- θ_{13} and reactor monitoring share the interest for data that is not statistics dominated: need small systematics.
  - -Very high statistics reactor spectrum from reactor monitoring may be useful to get to the bottom of errors for θ_{13}.
  - -Understanding in detail the effects of spent fuel maybe relevant for both.
- Knowledge of the reactor spectrum: who wants to repeat Schreckenbach's measurements and extend them to ^{238}U with fast neutrons ?
- Really large detectors (may be so large that the science community can't build them alone)

When one needs the map below to site a detector (KamLAND), it is quite clear that there maybe synergies with other field



Synergy/collaboration: Some future detectors for neutrino science and non-proliferation may share interests: here are some themes

The really large detector would have applications in:

- Geophysics
- Supernova (astrophysics)
- Nuclear non-proliferation
- Neutrino physics

The exact size, timing, technology, location(s) maybe different for the different topics above

The technology may still require time to mature

But there is clearly a common interest here that needs to be cultivated and encouraged !

Synergy/collaboration: Some future detectors for neutrino science and non-proliferation may share interests: here are some themes

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- Knowledge of the reactor spectrum: who wants to repeat Schreckenbach's measurements and extend them to ^{238}U with fast neutrons ?
- Really large detectors (may be so large that the science community can't build them alone)
- ULTNMME (Ultra Large Tritium Neutrino Magnetic Moment Experiment)

  What if we use "all of the tritium in the world" to build a really large neutrino magnetic moment experiment

New technology: 1) compact detectors

Coherent scattering

This is of primary interest for non-proliferation, as it would allow detectors to be small. Important when the detector is an "accessory".

But once the technology is developed, small detectors may make science measurements easier or even possible.

Also the development of lower thresholds for coherent scattering have direct impact on many science topics (DM, ν magnetic moment,…)

New technology: 2) "unshielded" detectors

Neutrino detectors traditionally require heavy shielding

For science this is, at first order, no problem:
go underground, pile up lots of dirt, build heavy shields

Some non-proliferation technologies are simply impossible if heavy shielding is required (neutrino detector on a truck…) → do R&D on ultra-segmented detectors using very fast, modern electronics. How far can this be pushed?

But if shield-less detectors become possible this would have lots of neutrino physics applications. Think about a solar neutrino detector on a spacecraft flying towards the sun !

New technology: 3) reliable and stable detectors

Scientific neutrino detectors are carefully tended by loving graduate students

For non proliferation is this clearly a problem, one wants an "industrial type" of unattended operation

Again, science may not have the patience to develop rugged neutrino detectors but certainly can use them.

Just imagine if a *unshielded, miniaturized, rugged* neutrino detector were to be available in the lab like a –say- neutron counter !

Conclusions

This is a great opportunity for collaboration.