Updated assessment of the fragmentations of Atlas 5 Centaur upper stages

Vladimir Agapov, Nikolay Savin

IAA Space Debris Committee meeting

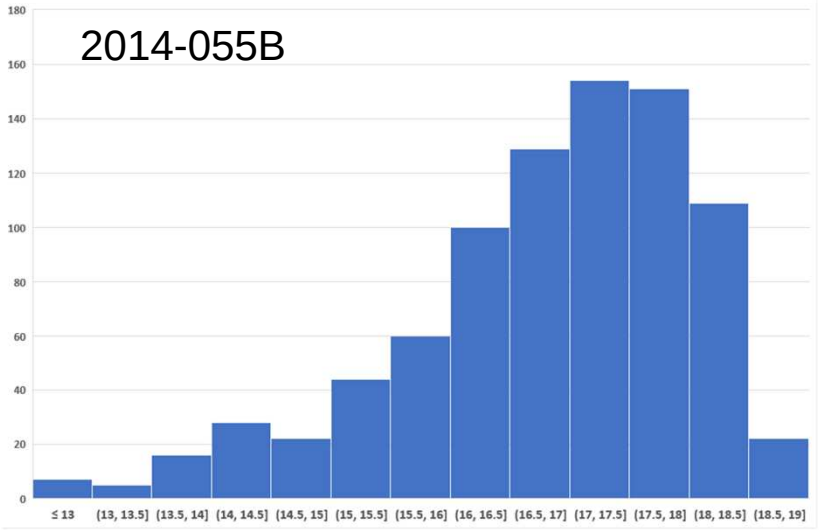
Washington, DC

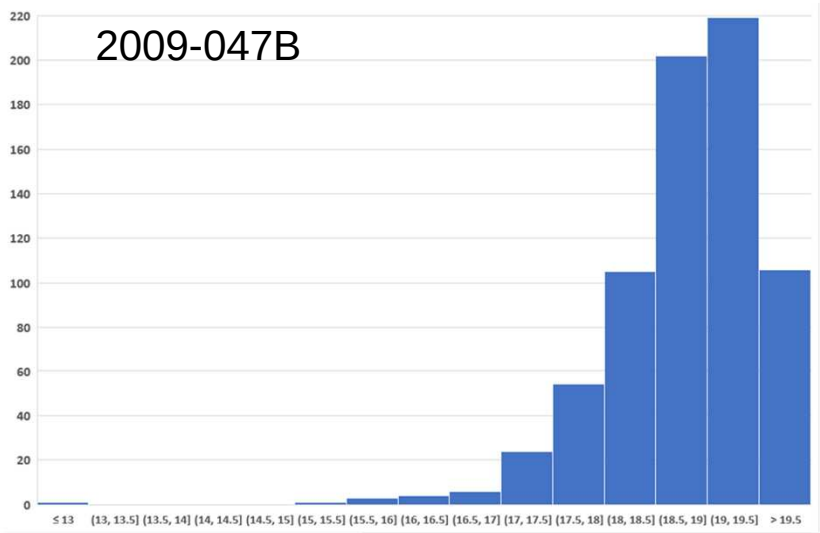
19 Oct 2019

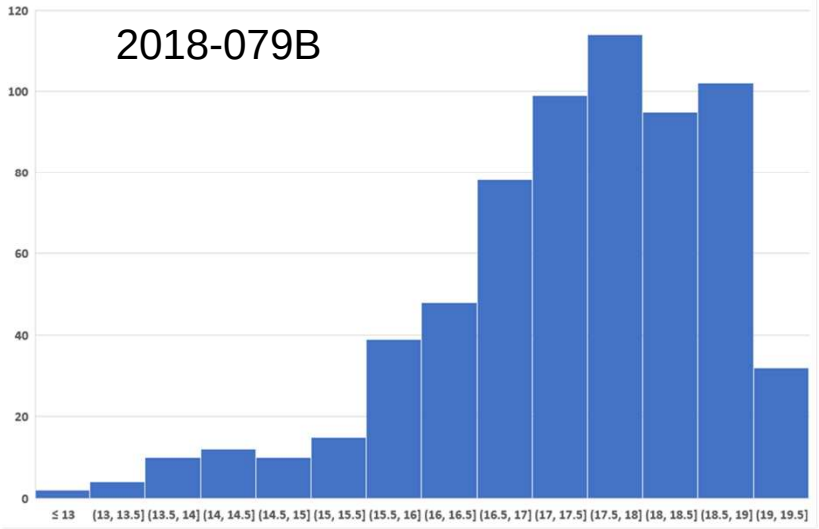
Summary of Atlas 5 Centaur R/B fragmentations

Parameter	Centaur R/B 2014-055B	Centaur R/B 2009-047B	Centaur R/B 2018-079B
Date of fragmentation	Aug 30, 2018 21:00 UTC	Mar 24, 2019 05:12 UTC	Apr 6, 2019 18:59 UTC
First detection	ASPOS OKP	ISON-Terskol	ASPOS OKP
Number of fragments catalogued+analyst (as of Oct 17, 2019)	660+6 (**5th** largest debris cloud *in orbit*)	725+1 (**4th** largest debris cloud *in orbit*)	847+18 (**3rd** largest debris cloud *in orbit*)
Indication of presence of non-modeled acceleration prior to the break-up	No	Yes	No
ΔT, min	540.1 (699.3-1239.4)	4.7 (735.2-739.9)	757.7 (604.6-1362.3)
Δi, °	2.4 (21.6-24.0)	2.0 (23.0-25.0)	7.1 (7.4-14.5)
Relative number of HAMR debris, %	41	3.6	40
Number of fragments crossing GEO protected zone altitude range (35785±200 km) as of Oct 17, 2019	163	16	395
Presence of mission/launch related debris in the orbital plane before break-up	Yes (10+)	Not confirmed yet	Yes (8+)

Distribution of Std_Mag for fragments of three Atlas 5 Centaur R/B break-ups

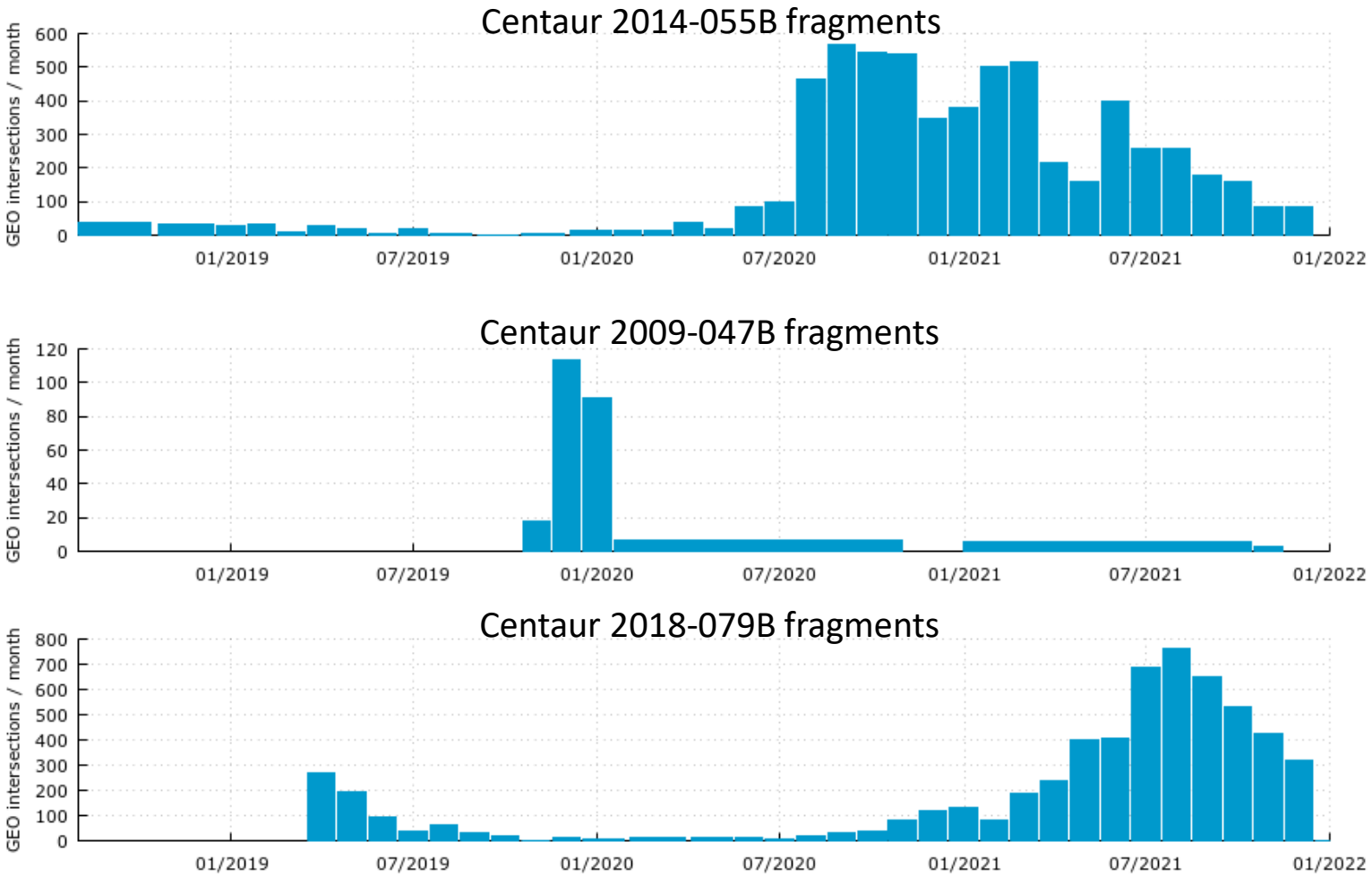




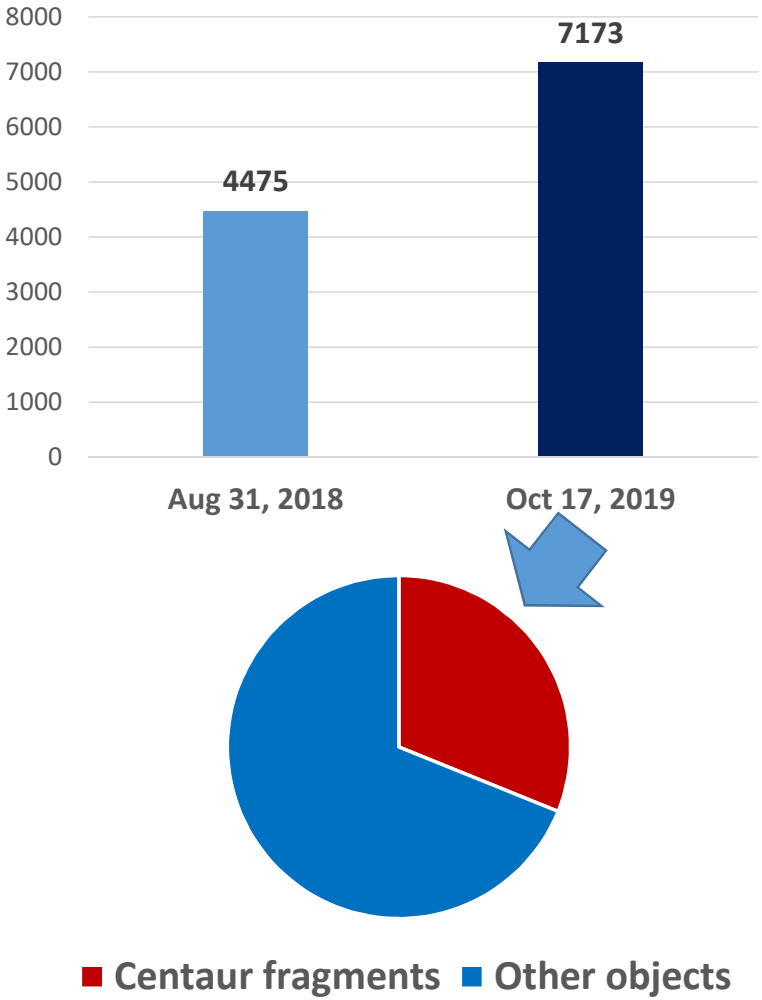


Std_Mag is a median of integral brightness measured in individual observations and adjusted to standard conditions (range 40000 km, phase angle 0 deg, diffuse sphere model)

GEO protected zone crossing by three Centaur fragments clouds



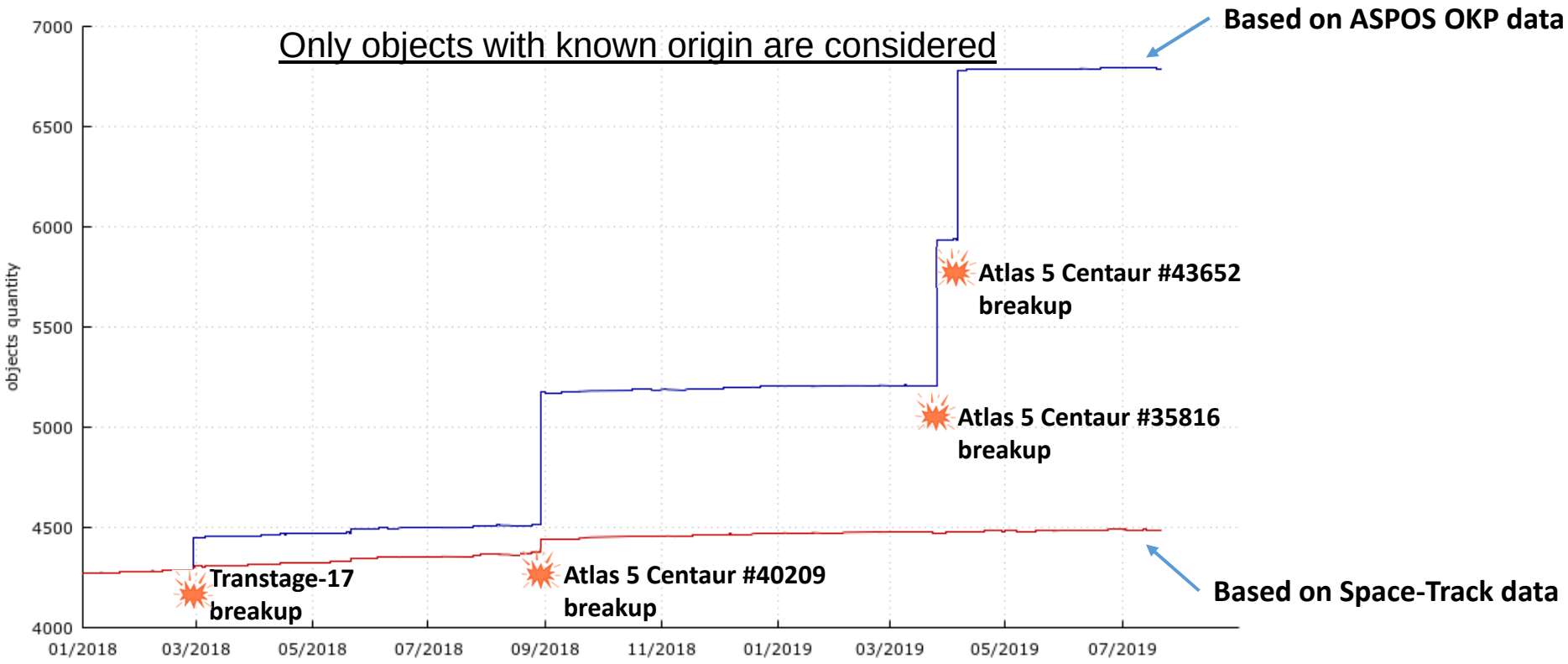
Population of HEO&MEO objects catalogued by ASPOS OKP



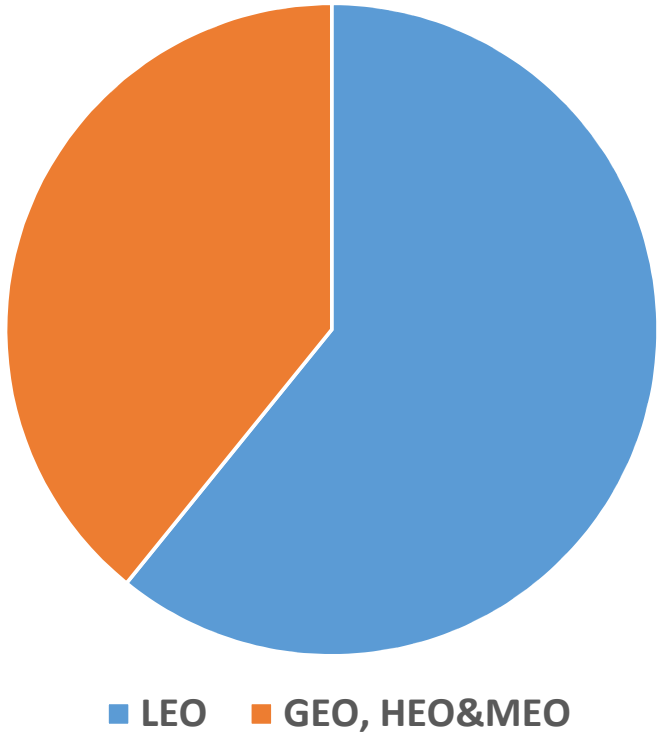
Increase by 2698 of the number of all catalogued HEO&MEO objects (**1.6 times!**) in 13.5 months

2232 of 2698 (or **82.7%**) of newly catalogued HEO&MEO objects are fragmentation debris of three Centaurs which now constitute >31% of the entire catalogued HEO&MEO population

Growth of catalogued space objects number in GEO, HEO and MEO



Number of objects catalogued by ASPOS OKP



As of Oct 17, 2019

LEO (>14600) - mainly objects larger than 10 cm

GEO, HEO & MEO (>9400) – mainly objects larger than 25-30 cm

Direct comparison of quantitative composition of two populations is not correct since they are not equally complete in terms of objects' size!

Thank you for your attention!