Space Vehicle Orbit Dynamics Working Group - News and Discussion Points
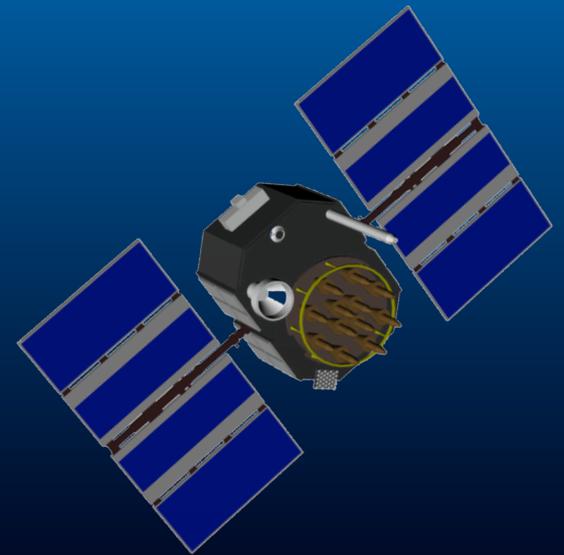
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IGS Workshop 8-12 February 2016, Sydney, NSW, Australia

Apologies………from Marek

- Sorry I can't be there
- I hope the meeting is excellent (I bet it is)
- I hope you enjoyed the talks
- See you all next time
- Thanks to Rolf for taking care of business
- Thanks to Gary Johnston for hosting and leadership

Orbit modelling splinter meeting/panel IGS workshop 2016

Space vehicle force modelling – key recent work (selection)

- Montenbruck, O., R. Schmid, F. Mercier, P. Steigenberger, C. Noll, R. Fatkulin, S. Kogure, and A. Ganeshan (2015), GNSS satellite geometry and attitude models, Advances in Space Research.

- Montenbruck, O., P. Steigenberger, and U. Hugentobler (2015), Enhanced solar radiation pressure modeling for Galileo satellites, Journal of Geodesy, 89(3), 283-297.

- Steigenberger, P., O. Montenbruck, and U. Hugentobler (2015), GIOVE-B solar radiation pressure modeling for precise orbit determination, Advances in Space Research, 55(5), 1422-1431.

- Arnold, D., M. Meindl, G. Beutler, R. Dach, S. Schaer, S. Lutz, L. Prange, K. Sośnica, L. Mervart, A. Jäggi; 2015: CODE's new solar radiation pressure model for GNSS orbit determination. Journal of Geodesy, vol. 89(8), pp. 775-791. DOI 10.1007/s00190-015-0814-4.

- Steigenberger, P., U. Hugentobler, S. Loyer, F. Perosanz, L. Prange, R. Dach, M. Uhlemann, G. Gendt, and O. Montenbruck (2015), Galileo orbit and clock quality of the IGS Multi-GNSS Experiment, Advances in Space Research, 55(1), 269-281

Galileo space vehicle force modelling – key recent work

- Good progress incorporating physical features of satellite into *a priori* models

- DLR box-plate model reduces SLR offset from 11cm to below 1cm
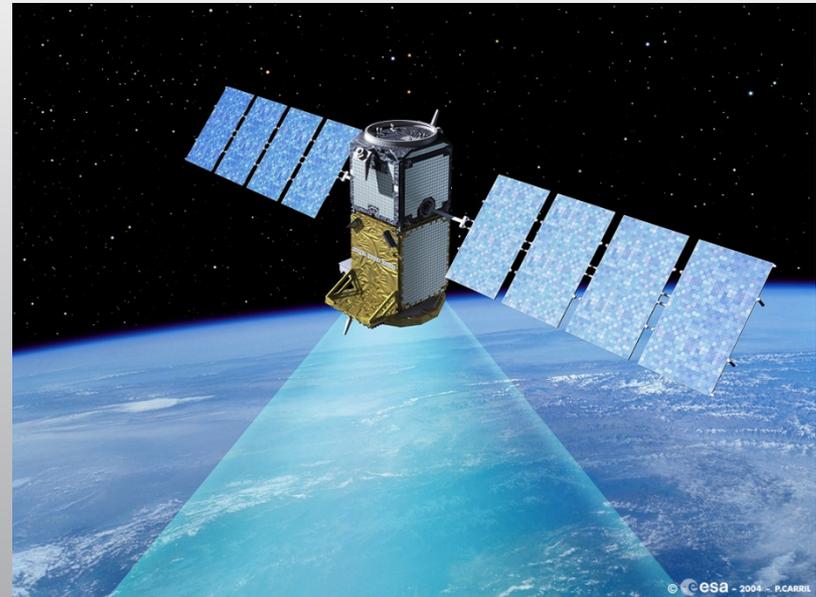
# SV Geometry, materials and phase centre information

- As ever – an ongoing challenge
- Both the importance and the utility of such data is ever more clear as standards are raised
- Thanks to Zuheir Altamimi for his work in the ICG on trying to acquire access to data for all systems
- Overall we are making progress – UCL recently signed non-disclosure agreements with two manufacturers to acquire data – it is possible!

ESA Galileo Force Modelling Contracts

- ESA has let two contracts on surface force modelling for Galileo IOV and FOC space vehicles
  - Group 1: Bern/Airbus
  - Group 2: UCL/GMV/ESOC (Positim)
- Very detailed information on SV materials, structure and attitude released to the groups
- **Agreement brokered with ESA to make all <u>resulting models</u> available to IGS**
- Model development, testing and release in 2016 - 2017

New PhD started at UCL on BeiDou orbit dynamics (in collaboration with Wuhan)
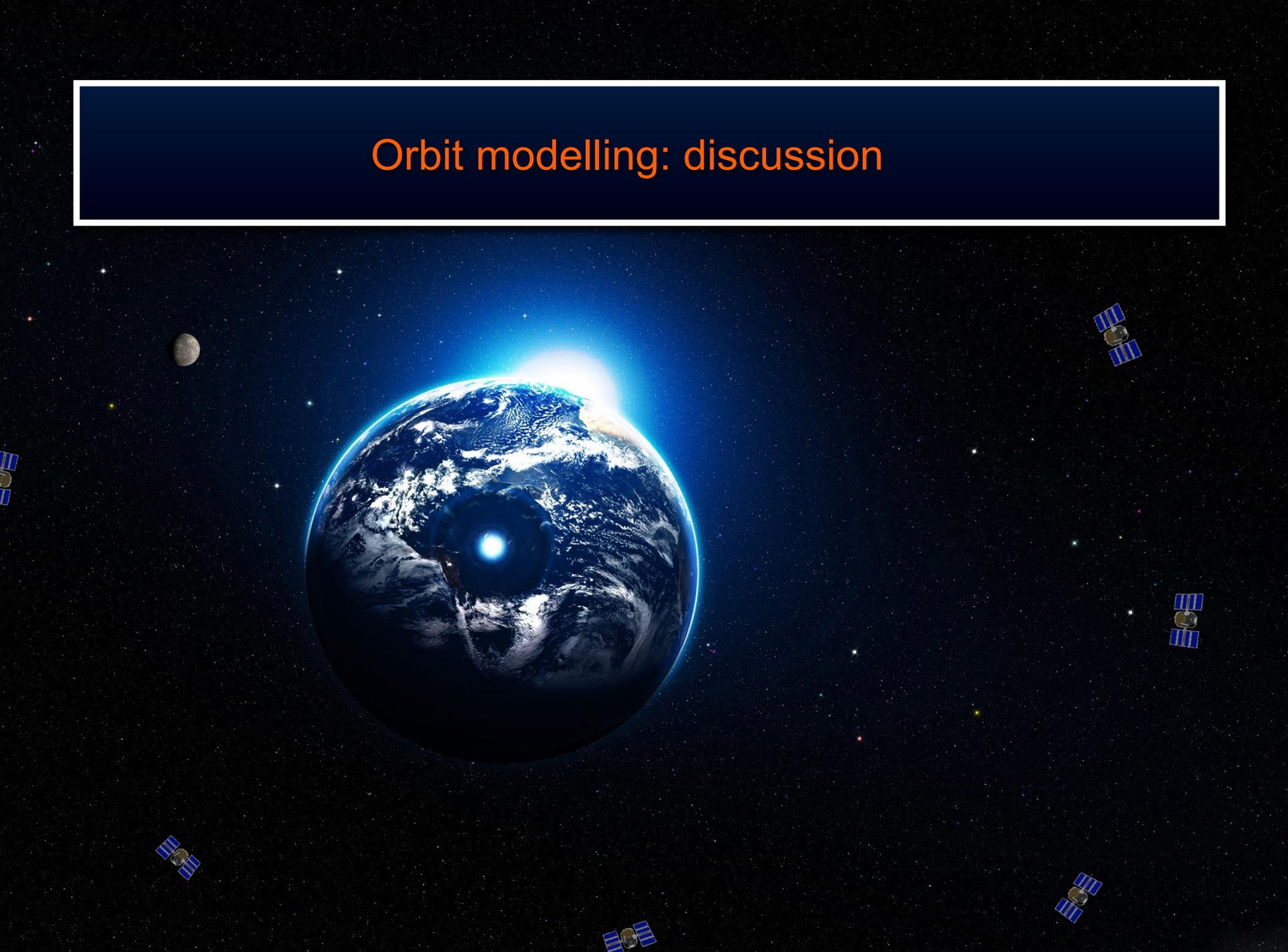
- Zhen Li
- Working on MEO, IGSO and GEO satellites
- Next generation Earth radiation forcing methods

- If any other groups are carrying out PhDs related to orbit dynamics – please contact Marek/Rolf – happy to give support/access to resources
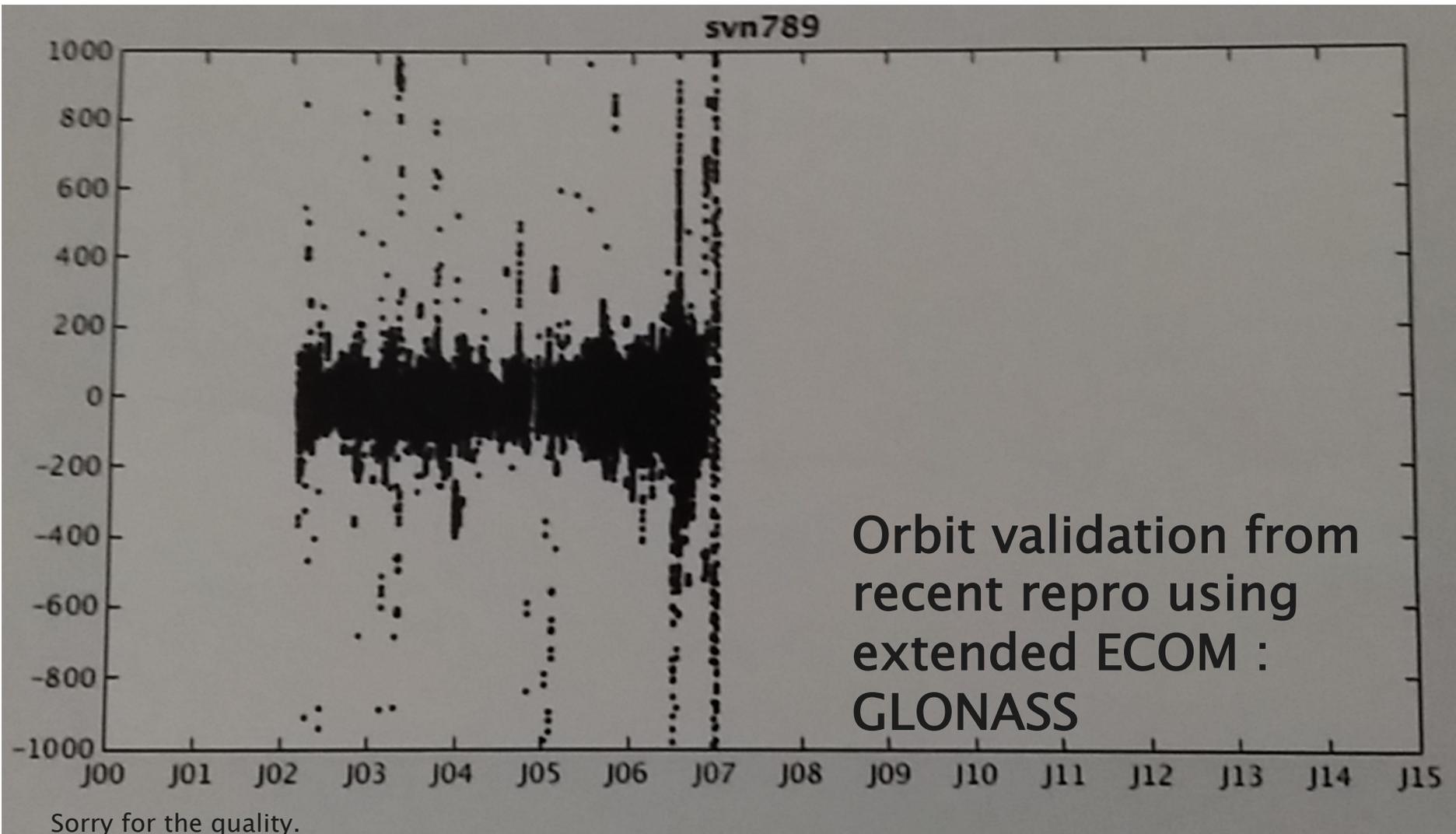
Orbit modelling splinter meeting/panel IGS workshop 2016
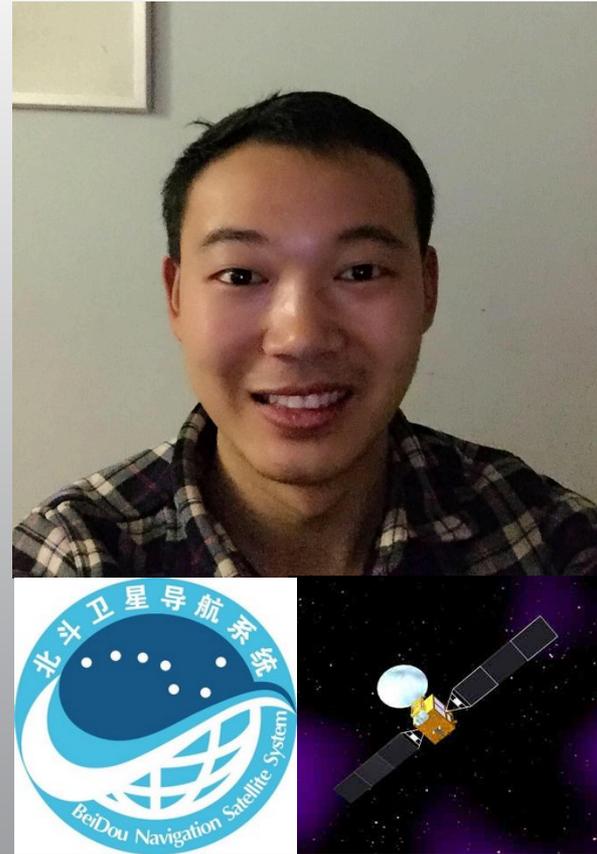
Discussion points

- Insights from REPRO2 analyses? What worked? What needs improving/development?

- Orbit dynamics at GEO/IGSO – may require new thinking – a more aggressive radiation environment (particulate, solar wind, alternative attitude behaviour)

- New area of development at UCL: Lorentz forcing – coupling of surface charge with magnetic field – early work seems significant – anyone interested in testing ideas?

- Next generation Galileo force models will become available late 2016 – worth testing? Who is interested?

- What about the "traditional" systems, GPS and GLONASS (Block III, GLONASS-K)?

Orbit modelling splinter meeting/panel IGS workshop 2016

Orbit modelling: discussion

SLR–Residuals in mm

Orbit validation from recent repro using extended ECOM : GLONASS

Sorry for the quality.

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AIUB CODE

SLR–Residuals in mm

Orbit validation from recent repro using extended ECOM : GLONASS–M

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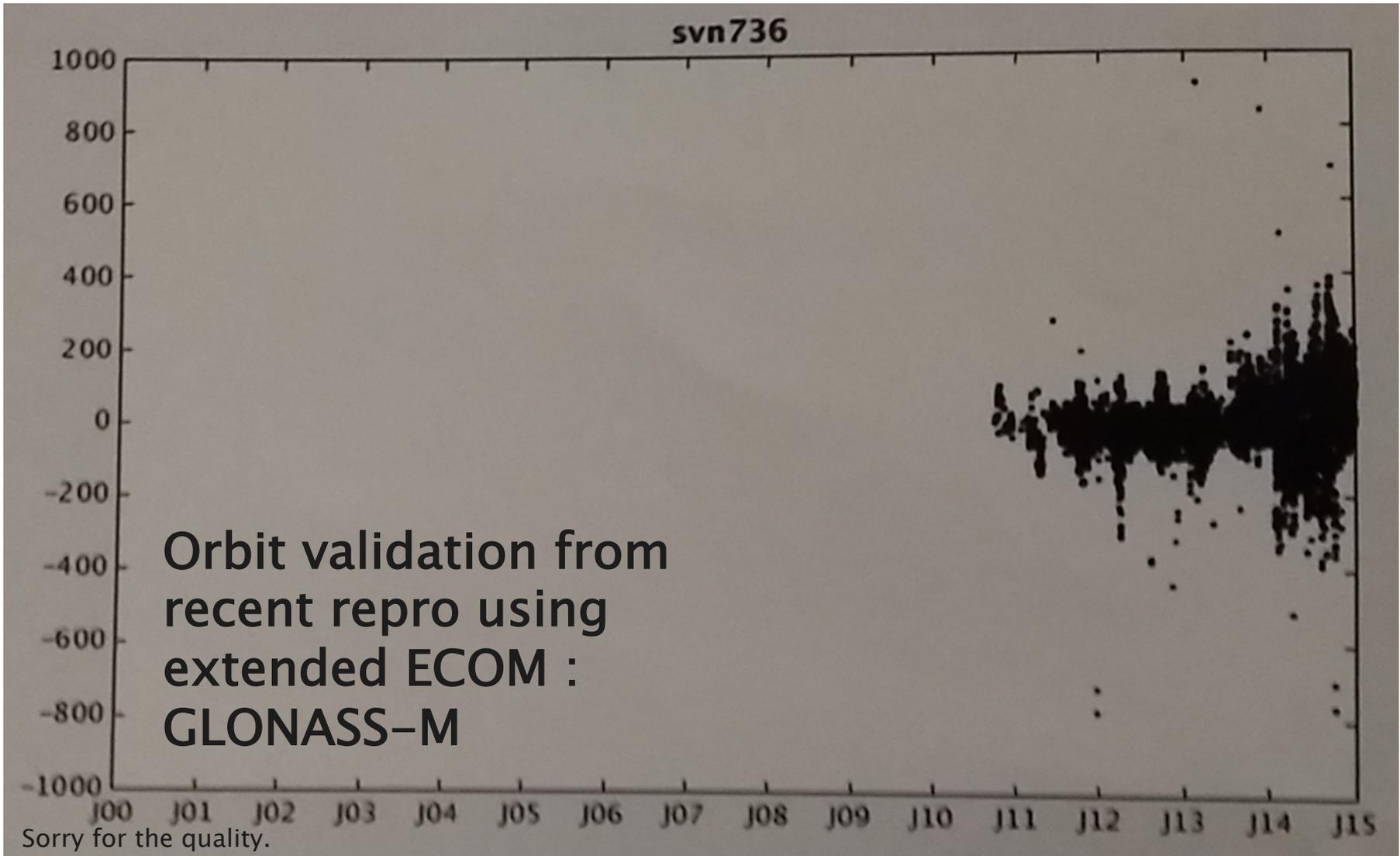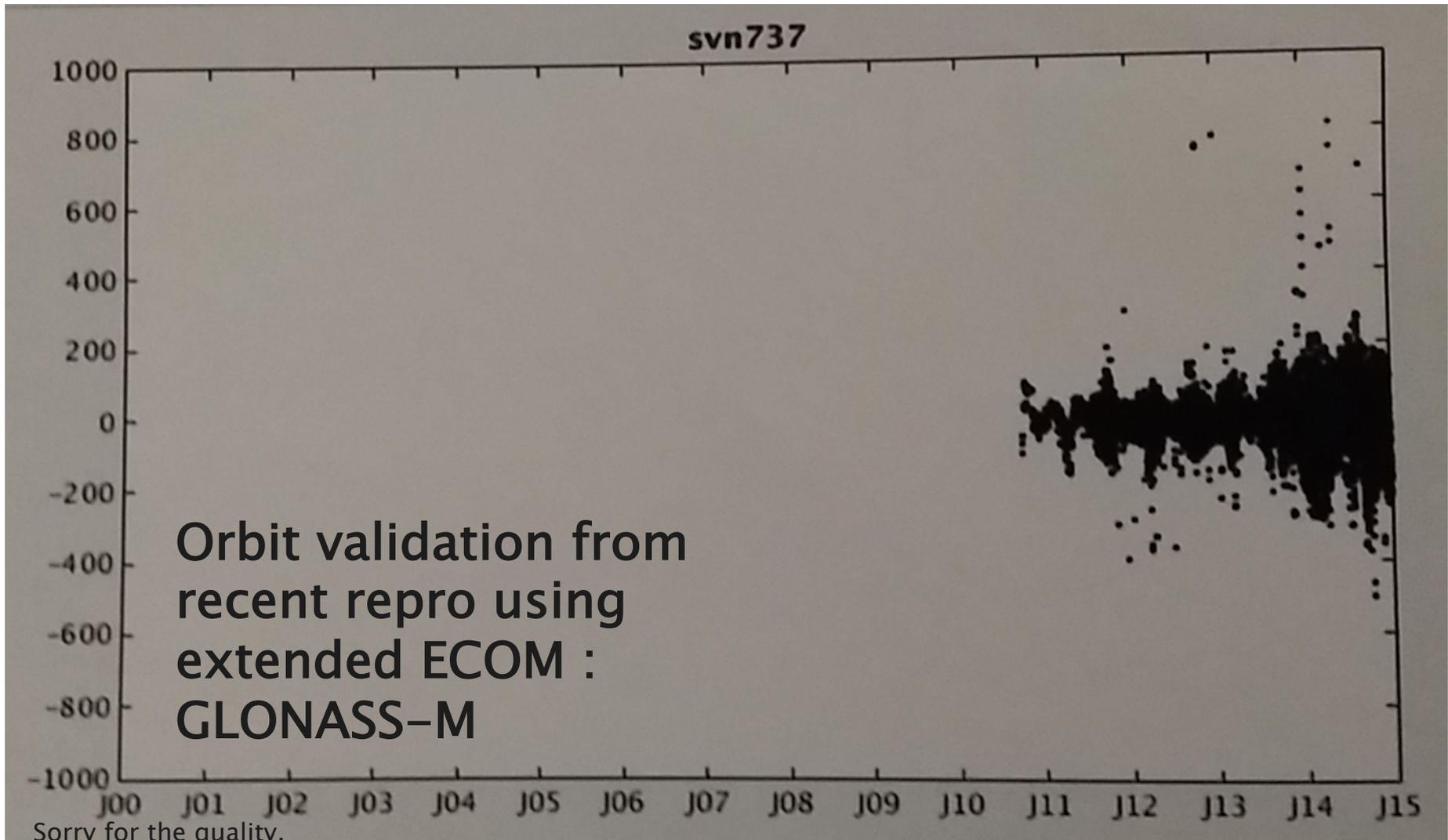
SLR validation
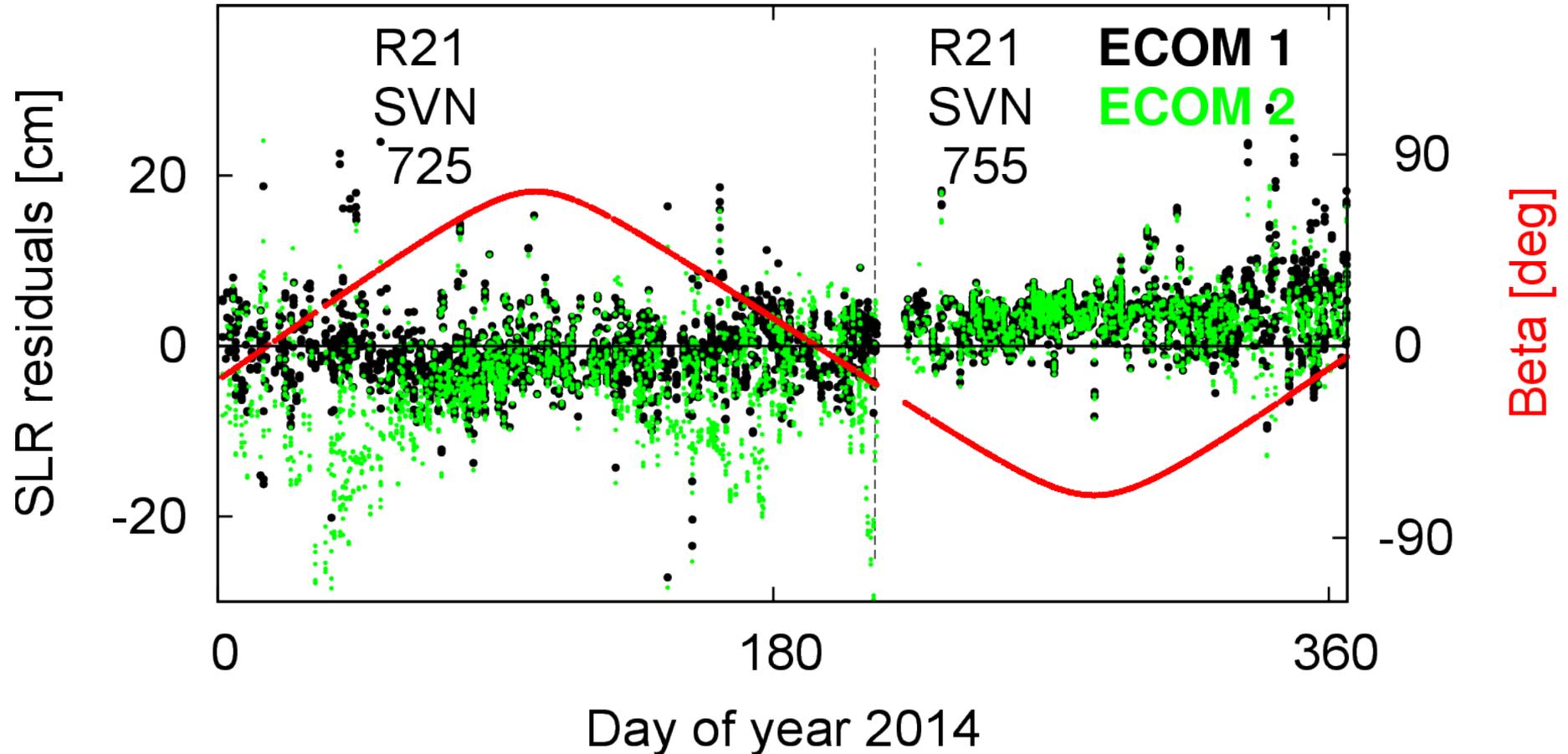
SLR residuals during the year 2014 for two different GLONASS satellites in the slot R21

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Miracle about GLONASS satellites

PRN	DUA*	DUA-	UNP	ELV	GAR	DUA*	O-C
120	10	0	70	134	562	607	4
105	9	0	87	68	694	441	1
121	8	0	92	182	1659	516	1
103	9	0	93	192	570	472	1
117	6	0	101	113	920	294	3
102	7	0	107	208	496	495	0
107	9	0	108	193	1018	483	0
112	22	0	112	23	1079	708	6
116	13	0	117	151	524	579	0
113	11	0	120	63	606	509	0
108	9	0	121	228	730	451	1
118	7	0	124	213	498	480	0
106	11	0	134	163	482	497	1
104	11	0	142	146	557	483	2
119	10	0	158	229	668	520	0
122	15	0	190	188	964	575	6
115	10	0	207	127	803	512	1
114	15	0	288	70	749	588	578
101	10	0	404	136	2033	500	4
111	11	0	434	108	1682	604	9
110	16	0	576	102	888	440	2
123	21	0	600	82	1166	584	9
109	40	1	1352	14	2674	573	9
124	31	1	1742	5	1704	586	592

- many single frequency data
- dead satellites do spin very quick

- **Does any other ACs have also problems with these satellites?**

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