Electron Scattering: Experimental Landscape

- Electron scattering has the distinct advantage of monochromatic beams with well determined energies, allowing for a significantly cleaner kinematic separation of the various production mechanisms.
- A large data set of high precision electron-nucleus scattering exist, covering many nuclei and wide energy range corresponding to different reaction mechanisms.
- The vector part of the weak response is related to the electromagnetic response through CVC. Any nuclear model and generator used to describe neutrino-nucleus scattering should first be validated against these data.

Electron Scattering: Archive of Past Measurements

Quasielastic Electron Nucleus Scattering Archive

Donal Day
April 14, 2015

Welcome to Quasielastic Electron Nucleus Scattering Archive

In connection with a review article (Quasielastic Electron-Nucleus Scattering, by O. Benhar, D. Day and I. Sick) published in the Reviews of Modern Physics [Rev. Mod. Phys. 80, 189-224, 2008], we have collected here an extensive set of quasielastic electron scattering data in order to preserve and make available these data to the nuclear physics community.

At present there are about 600 different combinations of targets, energies and angles consisting of some 19,000 data points.

- E12-14-012
- E02-019
- 2H
- 3H
- 3He
- 4He
- 6Li
- 12C
- 16O
- 27Al
- 40Ca
- 48Ca
- 56Fe
- 197Au
- 208Pb
- 238U
- Other
- Nuclear Matter

Data file structure

The data files consists of many lines, each with 8 (space delimited) columns as follows:

Z	A	E (GeV)	Theta (degrees)	energy loss (GeV)	sigma (nb/sr/GeV)	error (random)	citation (Spires notation)

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http://discovery.phys.virginia.edu/research/groups/qes-archive/

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Year	Laboratory	Energies (GeV)	Angles	Targets	Mode	PID	DeltaP/P (%)	In Archive	Citation
1980	Bates	0.1--0.37	90--160	Fe	S	Ckov	<0.1	N	Altemus:1980wt, Altemus:1980
1984	Bates	.15--.3	180	Fe	S	Ckov	<0.1	Y	Hotta:1984
1986	Bates	0.1-0.69	60--160	238U	S	Ckov	<0.1	Y	Blatchley:1986qd, Blatchley:1984
1986	Bates	0.22-0.32	180	2H	S	Ckov	<0.1	Y	Parker:1986
1987	Bates	.537 and .730	37.1	4He, Be, C and O	S	Ckov	<0.1	Y	O'Connell:1987ag
1988	Bates	0.07--0.79	54--134.5	3H, 3He	E	Ckov	<0.1	Y	Dow:1988rk, Dow:1987
1988	Bates	.3--.6	60, 134.5	2H, 3He, 4He	E	Ckov	<0.1	N	Dytman:1988fi
1988	Bates	.29--.44	60, 134.5	2H	E	Ckov	<0.1	N	Quinn:1988ua
1990	Bates	0.28--0.73	60 and 134.5	4He	E	Ckov	<0.1	Y	vonReden:1990a
1997	Bates	0.130--.84	45.5, 90, 140	Ca40	S/E	Ckov	<0.1	Y	Williamson:1997, Yates:1993jg
1971	CEA	1--4	8.5--18	C	E	SC,Ckov		N	Stanfield:1971eg
1974	DESY	2.7	12--15	Li	E	SC,Ckov	1.2	N	Heimlich:1974rk, Heimlich:1973
1974	DESY	2--2.7	15	C	E	SC,Ckov	1.2	Y	Zeller:1973ge
1996	Frascati	.7--1.5	32, 37.1 and 83	16O		SC,Ckov	few %	Y	Anghinolfi:1996vm
1971	HEPL	0.5	60	Li,C,Mg,Ca,Ni,Y,Sn,Ta,Pb	S	Ckov	0.1	Y	Moniz:1971mt, Whitney:1974hr
1976	HEPL	0.5	60	3He, 4He	S	Ckov	0.1	Y	McCarthy:1976re
1998	JLAB	4.045	15-55	2H,C,Fe,Au	E	SC,Ckov	0.1	Y	Arrington:1998ps, Arrington:1998hz
2011	JLAB	5.766	18.00-55.00	2H, 3He, 4He, 9Be, 12C, 64Cu, 197Au	E	SC,Ckov	0.1	Y	Fomin:2010ei
1969	Kharkov	0.6--1.	16--60	C		Ckov		N	Dementii:1969
1969	Kharkov	1.1	25	C		SC,Ckov		N	Titov:1969
1971	Kharkov	1.1--1.2	20--60	C,Al,Ni,Mo,W		SC,Ckov		N	Titov:1971
1972	Kharkov	1.18	16--55	6Li		SC,Ckov		N	Titov:1972
1974	Kharkov	1.2	20--35	Be,Cu, Ag		SC,Ckov		N	Titov:1974
1976	Kharkov			4He				N	Dementii:1976
1983	Saclay	0.120--0.60	36,60,90,and 145	C	S	Ckov	0.1	Y	Barreau:1983ht
1984	Saclay	0.120--0.695	60,90, and 140	40Ca, 48Ca, Fe	S	Ckov	0.1	Y	Meziani:1984is
1985	Saclay	0.12--0.67	36--145	3He	S	Ckov	0.1	Y	Marchand:1985us
1993	Saclay	0.14--0.65	34--145	4He and Pb	E	Ckov	0.1	Y	Zghiche:1993xg
1976	SLAC	6.5--18.4	8	2H	E	SC,Ckov	0.5	Y	Schutz:1976he
1979	SLAC	2.8--14.7	8	3He	E	SC,Ckov	0.2	Y	Day:1979bx
1981	SLAC	6.5--11.3	8	4He	E	SC,Ckov	0.1	Y	Rock:1981aa
1987	SLAC	up to 4 GeV	15-39	4He, C, Al, Fe, Au	E	SC,Ckov	0.1	Y	Day:1987az, Day:1993md, Potterveld:1989wn
1988	SLAC	0.65--1.65	11--55	C and Fe	E	SC,Ckov	0.1	Y	Baran:1988tw, Baran:1989
1988	SLAC	0.8 --1.3	180	2H	E	SC,Ckov	0.1	Y	Arnold:1988us
1989	SLAC	1--1.5	37.5	4He,C, Fe, W	E	SC,Ckov	0.1	Y	Sealock:1989nx
1991	SLAC	9.7-21	10	2H	E	SC,Ckov	0.1	Y	Rock:1991jy
1992	SLAC	1.1--4.3	15 and 85	3He, 4He, Fe	E	SC,Ckov	0.1	Y	Chen:1991vb, Chen:1990kq, Meziani:1992xr
1992	SLAC	1.5--5.5	15--90	2H	E	SC,Ckov	0.1	Y	Lung-thesis:1992
1992	SLAC	2--9.8	15--61	Al	E	SC,Ckov	0.1	Y	Bosted:1992fy
1992	SLAC	2.8--14.7	8	Al	E	SC,Ckov	0.1	Y	Rock-pc
1995	SLAC	2.--5.	15--57	2H, C, Fe, Au	E	SC,Ckov	0.1	Y	Arrington:1995hs
1988	Yerevan	1.9-2.1	16-18	C	S	SC	0.5	Y	Bagdasaryan:1988hp

Electron Scattering: Current and Planned Experiments

- Plan for this hour:
  - 5 mins presentations each from all the current and planned electron scattering programs
  - Discussion: identifying any experimental gaps or high interest measurements beyond the programs outlined here

Experiments	Kinematics Range	Nuclear Targets	Scattering Type	Detector Characteristics
E12-14-012 at JLab [Data collected in 2017]	E_e = 2.222 GeV Theta_e = 15.5^0, 17.5^0, 20.0^0, 21.5^0 Theta_p = -39.0^0, -44.0^0, -44.5^0, -47.0^0, -50.0^0	C, Al, Ar, Ti	Inclusive: e in the final state Exclusive: e, p in the final state	High resolution spectrometers Large acceptance Scintillator counter Drift chambers Cherenkov detector
E04-001 at JLab [Data collected]	E_e = 1.2, 2.3, 3.5, 4.6, … GeV	H, D, C, Al, Fe, Cu	Inclusive: e in the final state Exclusive?	Large acceptance spectrometer Scintillator counter Drift chambers Cherenkov counter Electromagnetic calorimeter
e4nu at JLab [CLAS12: Planned, LOI#102] [CLAS: data collected]	CLAS12: E_e = 1, 2, 4, 6 GeV CLAS: E_e = 1.2, 2.3, 4.5 GeV	CLAS12: C, O, Ar CLAS: He, C, Fe	CLAS12: Exclusive: e, p, n, pion in the final state CLAS: Exclusive: e, p, pion in the final state	Large acceptance spectrometer Scintillator counter Drift chambers Cherenkov counter Electromagnetic calorimeter
LDMX at SLAC [Planned, LOI#91]	E_e = 4, 8 GeV Theta < 40^0 degrees		Inclusive: e in the final state Exclusive: e, p, n, pion in the final state	Precision tracker Electromagnetic calorimeter Hadronic calorimeter Low-energy threshold
A1 Collaboration at MAMI [Some data collected in 2020, more data collection planned]	E_e = 1.6 GeV	H, D, He, C, O, Al, Ca, Ar, Xe, …	Inclusive: e in the final state Exclusive possible: e + 2 additional charged particles	Three magnetic spectrometers Neutron detector