BAA Meteor Section / NEMETODE Workshop Meeting

Saturday 27th September 2014
10:00 – 16:30 BST

The Macdonald Birmingham Hotel
126 New Street
Birmingham
B2 4JQ

www.britastro.org
www.nemetode.org

- Opening Remarks
- Introductions
- Agenda Review
- Expectations
- Logistics

Definitions:

Meteoroid:

A small body moving in the solar system that would become a meteor if it entered the earth's atmosphere.

Meteor:

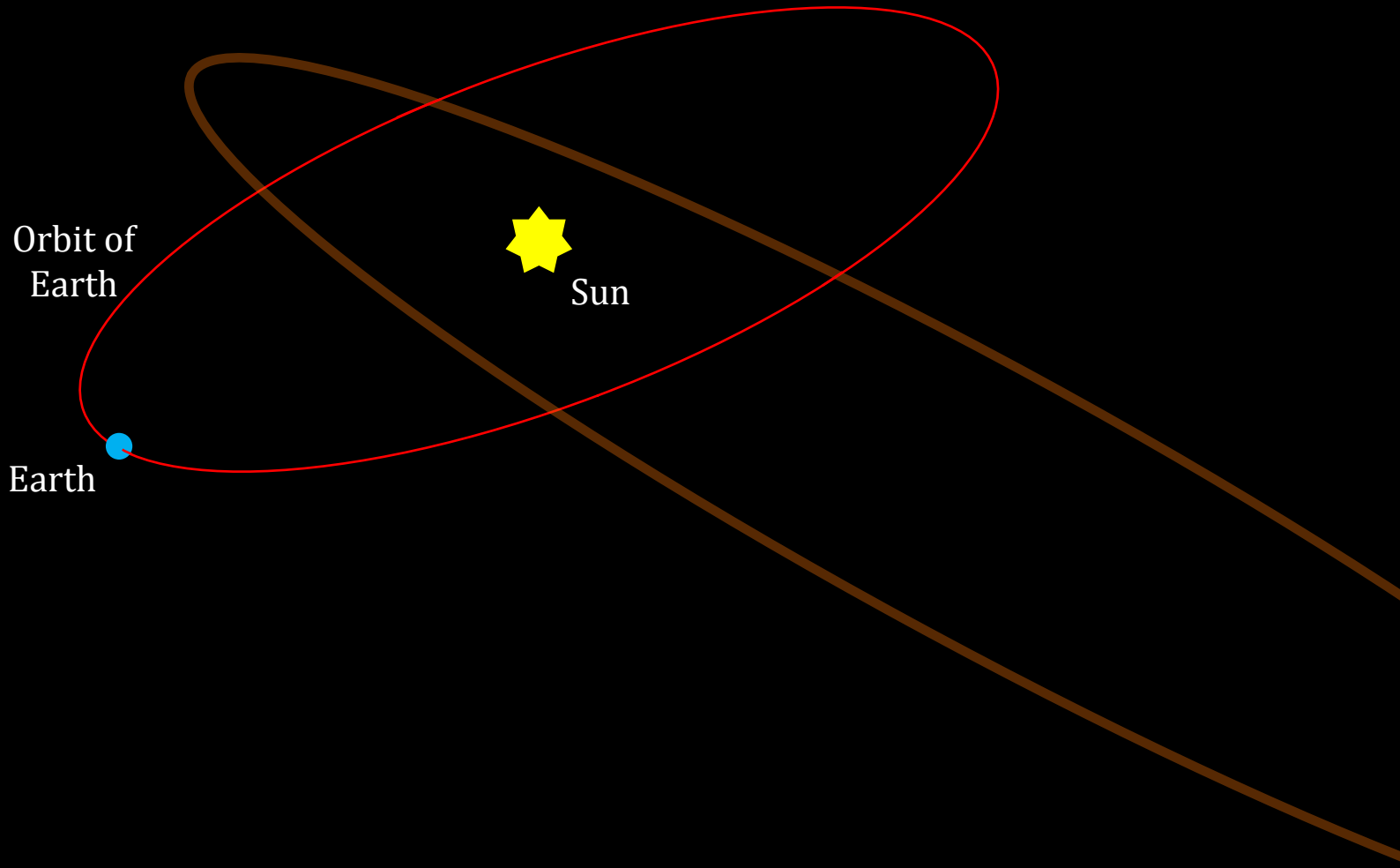
A small body of matter from outer space that enters the earth's atmosphere, becoming incandescent as a result of friction and appearing as a streak of light.

Meteorite:

A piece of rock or metal that has fallen to the earth's surface from outer space as a meteor. Over 90 per cent of meteorites are of rock while the remainder consist wholly or partly of iron and nickel.

Science Objectives

- *What questions can we answer with our data?*


Orbit of
Earth
Sun
Earth

Complications:

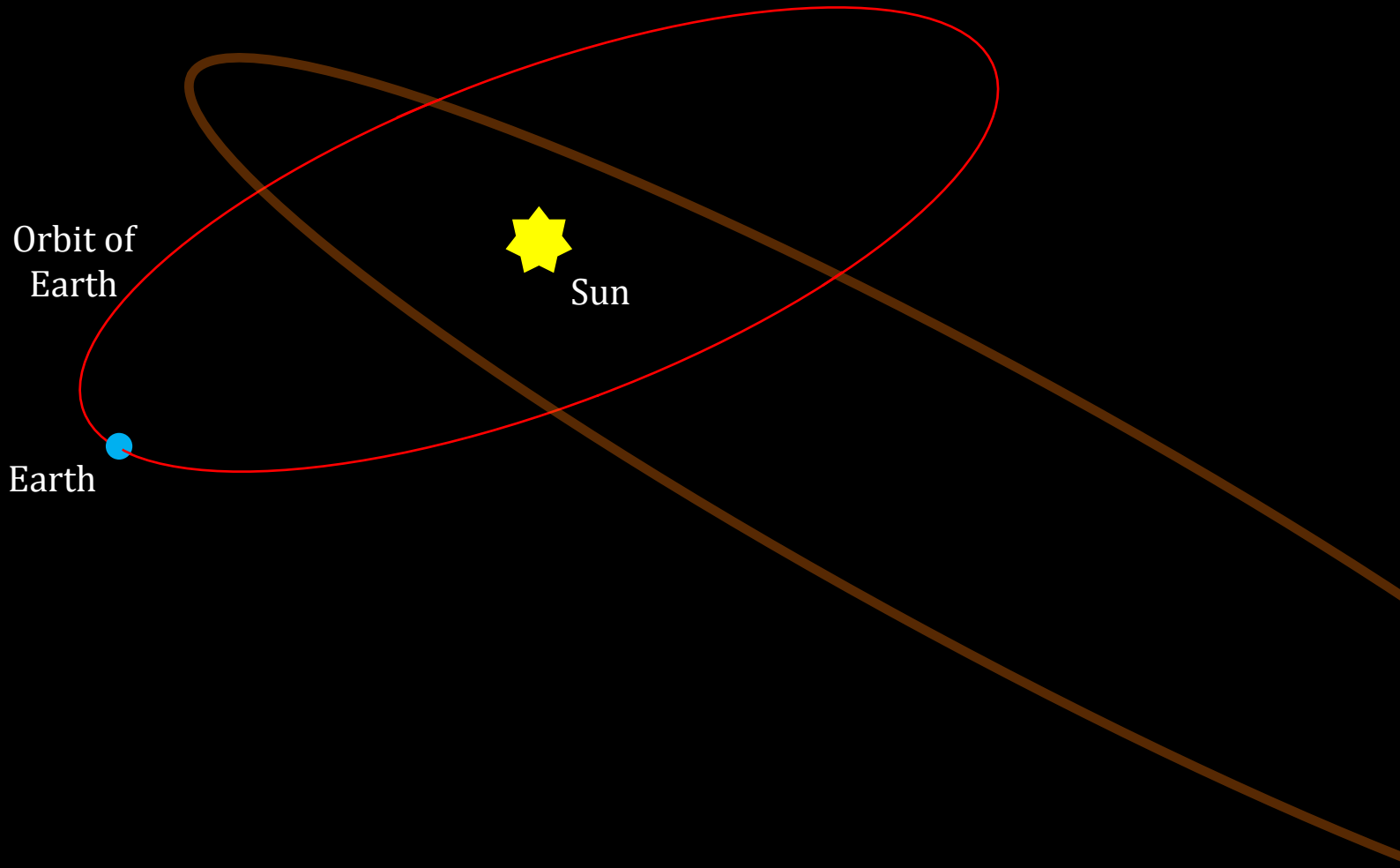
- Things change over time

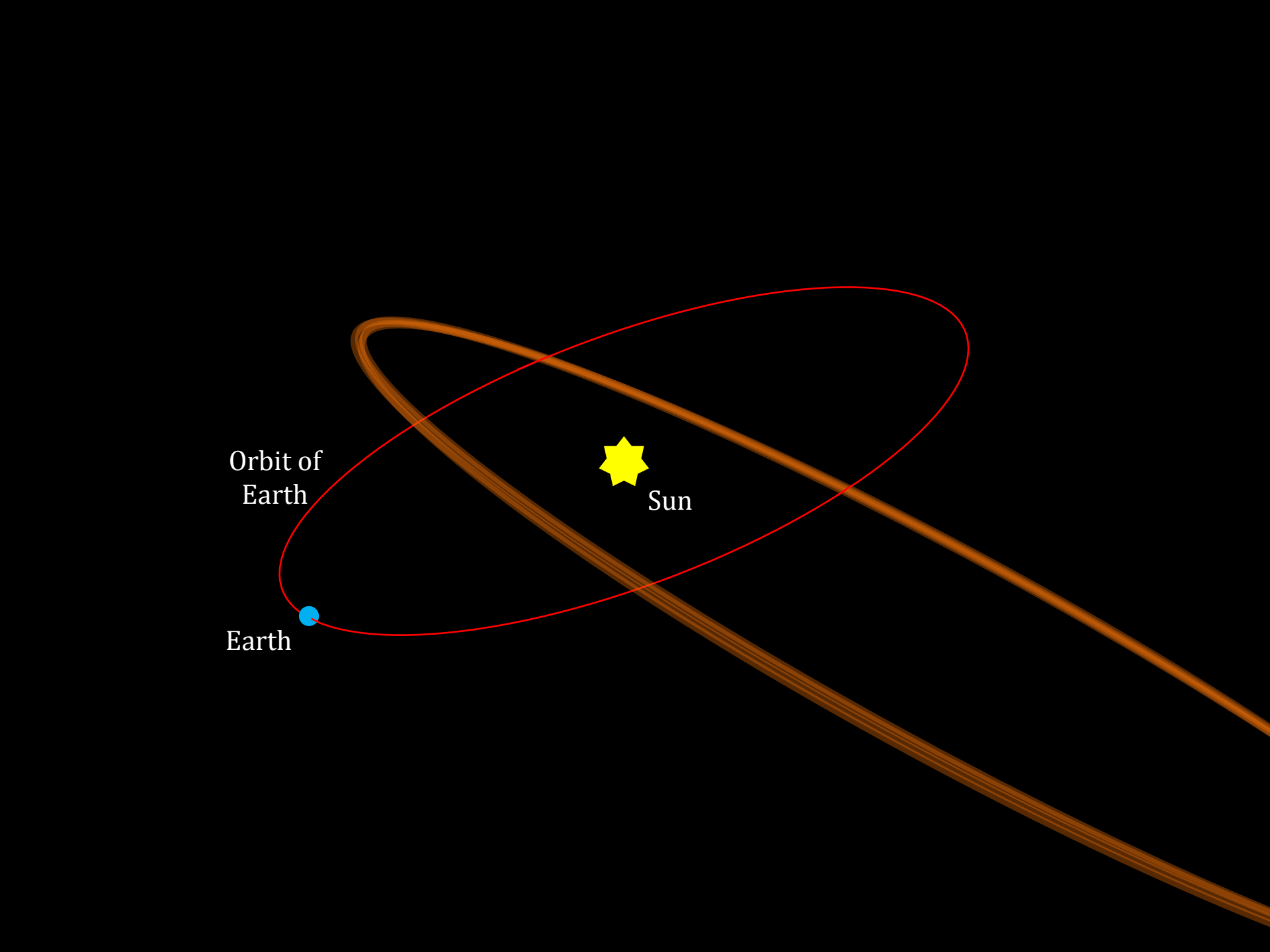
  Minutes / Hours / Days / Years / Decades / Centuries

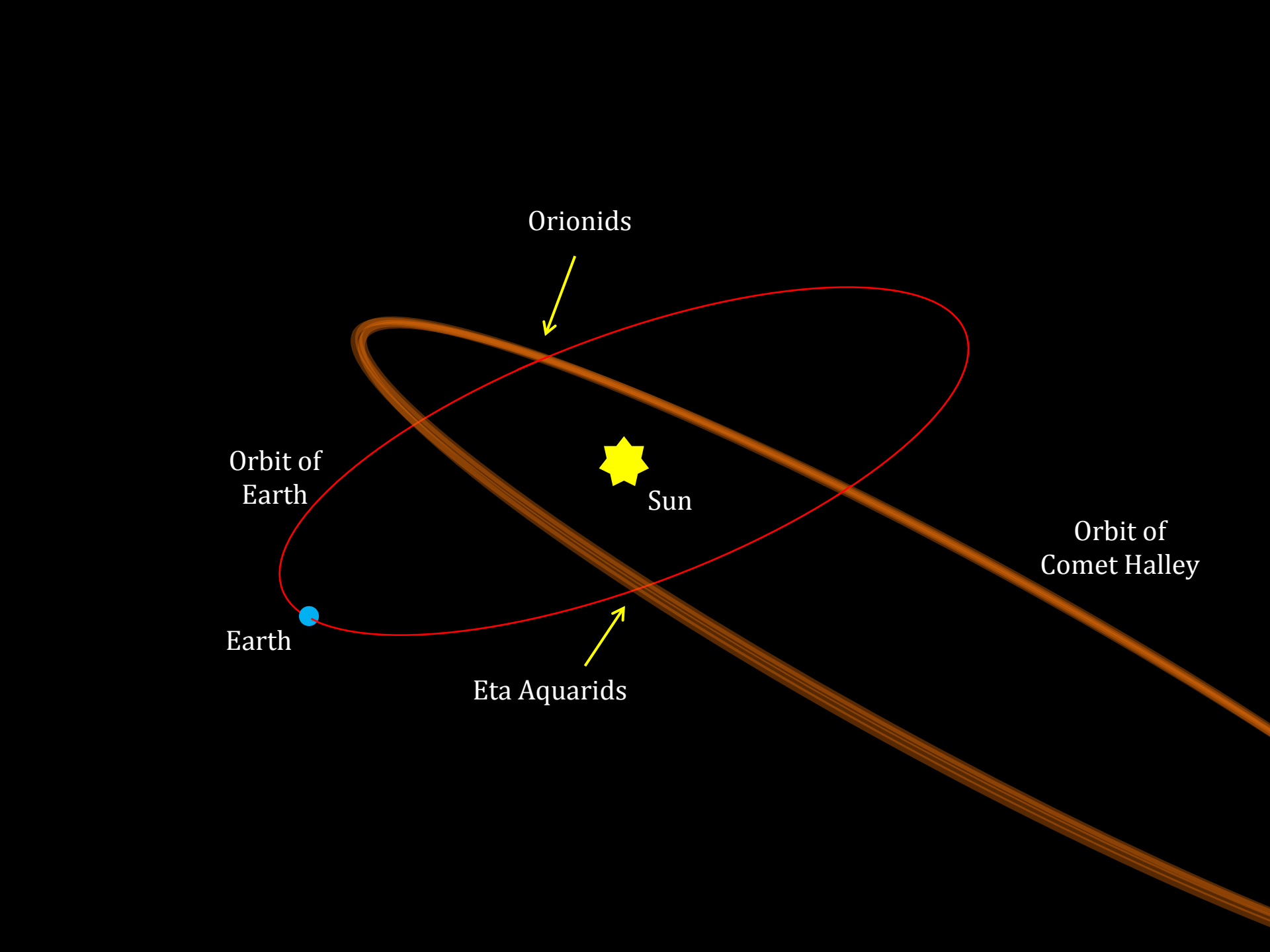
- Showers appear and disappear from view …
- Shower intensity varies with time …
- What about sporadics?

Complications:

- Each successive orbit of parent object (comet or asteroid) is slightly different


Orbit of
Earth
Sun
Earth


Orbit of
Earth
Sun
Earth


Orionids
Orbit of
Earth
Sun
Orbit of
Comet Halley
Earth
Eta Aquarids

Complications:

Complications:

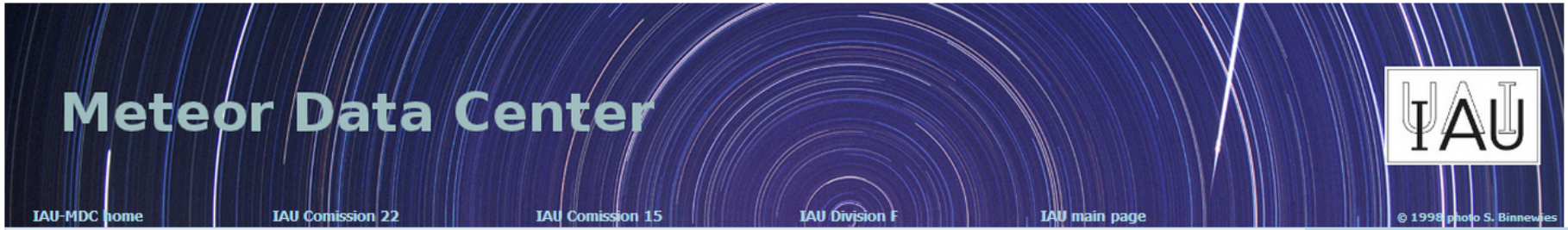
- Each successive orbit of parent object (comet or asteroid) is slightly different

- Hence filaments of material deposited in slightly different orbits with each successive revolution around the sun

  Differing ejections velocities, Varying starting points

- Having been deposited, individual meteoroid orbits change over time

  Perturbations due to gravity, solar wind, radiation pressure



List of all meteor showers

Sorting by: IAU No | Sol. Lon. | R.A. | D.E. | VG

DOWNLOAD list of all showers!

No	Code	Name	No	Code	Name	No	Code	Name
00001	CAP	alpha Capricornids	00228	OLY	October Lyncids	00425	PSA	psi Aurigids
00002	STA	Southern Taurids	00229	NAU	nu Aurigids	00426	DCR	Daytime Craterids
00003	SIA	Southern iota Aquariids	00230	ICS	October iota Cassiopeiids	00427	FED	February eta Draconids
00004	GEM	Geminids	00231	ACM	Daytime alpha Canis Majorids	00428	DSV	December sigma Virginids
00005	SDA	Southern delta Aquariids	00232	BCN	Daytime beta Cancrids	00429	ACB	alpha Coronae Borealids
00006	LYR	April Lyrids	00233	OCC	October Capricornids	00430	POR	September pi Orionids
00007	PER	Perseids	00234	EPC	October epsilon Piscids	00431	JIP	June iota Pegasids
00008	ORI	Orionids	00235	LCY	lambda Cygnids	00432	NBO	nu Bootids
00009	DRA	October Draconids	00236	GPS	gamma Piscids	00433	ETP	eta Pegasids
00010	QUA	Quadrantids	00237	SSA	sigma Arietids	00434	BAR	beta Arietids
00011	EVI	eta Virginids	00238	DOR	alpha Doradids	00435	MPR	mu Perseids
00012	KCG	kappa Cygnids	00239	GPU	October gamma Puppids	00436	GCP	gamma Cepheids
00013	LEO	Leonids	00240	DFV	Daytime psi Virginids	00437	NLY	November Lyncids
00014	XOR	chi Orionid Complex	00241	OUI	October Ursae Minorids	00438	MLE	mu Leonids
00015	URS	Ursids	00242	XDR	xi Draconids	00439	ASX	alpha Sextantids
00016	HYD	sigma Hydrids	00243	ZCN	zeta Cancrids	00440	NLM	November Leonis Minorids
00017	NTA	Northern Taurids	00244	PAR	psi1 Aurigids	00441	NLD	November lambda Draconids
00018	AND	Andromedids	00245	NHD	November Hydrids	00442	RLE	rho Leonids
00019	MON	December Monocerotids	00246	AMO	alpha Monocerotids	00443	DCL	December Leonids
00020	COM	Comae Berenicids	00247	TAU	Taurid Complex	00444	ZCS	zeta Cassiopeiids
00021	AVB	alpha Virginids	00249	NAR	November nu Arietids	00445	KUM	kappa Ursae Majorids
00022	LMI	Leonis Minorids	00250	NOO	November Orionids	00446	DPC	December phi Cassiopeiids
00023	EGE	epsilon Geminids	00251	IVI	Daytime iota Virginids	00448	AAL	April alpha Librids
00025	NOA	Northern October delta Arietids	00252	ALY	alpha Lyncids	00449	ABS	April beta Sextantids
00026	NDA	Northern delta Aquariids	00253	CMI	December Canis Minorids	00450	AED	April epsilon Delphinids
00027	KSE	kappa Serpentids	00254	PHO	Phoenicids	00451	CAM	Camelopardalids
00028	SOA	Southern October delta Arietids	00255	PUV	Puppid-Velids I Complex	00452	TVI	theta Virginids
00029	DLE	delta Leonid Complex	00256	ORN	Northern chi Orionids	00453	MML	May mu Leonids
00030	PSC	Piscid Complex	00257	ORS	Southern chi Orionids	00454	MPV	May phi Virginids
00031	ETA	eta Aquariids	00258	DAR	December alpha Aurigids	00455	MAC	May alpha Comae Berenicids
00033	NIA	Northern iota Aquariids	00259	CAR	Carinid Complex	00456	MPS	May psi Scorpiids
00034	DSE	delta Serpentids	00260	GTI	gamma Triangulids	00457	MDL	May delta Leonids
00038	CUR	xi Ursae Majorids	00261	DDC	Daytime delta Scorpiids	00458	JEC	June epsilon Cygnids
00039	NAL	Northern alpha Leonids	00262	KLI	Daytime kappa Librids	00459	JEO	June epsilon Ophiuchids
00040	ZCY	zeta Cygnids	00263	NAN	nu Andromedids	00460	LOP	lambda Ophiuchids
00043	ZSE	zeta Serpentids	00264	XCE	xi Cetids	00461	JGS	July delta Sagittariids
00045	PDF	phi Draconids	00265	JGD	January gamma Delphinids	00463	JRH	July rho Herculids
00046	BCR	beta Craterids	00266	ACC	alpha Cancrids	00464	KLY	kappa Lyrids
00047	DLI	mu Virginids	00267	JNO	January nu Orionids	00465	AXC	August xi Cassiopeiids
00049	LVI	lambda Virginids	00268	BCD	beta Cancrids	00466	AOC	August omicron Cetids
00050	VIR	March Virginid Complex	00269	OCS	omega Cassiopeiids	00467	ANA	August nu Aquariids
00052	OUM	omega Ursae Majorids	00270	FAO	Febuary alpha Orionids	00468	AAH	August alpha Herculids
00055	ASC	alpha Scorpiids	00271	MLY	March Lyncids	00469	AUS	August upsilon Sagittariids

CATALOGUES

- List of all showers
- List of established showers
- Working list of showers
- List of shower groups
- List of removed showers
- Database of photographic meteor orbits

DOCUMENTS

- New meteor shower reports
- Shower nomenclature rules
- Shower nom. working group

OTHER SITES

- Mirror of this site
- UWO - CMOR
- NASA - CAMS
- NASA's All Sky Fireball Network
- EDMOND database
- SonotaCo Meteor Data Sets
- Shower activity estimator
- IAU: Minor Planet Center
- NEODYS risk page
- ASTDYS main page
- IMO main page

00055	ASC	alpha Scorpiids
00061	TAH	tau Herculids
00063	COR	Corvids
00065	GDE	gamma Delphinids
00066	NSC	Northern omega Scorpiids
00067	NSA	Northern mu Sagittariids
00069	SSG	Southern mu Sagittariids
00073	ZDR	zeta Draconids
00076	KAQ	kappa Aquariids
00081	SLY	September Lyncids
00083	OCG	October Cygnids
00086	OGC	October gamma Cetids
00088	ODR	omicron Draconids
00089	PVI	January pi Virginids
00090	JCO	January Comae Berenicids
00091	JZA	January zeta Aurigids
00092	UER	upsilon Eridanids
00093	VEL	Puppid-Velids II Complex
00094	RGE	rho Geminids
00095	DCA	delta Cancrid Complex
00096	NCC	North. delta Cancrids
00097	SCC	South. delta Cancrids
00098	ECO	epsilon Columbids
00099	JSC	Daytime Scutids
00100	XSA	Daytime xi Sagittariids
00101	PIH	pi Hydrids
00102	ACE	alpha Centaurids
00103	TCE	Centaurid II Complex
00104	GBO	gamma Bootids
00105	OCN	Centaurid I Complex
00106	API	alpha Pictorids
00107	DCH	delta Chamaeleontids
00108	BTU	beta Tucanids
00109	ACN	alpha Carinids
00110	AAN	alpha Antliids
00111	FCM	February Canis Majorids
00112	NDL	Northern delta Leonids
00113	SDL	Southern delta Leonids
00114	DXC	Daytime chi Capricornids
00115	DSC	Dayt. Sagittariids-Capricornids
00116	DEQ	Daytime epsilon Aquariids
00117	DCQ	Daytime c Aquariids
00118	GNO	gamma Normids
00119	LCE	lambda Centaurids
00120	DPA	delta Pavonids
00121	NHY	nu Hydrids
00122	APX	alpha Pyxidids
00123	NVI	Northern March Virginids
00124	SVI	Southern March Virginids
00125	SAL	Southern alpha Leonids
00126	SGE	March delta Geminids
00127	MCA	March Cassiopeiids
00128	MKA	Daytime kappa Aquariids
00129	QPE	Daytime q Pegasids
00130	DME	delta Mensids
00131	DAL	delta Aquilids
00133	PUM	April psi Ursae Majorids
00134	NGV	Northern gamma Virginids
00135	SGV	Southern gamma Virginids
00136	SLE	sigma Leonids
00271	MLY	March Lyncids
00272	ACO	April alpha Comae Berenicids
00273	PBO	phi Bootids
00274	NUM	nu Ursae Majorids
00275	CLI	chi Librids
00276	ADR	alpha Draconids
00277	GCA	gamma Camelopardalids
00278	MSR	July mu Serpendids
00279	ZED	July zeta Draconids
00280	ADL	delta Librids
00281	OCT	October Camelopardalids
00282	DCY	delta Cygnids
00283	OPL	pi Leonids
00284	OMA	Omicron Ursae Majorids
00285	GTA	gamma Taurids
00286	FTA	omega Taurids
00287	NER	November epsilon Eridanids
00288	DSA	Southern December delta Arietids
00289	DNA	Northern December delta Arietids
00290	ALL	alpha Leonid Complex
00291	GVR	gamma Virginid Complex
00292	OPH	May Ophiuchid Complex
00293	DCE	Daytime omega Cetid Complex
00294	DMA	Daytime May Arietid Complex
00295	JAQ	June Aquilid Complex
00296	SIS	sigma Sagittariid Complex
00297	DAQ	delta Aquariid Complex
00298	IAQ	iota Aquariid Complex
00299	OAR	October Arietid Complex
00300	ZPU	zeta Puppids
00301	PUP	gamma Puppids
00302	PVE	b Puppids
00303	LVL	lambda Velids
00304	CVE	c Velids
00305	SPU	sigma Puppids
00306	COL	Columbids
00307	TPU	tau Puppids
00308	PIP	January pi Puppids
00309	GVE	gamma Velids
00310	APY	January alpha Pixidids
00311	DVE	delta Velids
00312	ECA	epsilon Carinids
00313	ECR	eta Carinids
00314	ACR	alpha Crucids
00315	OCA	omega Centaurids
00316	BHD	beta Hydrids
00317	TCN	theta Centaurids
00318	MVE	mu Velids
00319	JLE	January Leonids
00320	OSE	omega Serpentids
00321	TCB	theta Coronae Borealids
00322	LBO	lambda Bootids
00323	XCB	xi Coronae Borealids
00324	EPR	epsilon Perseids
00325	DLT	Daytime lambda Taurids
00326	EPG	epsilon Pegasids
00327	BEQ	beta Equuleids
00328	ALA	alpha Lacertids
00330	SSE	sigma Serpentids
00331	AHY	alpha Hydrids
00469	AUS	August upsilon Sagittariids
00470	AMD	August mu Draconids
00471	ABC	August beta Capricornids
00472	ATA	August theta Aquilids
00473	LAQ	lambda Aquariids
00474	ABA	August beta Aquariids
00475	SAQ	September Aquariids
00476	ICE	iota Cetids
00477	SRP	September rho Pegasids
00478	STC	September theta Capricornids
00479	SOO	September omicron Orionids
00480	TCA	tau Cancrids
00481	OML	October mu Leonids
00482	NGP	November gamma Pegasids
00483	NAS	November alpha Sextantids
00485	NZT	November zeta Taurids
00486	NZP	November zeta Perseids
00487	NRC	November rho Cygnids
00488	NSU	November sigma Ursae Majorids
00489	ZLE	zeta Leonids
00490	DGE	December delta Eridanids
00491	DCC	December delta Cancrids
00492	DTH	December theta Hydrids
00493	DEC	December epsilon Craterids
00494	DEL	December Lyncids
00495	DMT	December mu Taurids
00496	DED	December epsilon Eridanids
00497	DAB	December alpha Bootids
00498	DMH	December mu Hydrids
00500	JPV	January phi Virginids
00501	FPL	February pi Leonids
00502	DRV	December rho Virginids
00503	NNA	99 Aquariids
00505	AIC	August iota Cetids
00506	FEV	February epsilon Virginids
00507	UAN	upsilon Andromedids
00508	TPI	theta Piscids
00509	KVI	kappa Virginids
00510	JRC	June rho Cygnids
00511	FLY	15 Lyncids
00512	RPU	rho Puppids
00513	EPV	epsilon Virginids
00514	OMC	omega Capricornids
00515	OLE	omicron Leonids
00516	FMV	February mu Virginids
00517	ALO	April lambda Ophiuchids
00518	AHE	April 102 Herculids
00519	BAQ	beta Aquariids
00520	MBC	May beta Capricornids
00522	SAP	Southern alpha Pegasids
00523	AGC	August gamma Cepheids
00524	LUM	lambda Ursae Majorids
00525	ICY	iota Cygnids
00526	SLD	Southern lambda Draconids
00527	UUM	upsilon Ursae Majorids
00528	JZD	January zeta Draconids
00529	EHY	eta Hydrids
00530	ECV	eta Corvids
00531	GAQ	gamma Aquilids
00532	MLD	May lambda Draconids

00137	PPU	pi Puppids
00138	ABO	alpha Bootids
00139	GLI	gamma Librids
00140	XLI	April chi Librids
00141	DCP	Daytime chi Piscids
00142	MDR	mu Draconids
00143	LPE	Daytime lambda Pegasids
00144	APS	Daytime April Piscids
00145	ELY	eta Lyrids
00146	CAU	beta Coronae Australids
00147	PAQ	phi Aquariids
00148	MLV	May lambda Virginids
00149	NOP	Northern May Ophiuchids
00150	SOP	Southern May Ophiuchids
00151	EAU	epsilon Aquilids
00152	NOC	Northern Daytime omega Cetids
00153	OCE	Southern Daytime omega Cetids
00154	DEA	Daytime epsilon Arietids
00155	NMA	Northern Daytime May Arietids
00156	SMA	Southern Daytime May Arietids
00157	ICA	iota Cassiopeiids
00158	CET	pi Cetids
00159	TAQ	tau Aquariids
00160	OSC	omega Scorpiid Complex
00161	SSC	Southern omega Scorpiids
00162	ACI	alpha Circinids
00163	SAG	Scorpiid-Sagittariid Complex
00164	NZC	Northern June Aquilids
00165	SZC	Southern June Aquilids
00166	JLY	June Lyrids
00167	NSS	Northern sigma Sagittariids
00168	SSS	Southern sigma Sagittariids
00169	SCU	Scutids
00170	JBO	June Bootids
00171	ARI	Daytime Arietids
00172	ZPE	Daytime zeta Perseids
00173	BTA	Daytime beta Taurids
00174	TAS	Daytime theta Aurigids
00175	JPE	July Pegasids
00176	PHE	July Phoenicids
00177	BCA	beta Cassiopeiids
00178	JCE	July Centaurids
00179	SCA	sigma Capricornids
00180	MSE	mu Serpentids
00181	KPA	kappa Pavonids
00182	OCY	omicron Cygnids
00183	PAU	Piscis Austrinids
00184	GDR	July Gamma Draconids
00185	DBA	Daytime beta Andromedids
00186	EUM	epsilon Ursae Majorids
00187	PCA	psi Cassiopeiids
00188	XRI	Daytime xi Orionids
00189	DMC	Daytime mu Cancrids
00190	BPE	beta Perseids
00191	ERI	eta Eridanids
00192	TRI	August Triangulids
00193	ZAR	zeta Arietids
00194	UCE	upsilon Cetids
00195	BIN	beta Indids
00196	NPH	nu Phoenicids
00332	BCB	Bootid-Coronae Borealid Complex
00333	OCU	October Ursae Majorids
00334	DAD	December alpha Draconids
00335	XVI	December chi Virginids
00336	DKD	December kappa Draconids
00337	NUE	nu Eridanids
00338	OER	omicron Eridanids
00339	PSU	psi Ursae Majorids
00340	TPY	theta Pyxidids
00341	XUM	January xi Ursae Majorids
00343	HVI	h Virginids
00345	FHE	f Herculids
00346	XHE	x Herculids
00347	BPG	beta Pegasids
00348	ARC	April rho Cygnids
00349	LLY	lambda Lyrids
00350	MAL	May Lacertids
00351	DTR	Daytime Triangulids
00352	ZOP	zeta Ophiuchids
00353	SCT	sigma Cetids
00354	DDT	Daytime delta Triangulids
00355	XIC	Daytime xi Cetids
00356	MVL	May Vulpeculids
00357	PHP	phi Pegasids
00358	TOP	tau Ophiuchids
00359	MZC	May zeta Cygnids
00360	PSP	psi Pegasids
00361	TSR	theta Serpentids
00362	JMC	June mu Cassiopeiids
00363	ZER	zeta Eridanids
00364	KCT	kappa Cetids
00365	BCM	beta Camelopardalids
00366	JBP	July beta Pegasids
00367	OPG	omicron Pegasids
00368	JAD	July Andromedids
00369	JTR	July Taurids
00370	MIC	Microscopiids
00371	APG	alpha Pegasids
00372	PPS	phi Piscids
00373	TPR	theta Perseids
00374	ISC	iota Sculptorids
00375	AOE	August omicron Eridanids
00376	ALN	August Lyncids
00377	DMO	Daytime Monocerotids
00378	GER	gamma Eridanids
00379	ACT	August Cetids
00380	KDR	kappa Draconids
00381	DPL	Daytime pi Leonids
00382	BUM	beta Ursae Majorids
00383	LDR	lambda Draconids
00384	OLP	October Leporids
00385	AUM	alpha Ursae Majorids
00386	OBC	October beta Camelopardalids
00387	OKD	October kappa Draconids
00388	CTA	chi Taurids
00389	OME	omega Eridanids
00390	THA	November theta Aurigids
00391	NDD	November delta Draconids
00392	NID	November i Draconids
00393	RBO	rho Bootids
00533	JXA	July xi Arietids
00534	FOA	51 Andromedids
00535	THC	theta Cetids
00536	FSO	47 Ophiuchids
00537	KAU	kappa Aurigids
00538	FFA	55 Arietids
00539	ACP	alpha Cepheids
00540	TCR	theta Craterids
00541	SSD	66 Draconids
00542	DES	delta Sextantids
00543	TTB	22 Bootids
00544	JNH	January nu Hydrids
00545	KCA	xi Cassiopeiids
00546	FTC	43 Cassiopeiids
00547	KAP	kappa Perseids
00548	FAQ	15 Aquariids
00549	FAN	49 Andromedids
00550	KPC	kappa Cassiopeiids
00551	FSA	47 Andromedids
00552	PSO	pi6 Orionids
00553	DPE	delta Perseids
00554	APE	alpha Perseids
00555	OCP	October gamma Camelopardalids
00556	PTA	phi Taurids
00557	SFD	64 Draconids
00558	TSM	27 Monocerotids
00559	MCB	beta Canis Majorids
00560	SES	17 Sextantids
00561	SSX	6 Sextantids
00562	BCT	13 Comae Berenicids
00563	DOU	December omega Ursae Majorids
00564	SUM	61 Ursae Majorids
00565	FUM	59 Ursae Majorids
00566	BCF	5 Comae Berenicids
00567	XHY	xi Hydrids
00568	FCV	14 Canum Venaticids
00569	OHY	omicron Hydrids
00570	FBH	February beta Herculids
00571	TSB	26 Bootids
00572	TOH	21 Herculids
00573	TLM	32 Leonis Minorids
00574	GMA	gamma Ursae Majorids
00575	SAU	63 Aurigids
00576	FOB	40 Comae Berenicids
00577	FPI	58 Piscids
00578	TUM	theta Ursae Majorids
00579	TCV	Canum Venaticids-Bootids
00580	CHA	chi Andromedids
00581	NHE	90 Herculids
00582	JBC	January beta Craterids
00583	TTA	12 Taurids
00584	GCE	Cepheids-Cassiopeiids
00585	THY	33 Hydrids
00586	TLA	2 Lacertids
00587	FNC	59 Cygnids
00588	TTL	22 Lyncids
00589	FCA	50 Cancrids
00590	VCT	10 Canum Venaticids
00591	ZBO	zeta Bootids
00592	PON	91 Piscids

00173	BTA	Daytime beta Taurids	00370	MIC	Microscopiids	00569	OHY	omicron Hydrids
00174	TAS	Daytime theta Aurigids	00371	APG	alpha Pegasids	00570	FBH	February beta Herculids
00175	JPE	July Pegasids	00372	PPS	phi Piscids	00571	TSB	26 Bootids
00176	PHE	July Phoenicids	00373	TPR	theta Perseids	00572	TOH	21 Herculids
00177	BCA	beta Cassiopeiids	00374	ISC	iota Sculptorids	00573	TLM	32 Leonis Minorids
00178	JCE	July Centaurids	00375	AOE	August omicron Eridanids	00574	GMA	gamma Ursae Majorids
00179	SCA	sigma Capricornids	00376	ALN	August Lyncids	00575	SAU	63 Aurigids
00180	MSE	mu Serpentids	00377	DMO	Daytime Monocerotids	00576	FOB	40 Comae Berenicids
00181	KPA	kappa Pavonids	00378	GER	gamma Eridanids	00577	FPI	58 Piscids
00182	OCY	omicron Cygnids	00379	ACT	August Cetids	00578	TUM	theta Ursae Majorids
00183	PAU	Piscis Austrinids	00380	KDR	kappa Draconids	00579	TCV	Canum Venaticids-Bootids
00184	GDR	July Gamma Draconids	00381	DPL	Daytime pi Leonids	00580	CHA	chi Andromedids
00185	DBA	Daytime beta Andromedids	00382	BUM	beta Ursae Majorids	00581	NHE	90 Herculids
00186	EUM	epsilon Ursae Majorids	00383	LDR	lambda Draconids	00582	JBC	January beta Craterids
00187	PCA	psi Cassiopeiids	00384	OLP	October Leporids	00583	TTA	12 Taurids
00188	XRI	Daytime xi Orionids	00385	AUM	alpha Ursae Majorids	00584	GCE	Cepheids-Cassiopeiids
00189	DMC	Daytime mu Cancrids	00386	OBC	October beta Camelopardalids	00585	THY	33 Hydrids
00190	BPE	beta Perseids	00387	OKD	October kappa Draconids	00586	TLA	2 Lacertids
00191	ERI	eta Eridanids	00388	CTA	chi Taurids	00587	FNC	59 Cygnids
00192	TRI	August Triangulids	00389	OME	omega Eridanids	00588	TTL	22 Lyncids
00193	ZAR	zeta Arietids	00390	THA	November theta Aurigids	00589	FCA	50 Cancrids
00194	UCE	upsilon Cetids	00391	NDD	November delta Draconids	00590	VCT	10 Canum Venaticids
00195	BIN	beta Indids	00392	NID	November i Draconids	00591	ZBO	zeta Bootids
00196	NPH	nu Phoenicids	00393	RBO	rho Bootids	00592	PON	91 Piscids
00197	AUD	August Draconids	00394	ACA	alpha Canis Majorids	00593	TOL	28 Lyncids
00198	BHY	beta Hydrusids	00395	GCM	gamma Canis Majorids	00594	RSE	Serpentids-Coronae Borealids
00199	ADC	August delta Capricornids	00396	DTA	December theta Aurigids	00595	TTT	13 Taurids
00200	ESE	eta Serpentids	00397	NGM	nu Geminids	00596	MUS	78 Ursae Majorids
00201	GDO	gamma Doradids	00398	DCM	December Canis Majorids	00597	TTS	theta2 Sagittariids
00202	ZCA	Daytime zeta Cancrids	00399	DHY	December Hydrids	00598	TCT	tau Cetids
00203	GLE	Daytime gamma Leonids	00400	BMO	beta Monocerotids	00599	POS	72 Ophiuchids
00204	DXL	Daytime chi Leonids	00401	BSX	beta Sextantids	00600	FAU	43 Aurigids
00205	XAU	xi Aurigids	00402	JHY	January Hydrids	00601	ICT	iota Craterids
00206	AUR	Aurigids	00403	CVN	Canum Venaticids	00602	KCR	kappa Craterids
00207	SCS	September beta Cassiopeiids	00404	GUM	gamma Ursae Minorids	00603	FCR	15 Cancrids
00208	SPE	September epsilon Perseids	00405	MHY	mu Hydrids	00604	ACZ	zeta1 Cancrids
00209	EER	epsilon Eridanids	00406	FCB	February Comae Berenicids	00605	FHR	52 Herculids
00210	BAU	beta Aurigids	00407	OEE	October eta Eridanids	00606	JAU	January alpha Ursae Majorids
00211	AOR	September alpha Orionids	00408	KHY	kappa Hydrids	00607	TBO	12 Bootids
00212	KLE	Daytime kappa Leonids	00409	NCY	nu Cygnids	00608	FAR	14 Aurigids
00213	BRC	beta Gruids	00410	DPI	delta Piscids	00609	BOT	37 Comae Berenicids
00214	BCP	beta Capricornids	00411	CAN	c Andromedids	00610	SGM	68 Geminids
00215	NPI	North. delta Piscids	00412	FOP	f Ophiuchids	00611	VCF	4 Canum Venaticids
00216	SPI	South. delta Piscids	00413	MUL	mu Lyrids	00612	NCA	19 Canum Venaticids
00217	OPC	omega Piscids	00414	ATR	alpha Triangulids	00613	TLY	31 Lyncids
00218	GSA	September gamma Sagittariids	00415	AUP	August Piscids	00614	JOS	January omega Serpentids
00219	SAR	September mu Arietids	00416	SIC	September iota Cassiopeiids	00615	TOR	35 Comae Berenicids
00220	NDR	nu Draconids	00417	ETT	eta Taurids	00616	TOB	26 Comae Berenicids
00221	DSX	Daytime Sextantids	00418	BHE	beta Herculids	00617	IUM	iota Ursae Majorids
00222	DDL	Daytime delta Leonids	00419	DAC	Daytime April Cetids	00618	THD	12 Hydrids
00223	GVI	Daytime gamma Virginids	00420	CCA	chi Capricornids	00619	SLM	7 Leonis Minorids
00224	DAU	October delta Aurigids	00421	MMI	May Microscopiids	00620	SBO	sigma Bootids
00225	SOR	sigma Orionids	00422	NLL	Northern Librids-Lupids	00621	SUA	73 Ursae Majorids
00226	ZTA	zeta Taurids	00423	SLL	Southern Librids-Lupids	00622	PUA	phi Ursae Majorids
00227	OMO	October Monocerotids	00424	SOL	September-October Lyncids			

Total: 578 showers, including 95 established, 0 nominated to be established. 95 pro tempore 0 to be removed.

Updated AD 2013, December 13, by Z. Kanuchova and T.J. Jopek

Considerations:

- Perseids
  Consistent Performer, Known for many Centuries
- Geminids
  Is currently the best performing shower
  But unknown before 1850
- How will current showers perform in the future ?
- What meteoroid streams are just beyond earth's orbit?
  In coming years will they be perturbed across it?
- Is it happening now?
  Poor coverage over large parts of the earth?

Science Objectives

- *What questions can we answer with our data?*
  - Geert Barentsen IMC2014 Conference Summary
  - *http://www.geert.io/international-meteor-conference-2014-summary.html*

System Optimisation

- Physical Hardware - General
  - Good Quality Cables & Connectors
    Frost & Sunlight
  - Well Secured
    Firmly attached to solid base
    Tie Wraps / Cable Clips etc
  - Demist Heater
    Activate early
    Gap between lens and window

System Optimisation

- Multiple Camera Systems

Single PC

Pros

Reduced Power Consumption
Less Physical Space
Reduced Thermal Control Issues

Cons

Increased Unit Cost
Reduced Redundancy

Multiple PCs

Pros

Reduced Unit Cost
Increased Redundancy

Cons

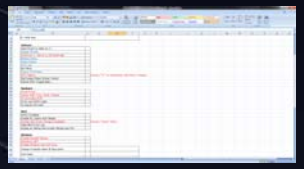
More Physical Space – offset by KVM use
Increased Power Consumption
Increased Thermal Control Issues

System Optimisation

- Computer Software
    - Periodic Re-boot: PC (& Router?)
    - Empty Recycle Bin
    - Check Windows Update
    - Patch Tuesday
    - Daytime Hibernation … or Leave Running 24/7

PC Checklist

- Designed to ensure consistency with pre-built systems
- Common “Technical Support” questions / guidance
  - *“Maximum Correction” parameter in Dimension 4*
  - *Empty Recycle Bin after deleting false captures*
  - *Defragment hard drive(s)*
  - *Periodic (preventative) reboots and virus scans*
  - *“Green” labelled HDDs: issues with deactivating power saving*
- UFO Capture
  - *Include time-zone (e.g. UTC) after date / time overlay*
  - *Also suggest including location, camera and lens details*
  - *Do not exceed maximum number of characters*
  - *Minimise to taskbar when running*



System Optimisation

- Power
  - Separate vs Common PSUs / Linking of 12V DC
  - Timeswitches

Rotary, Electronic, Theben SEL170

System Optimisation

- Power
  - Separate vs Common PSUs / Linking of 12V DC
  - Timeswitches
  - UPS … *to prevent PC reboot resulting from intermittent, short duration power outages*

System Optimisation

- Video Signal
  - Ground Loop Isolator… *to eliminate rolling banding on video images*
    Positioning … *is your video lead an antenna? Either as video signal exits camera or just before video signal enters PC*

System Optimisation

- User Environment
  - Desktops vs Laptops
  - KVM (Keyboard, Video, Mouse) Switches

System Optimisation

- User Environment
  - Desktops vs Laptops
  - KVM (Keyboard, Video, Mouse) Switches
    To reduce number of Keyboards, Monitors, Mice
    Unless you like the "Mission Control" look

Timing Corrections

- Rationale
  - Identification of Common Events
  - Astrometry

Focal Length (mm)	Resolution (arcsec / pixel)
3.8	494
6.0	313
8.0	235
12.0	156

- Techniques
  - Dimension 4
  - Update Frequency; Maximum Correction
  - Minimise – DO NOT CLOSE!

System Optimisation

- Network Switches

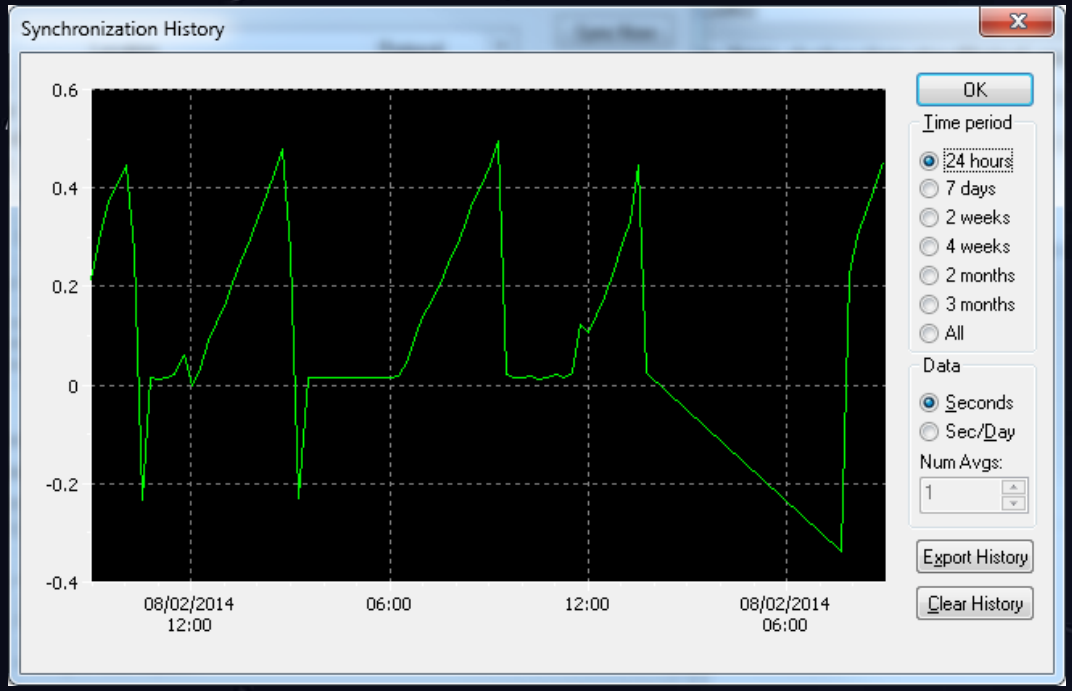
Timing Corrections

- Issues
  - Loss of Internet Connection
  - Local vs. Remote vs. Random NTP Servers
  - Large jumps post re-boot
  - Internet activity
  - Simultaneous synchronisation requests
  - Analysis Spreadsheet

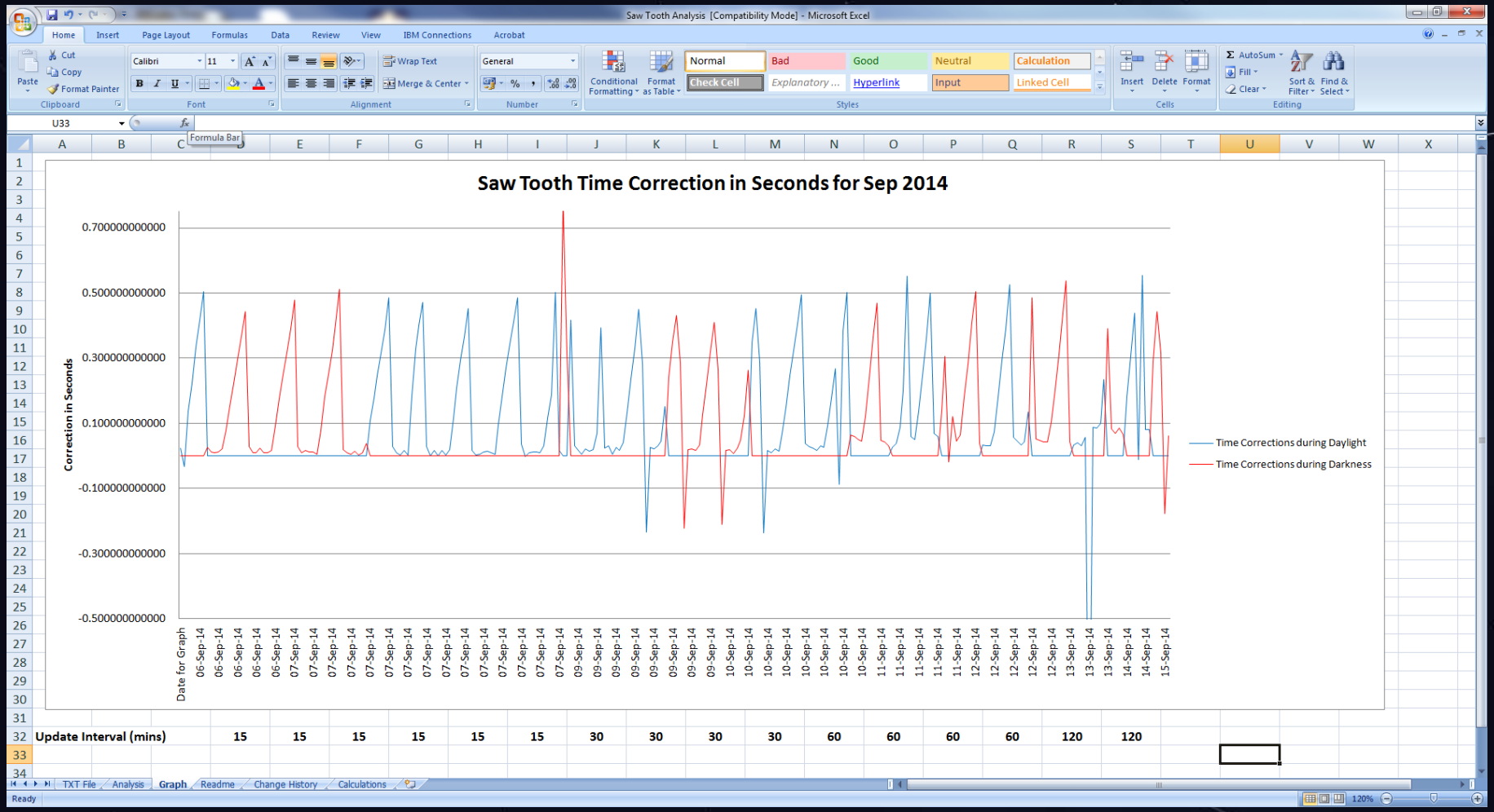
Timing Corrections

- Issues
  - "Saw-tooth" Pattern

Gordon Reineke 02nd August 2014



Timing Corrections



Lenses

- Lenses
  - Ideally f0.8 or better
  - $^{1}/_{2}$" or $^{1}/_{3}$" or $^{1}/_{4}$" – match lens to camera sensor size
  - Auto-iris (if manual iris then suggest north facing)

  - Focal Ratio for given Focal Length

$$\Delta_{LM}=5*\log_{10}(^{\text{Aperture 1}}/_{\text{Aperture 2}})$$

  - Computar
  - Cosmicar / Pentax
  - Panasonic – *but no focus ring!*

- Aberration Compensation Filters
  - Lens Mount Compatibility – mind the step!
  - No: Watec 902DM2S, 902H, 902H2/H3 Supreme
  - Yes: Watec 902H2/H3 Ultimate & 910HX

Lenses

- Lens Iris: Video Drive Auto-Iris vs DC Auto-Iris
  - Will the connector on side of camera drive the lens iris?

  - DC auto-iris: the control circuit resides inside the camera
  - Video auto-iris: the control circuit resides inside the lens

  - Watec 902H does not contain necessary control circuitry
  - Later models (Supreme / Ultimate) do.

- Workaround
  - Apply 12V DC directly to the lens iris
  - Sockets: eBay: *http://www.ebay.com/itm/Lot-10-pcs-4-pin-socket-for-Auto-iris-cctv-camera-NEW-/370290110550?ssPageName=ADME:L:OC:GB:3160*

Resolution

- 768 x 576 or 640 x 480
- Issue with USB based video capture devices
- Default resolution and frame rate (as loaded during manufacture) does not match the requirements of the camera / UFO Capture software.

Resolution – Corrective Workflow *(courtesy of Nick & Alex)*

- Run VirtualDub (I'm using version 1.10.4).
- Select File->Capture AVI.
- Select Device-> and select your camera.
- Select Video->CaptureFilter and then select PAL_I in the dropdown for video standard.
- Select Video->CapturePin and ensure the video standard is PAL_I, the frame rate is 25.00, the colour space is YUY2 and the size is 720x576. Click OK.
- Select Video->crossbar and select "composite in" as the input (assuming you are using composite video).
- Exit VirtualDub.
- Run UFO capture and load the default settings file PF720x576N.ufi. Connect to the camera and you should now have video in native resolution and frame-rate.

Settings & Triggers - From UFO Capture User Guide

Detect Level Noise Tracking

This option is to tune "Detect Lev" automatically by the background noise level.

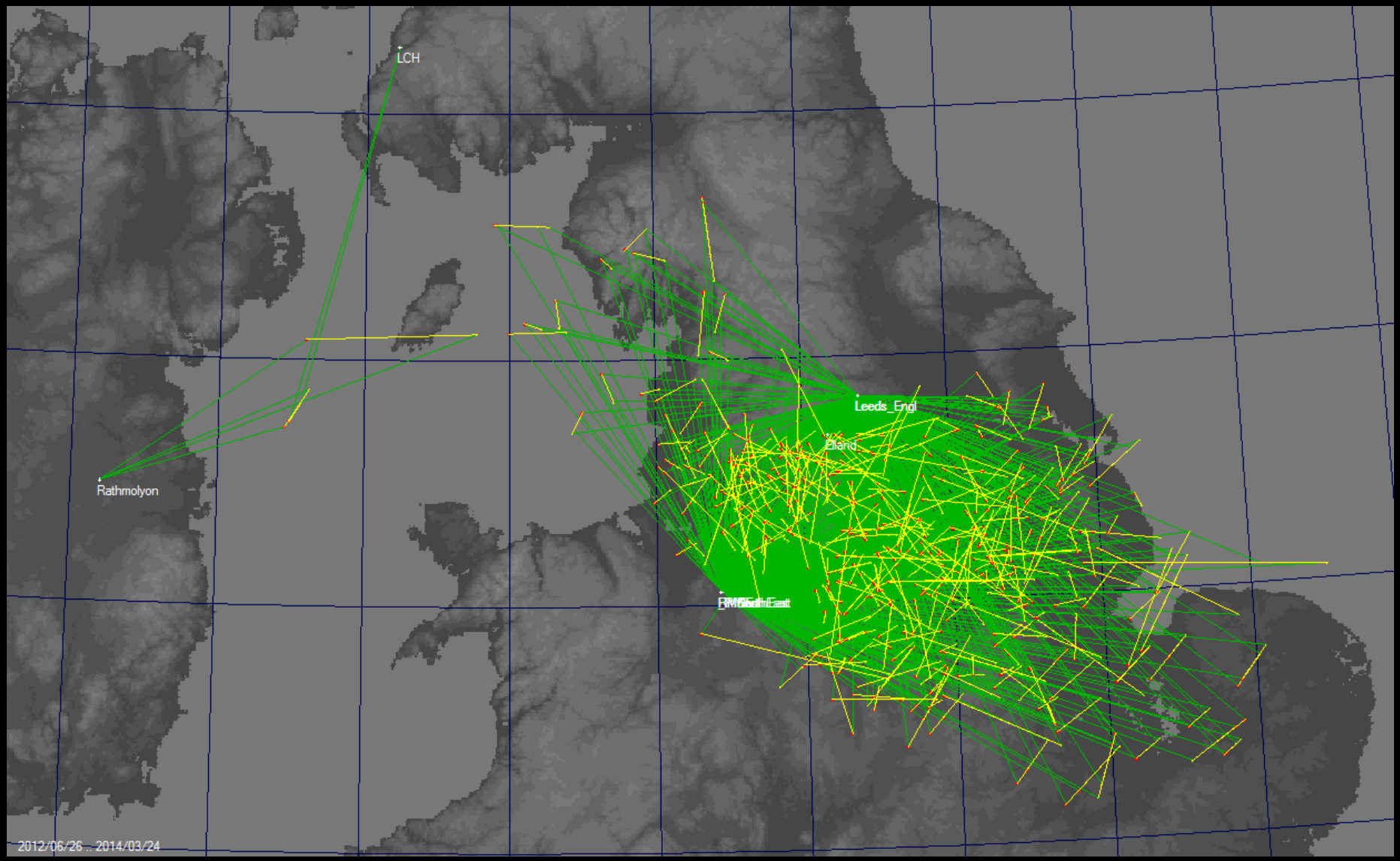
- *DLratio : ratio(%) between noise level and "Detect Lev".*
  Normally 105 to 130 is appropriate.
- *MinDL : Minimum value of "Detect Lev".*
  Use this to avoid continuous recording - happens when "Detect Lev" become too low .
- *MinL-N : Minimum difference of "Detect Lev" and noise level.*
  Use this value to keep margin.

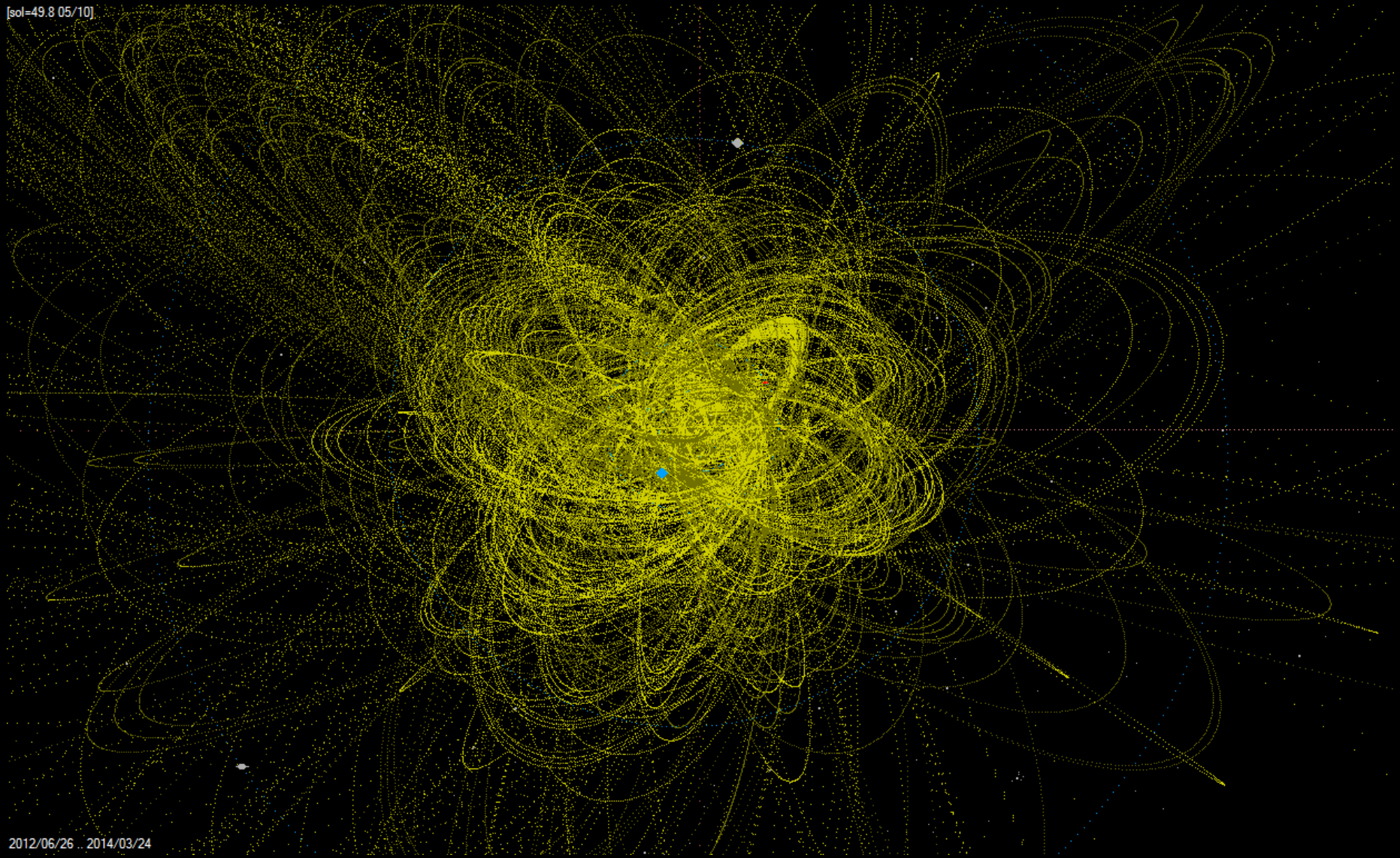
Detect Size Slider

Set motion detect size threshold level.

- *When bar exceeds slider position for more than "Min(frm)"time, a trigger will be raised.*
- *Detect Size is number of pixels which change brightness more than Detect Lev threshold*

UFO Analyser


LCH
Rathmolyon
Leeds_Engl
Bland
2012/06/26 .. 2014/03/24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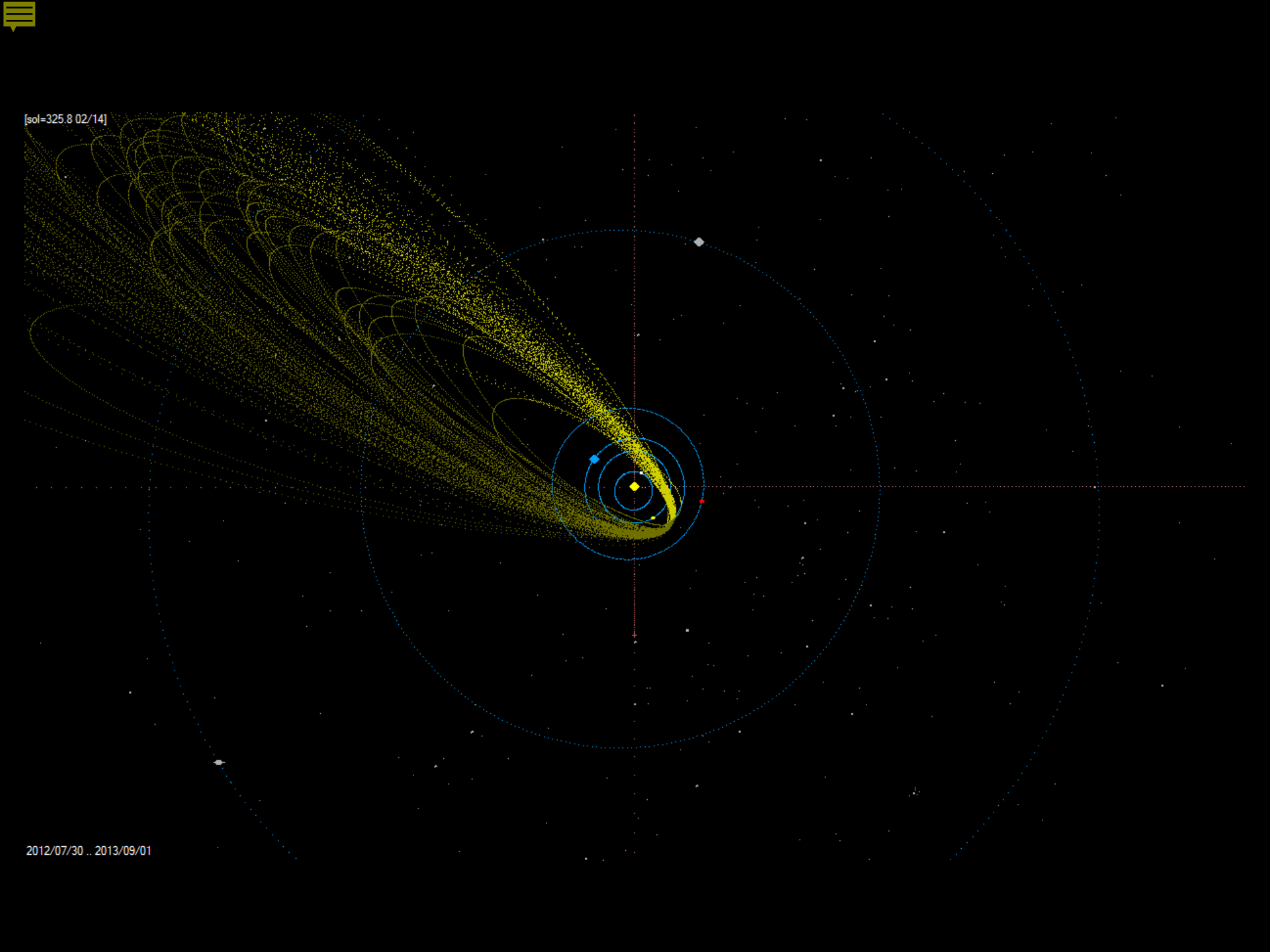
2012/06/26 .. 2014/03/24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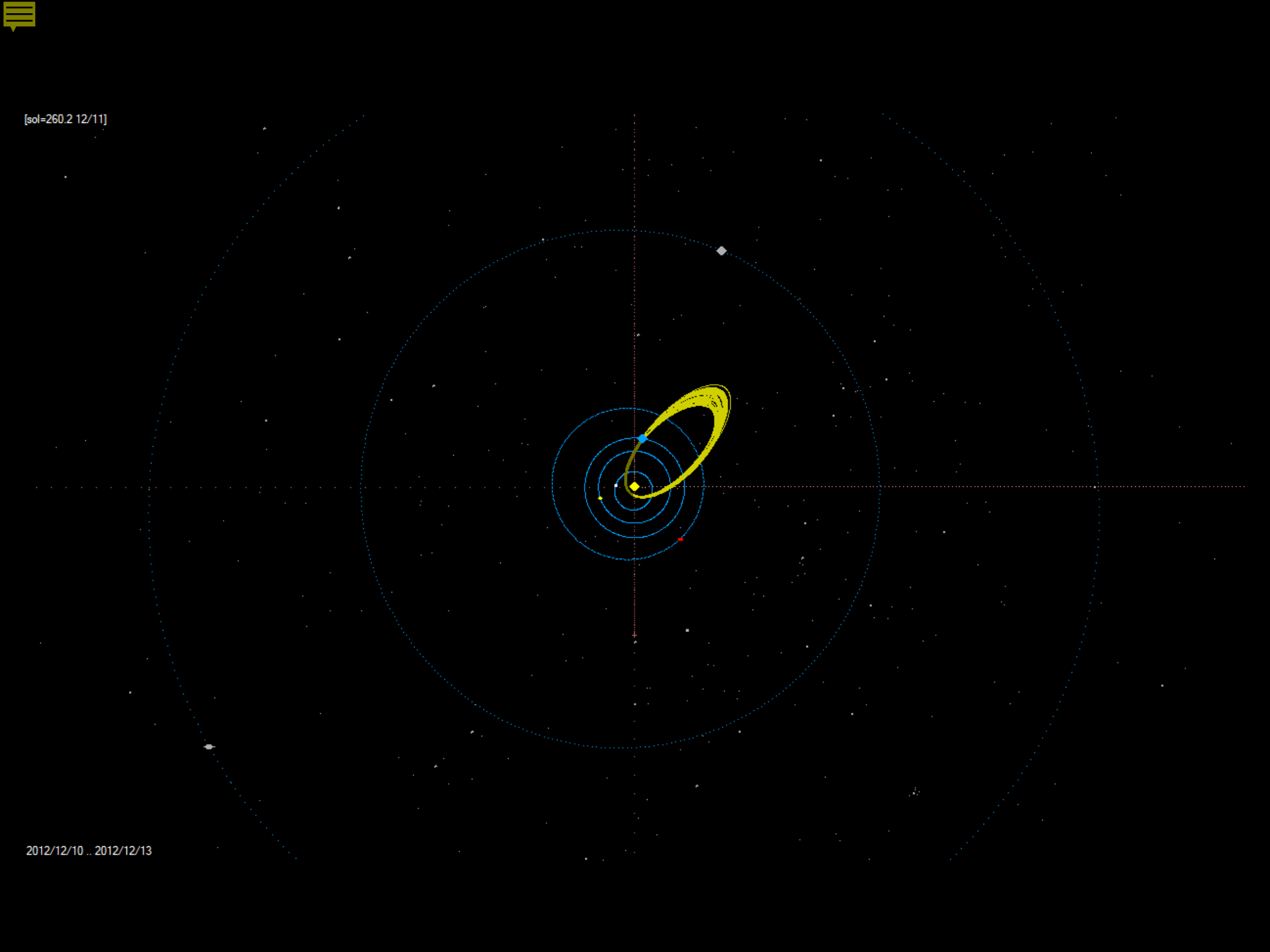
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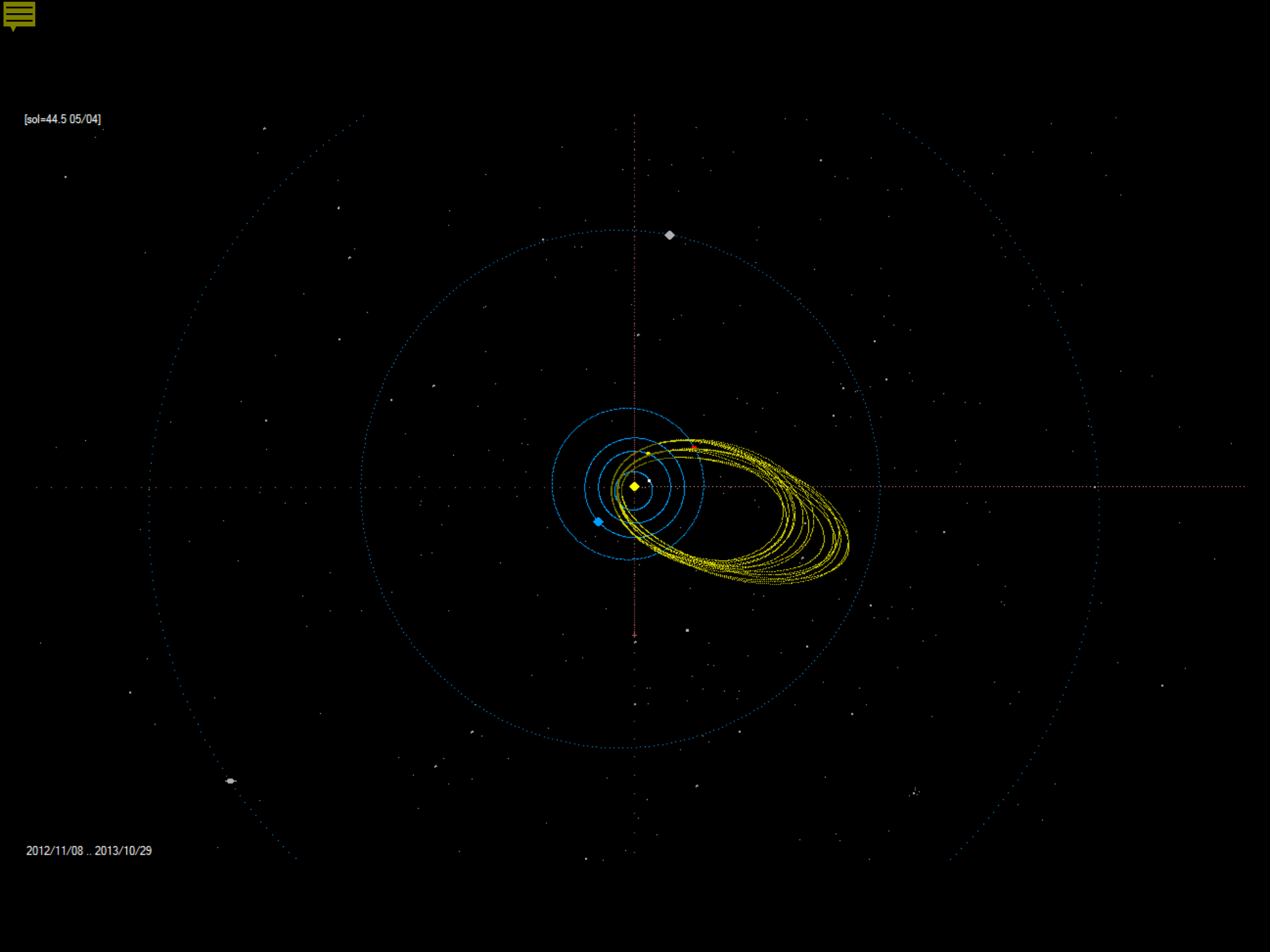
2012/12/10 .. 2012/12/13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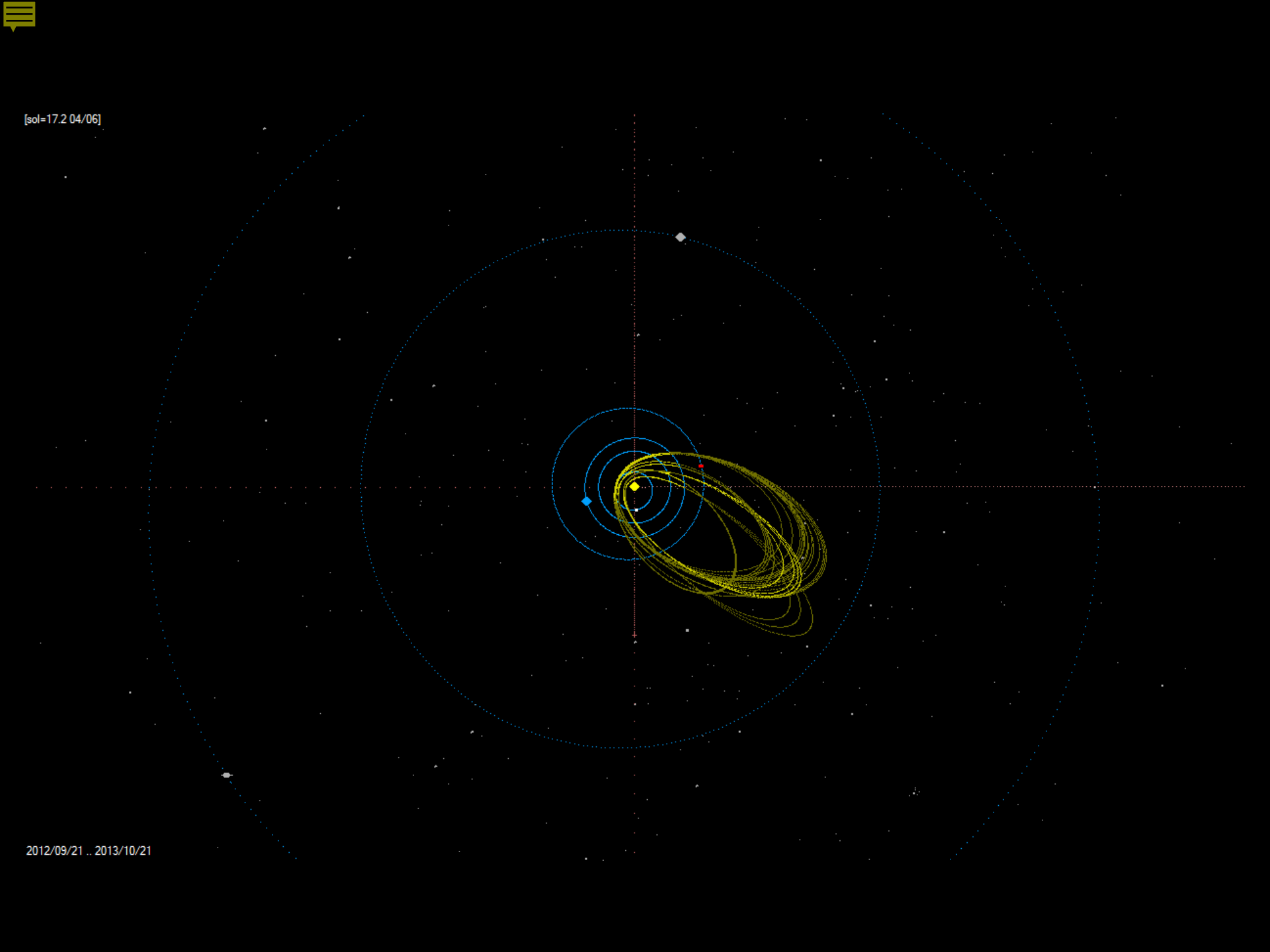
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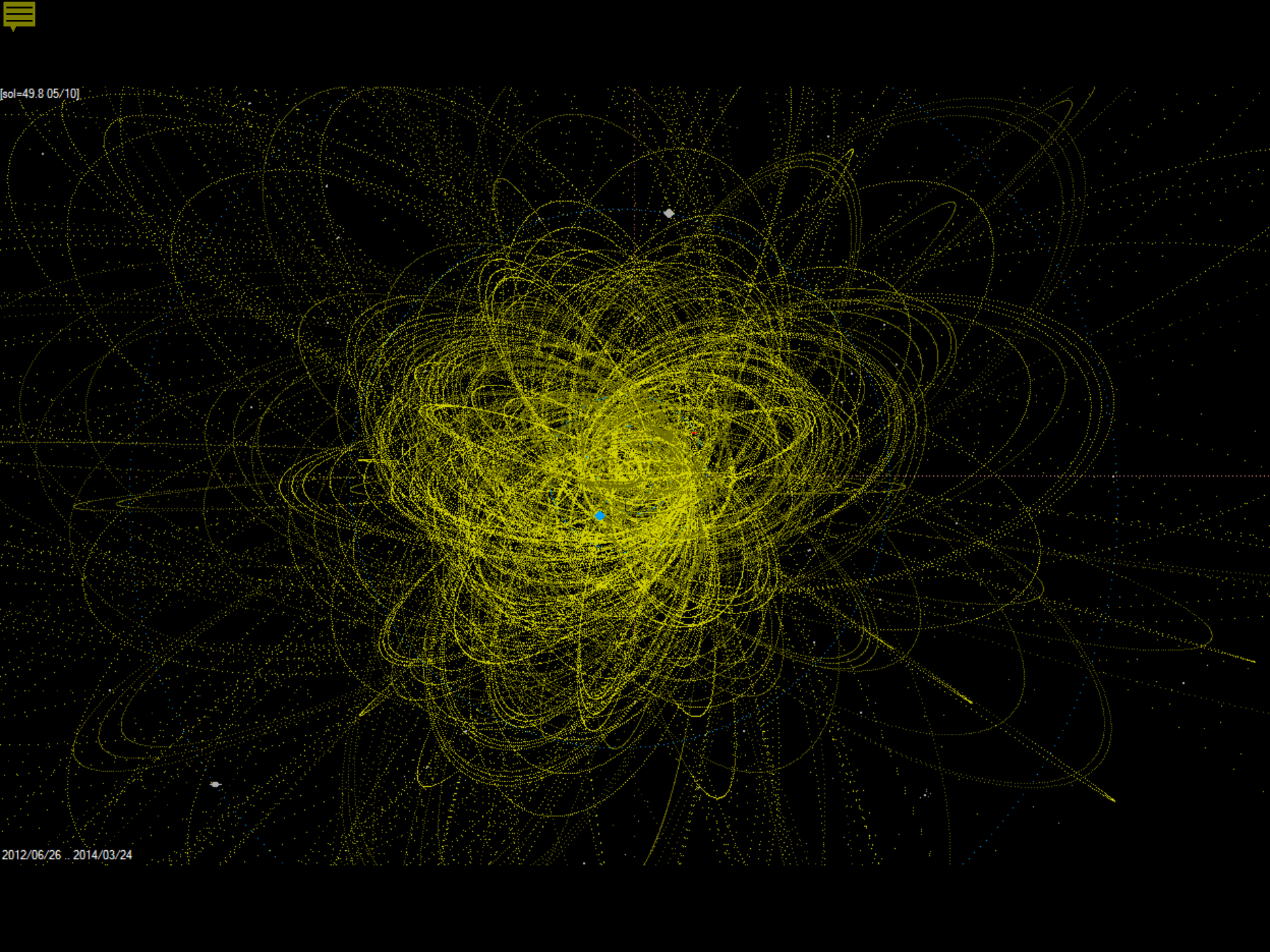
2012/09/21 .. 2013/10/21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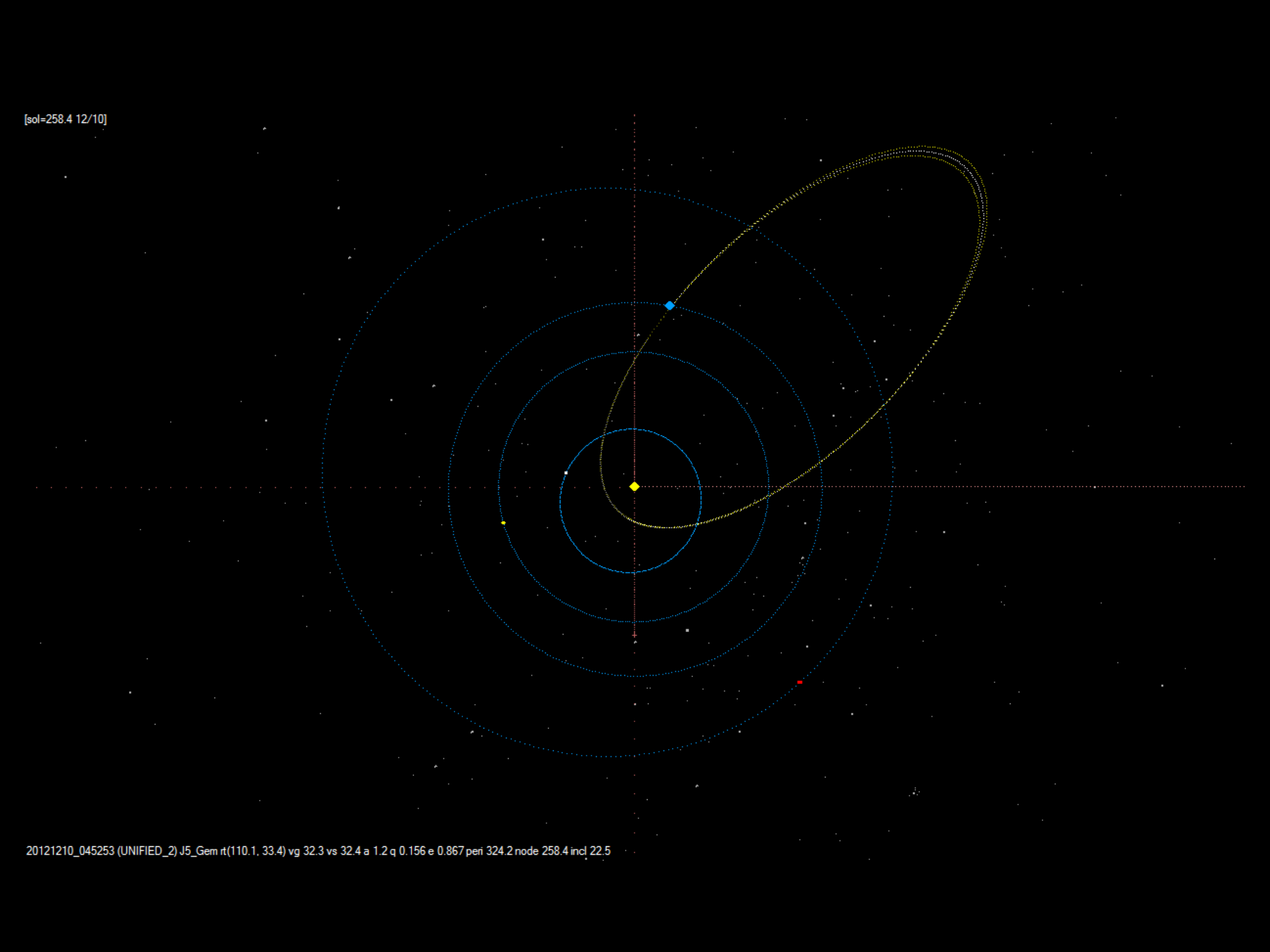
2012/06/26 .. 2014/03/24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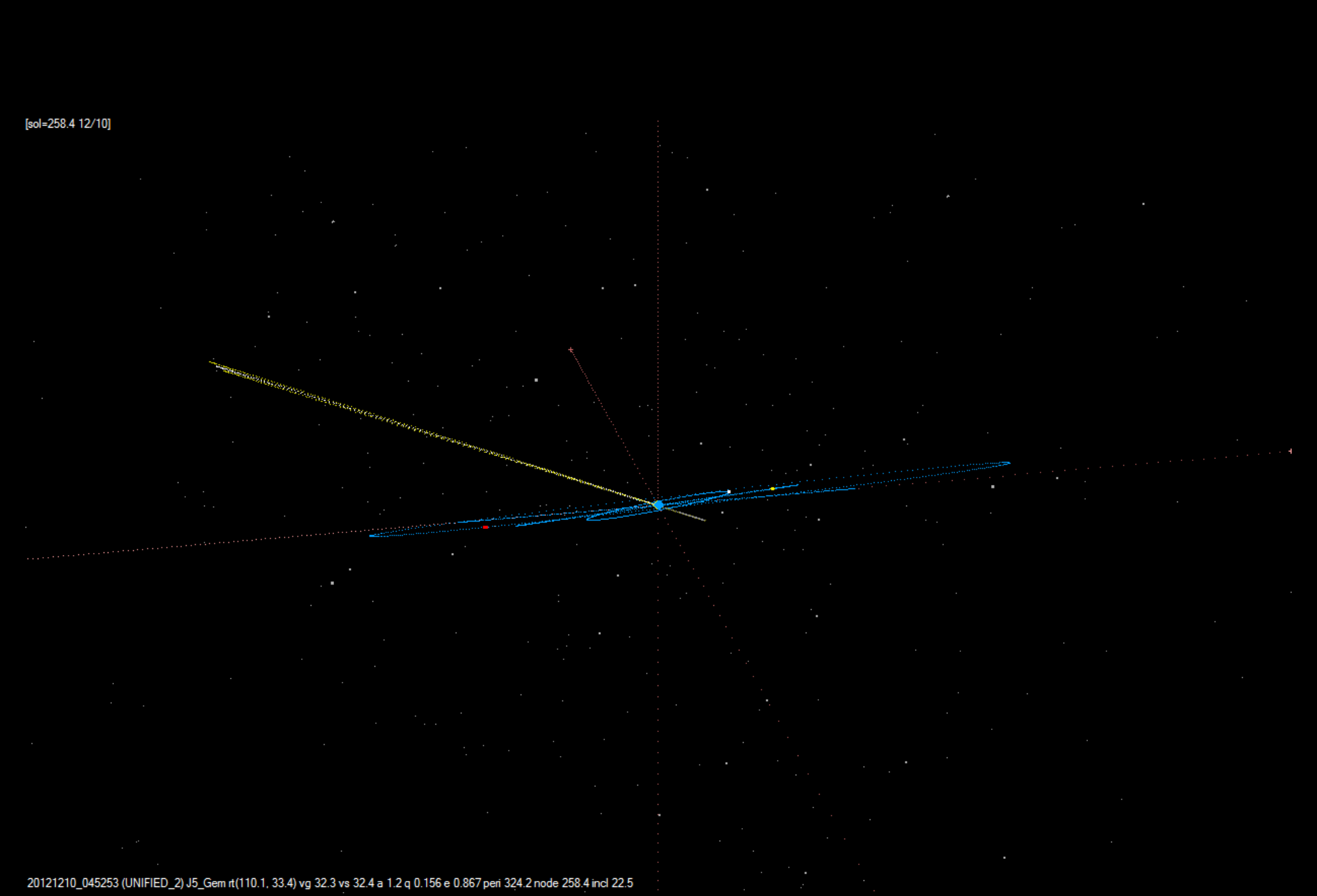
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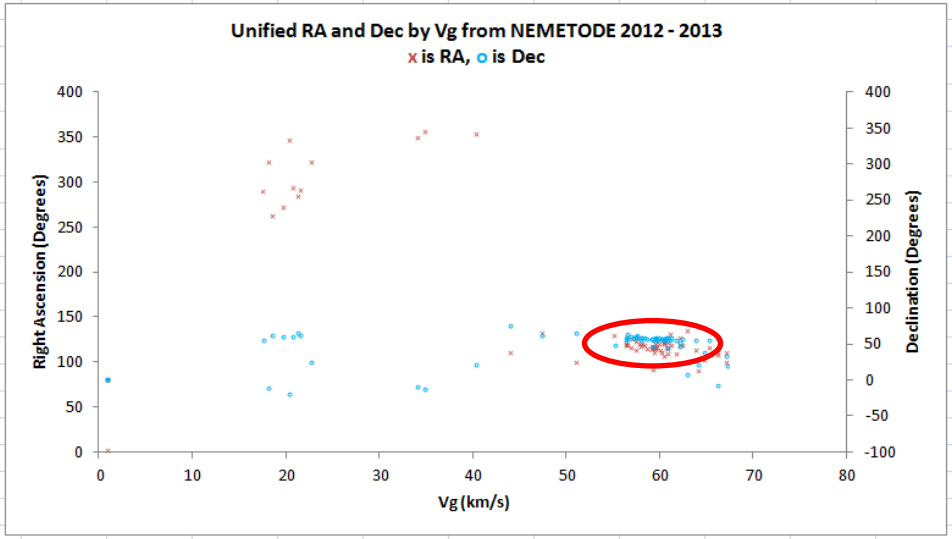
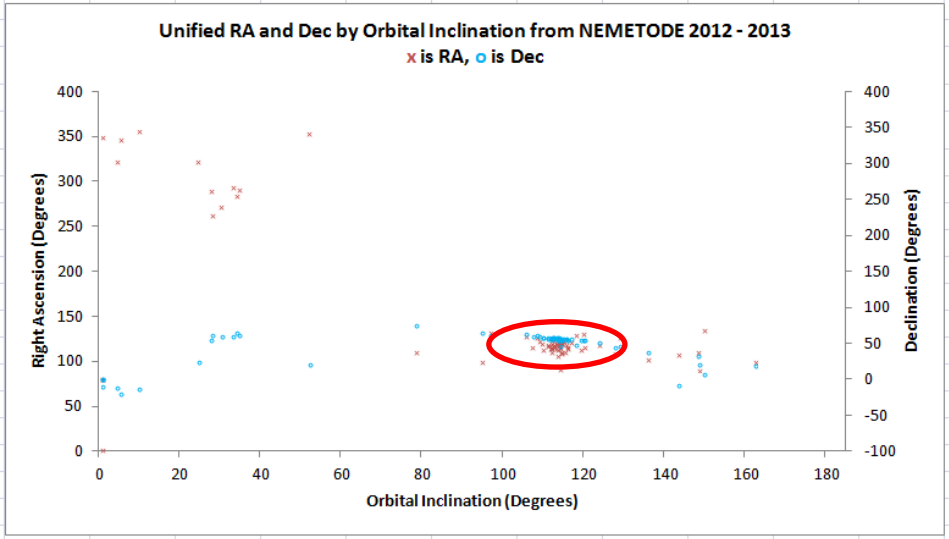
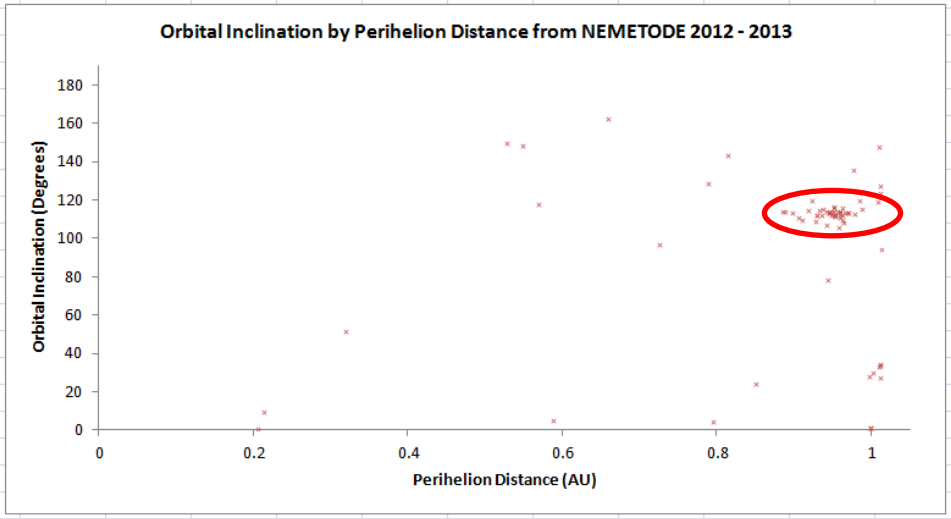
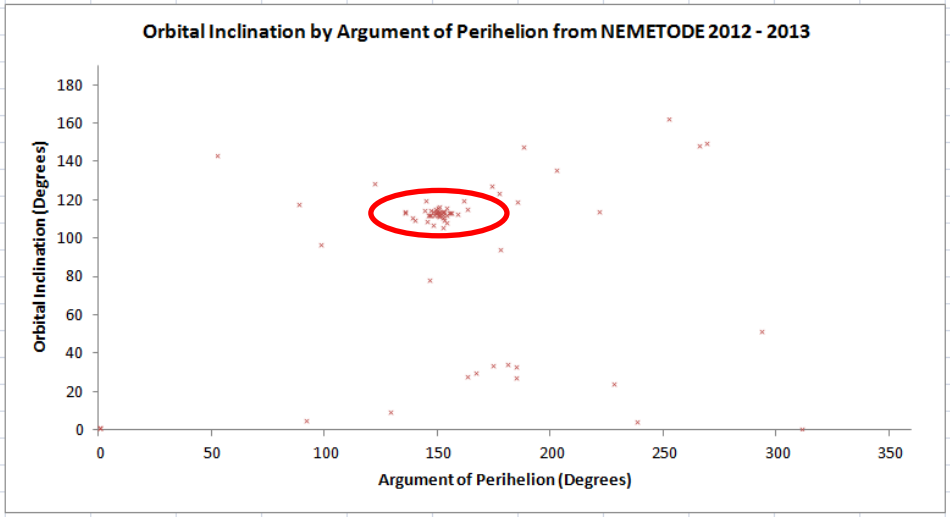
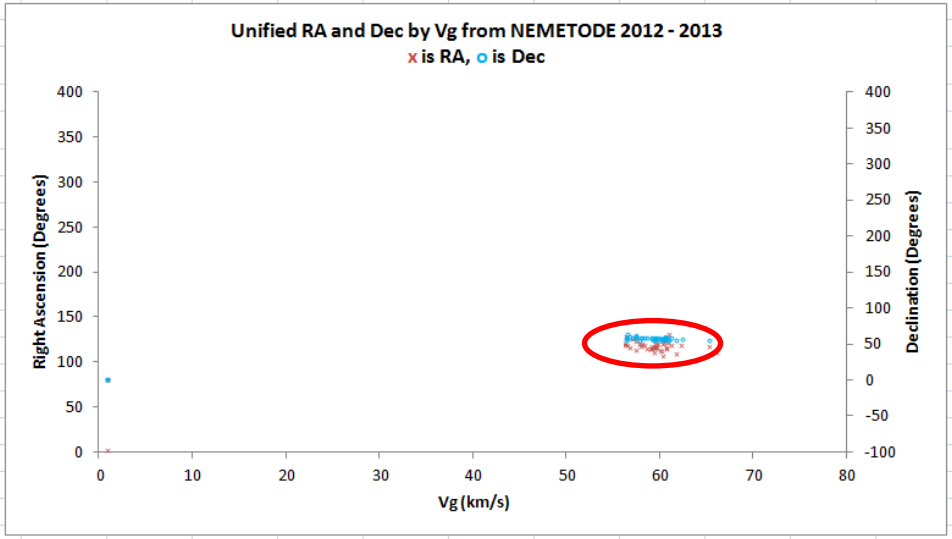
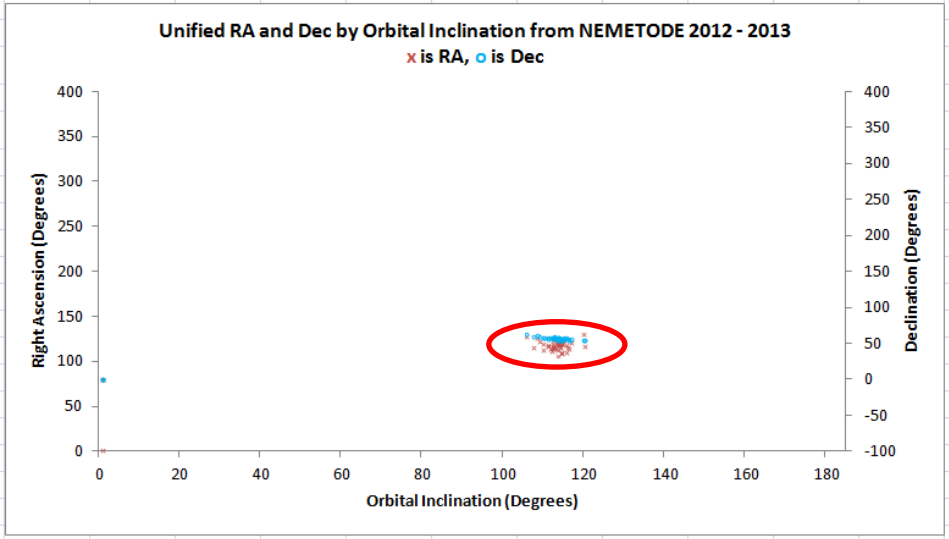

Unified RA and Dec by Vg from NEMETODE 2012 - 2013
x is RA, o is Dec
Right Ascension (Degrees)
Declination (Degrees)
Vg (km/s)

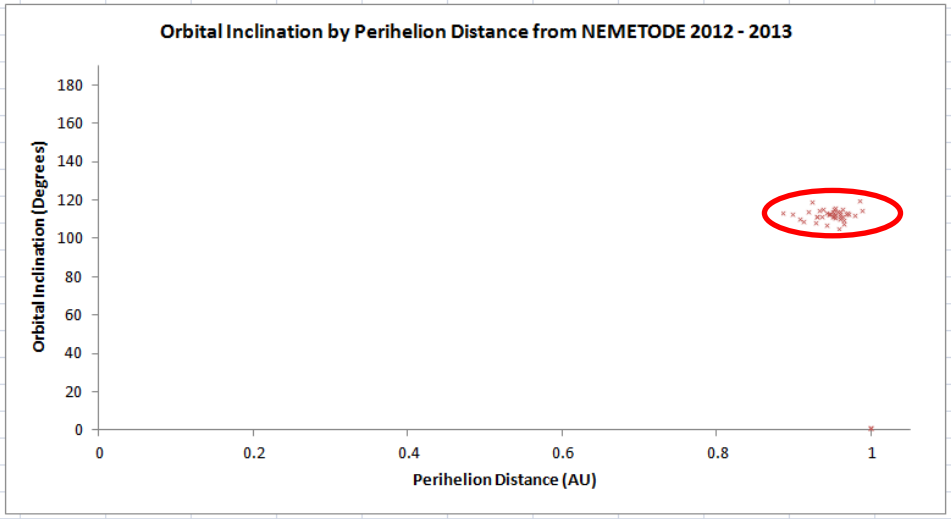

Unified RA and Dec by Orbital Inclination from NEMETODE 2012 - 2013
x is RA, o is Dec
Right Ascension (Degrees)
Declination (Degrees)
Orbital Inclination (Degrees)

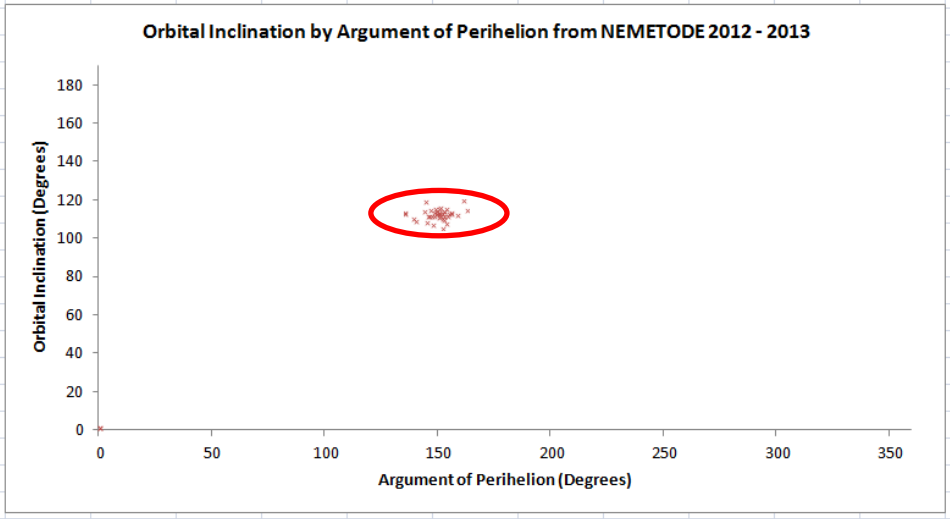

Orbital Inclination by Perihelion Distance from NEMETODE 2012 - 2013
Orbital Inclination (Degrees)
Perihelion Distance (AU)

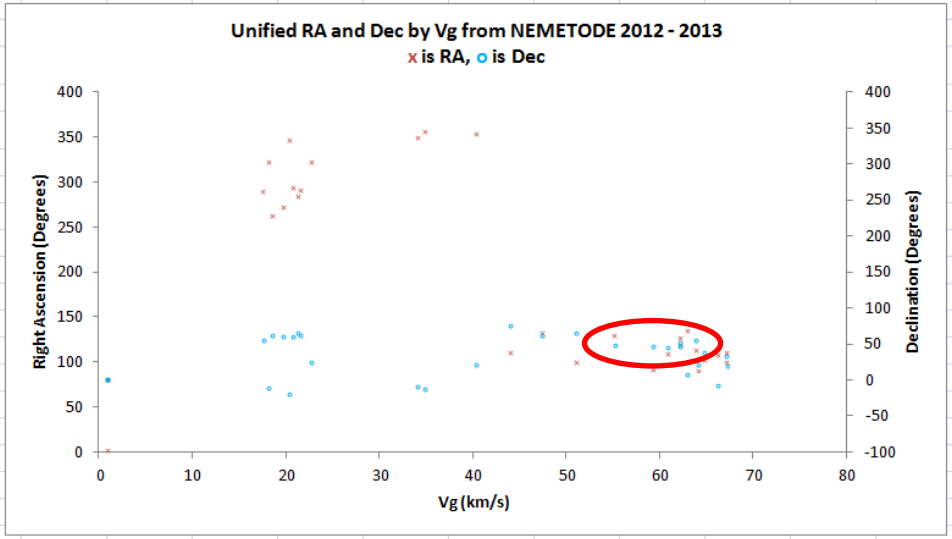

Orbital Inclination by Argument of Perihelion from NEMETODE 2012 - 2013
Orbital Inclination (Degrees)
Argument of Perihelion (Degrees)


Unified RA and Dec by Vg from NEMETODE 2012 - 2013
x is RA, o is Dec
Right Ascension (Degrees)
Declination (Degrees)
Vg (km/s)
0
10
20
30
40
50
60
70
80
400
350
300
250
200
150
100
50
0
-50
-100


Unified RA and Dec by Orbital Inclination from NEMETODE 2012 - 2013
x is RA, o is Dec
Right Ascension (Degrees)
Declination (Degrees)
Orbital Inclination (Degrees)
0
20
40
60
80
100
120
140
160
180
400
350
300
250
200
150
100
50
0
-50
-100


Orbital Inclination by Perihelion Distance from NEMETODE 2012 - 2013
Orbital Inclination (Degrees)
Perihelion Distance (AU)
0
0.2
0.4
0.6
0.8
1
180
160
140
120
100
80
60
40
20
0


Orbital Inclination by Argument of Perihelion from NEMETODE 2012 - 2013
Orbital Inclination (Degrees)
Argument of Perihelion (Degrees)
0
50
100
150
200
250
300
350
180
160
140
120
100
80
60
40
20
0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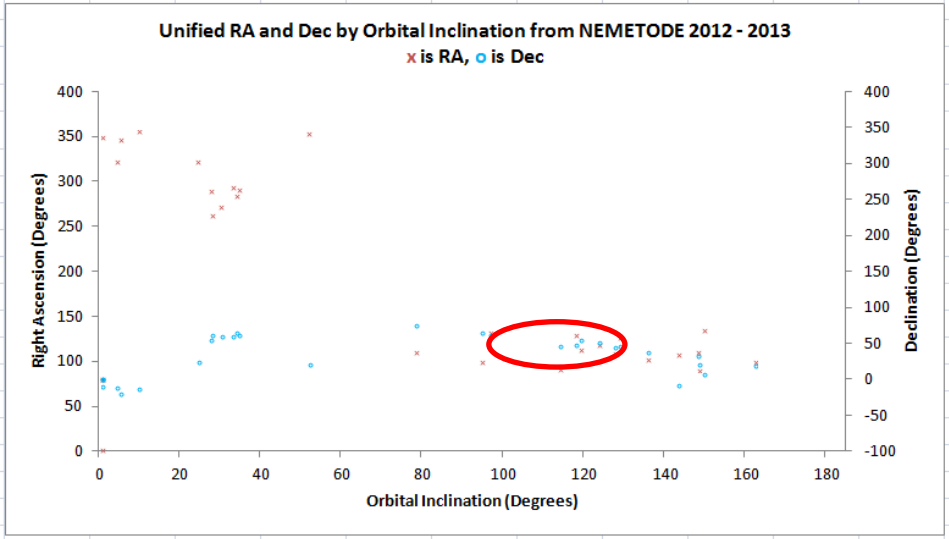
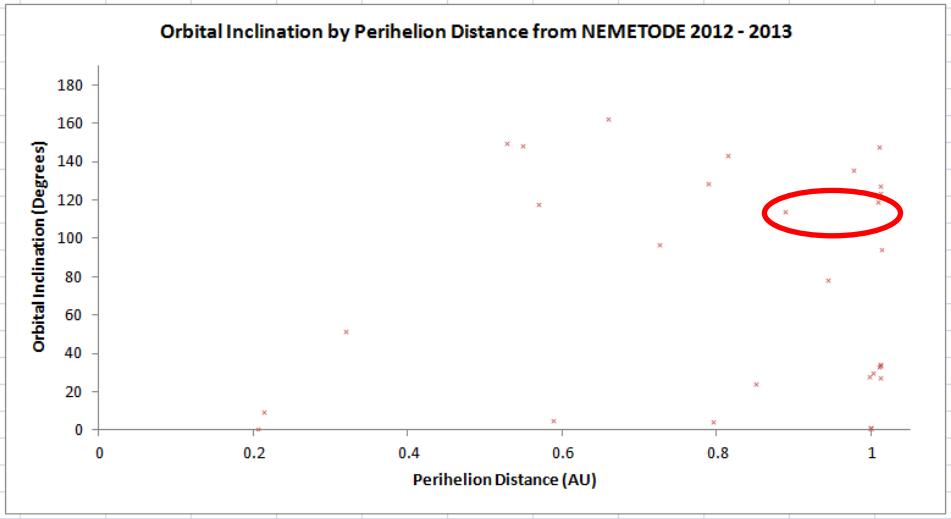
Right Ascension (Degrees)
Declination (Degrees)
Vg (km/s)


Unified RA and Dec by Orbital Inclination from NEMETODE 2012 - 2013
x is RA, o is Dec
Right Ascension (Degrees)
Declination (Degrees)
Orbital Inclination (Degrees)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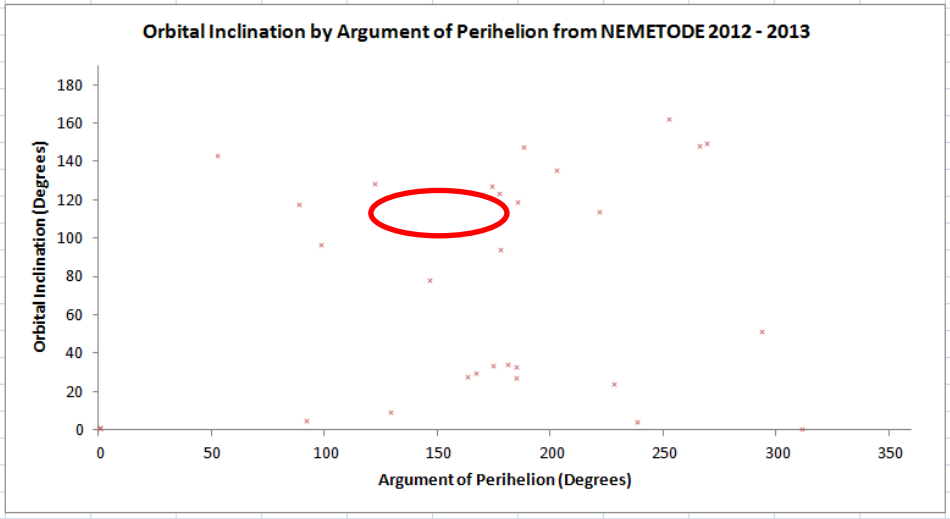
Orbital Inclination (Degrees)
Perihelion Distance (AU)


Orbital Inclination by Argument of Perihelion from NEMETODE 2012 - 2013
Orbital Inclination (Degrees)
Argument of Perihelion (Degrees)

UFO Analyser

- Before you start …
- UFO Analyser Overview & Environment
- User Profile
- Alex's Document
- Examples
  Basics
- Once you've finished …
  … the files you need to save

What's for dinner Dad?
Wookie steak.
Is it any good?
It's a little Chewy...

UFO Analyser

- Questions & Answers
- Administrative Burden of Proposed Approach
  Potential Mitigations

From Data to Science

- Data Ownership & Sharing
- Analysis & Report Writing
- Forum vs Email
- Importance of Communication
- The Feedback Loop

Ancillary Techniques

Spectral Analysis of Meteors

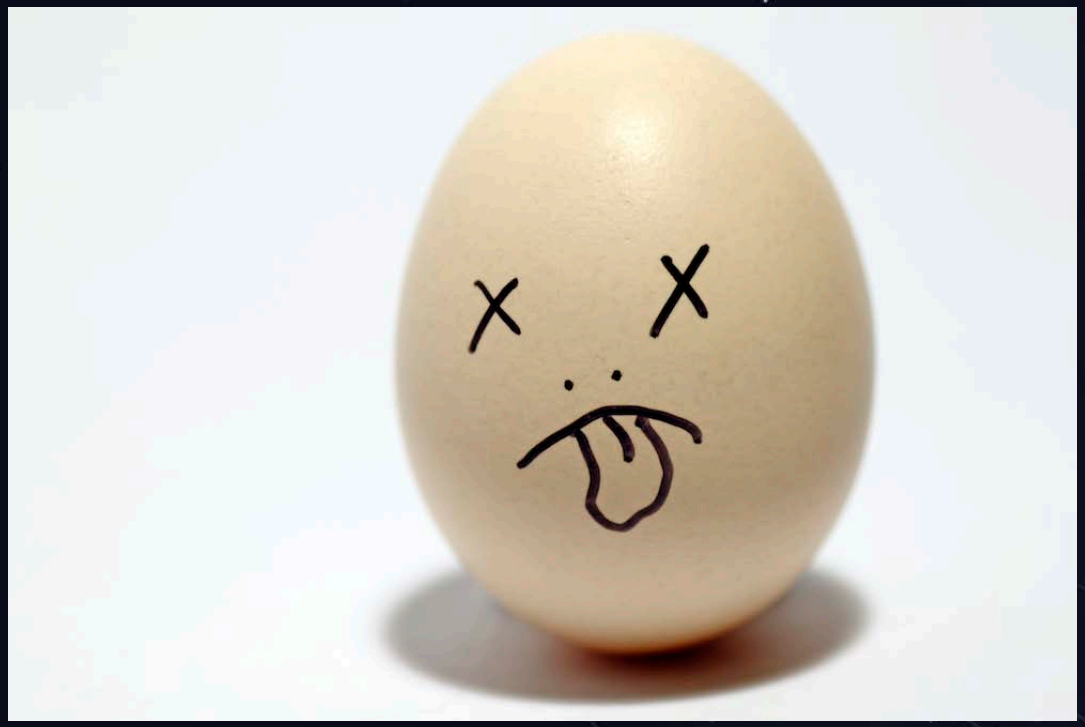
Bill Ward

Ancillary Techniques

Spectral Analysis of Meteors

~~Bill Ward~~

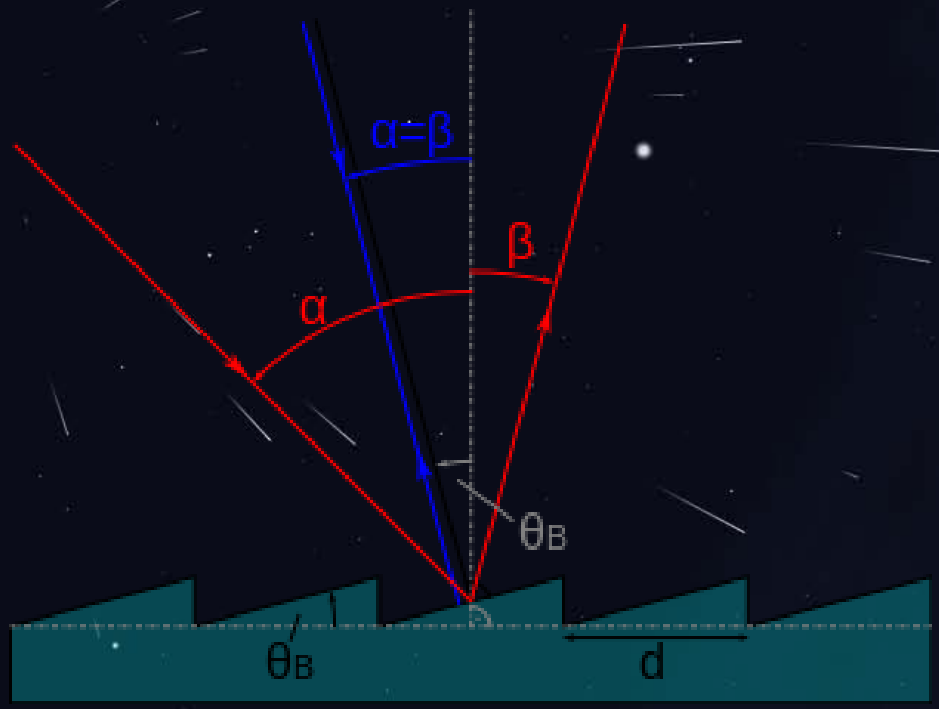
William Stewart … using Bill's slides!



Video of spectra from bright meteor (courtesy SonotaCo) obtained using diffraction grating available at: *http://sonotaco.sub.jp/report/2006/200603/media/M20060329_202422_TK1_G6.wmv*

- Grating Choice

  Blazed glass gratings preferable. Better efficiency in one selected order (spectrum). Depends on goals.



- Grating Choice

  Blazed glass gratings preferable. Better efficiency in one selected order (spectrum). Depends on goals.

- Low Resolution (~300 lines per mm)

  Good chance of catching all or majority of spectrum. Low line resolution, detail may be lost. Can identify stony types from stony irons from nickel iron types.

- Medium Resolution (~600 lines per mm)

  Much better line resolution, better for identifying individual lines. Longer spectrum on chip so less chance of catching whole spectrum.

- High Resolution (>800 lines per mm)

  Common gratings are 830 and 1200 lines per mm

  Best for line identification. With good corrections relative line abundances can be derived. Can start to derive mineral composition.

  Serious research possibilities. However lower chance on any given system of catching a spectrum.

- Personal Opinion

  600 lines per mm for regular observational use
  300 lines per mm to build up numbers for processing practice

- CCD's and DSLR's can be used as well as video cameras.

  Although less efficient than glass blazed gratings, inexpensive plastic grating material will still give excellent results if a bright meteor obliges.

  Plastic grating material is available in large 6 x 12 inch sheets in 12500 lines per inch (~492 lines per mm) and 25000 lines per inch (~984 lines per mm).

  Can be cut to size and mounted in rotating holders bought from photo suppliers.

Figure 1: Obtain spectrum! Fastest lens possible: f1.2 and 0.8 are OK. Largest possible aperture for best limiting magnitude.

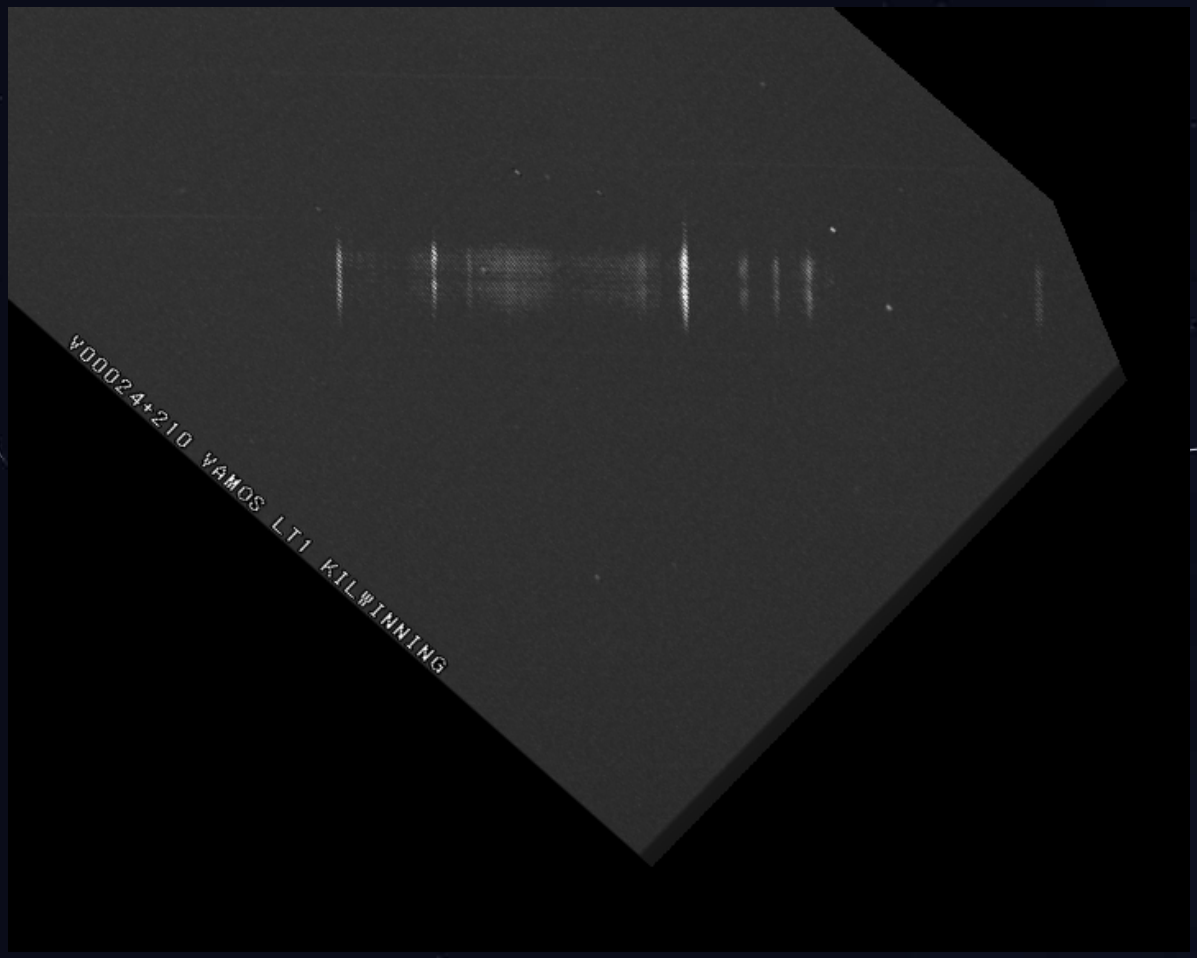


Figure 2: For processing spectrum must be rotated and slant corrected. This is for spectrum processing (IRIS package).

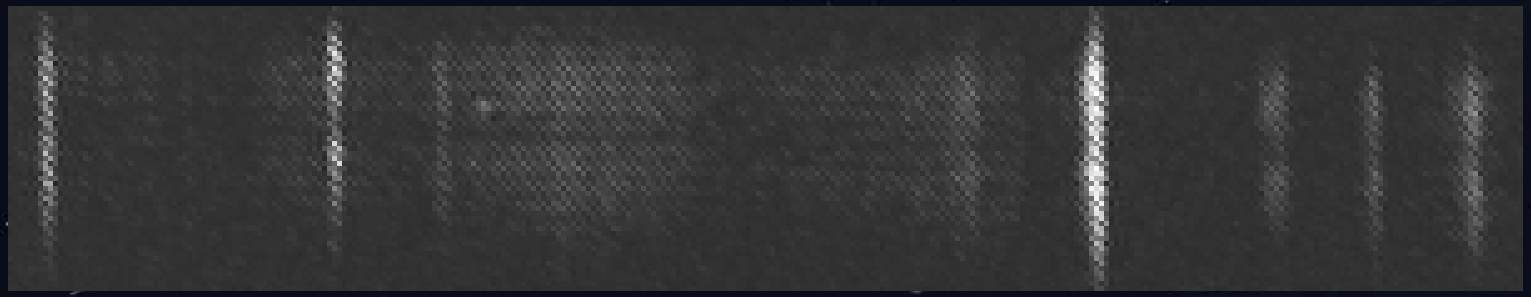


Figure 3: Crop image to remove background sky and stars if possible (minimise artefacts in spectrum). Flip image so spectrum runs from blue end at left to red end at right. Prominent atmospheric lines help with this.

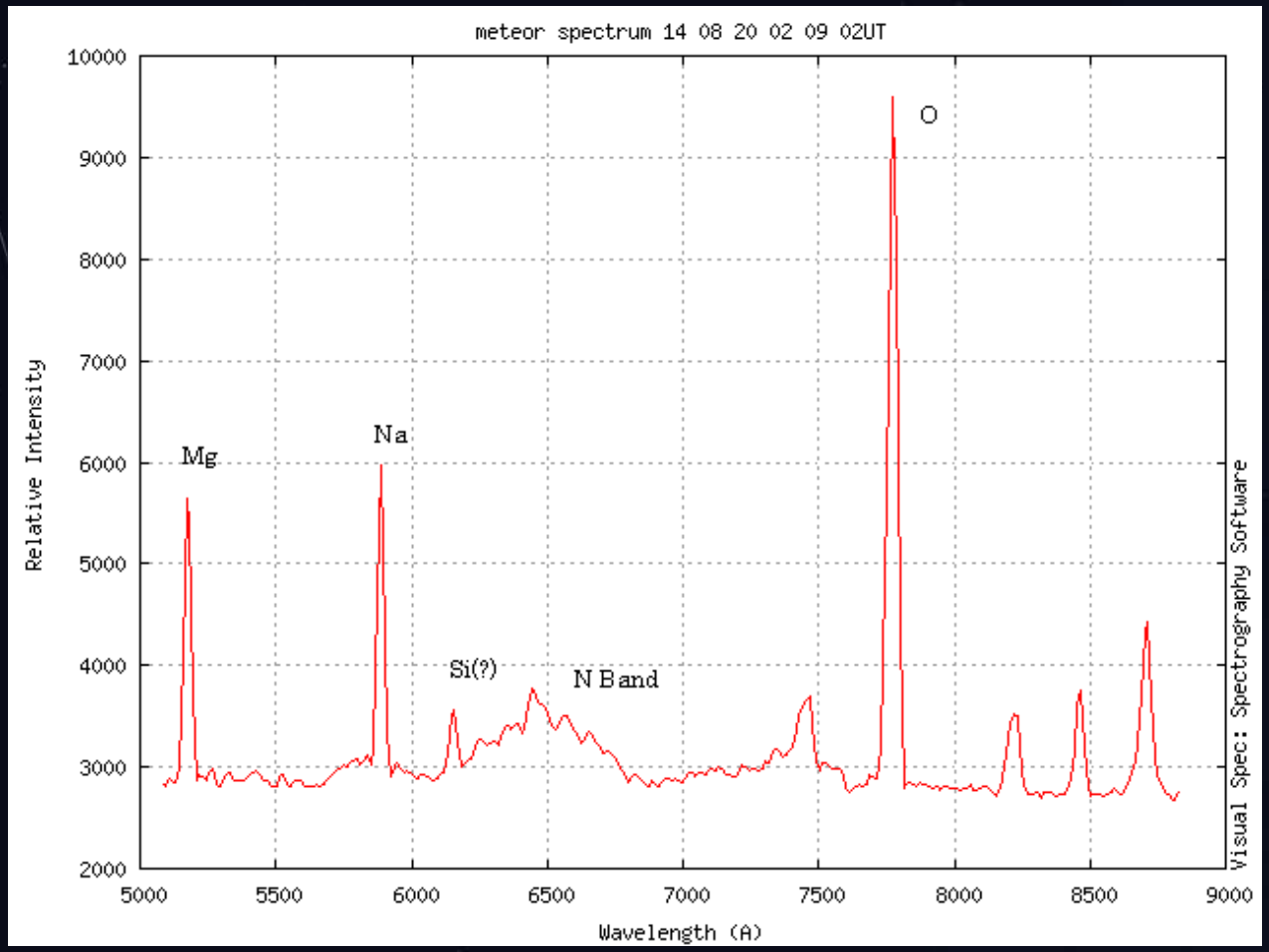


Figure 4: Import aligned image into VSPEC and process as required. This will vary from spectrum to spectrum. Again the use of prominent atmospheric lines helps.

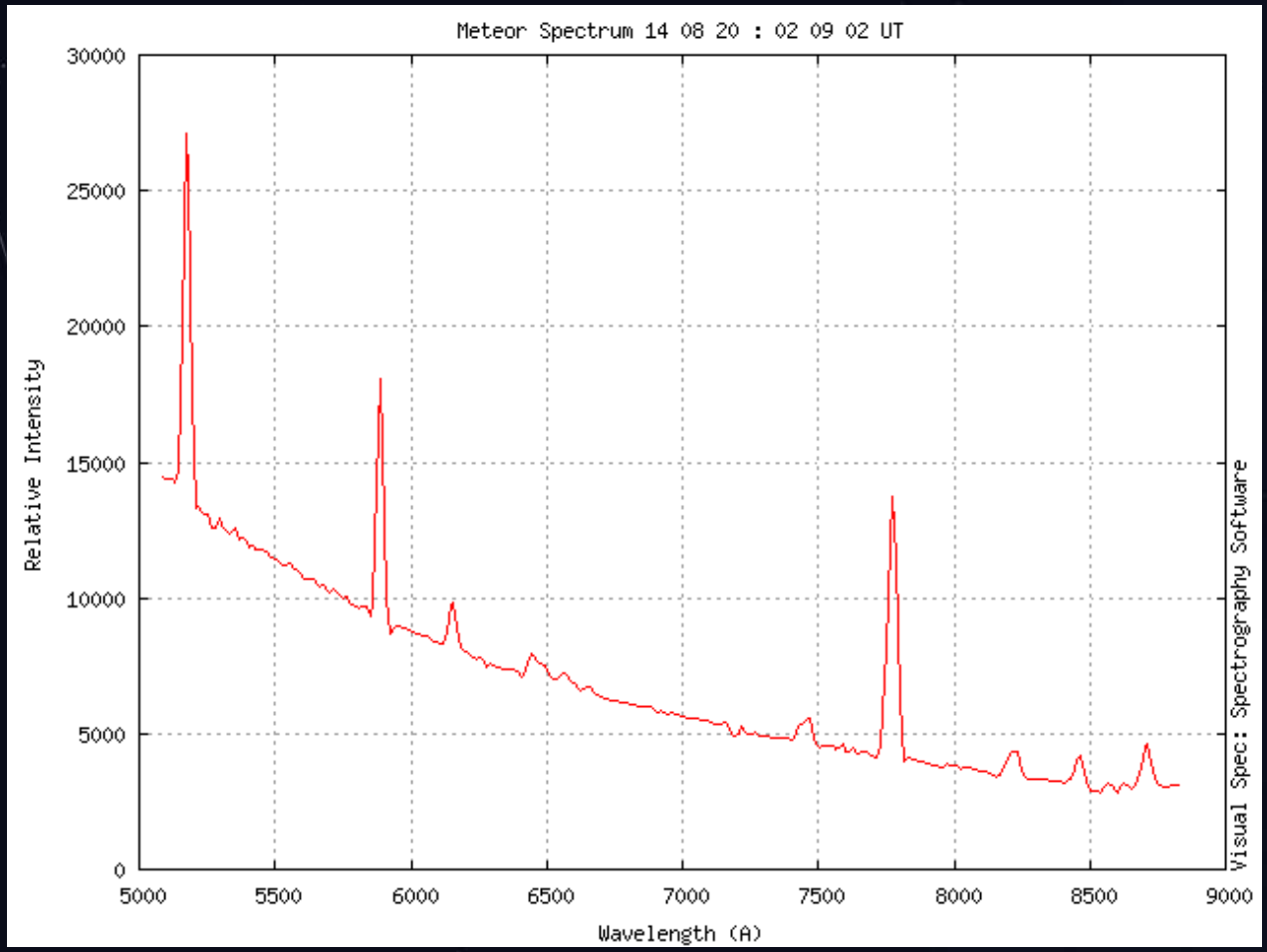
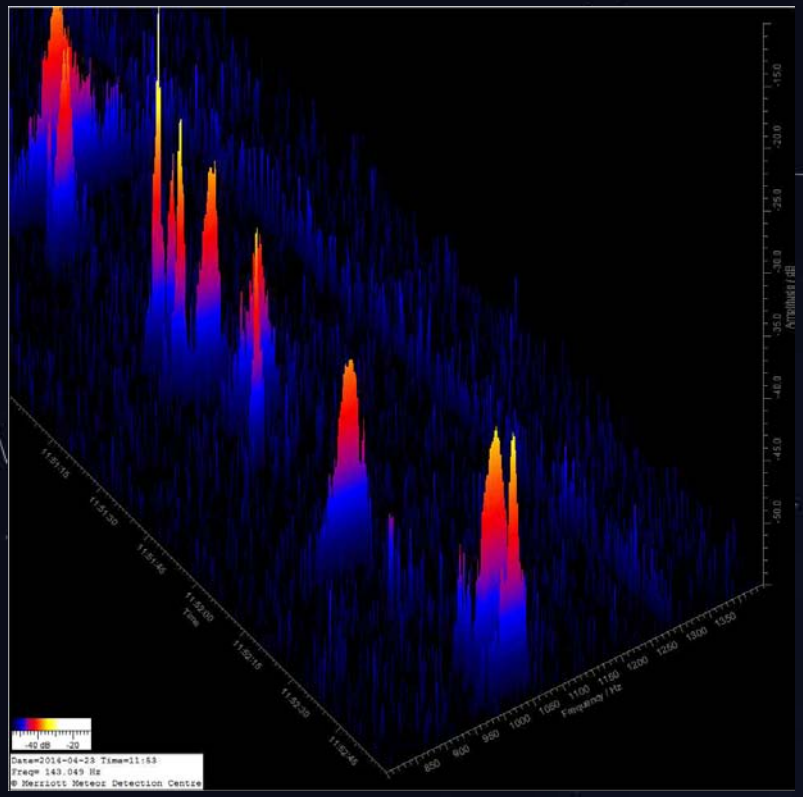


Figure 5: Use flux corrected black body spectrum of bright star to correct for instrument sensitivity. This shows the corrected spectrum compensating for chip sensitivity. Most silicon sensors are much better in near IR as shown by comparison of Figures 4 & Figure 5. The corrected spectrum shows the true appearance of the visible lines.

Ancillary Techniques

Radio Detection of Meteors

Ian Williams



Ancillary Techniques

- Sonic Booms – UFO Capture Input

  James Finnegan, Armagh Observatory

- Electrophonic Noise – UFO Capture Input

  James Finnegan, Armagh Observatory

- Smoke Trails

  Probe for upper atmospheric wind velocities

Cuillan Mountain Fireball 14th October 2013:

Video of bright meteor and resultant smoke trail (courtesy Marcus McAdam) and subject of accepted JBAA paper available at: *https://www.facebook.com/video.php?v=10151629153951370&set=vb.371383149581941&type=2&theater*

Cuillan Mountain Fireball 14th October 2013:

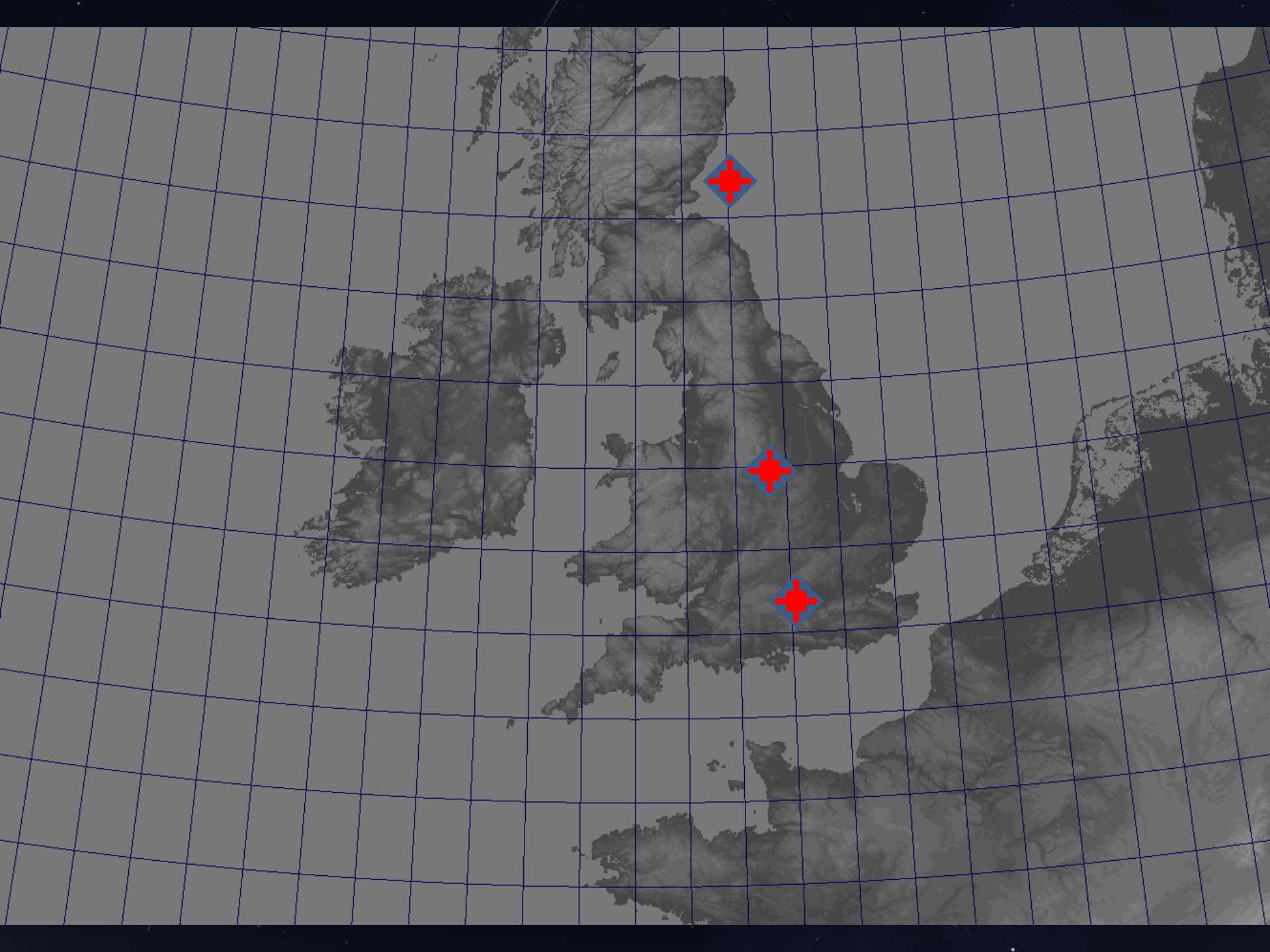
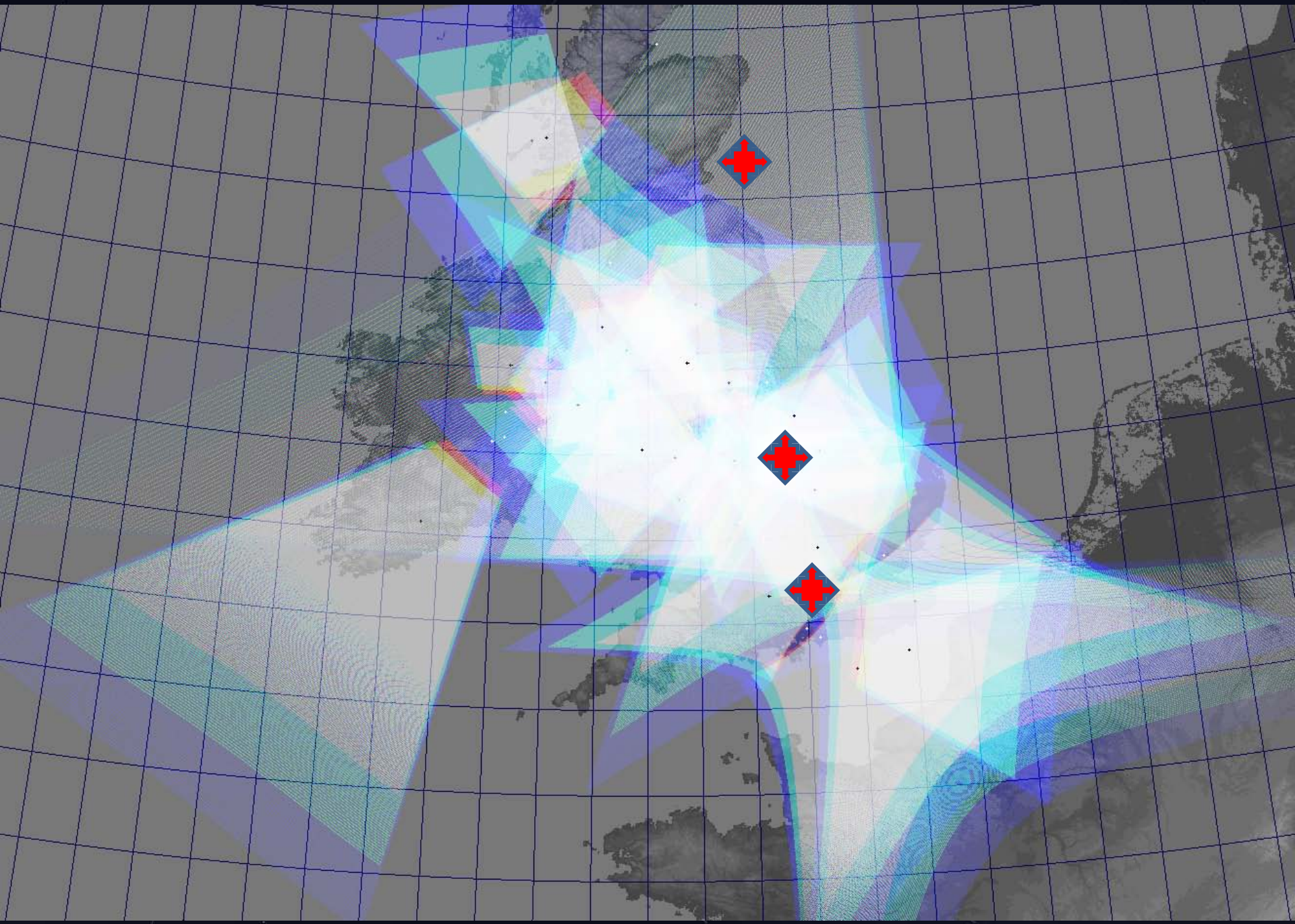
DSLRs

- DSLRs in Widespread Use …

  … but where should they be pointed?
  Recommendation: towards regions with extensive video coverage
  Rationale is that video allows triangulation
  DSLR provides imagery of residual effects

- Traditional Triangulation Points:

Scotland & NE England:	*Bell Rock Lighthouse*
Midlands:	*Derby*
South:	*Reading*

- DSLRs provide higher angular resolution …

  … but without rotating shutter, no velocity data