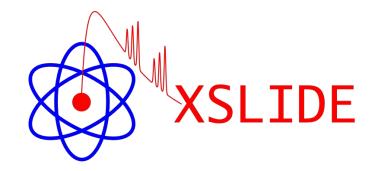
# An Introduction to XSLIDE

X-Ray Spectral Line IDentifier and Explorer



NASA/GSFC XRISM SDC

### Outline

- Scientific Methodology of Plotting X-Ray Spectra
- Overview of XSLIDE Software
- XSLIDE Walkthrough
- Software Development

# Scientific Methodology of Plotting X-Ray Spectra

### X-Ray Spectral Fitting

• An X-Ray spectrometer obtains photon counts, from which we seek to determine the source spectrum via the equation:

$$C(I) = T \int R_{\rm RMF}(I, E) R_{\rm ARF}(E) S(E) dE$$

C = counts [photons],T = observation time [second],I = instrument channel,E = energy [keV] $R_{\rm RMF} =$  redistribution matrix (probability of photon of given energy being counted in given instrument channel) [unitless] $R_{\rm RMF} =$  ancillary response file containing effective area [cm<sup>2</sup>],S = source spectrum [photons/(cm<sup>2</sup>·second·keV)]

- Problem: This equation cannot be analytically solved for S(E)
- Rigorous Solution: Forward fitting, by positing a model for *S*(*E*), minimizing the error by varying the model parameters, and revising the model as necessary

### **Problem With the Rigorous Solution**

equil, vequil

etable

expabs

expdec

expfac

gabs

grad

grbcomp

gsmooth

highecut, zhighect

grbjet

grbm

hatm

heilin

hrefl

jet

ireflect

ismabs

kdblur

kdblur2

kerrconv

kerrdisk

kyconv

kyrline

laor

laor2

lorentz

lsmooth

logconst

log10con

lyman meka, vmeka

mtable

nlapec

nsagrav

nsatmos

nsmax

nsx

nteea

nsmaxg

nthcomp

olivineabs

partcov

pegpwrlw

pexmon

pexrav

pexriv

phabs,

optxagnf, optxagn

pcfabs, zpcfabs

zphabs, zvphabs

notch

nsa

nei, vnei

kerrd

kerrbb, zkerrbb

logpar, zlogpar

mekal, vmekal

mkcflow, vmcflow

npshock, vnpshock

ismdust

ezdiskbb

gadem, vgadem

gauss, zgauss gnei, vgnei

#### **XSPEC** Models

#### 6.1 Alphabetical Summary of Models

	acisabs
	agauss, zag agnsed
	agnslim
	ascac
	apec, vape atable
	bapec, by
Chapping the	vapec
Choosing the	bbody, zbl bbodyrad
0	bexrav
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right model is	bknpower, bkn2pow
ingine into diot lo	bmc
4	bremss, zbremss
not always	zbremss brnei, byri
not always	btapec,
	bvvtapec
apply and doing	bwcycl
easy, and doing	c6mekl, c6vmekl, c
	cabs
an taken time	carbatm
so takes time	cemekl, ce
	cflux
	clmass,
	monomass
	compbb
	compLS
	compmag

	Table 6.1: Summary of Models
fodel	Description
bsori	Ionized absorber.
cisabs	Extra absorption due to contamination on the ACIS filters.
igauss, zagauss	Gaussian line profile in wavelength space.
gnsed	AGN SED model.
gnslim	AGN super-Eddington accretion model.
iscac	ASCA PSF mixing model.
apec, vapec, vvapec	APEC thermal plasma model.
table	Additive table model.
papec, bvapec, bv-	Velocity broadened APEC thermal plasma model.
apec	
body, zbbody	Blackbody spectrum, with redshift variant
obodyrad	Blackbody spectrum with norm proportional to surface area.
Dexrav	E-folded broken power-law reflected from neutral matter
pexriv	E-folded broken power-law reflected from ionized matter
oknpower, zbknpower okn2pow	Broken powerlaw. Three-segment broken powerlaw.
omc	Comptonization by relativistically moving matter.
oremss, vbremss,	Thermal bremsstrahlung, with redshift variant.
bremss	
ornei, bvrnei, bvvrnei	Velocity broadened non-equilibrium thermal plasma model.
otapec, bytapec,	Broadened APEC emission spectrum with separate continuum and
ovvtapec	line temperatures.
bwevel	Becker-Wolff self-consistent cyclotron line model
c6mekl, c6pmekl,	6th-order Chebyshev polynomial DEM using mekal and variants
comekl, c6pvmkl	oth-order Chebysnev polyholinai DEM using mekai and variants
cabs	Compton scattering (non-relativistic)
carbatm	Nonmagnetic carbon atmosphere of a neutron star
cemekl, cevmkl	Multi-temperature mekal.
flow	Cooling flow model.
flux	Calculate flux of other model components.
clmass, nfwmass,	Cluster mass mixing models.
monomass	
clumin	Calculate luminosity of other model components.
compbb	Comptonized blackbody spectrum after Nishimura et al. 1986.
compLS	Comptonization spectrum after Lamb and Sanford 1979.
compmag	Thermal and bulk Comptonization for cylindrical accretion onto
	the polar cap of a magnetized neutron star.
compPS	Comptonization spectrum after Poutanen and Svenson 1986.
compST	Comptonization spectrum after Sunyaev and Titarchuk 1980.
comptb	Thermal and bulk Comptonization of a seed blackbody-like spec-
(D)(D)	trum.
COMPTT	Comptonization spectrum after Titarchuk 1994.
constant cpflux	Energy-independent multiplicative factor. Convolution model to calculate photon flux.
epnux eph, veph	Cooling + heating model for cool core clusters.
cplinear	Non-physical model for low count background spectra
cutoffpl, zcutoffpl	Powerlaw with high energy exponential rolloff.
cyclabs	Cyclotron absorption line.
lisk	Disk model.
liskbb	Multiple blackbody disk model.
liskir	Irradiated inner and outer disk.
liskline	Line emission from relativistic accretion disk.
liskm	Disk model with gas pressure viscosity.
lisko	Modified blackbody disk model.
liskpbb	Accretion disk with power-law T(r)
liskpn	Accretion disk around a black hole.
dust	Dust scattering out of the beam.
edge, zedge	Absorption edge.
eplogpar	Log-parabolic blazar model with vFv normalization.
eqpair, eqtherm,	Paolo Coppi's hybrid hot plasma emission models.
compth	

	Equilibrium ionization collisional plasma model from Borkowski. Table model for exponential of -1 times the input. Low-energy exponential rolloff.
	Exponential decay
	Exponential factor. Multiple blackbody disk model with zero-torque inner boundary. Gaussian absorption line.
em	Plasma emission, multi-temperature with gaussian distribution of emission measure.
8	Simple gaussian line profile.
	Generalized single ionization NEI plasma model. GR accretion disk around a black hole.
	Comptonization model for GRB prompt emission.
	Two-phase Comptonization model of soft thermal seed photons for GRB prompt emission.
	Gamma-ray burst model.
	Gaussian smoothing with an energy dependent sigma.
	Nonmagnetic hydrogen atmosphere of a neutron star. Voigt absorption profiles for He I series.
ighect	High energy cutoff.
	Simple reflection model good up to 15 keV. Reflection from ionized material.
	High resolution ISM absorption model.
	Extinction due to silicate and graphite grains. Leptonic relativistic jet model.
	Convolve with the Laor model shape.
	Convolve with the Laor2 model shape.
rbb	Multi-temperature blackbody model for thin accretion disk around a Kerr black hole.
	Accretion disk line shape with BH spin as free parameter. Optically thick accretion disk around a Kerr black hole.
	Accretion disk line emission with BH spin as free parameter.
	Convolve with kyrline model shape. Line from accretion disk around a spinning black hole.
	Line from accretion disk around a black hole.
	Line from accretion disk with broken power-law emissivity around a black hole.
ar	Log-parabolic blazar model.
	Lorentzian line profile.
	Lorentzian smoothing with an energy dependent sigma. Constant in log units.
	Constant in base 10 log units.
	Voigt absorption profiles for H I or He II Lyman series. Mewe-Gronenschild-Kaastra thermal plasma (1992).
al	Mewe-Kaastra-Liedahl thermal plasma (1992).
cflow	Cooling flow model based on mekal.
	Multiplicative table model. Simple nonequilibrium ionization plasma model.
	Continuum-only APEC emission spectrum.
oshock	Notch line absorption. Plane-parallel shock with ion and electron temperatures.
	Neutron star with hydrogen atmosphere
	Neutron star with hydrogen atmosphere for different g.
	Neutron star H atmosphere with e-conduction and self-irradiation Neutron star magnetic atmosphere.
	Neutron star with a magnetic atmosphere.
	Neutron star with a non-magnetic atmosphere. Pair plasma model.
	Thermally comptonized continuum.
	Extinction due to olivine grains.
otxagn	Colour temperature corrected disc and energetically coupled Comptonisation model for AGN.
10.54	Convert absorption model into a partial covering absorption.
abs	Partial covering fraction absorption. Powerlaw with pegged normalization.
	Neutral Compton reflection with self-consistent Fe and Ni lines.
	Exponentially cut-off power-law reflected from neutral matter.
vphabs,	Exponentially cut-off power-law reflected from ionized matter. Photo-electric absorption
nabs	

planbs         Absorption model with power-law dependence on energy.           poleconst         Constant polarization.           polonin         Linearly dependent polarization.           polony         Powerlaw dependent polarization.           powerlaw.         Simple photon power law.           projet         3D to 2-D projection mixing model.           pshock, vpshock         Simple photon power law.           projet         3D to 2-D projection mixing model.           raymond, versymood         Raymood-Smith theman plasma.           raymond, versymood         Raymood-Smith theman plasma.           robust         Convolve with the diskline model shape.           recorn         Convolve with the reline model shape.           reflect         reflection from carterial matter           reflect         reflection from carterial matter           reflection         reflection from an ionized relativistic disk.           reflection         Recombination edge.           reflection         Recombination edge.           reflection         Robided power-law reflection from an ionized relativistic disk.           reflection         Recombination recombining collisional plasma.           reflection         Recombination recombining collisional plasma.           reflection         Recombination from car	pileup	CCD pile-up model for Chandra
polocost         Constant polarization.           polin         Linearly dependent polarization.           poor         Powerlaw dependent polarization.           powerlaw.         Simple photon power law.           projet         3D to 2-D projection mixing model.           pshock, vphhock         Constant temperature, plane-parallel shock plasma model.           pwab         Power-law distribution of neutral absorbers.           gesed         Simplified form of the AGN SED model.           raymond, vreymond         Raymond-Smith themain plasma.           rdblur         Convolve with the diskline model shape.           recorn         Change correction norm for a spectrum (replaces old recorntm command).           redde         Recombination edge.           reline, relinelp,         Ediodel power-law reflected from an ionized relativistic disk.           reline, relinelp,         Emission line from relativistic accretion disk around a BH.           reline, relinelp,         Rober polarization.           reline, vsteov         XAM RGS statunded source           render, vsteov         Sedov model with electron and ion temperatures.           stru         Much ray sim accretion disk.           smapl         Comptonization of a seed spectrum.           slimbh         Stationary sim accretion disk. <t< td=""><td></td><td></td></t<>		
pollin         Linearly dependent polarization.           polopow         Powerlaw dependent polarization.           powerlaw, spowerlaw,         Spipple polora power law.           projet         3-D to 2-D projection mixing model.           pshock, vphock         Constant temperature, plane-parallel shock plasma model.           pwab         Spipple photon power law.           gosed         Simplified from of the ACM SED model.           raymond, vraymond         Raymond-Smith thermal plasma.           rdblur         Convolve with the disklue model shape.           redeen         Raymond-Smith thermal plasma.           rdblur         Convolve with the disklue model shape.           redge         Recombination edge.           redge         Recombination edge.           redge         Recombination edge.           redeonv, releonvp.         Convolve with the relline model shape.           releonv, releonvp.         Convolve with dielectron and ionized disk around a BH.           relline, rellinelpe, trike, vrnei         None-quilibrium recombining collisional plasma.           simpl         Convolve with dielectron and ion temperatures.           simpl         Convolva y diate spectrum.           simpl         Convolva y diate apolity.           polorot         Rota apolity.	plcabs	Cut-off powerlaw observed through dense, cold matter.
polopow         Powerlaw dependent polarization.           powerlaw, zpowerlw         Simple photon power law.           projet         3D to 2-D projection mixing model.           pshock, vpshock         Constant temperature, plane-parallel shock plasma model.           pwab         Power-law distribution of neutral absorbers.           geosed         Simplified form of the AGN SED model.           raymond, vreymond         Raymond-Smith theman plasma.           rdblur         Convolve with the diskline model shape.           recorn         Convolve with the diskline model shape.           reflect         reflection from central matter           reflect         reflection from central instance           reflored         reflection from entral instance      <		
poor         Positronium continuum.           proverlaw, growerlaw, grower		
proved law, spower law,         Simple photon power law,           projet         3D to 2-D projection mixing model.           pshock, vpshock         Power-law distribution of neutral aborbers.           geosed         Simplified form of the AGN SED model.           raymond, vraymond         Raymond-Smith themail plasma.           rdblum         Convolve with the diskline model shape.           recorm         Convolve with the diskline model shape.           recorm         Raymond-Smith therms for a spectrum (replaces oil recornm command).           refdect         reflection from central matter           reflor         reflection from central matter           reflor         reflection from entral matter           reflor         reflection from an ionized relativistic disk.           reflor         reflection from entral matter           reflor         reflection from an ionized disk		
projet         3-D to 2-D projection mixing model.           pshock, Yphohck         Constant temperature, plane-parallel abock plasma model.           pwab         Power-law distribution of neutral absorbers.           goosed         Simplified form of the AGN SED model.           raymond, vraymond         Raymond-Smith thermal plasma.           rdblur         Convolve with the disklue model abape.           recorm         Change correction norm for aspectrum (replaces oil recorntm com- mand).           redden         IR/optical/UV extinction from Cardelli et al. (1989)           redge         Recombination edge.           reflect         reflected form an ionized relativistic disk.           relocovy         relocavipo.           relocaviport         Formation from an ionized relativistic disk.           relocaviport         Rote relativistic accretion disk around a BH.           rellineipoxt         Rote relativistic accretion disk around a BH.           r		
pshock         Constant temperature, plane parallel shock plasma model.           pwab         Power-aw distribution of neutral absorbers.           quessed         Simplified form of the AGN SED model.           raymond, raymond         Raymond-Smith themain plasma.           rdblur         Convolve with the diskline model shape.           recorm         Convolve with the diskline model shape.           recored         Rege correction norm for a spectrum (replaces of recorntr non-mand).           reflect         reflection from central matter           reflect         reflection from entral institue           reflection reliance         E folded power-law reflection from an ionized relativistic disk.           reline, rellinelp,         relinesion line from relativistic accretion disk around a BH.           reline, relinelp,         religibing recombining collisional plasma.           pairot         XMM RGS estended source           stray         weedow           stray weedow         Kate polarization.           stray         Model for an optical/Uv-symmetric thermal plasma.           stray         Supercontral acting absorption.           simpl         State polarization.           supercontral acting absorption.         stray           relextro.         Supercontral ation themaperatures.           s		
pwab         Power-law distribution of neutral absorbers.           geosed         Simplified form of the AGN SED model.           raymond, vraymond         Raymond-Sinith thermal plasma.           rdblur         Convolve with the disklue model shape.           recorn         Change correction norm for a spectrum (replaces oil recorntrm com- mand).           redden         IR/optical/UV extinction from Cardelli et al. (1989)           redge         Recombination edge.           reflect         reflected form an ionized relativistic disk.           releconvipext         Convolve with the relline model shape.           releconvipext         angle-dependent reflection from an ionized relativistic geoscience           relline post         angle-dependent reflection from an ionized disk           regsser         XM RGS extended source           rnel, vyrnel, vyrnei         Non-equilibritum recombining collisional plasma.           soliro         Rotare polarization.           soliro         Solary obster spectrum using SN yields.           sprexpcut         Sprexpcut           sprexpcut         Sprexpcut           sprexpcut         Sprexpcut           sprexpcut         Sprexpcut           sprexpcut         Sprexpcut           sprexpcut         Sprexpcut           sprexpcut		
esseed         Simplified form of the AGN SED model.           raymond, vraymond         Raymond-Smith themain plasma.           reburn         Change correction norm for a spectrum (replaces oil recornm command).           recden         IR/optical/UV extinction from Cardelli et al. (1989)           redge         Recombination edge.           reflect         reflection from neutral matter           reflect         reflection from neutral instre           reflect         reflection from neutral instre           reflection         reflection from an ionized relativistic disk.           reloconv/pext         angle-dependent reflection from an ionized disk around a BH.           relinice, relinice/pext         XMA RGS extended source           rescov         XMA RGS extended source           source/pext         Rotate polarization.           source/pext         Rotate polarization.           source/pext         Source-restrication fumentioneu.           simpl         Comptoinzation of a seed spectrum.           simpl         Comptoinzation of a seed spectrum.           simpl         Comptoinzation of a seed spectrum.           spexpcut         Super-exponential cuttoff absorption.           spline         Spline multiplicative factor.           spexpcut         Super-exponential cuttoff absorptio		Power-law distribution of neutral absorbers
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recorn mand)         Change correction norm for a spectrum (replaces old recorrum com- mand)           redden         IR/optica/UV extinction from Cardelli et al. (1989)           redge         Recombination edge.           reffect         reflection from neutral matter           reffect         reflected/fede/dower-law reflected from an ionized relativistic disk.           reloon/poet         Convolve with the relline model shape.           reloon/poet         reloon/poet           refline/poet         Emission line from relativistic accretion disk around a BH.           relline/poet         Rom equilibrium recombining collisional plasma.           gessrc         XMM RGS extended source           rnel, vrnei, vrnei         Non-equilibrium recombining collisional plasma.           soldry, visedov         Sedov model with electron and ion temperatures.           simpl         Comptoinzation of a seed spectrum.           simpl         Comptoinzation of a seed spectrum.           simpl         Comptoinzation of a seed spectrum.           spine         Spine multiplicative factor.           spexpeut         Spece-exponential cuttoff absorption.           spine         Spine multiplicative factor.           set         Synchrotron radiation from ecs-ape-limited electron distribution.           set         Synchrotron radiation from		
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reflect         reflection from neutral matter           refsch         E-folded power-law reflected from an ionized relativistic disk.           reloom/pow         Convolve with the reline model shape.           reloom/pow         Emission line from relativistic accretion disk around a BH.           reline-         reline-           resiston line from relativistic accretion disk around a BH.           reline-         reline-           resiston line from relativistic accretion disk           resiston         AMI ReS extended source           rend, vrnei, vrnei, vrnei         Non-equilibritum recombining collisional plasma.           soldry, vsedov         Sedov model with electron and ion temperatures.           suri         Mutt-backoty sele-translated nume model.           simpl         Comptoinzation of a seed spectrum.           simpl         Comptoinzation of assed spectrum.           simpl         Suri dia alsorption dege.           spececc         Galaxy cluster spectrum using SN yields.           spececc         Syndrottorn radiation from ce-ord electron distribution.           sec         Syndrottorn radiation from ce-ord electron distribution.           sec         Syndrottorn radiation from ce-ord electron distribution.           sec         Syndrottorn radiation from ce-ord electron distribution.           s		
refsch         E-folded power-law reflected from an ionized relativistic disk.           releonvipext         Convolve with the relline model shape.           relline, relline)         E-mission line from relativistic accretion disk around a BH.           relline/poxt         angle-dependent reflection from an ionized disk           rgsser         XMM RGS extended source           rgsser         XMM RGS extended source           sodov, vaedov         Sedov model with electron and ion temperatures.           soft         Not equilibrium recombining collisional plasma.           simpl         Comptonization of a sed spectrum.           simpl         Mutti-bacetoedy seti-irradusted tunnel model.           simpl         Stationary slim accretion disk.           smarg         Model for an optically thin, spherically-symmetric thermal plasma.           smarge         Stationary slim accretion disk.           spline         Stationary slim accretion disk.           spline </td <td></td> <td></td>		
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rellineipext refsconv angle-dependent reflection from an ionized disk rgssarc XMM RGS extended source rgssarc Non-equilibrium recombining collisional plasma. polorot Rotate polarization. sedov, vaedov Sedov model with electron and ion temperatures. surpl Comptonization of a seed spectrum. slimbh Stationary slim accretion disk smape Galaxy cluster spectrum using SN yields. specpreut Super-expendial cutoff aborption. recever Synchrotron radiation from cut-off electron distribution. resec Synchrotron radiation from cut-off electron distribution. String		Emission line from relativistic accretion disk around a BH
rkconv         angle-dependent reflection from an ionized disk           rgssrc         XMM RGS extended source           rnel, vrnei, vrnei         Non-equilibrium recombining collisional plasma.           sodor, vsedov         Sedov model with electron and ion temperatures.           strl         Muth-backcoby sett-tradiated tumbe model.           simpl         Comptonization of a seed spectrum.           simpl         Comptonization of a seed spectrum.           simpl         Stationary slim accritor disk.           smarge         Model for an optically-thin, spherically-symmetric thermal plasma.           smedge         Smodted absorption edge.           specker         Spline multiplicative factor.           spline         Spline multiplicative factor.           scrut         Synchrotron radiation from exc-off electron distribution.           screac         Synchrotron radiation from exc-off electron distribution.           strigge         Striggero stra atmosphere model.           striggero         <		initiation into italii taliitatio destationi dish distanti e pri-
rgsserc         XMM RGS extended source           polotot         Rotate polarization.           sedov, vsedov         Sedov model with electron and ion temperatures.           surf         Rotate polarization.           sedov, vsedov         Sedov model with electron and ion temperatures.           surf         Comptoination of a sed spectrum.           slimpl         Comptoination of a sed spectrum.           simpl         Model for an optically-thin, spherically-symmetric thermal plasma.           smadge         Salo for an optically-thin, spherically-symmetric thermal plasma.           smapec         Galaxy cluster spectrum using SN yields.           spectrum         Super-exponential cutoff absorption.           spline         Symmetric factor.           spline         Symmetric factor.           servec         Symhetion radiation from escape-limited electron distribution.           servec         Symmetric factor.           symmetric factor.         Symmetric factor.           symmetric factor.         Symmetric factor.           symmetric factor.         Symmetric factor.           specer.         Symmetric factor.           specer.         Symmetric factor.           specer.         Symmetric factor.           symmetric factor.         Symmetric facto		angle-dependent reflection from an ionized disk
policit         Rotate polarization.           serdov, vsedov         Sedov model with electron and ion temperatures.           strip         Comptonization of a seed spectrum.           slimbh         Stationary slim accretion disk.           smaug         Model for an optically-thin, spherically-symmetric thermal plasma.           smadge         Smoothed absorption edge.           snapec         Galaxy cluster spectrum using SN yields.           spectru         Super-exponential cutoff absorption.           spline         Synchrotron radiation from exct-off electron distribution.           srcut         Synchrotron radiation from exct-off electron distribution.           ssa         Strangeon star atmosphere model.           SSSice         Einstein Observatory SS ice absorption.           step         Step function convolved with gaussian.           suzpef         Step function convolved with gaussian.           suzpef         Step function convolved with gaussian.           synchroter adjation from excto-functime detectron distribution.           synchroter         Absorption due to the ISM including molecules and grains.           strapec.         vtape           vtape         Thermally comptonized continuum convolution model.           vtape         Thermally comptonized continum convolution model.           <	rgsxsrc	
sedov, vsedov         Sedov model with electron and ion temperatures.           str         Muth-backooy set-transmater nume mode.           simpl         Comptonization of a seed spectrum.           simpl         Standard Sta	rnei, vrnei, vvrnei	Non-equilibrium recombining collisional plasma.
strt         Muttb-backcoory seti-trrainated numet model.           simpl         Comptonization of as esd spectrum.           silmabh         Stationary silm accretion disk.           smaug         Model for an opticality-thin, spherically-symmetric thermal plasma.           smapec         Galaxy cluster spectrum using SN yields.           supple         Super-exponential cutoff absorption.           spine         Synchrotron radiation from ext-off electron distribution.           sreac         Synchrotron radiation from ext-off electron distribution.           sreac         Synchrotron radiation from ext-off electron distribution.           ssa         Strangon star atmosphere model.           SSSice         Enstein Observatory SS ice absorption.           step         Step function convolved with gaussian.           suzpef         Decemption due to the ISM including molecules and grains.           strahe         Plotocletric absorption with variable abundances.           strahe         Nobrolectric absorption w		
simpl         Comptoinzation of a seed spectrum.           silinbh         Stationary silin accretion disk.           smedge         Smodthed absorption edge.           smapce         Galaxy cluster spectrum using SN yields.           spectrum         Super-exponential cuttoff absorption.           spline         Spline multiplicative factor.           scrut         Synchrotron radiation from except-limited electron distribution.           sreac         Synchrotron radiation from except-limited electron distribution.           scrut         Synchrotron radiation from except-limited electron distribution.           ssa         Stragono star atmosphere model.           Step         Step function convolved with gaussin.           suzper         Step function convolved with gaussin.           suzper         Pattore partures.           thabs, stbabs, tb         Absorption bp partially lonized material with large velocity shear.           tapee,         vtage           grain, thyware         Patocolectric absorption with variable abundances.           variabs, stbabs, tb         Absorption due to the ISM including model.           vortif         Vietally tables and attribution of emission meanure.           vortif         Vietally tables and attribution of emission meanure.           varabs, zvadabs         Photoelectric absorption (		
slinbh         Stationary sim accretion disk.           smaug         Model for an optically-thin, spherically-symmetric thermal plasma.           smapec         Smoothed absorption edge.           snapec         Smoothed absorption edge.           spepcrut         Super-exponential cutoff absorption.           spline         Spine multiplicative factor.           sreut         Synchrotron radiation from exc-off electron distribution.           sreac         Synchrotron radiation from esc-off electron distribution.           ssa         Strangeon star atmosphere model.           SSSice         Einstein Observatory SSS ice absorption.           step         Step function convolved with gaussian.           suzpef         Suzorption by partially ionized material with harge velocity shear.           rapec,         vtabe, PCE emission spectrum with separate continuum and line tem-           vtabs, zababs,         Hoterpriston duct to the ISM including molecules and grains.           grain, thvarabs         Hoterpriston duct to the ISM including molecules and grains.           varabs, zvarabs         Photeolectric absorption with variable abundances.           varabs, varabs, white well with sint anditive model.         Varabs, zvarabs           varabs, zvarabs         Photeolectric absorption with variable abundances.           varabs, zvarabs         Photeolectric a		
smadge         Model for an optically-thin, spherically-symmetric thermal plasma.           smedge         Smothed absorption edge.           suppect         Galaxy cluster spectrum using SN yields.           spexpecut         Supre-exponential cuttoff absorption.           spline         Spline multiplicative factor.           srcut         Synchrotron radiation from cene-of electron distribution.           ssa         Stragon star atmosphere model.           SSIce         Einstein Observatory SSS ice absorption.           step         Step function convolved with gaussian.           suzgef         Suzaku PSF mixing model.           swind1         Absorption by partially lonized material with large velocity shear.           tabes, zthabs, tb         Absorption by partially lonized material with large velocity shear.           tapec,         vtapec         APEC emission spectrum with sparate continuum and line tem- peratures.           thoop         Thermally comptonized continuum convolution model.           uvred         Urredening.         Variable           varabs, zwarbs         Photoelectric absorption (Morrison & McCammon).           volat         A single-dependent reflection from an ionized disk           varabs, zwarbs         Photoelectric absorption with variable abundances.           volat         angle-dependent reflection from an		
smapec         Smoothed absorption edge.           snapec         Galaxy cluster spectrum using SN yields.           spine         Spine-rexponential cutoff absorption.           spine         Spine-rexponential cutoff absorption.           srcut         Synchrotron radiation from exc-op-limited electron distribution.           sreac         Synchrotron radiation from exc-op-limited electron distribution.           ssa         Strangon star atmosphere model.           SSSice         Einstein Observatory SS ice absorption.           step         Step function convolved with gaussian.           suzpsf         Suzer Cemsions spectrum with sparate continuum and line tem- peratures.           thabs,         Absorption by partially ionized material with large velocity shear.           grain, thvarabs         Horeadoriag.           theomp         Thermally comptonized continuum convolution model.           uvred         UV reddening.           varabs, zvarabs         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           vasit         A simple Voigt line profile.           vashift         Velocietric absorption with low emergy window.           sincion measure.         Photoelectric absorption with low emergy window.           tem         anigle-dependent reflection fr		
snapec         Galaxy cluster spectrum using SN yields.           spine         Spine enultiplicative factor.           spline         Spline multiplicative factor.           srcut         Synchrotron radiation from car-off electron distribution.           sreac         Synchrotron radiation from car-off electron distribution.           ssa         Stragons star atmosphere model.           SSIce         Einstein Observatory SSS ice absorption.           step         Storption by partially lonized material with large velocity shear.           swind1         Absorption by partially lonized material with large velocity shear.           tabos, stbabs, tb         Absorption by partially lonized material with large velocity shear.           tabos, stbabs, tb         Absorption by partially lonized material with large velocity shear.           tabos, stbabs, tb         Absorption due to the ISM including molecules and grains.           grain, thware         Thermally comptonized continuum convolution model.           uvred         U'reddening.           varabs         Photoelectric absorption (Morrison & McCammon).           voigt         A simple Voigt large profile.           volgt         A simple Voigt large profile.           volgt         A simple Voigt large profile.           volgt         A single-dependent reflection from an ionized disk <t< td=""><td></td><td></td></t<>		
specpcut         Super-exponential cutoff absorption.           spline         Spline multiplicative factor.           srcut         Synchrotron radiation from ext-off electron distribution.           sreac         Synchrotron radiation from ext-off electron distribution.           ssreac         Synchrotron radiation from ext-off electron distribution.           ssreac         Strangon star atmosphere model.           SSSice         Einstein Observatory SSS ice absorption.           step         Step function convolved with gaussian.           suzpef         Suzda PSF mixing model.           swind1         Absorption by partially ionized material with large velocity shear.           tabbs,         Pacewrption due to the ISM including molecules and grains.           grain, thvarabs         Horeaderia.           theomp         Thermally comptonized continuum convolution model.           uvrod         UV reddening.           varabs, zvandab         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           vais,         Photoelectric absorption with over energy window.           vian         effected spectrum from a photo-onized accretion dist.           valow         Photoelectric absorption with over energy window.           valow         anigle-dependent reflection		
sreat         Synchrotron radiation from cu-off electron distribution.           sresce         Synchrotron radiation from escape-limited electron distribution.           ssa         Strangon star atmosphere model.           SSSice         Einstein Observatory SSS ice absorption.           step         Step function convolved with gaussian.           swind1         Absorption by partially ionized material with large velocity shear.           tapec,         vtape           vtabbs,         Absorption by partially ionized material with large velocity shear.           grain, thvarabs         Pateroms, separate continuum and line temportation.           varabs, zvababs,         Absorption due to the ISM including molecules and grains.           grain, thvarabs         Photoelectric absorption with variable abundances.           varabs, zvardas         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           vasis         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an until/temperature with power-law distribution of emission measure.           vashas, zwadabs         Photoelectric absorption with low emergy window.           xion         The reflected spectrum from a photo-ionized accretion disk.           xilon         The reflected spectrum from a photo-ioninionized accretion disk.		
sreec         Synchrotron radiation from escape-limited electron distribution.           ssa         Stragons star atmosphere model.           StSice         Einstein Observatory SSI ice absorption.           step         Storption function convolved with gaussian.           suzpef         Suzaku PSF mixing model.           swind1         Absorption by partially lonized material with large velocity shear.           tabec,         vtapee           partures.         Absorption by partially lonized material with large velocity shear.           tabes, stbabs, tb         Absorption due to the ISM including molecules and grains.           grain, tbware         Thermally comptonized continuum convolution model.           vurede         UV reddening.           varabs, svarabs         Photoelectric absorption (Morrison & McCammon).           wolet, warabs         Photoelectric absorption (Morrison & McCammon).           woletn, woletn, woletn, woletn, and the energy window.         Plane emission masure.           volation         angle-dependent reflection from an ionized disk           sammprif         MBY PSF model.           sambit         Redshift an additive model.           varabs         EUV ISM atternation by dats grains (Pei, 1992).           sigm         UV/Optical atternation by the intergalactic medium.           sambit		
ssa         Strangeon star atmosphere model.           SSSice         Einstein Observatory SSi ice absorption.           step         Step function convolved with gaussian.           suzpef         Stezku PSF mixing model.           swind1         Absorption by partially ionized material with large velocity shear.           tapec,         vytape           peratures.         Peratures.           tabbs,         Absorption the to the ISM including molecules and grains.           grain, thvarabs         Hotocytapic continuum convolution model.           uvred         UV reddening.           varabs, zvrabs         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           vashs, was         Photoelectric absorption with variable abundances.           vashs, avadabs         Photoelectric absorption with over energy window.           window         mession measure.           wndsbs, zwndabs         Photoelectric absorption with low energy window.           xion         Thereflected spectrum from a photo-onized accretion disk.           xilonv         angle-dependent reflection from an ionized disk           xating         Kasifi an additive model.           zashift         Rodshift an additive model.           zashift         Rodshift an		
StSice         Einstein Observatory SSS ice absorption.           step         Step function convolved with gaussian.           suzpaf         Suzaku PSF mixing model.           swind1         Absorption by partially lonized material with large velocity shear.           tapec,         vtapec           partures.         Absorption by partially lonized material with large velocity shear.           tababs, stbabs, tb         Absorption due to the ISM including molecules and grains.           grain, tbwars         Thermally comptonized continuum convolution model.           uvredd         UV reddening.           varabs, stvarabs         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an adultive model.           voigt         A simple Voigt lange robin.           wabs, zwndabs         Photoelectric absorption (Morrison & McCammon).           wdem, wdem, vvw         Plane emission, multi-temperature with power-law distribution of moreadon measure.           wolan         Thermaduce absorption (Morrison & McCammon).           wdem, wdem, wdem         YBM PSF model           xilonv         angle-dependent reflection from an ionized disk           xammpaf         MM PSF model           sashift         Redshifted andtlive model.           zashift         Redshiften additive model. </td <td></td> <td></td>		
step         Step function convolved with gaussian.           swind1         Suzdaku PSF mixing model.           swind1         Absorption by partially ionized material with large velocity shear.           tapec,         vytape           perturbed         PEC emission spectrum with separate continuum and line tem- peratures.           tabbs,         tabbs,           grain, thvarabs         tabesorption due to the ISM including molecules and grains.           grain, thvarabs         Photoelectric absorption with variable abundances.           varabs, zvarab         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           voist         A simple Voigt line profile.           valos, zvadabs         Photoelectric absorption (Morrison & McCammon).           wdem,         Photoelectric absorption with low energy window.           xion         Thereflected spectrum from a photo-inside accretion disk.           xilconv         angle-dependent reflection from an ionized disk           xastift         Rodshift an additive model.           zashift         Rodshift an additive model.           zashift         Rodshift and attemation zonized certain disk.           zashift         Rodshift and attemation zonized disk.           zastut         Guat scantering		
suzjef Suzaku PSP mixing model. swind1 Absorption by partially lonized material with large velocity shear. tapec, vtapec, APEC emission spectrum with sparate continuum and line tem- vytapec paratumes. tbabs, tb Absorption due to the ISM including molecules and grains. grain, tbywas theomp Thermally comptonized continuum convolution model. uvred Ureldening. varabs, svarabs Photoelectric absorption with variable abundances. vashift Velocity shifts an additive model. visit Velocity shifts an additive model. visit A simple Voigt large profile. Photoelectric absorption (Morrison & McCammon). Medm, wedm, vvvv dem, wedm, vvvv stam a emission, multi-temperature with power-law distribution of emission neasure. visit Photoelectric absorption (Morrison & McCammon). Medm, wedm, vvvv tam emission measure. visit Photoelectric absorption (Morrison & McCammon). The reflected spectrum from a ploto-ionical accretion disk. xion The reflected spectrum from a ploto-ionical disk sect dust scattering. Summingf Redshift an additive model. zashift Redshift an additive model. zueshift Redshift an additive model. zendust Etric in by dust grains (Pei, 1992). zigm UV/Optical attemnation by the intergalactic medium. zenshift Redshift anditiplicative model. zendust Etric in by dust grains in starburg adaxies. zyfeabs Redshifted absorption with variable iron abundance. zxipab Power-law distribution of ionized absorbers.		
swind         Absorption by partially ionized material with large velocity shear.           tappec,         veloce           tupec,         veloce           uvred         UV reddening.           varabs,         velocity shifts an additive model.           vashift         Velocity shifts an utiliplicative model.           volgt         A simple Voigt line profile.           walos, zwndabs         Photoelectric absorption with variable abundances.           valos, zwndabs         Photoelectric absorption (Morrison & McCammon).           wden,         veloce         emission measure.           wndabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-onized accretion disk.           xummpsf         XMM PSF model           zashift         Redshift an additive model.           zashift         Redshift and attemation by the intergalactic medium.           zmethift		
tapec,         vtapec,         APEC emission spectrum with separate continuum and line tem- vvtapec           totage         peratures.           Absorption due to the ISM including molecules and grains.         grain, tbvaras           theomp         Thermally comptonized continuum convolution model.           vvrade         UV reddening.           varabs, svarabs         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           vogit         A simple Voigt line profile.           wabs, svarbs         Photoelectric absorption (Morrison & McCammon).           wdem, weden, vvw         Plasma emission, multi-temperature with power-law distribution of emission measure.           vindubs, swindabs         Photoelectric absorption (Morrison & McCammon).           wdem, vedem, vvw         The reflected spectrum from a photo-ionized accretion disk.           xinomys         The reflected spectrum from a photo-ionized accretion disk.           scart         dust scattering distribution of emission measure.           varabit         Redshift an additive model.           zashift         Redshift an additive model.		
vytape         peratures.           tables, ztables, tbabs, stables, tbabs, ztables, ztab		
grain, thvarabs           theomp         Thermally comptonized continuum convolution model.           uvred         UV reddening.           varabs, zvrabs         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           voshift         Velocity shifts an utilipicative model.           voshift         Velocity shifts an utilipicative model.           vost         A simple Voigt line profile.           wabs, zwadas         Photoelectric absorption with one energy window.           windows, weem         Photoelectric absorption with one unergy window.           xion         The reflected spectrum from a photo-onized accretion disk.           xilconv         angle-dependent reflection from an ionized disk           xasatift         Rodshift an additive model.           zashift         Rodshift an additive model.           zashift         Rodshift and attennation by the intergalactic medium.           zelost         EUV ISM attennation zonized disk           zushift         Rodshift and attrubustive model.           zredden         Redshift aditive model.           zredden         Redshift and attrubustive model.           zelost         Euroit by dust grains in starburg zakakies.           zenshift         Rodshift an adutiplicative model. <td></td> <td></td>		
theomp         Thermally comptonized continuum convolution model.           varaba         Victodenize.           varaba, xvaraba         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an adultifice model.           vmshift         Velocity shifts an adultiplicative model.           vosigt         A simple Voigt line profile.           wales, zwaba         Photoelectric absorption (Morrison & McCammon).           woden, vwe         Plasme emission, multi-temperature with power-law distribution of emission measure.           windabs, zwndabs         Photoelectric absorption (Morrison & McCammon).           windabs, zwndabs         Photoelectric absorption an ionized disk           xinon         The reflected spectrum from a photo-ionized accretion disk.           xinony         aggle-dependent reflection from an ionized disk           xasatt         dust seattering           zashift         Redshift an additive model.           zbabs         EUV ISM attemation.           zdust         Etico by dust grains (Pei, 1992).           zigm         UV/Optical attemation by dust grains in starburst galaxies.           zredden         Redshift and Altypical/UV extinction from Cardelli et al. (1989)           zamdust         Extinction by dust grains in starburst galaxies.           zytophs		
uvred         UV reddening.           varabs, zvrabs         Photoelectric absorption with variable abundances.           vashift         Velocity shifts an additive model.           vmshift         Velocity shifts an utilipicative model.           vojet         A simple Voigt line profile.           vask, zwabs, zwada         Photoelectric absorption (Morrison & McCammon).           wden, vwee         Plasma emission, multi-temperature with power-law distribution of emission measure.           wndabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-onised accretion disk.           xilconv         angle-dependent reflection from an ionized disk           xasatift         Rodshift an additive model.           zashift         Rodshift an additive model.           zbabs         EUV ISM attennation.           zdust         EUV ISM attennation by the intergalactic medium.           zmelden         Redshifted if A multipleative model.           zredden         Redshifted if Acputical/UV extinction from Cardelli et al. (1989)           zmdust         Extinction by dust grains in starburg takakes.           zredden         Rodshifted absorption with variable iron abundance.           zytopab         Power-law distribution of ionized absorberks.	grain, tbvarabs	
varabs         Photoelectric absorption with variable abundances.           vnshift         Velocity shifts an adultive model.           vosigt         A simple Voigt line profile.           wabs.         Photoelectric absorption (Morrison & McCammon).           woden, vww         Plasme emission, multi-temperature with power-law distribution of emission measure.           windubs, zwndabs         Photoelectric absorption (Morrison & McCammon).           wordabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-ionized accretion disk.           xilconv         aggle-dependent reflection from an ionized disk           xstat         dust stattering           zashift         Redshift an additive model.           zbabs         EUV ISM attenuation.           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attenuation by the intergalactic medium.           zmediden         Redshifted absorption with variable iron Annotance.           zvipanb         Redshifted absorption to invistab absorbers.		
vashift         Velocity shifts an additive model.           vmshift         Velocity shifts an anditive model.           voigt         A simple Voigt line profile.           wabs, zwads         Photoelectric absorption (Morrison & McCammon).           wdem, vwe         Plasma emission, multi-temperature with power-law distribution of emission measure.           wndabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-onixed accretion disk.           xilconv         angle-dependent reflection from an ionized disk           xacat         dust scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attemnation           zushift         Redshift anditive model.           zredden         Redshift and ithrow model.           zredden         Redshift and attriputer model.           zredden         Redshift and attriputer model.           zredden         Redshift and attriputer model.           zredden         Redshift andustret mode mode mode mode mode mode.		
vmshift         Velocity shifts a multiplicative model.           voigt         A simple Voigt line profile.           wabs, zwabs         Photoelectric absorption (Morrison & McCammon).           wdem, vwew         Plasm emission, multi-temperature with power-law distribution of emission measure.           ordabs, zwndabs         Photoelectric absorption (Morrison & McCammon).           vdma         The reflected spectrum from a photo-ionized accretion disk.           xilon         The reflected spectrum from a photo-ionized accretion disk.           xilonV         aggle-dependent reflection from an ionized disk           xscat         dist scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attenuation.           zdust         Extriction by dust grains (Pei, 1992).           zigm         UV/Optical attenuation by the intergalactic medium.           zmshift         Redshifted absorption with variable iron Cardelli et al. (1989)           zemdust         Extinction by dust grains in starbury sgalaxies.           zvfoabs         Redshifted absorption with variable iron abundance.		
voigt         A simple Voigt line profile.           wabs, zwabs         Photoelectric absorption (Morrison & McCammon).           wdem, vwee         Plasma emission, multi-temperature with power-law distribution of emission measure.           wndabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-onized accretion disk.           xilconv         angle-dependent reflection from an ionized disk           xacmmpsf         XMM PSF model           zashift         Redshift an additive model.           zbabs         EUV ISM attennation.           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attennation by the intergalactic medium.           zmedden         Redshifted if Acoptical/UV extinction from Cardelli et al. (1989)           zmdust         Extinction by dust grains in starburg adaxies.           zrefden         Redshifted absorption with variable iron abundance.           zrignab         Power-law distribution of ionized absorbers.		
wabs, wabs         Photoelectric absorption (Morrison & McCammon).           wdem, vwdem, vwe         Phasm emission, multi-temperature with power-law distribution of emission measure.           wndabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-ionized accretion disk.           xileonv         angle-dependent reflection from an ionized disk           xmmpsf         XMM PSF model           zashift         Redshift an additive model.           zbabs         EUV ISM attemnation.           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attemnation by the intergalactic medium.           zmethift         Redshifted altocyture model.           zredden         Redshifted IK/optical/UV extinction from Cardelli et al. (1989)           zamdust         Extinction by dust grains in starburst galaxies.           zv(pabs         Redshifted absorption with variable iron abundance.           zycipab         Power-law distribution of ionized aborbers.		
wdem, vwe         Plasma emission, multi-temperature with power-law distribution of emission measure.           wndabs, zwndabs         Photoelectric absorption with low energy window.           xion         The reflected spectrum from a photo-inniced accretion disk.           xmmpsf         XMM PSF model           zashift         Redshift an additive model.           zbabs         EUV ISM attemnation.           zdust         EUV ISM attemnation.           zgigm         UV/Optical attemnation by the intergalactic medium.           zredden         Redshifted IR Apoptical/UV extinction from Cardelli et al. (1989)           zendust         Extinction by dust grains in starburg alaxies.           zyfoabs         Redshifted absorption with variable iron abundance.           zyfoabs         Power-law distribution of ionized absorbers.		
dem         of emission measure.           wndabs, zwndabs         Photoelertic absorption with low energy window.           xion         The reflected spectrum from a photo-ionized accretion disk.           xilleonv         angle-dependent reflection from an ionized disk           xmmpsf         XMM PSF model           xscat         dust scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attemation.           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attemation by the intergalactic medium.           zmehlft         Redshift an antilpicative model.           zredden         Redshift and thypical/UV extinction from Cardelli et al. (1989)           zamdust         Extinction by dust grains in starburst galaxies.           zvfoabs         Redshifted absorption with variable iron abundance.           zytopab         Power-law distribution of ionized aborbers.		Plasma emission, multi-temperature with power-law distribution
xion         The reflected spectrum from a ploto-ionized accretion disk.           xiliconv         angle-dependent reflection from an ionized disk           xmmpsf         XMM PSF model           xseat         dust scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attenuation.           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attenuation by the intergalactic medium.           zmshift         Redshift an adultiple-attenuitor model.           zredden         Redshift an adultiple-attentive model.           zamdust         Extinction by dust grains in starburst galaxies.           zyfenbs         Redshifted alscorption with variable iron abundance.           zyfenbs         Power-law distribution of ionized aborbers.		
xilcorv         angle-dependent reflection from an ionized disk           xmmmpsf         XMM PSF model           xscat         dust scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attemnation.           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attemnation by the intergalactic medium.           zmebift         Redshifted IR/optical/UV extinction from Cardelli et al. (1989)           zendust         Extinction by dust grains in starburg alaxies.           zerdeden         Redshifted alscorption with variable iron abundance.           zxipab         Power-law distribution of ionized aborbers.	wndabs, zwndabs	
xmmpsf         XMM PSF model           seart         dust scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attenuation.           zdust         Extinction by dust grains (Pei, 1992).           zdust         Extinction by dust grains (Pei, 1992).           zgm         UV/Optical attenuation by the intergalactic medium.           zmebift         Redshifted IR/optical/UV extinction from Cardelli et al. (1989)           zamdust         Extinction by dust grains in starburst galaxies.           zvfoabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
xscat         dust scattering           zashift         Redshift an additive model.           zbabs         EUV ISM attemnation.           zdust         Extinction by dust grains (Pel, 1992).           zigm         UV/Optical attemnation by the intergalactic medium.           zmshift         Redshifted IR/optical/UV extinction from Cardelli et al. (1989)           zendust         Extinction by dust grains in starburg adaxies.           zyfeabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
zashift         Redshift an additive model.           zhabs         EUV ISM attenuation           zdust         Extinction by dust grains (Pei, 1992).           zigm         UV/Optical attenuation by the intergalactic medium.           zmehift         Redshift a multiplicative model.           zredden         Redshift an multiplicative model.           zamdust         Extinction by dust grains in starburst galaxies.           zwiches         Redshifted BK/optical/UV extinction from Cardelli et al. (1989)           zwiches         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
zbabs         EUV ISM attemuation.           zclust         Extinction by dust grains (Pel, 1992).           zigm         UV/Optical attemuation by the intergalactic medium.           zmshift         Redshifted IR/optical/UV extinction from Cardelli et al. (1989)           zendust         Extinction by dust grains in starburg galaxies.           zendust         Extinction by dust grains in starburg galaxies.           zefgabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
zdust Extinction by dust grains (Pei, 1992). zigm UV/Optical attemutation by the intergalactic medium. zmshift Redshift a multiplicative model. zredden Redshifted IR/optical/UV extinction from Cardelli et al. (1989) Extinction by dust grains in starburst galaxies. zvfeabs Redshifted alscorption with variable iron abundance. zxipab Power-law distribution of lonized absorbers.		
zigm         UV/Optical attemation by the intergalactic medium.           zmshift         Redshift a multiplicative model.           zredden         Redshifted IR/optical/UV extinction from Cardelli et al. (1989)           zsmdust         Extinction by dust grains in starburgt galaxies.           zrefabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
zmshift         Redshift a multiplicative model.           zredden         Redshifted IN/optical/UV extinction from Cardelli et al. (1989)           zmdust         Extinction by dust grains in starburst galaxies.           zvfeabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
zredden         Redshifted IR/optical/UV extinction from Cardelli et al. (1989)           zsmdust         Extinction by dust grains in starburst galaxies.           zvfeabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.		
zvfeabs         Redshifted absorption with variable iron abundance.           zxipab         Power-law distribution of ionized absorbers.	zredden	
zxipab Power-law distribution of ionized absorbers.		
zxipct Partial covering absorption by partially ionized material.		
	zxipct	Fartial covering absorption by partially ionized material.

### XSLIDE's solution

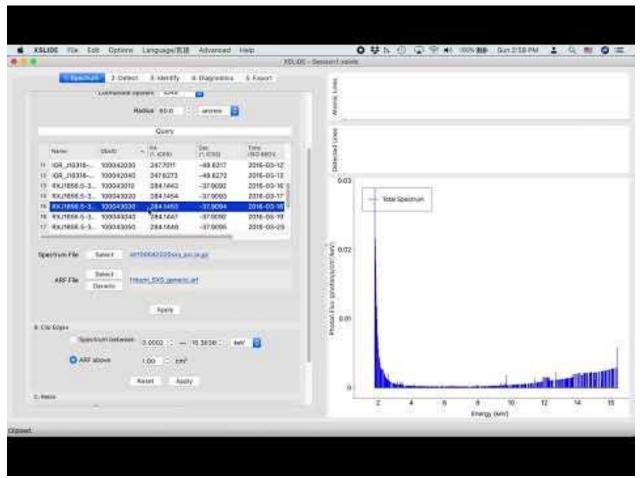
 $C(I) = T \int R_{\rm RMF}(I, E) R_{\rm ARF}(E) S(E) dE$ 

C = counts [photons],T = observation time [second],I = instrument channel,E = energy [keV] $R_{\text{RMF}} = \text{redistribution matrix (probability of photon of given energy being counted in given instrument channel) [unitless]<math>R_{\text{ARF}} = \text{ancillary response file containing effective area [cm<sup>2</sup>]},$ S = source spectrum [photons/(cm<sup>2</sup>·second·keV)]

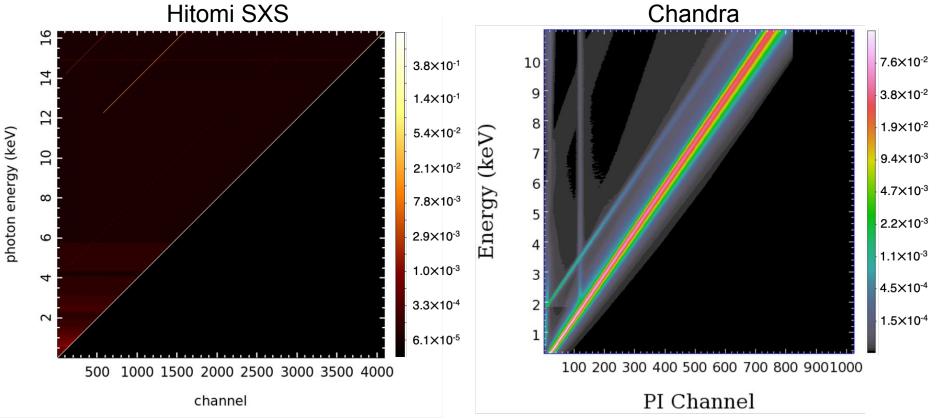
- Assume RMF is a diagonal matrix providing an ideal one-to-one mapping between incident photon energy and detector channel
- Assume ARF is slowly varying such that it is approximately constant between neighboring instrument channels
- Allows for *S*(*E*) to be solved directly as:

$$S(E) = \frac{C(I)}{R_{\rm ARF}(E)T\Delta E}$$

### Benefit of XSLIDE's Solution

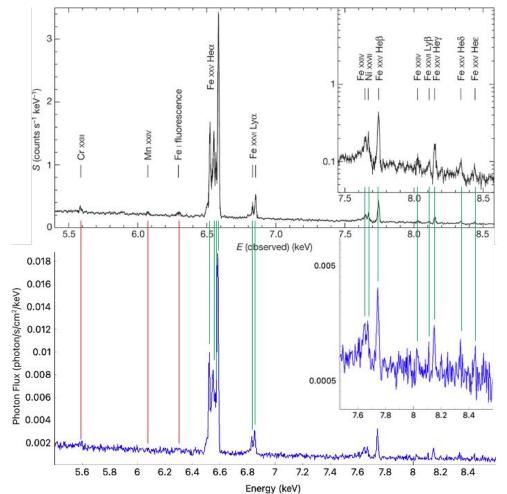


### **Diagonal RMF Assumption**



https://cxc.harvard.edu/cdo/xray\_primer.pdf

### Validity of XSLIDE's Solution

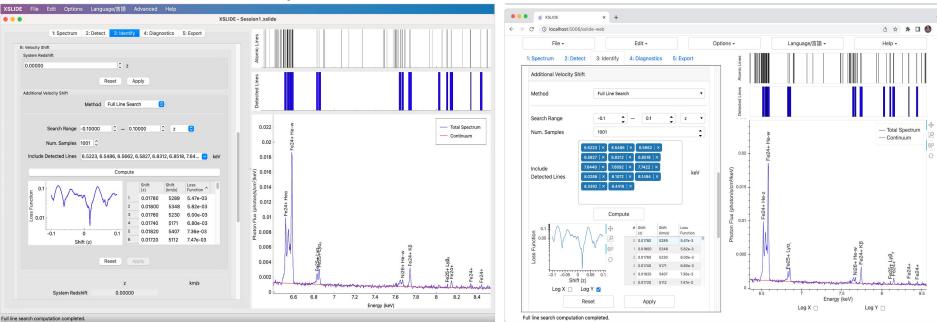


### The Hitomi collaboration, *Nature*, 2016

# **Overview of XSLIDE Software**

### How to Access XSLIDE

• Both desktop and web versions are available, with very similar user interfaces

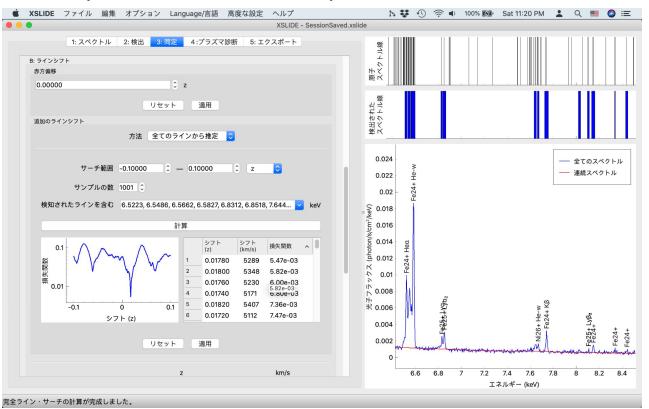


#### Desktop

#### Web

### Language Localisation

• Available in Japanese on both desktop and web



Thanks to Chris Baluta and Megumi Shidatsu for their work on these translations!

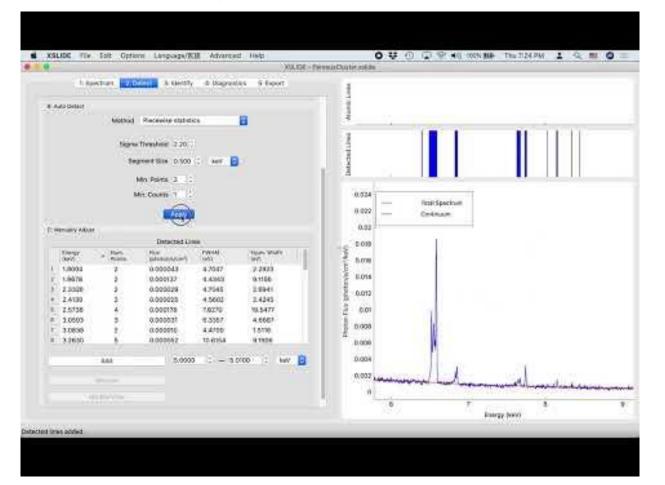
### Design

- XSLIDE is designed to be simple and easy to use
- The user is guided through ordered steps and substeps:
  - 1. Load and Modify Spectrum
  - 2. Detect Lines
  - 3. Identify Lines
  - 4. Perform Diagnostics
  - 5. Export Results

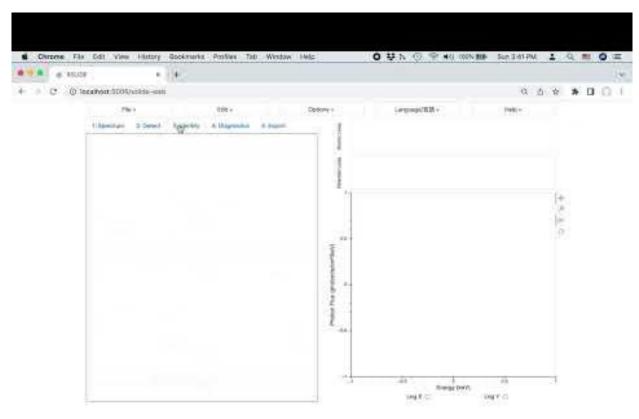
• XSL	IDE - Session1.	kslide									
1: Spectrum       2: Detect       3: Identify       4: Diagnostics       5: Export         A: Load Spectrum       Method       Local file       C         Spectrum File       Open       ARF File       Open	stected Lines Atomic Lines										
Spectrum Ipdex 1 C Apply B: Clip Edges ARF above 1.00 C - 100.0000 C keV C ARF above 1.00 C cm <sup>2</sup> C: Rebin C: Rebin Group adjacent bins 1 C Use constant bin size 0.0010 C keV C	8.0 Photon Flux (photon/s/cm <sup>2</sup> / ev) 9.0 7.0										
Reset Apply	o	-0.4	-0.3	-0.2	-0.1	0 Energy (ke	0.1 V)	0.2	0.3	0.4	

# XSLIDE Walkthrough

### **Exploring Hitomi's Perseus Data**

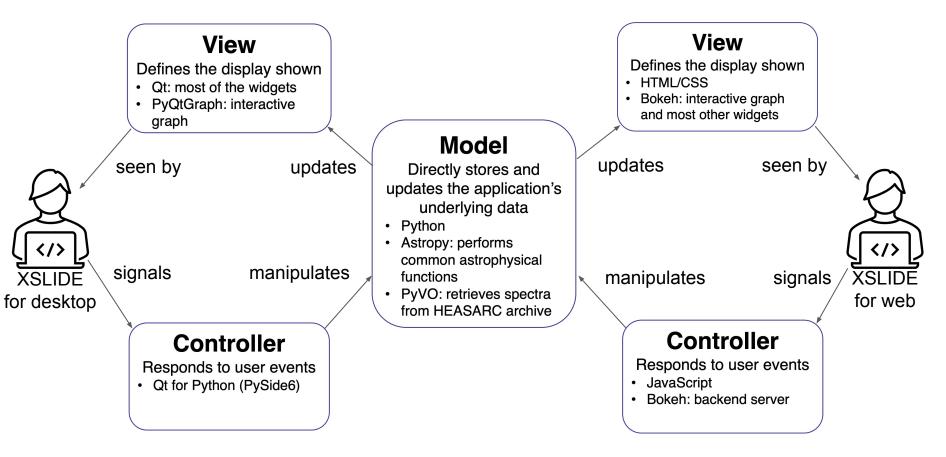


### **Brief Demonstration of Web Version**



# Software Development

### Model-View-Control Software Architecture



### Testing

- Unit testing for Python-based Model
- Functional testing for GUIs
  - Squish for desktop
  - $\circ \quad \ \ \text{Selenium for web}$

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### Summary

- XSLIDE is a simple and user-friendly application that allows for the interactive plotting of spectra from XRISM's Resolve instrument without forward-fitting.
- XSLIDE performs many common tasks involved in X-ray spectrum analysis:
  - Rebinning
  - Continuum fitting
  - Automatically detecting lines
  - Assigning detected lines to known atomic transitions
  - Spectral diagnostics
- XSLIDE will help XRISM's scientific investigators to rapidly examine many spectra to find those that contain spectral lines of particular interest.
- XSLIDE will also allow astronomers from outside the field of X-ray spectroscopy to easily interact with XRISM data.

# Thank You!

# **Questions?**

For follow-up questions, or to request access to the beta version of XSLIDE, please contact xrism-sdc-help@lists.nasa.gov