MicroBooNE xs task list

1. list of XS errors for MiniBooNE oscillation analysis
2. MicroBooNE task list, oscillation physics

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MicroBooNE XSWG meeting, June 21, 2012

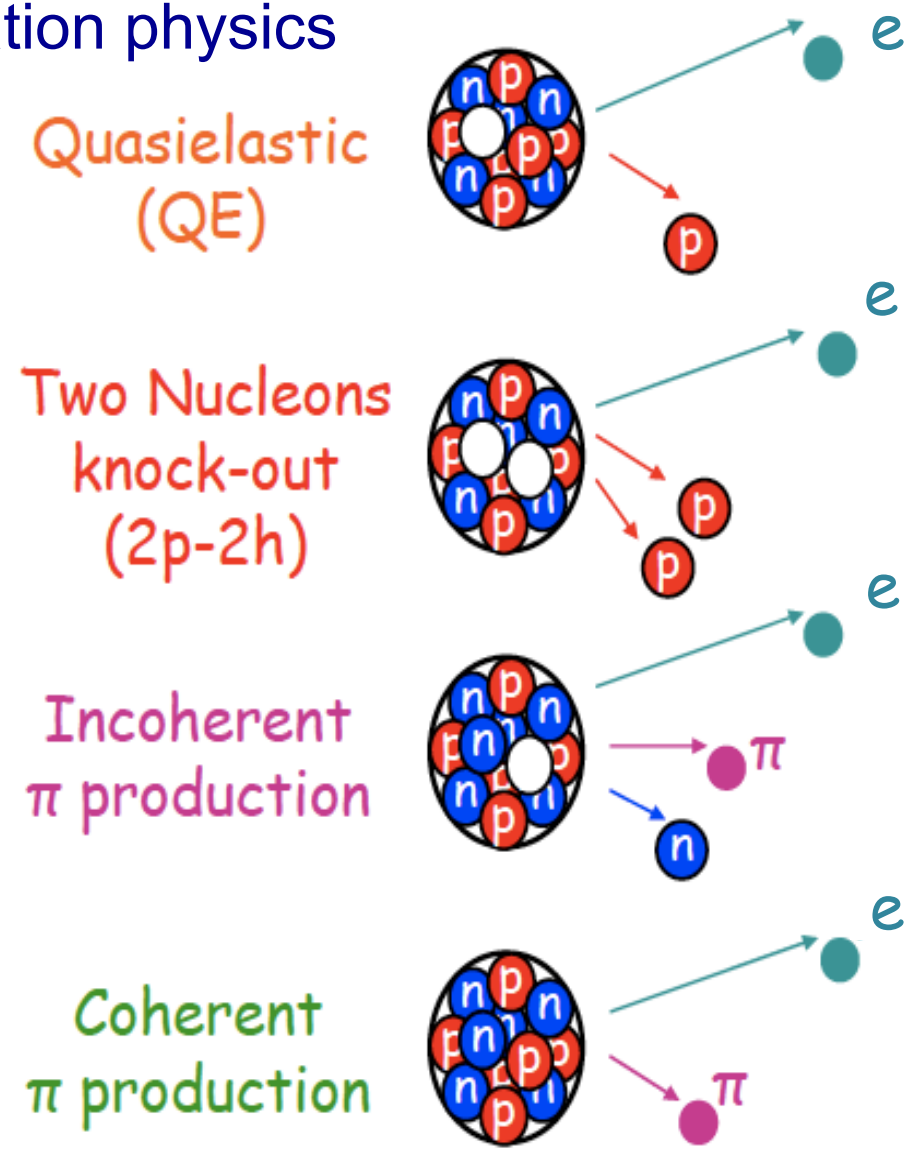
1. List of XS errors from internal measurements

2 of most important channels, CCQE and NCπ^o
- For CCQE, parameter values and errors are measured
- For NCπ^o, production rate are modified with function of π^o kinematics based on measurement
- For radiative Δ-decay, error is constraint from the NCπ^o rate measurement

	value	error (%)	description
M_A_QE	1.2341 GeV	6.24	MA of carbon
delrad	1.022	12.2	scale factor of radiative Δ-decay
EloSF	1.022	2.01	scale factor of Pauli blocking
coh	1.0	14	coherent pion production
Res Pi0	0.947	14.8	Normalization of NCπ^o
Pi0 (9)	1.0	3?	Weight for NCπ^o production rate shape

2. MicroBooNE task list, oscillation physics

Oscillation physics
- signal is single electron-like track from ν_e CC interaction
- simulation of CC event, including all primary processes
  - CCQE
  - CC1π production (both incoherent, or resonance, and coherent channel)
  - CC MEC (multi-nucleon emission channel)



2. MicroBooNE task list, oscillation physics

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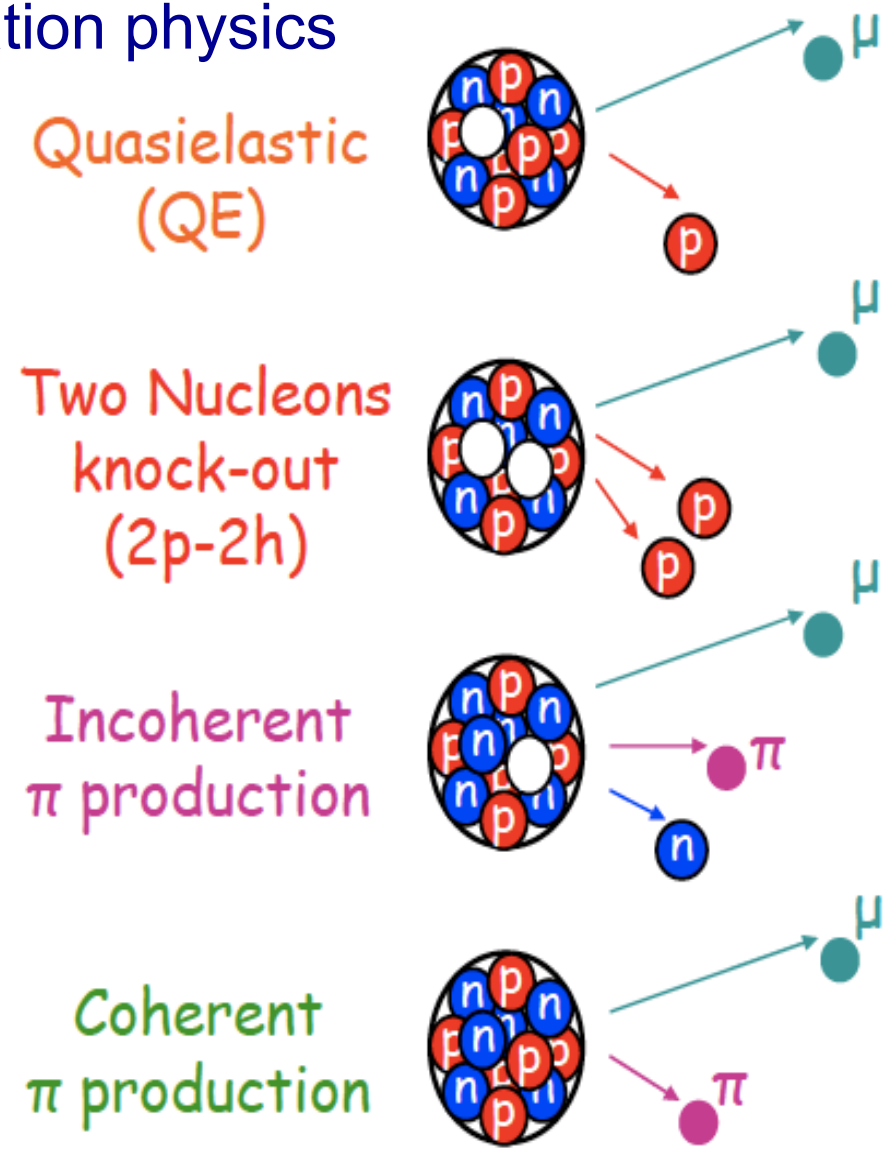
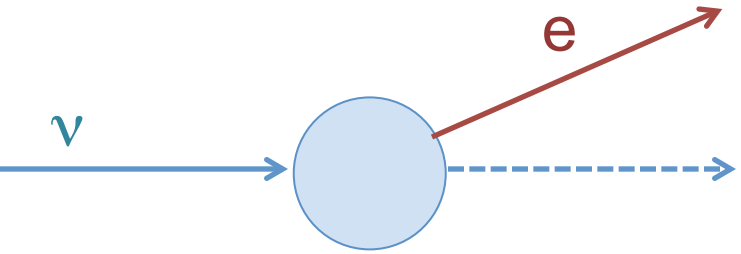
Traditionally, we use ν_μ CC interaction to understand above all

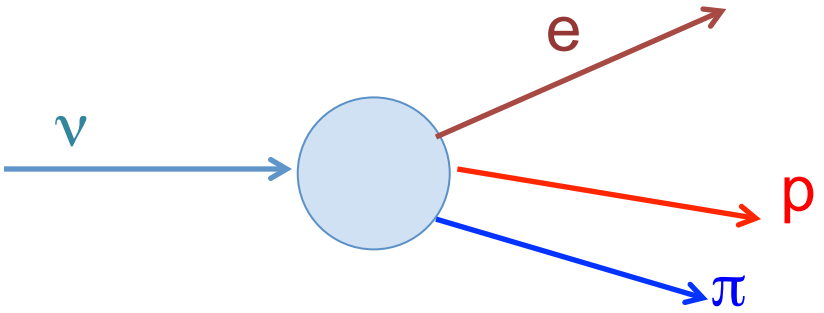
We need to check all CC models
- ν_μ CCQE
- ν_μ CC1π
- ν_μ CC MEC
- are they look OK?
  - final state particles
  - kinematics



2. MicroBooNE task list, oscillation physics

Oscillation physics
- signal is single electron-like track from ν_e CC interaction
- energy reconstruction is based on total CC energy, not QE assumption.





neutrino energy reconstruction from QE assumption
- only outgoing lepton is measured
- measured energy and angle is used to reconstruct neutrino energy by assuming primary interaction is CCQE

neutrino energy reconstruction from total CC energy
- all particle tracks and energy deposits are measured.
- measured energy are summed up to reconstruct initial neutrino energy

We need to understand hadronic system
- calibration of hadronic tracks, vertex activity
- FSI (final state interaction), does it make sense?
  - energy loss, angle change
  - multiplicity of particles

2. MicroBooNE task list, oscillation physics

Oscillation physics
- background is any other electron-like track
  - π^o production
  - radiative Δ decay
  - these background from outside (dirt simulation)

We need to understand all processes to make single gamma ray/electron.
- NCπ^o production
- radiative Δ decay
- dirt model

Then, in situ measurement should be used to tune our simulation
- reweighting?

2. MicroBooNE task list, oscillation physics, summary

ν_μ CC related
- Check of kinematics and multiplicity of all CC channels
- mainly CCQE, CC1π, and CC MEC

Energy reconstruction
- FSI
- Hadronic system validation (comparison with other MC, comparison with external data)

Background
- Check of all single gamma/electron production processes
- mainly NCπ^o, radiative Δ decay
- dirt model

1. List of XS errors from external data

Relative less important for the oscillation analysis in MiniBooNE
- Values and errors are from external data (EB, PF, MA_H)
- Errors are estimated from external data and MB MC comparison (MA_coh?, Cex, Abs)
- Errors are estimated from external models and MB MC comparison (mu to e, CCQE E)

	value	error (%)	description
E_B	34.0	26.5	binding energy (with isospin collection)
P_F	220.0	13.6	Fermi momentum
mu to e (2)	0.0	50.0	ν_μCCQE to ν_eCCQE difference
CCQE E (2)	0.0	15.0	CCQE model dependence
M_A coh	1.03	26.7	MA of CC1π coherent (not include NCπ^o)
Pip Cex detec	0.0	50	pion charge exchange in media
Pip Abs detec	0.0	35	pion absorption in media
M_A QE H	1.13	8.85	MA of hydrogen
Pip Cex nucl	1.0	25	pion charge exchange in nuclei
Pip Abs nucl	1.0	30	pion absorption in nuclei

1. List of XS errors from wild guess

Not important for the oscillation analysis in MiniBooNE
- Values are based on wild guess from data or models

	value	error (%)	description
dels	0.0	10	isoscalar contribution on NC interaction
M_A_1pi	1.1	25	MA for CC/NC 1 pion production
M_A_Npi	1.3	40	MA for CC/NS N pion production
dis	1.0	25	scale factor of DIS event (<2%)
CCQE Norm	0.0	10	scale factor of CCQE event
Nubar	0.0	10	scale factor of anti-neutrino event