Overview of GENIE

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Costas Andreopoulos and Hugh Gallagher started GENIE
Overview talk

- GENIE is the most common code in use, has many structural features that will be hard to develop again.
- It tries to be the Universal Generator requested at NUI NT
- Major tasks
  - Code development
  - Code validation, releases
  - Interactions with experiments, theorists
- Existing manpower, fractions of CA, SD, HG, GP, and RH + fractions of undergrads (~2), grad students (~6), postdocs (~5) with help from theorists. [total ~2 FTE] (30% increase in last year – FNAL staff, workshop)
Physics Models

- All flavors, all targets, all processes
- Physics models are not *universal*, need significant work!
  - Model development too slow (bad funding, slow action)
- Models for success
  - Theorists work more directly with developers
  - Each experiment provides ~1/3 time of a few students
  - Developers get more resources
  - Fermilab devotes personnel to technical tasks
  - Some group decides to build a new generator
cross sections in GENIE

- GENIE has complete kinematics for all final state particles for all cross sections at all energies.
- Here, we show $\nu_\mu$ Carbon:
  - $q_e$
  - All resonances
  - coherent
  - DIS of all flavors
  - Many others
- Input spline functions + many PDF’s used to generate events.
- Works because models are simple.
Development

- **Success** - major advance in 1-2 years
  - Jarek Novak did research, testing, and coding for new $\Delta$ model.
  - Tinjun Yang did AGKY model with CA, HG, and Pauli Kehiyas (Tufts)

- **Slow success** - major advance in 3-4 years
  - Coherent model with Warwick students, Luis Alvarez-Ruso, CA, SD
  - FSI model with Pitt undergrads, SD

- **No success** -
  - GIBUU
  - Sato-Lee $\Delta$ model

- **Problems**
  - Theorists provide no model, formulas (exception is Paschos)
  - Theorists provide FORTRAN code
  - Not enough time commitment, training to do conversion/coding
Lessons learned

- GENIE is excellent, sophisticated code with new bylaws
- Core of a truly universal code is there
  - 2-4 QE models, 2 FSI codes, 3 coherent models, 2 $\Delta$ models ‘soon’
- CA, SD, GP, and HG are team leaders of good coders.
  - New interest, structure should diffuse effort in good way.
  - New efforts encouraged, but early connection with us very helpful.
- Small existing group means time delays can be long
- Recent progress
  - New staff at FNAL – Gabe Perdue (~50%), Julia Yarba (~10%)
  - New postdoc at FNAL – Tomasz Golan (PhD with NuWro)
  - New postdoc at Liverpool (50% FNAL), new PhD student funding
  - First developers’ workshop – FNAL – Mar, 2014