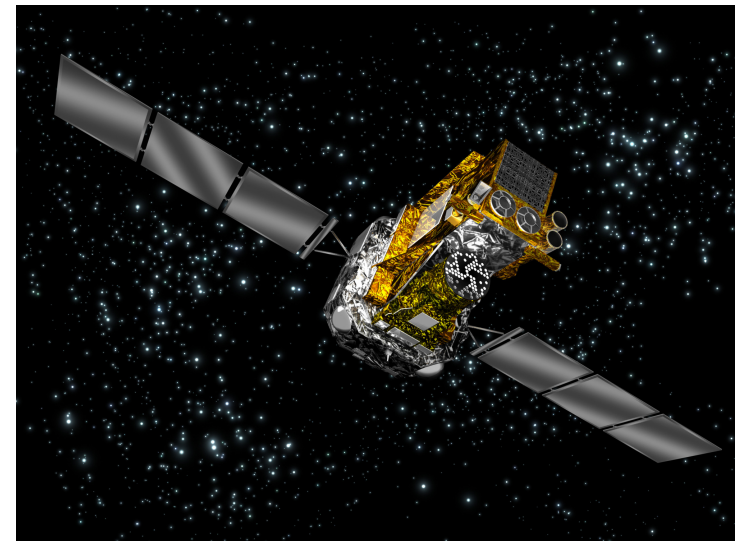




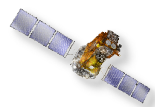
INTEGRAL

Project Scientist Report

Erik Kuulkers
(ESA/ESTEC)



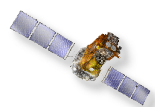
IUG Meeting #20 – ESTEC – 21 & 22 February 2017



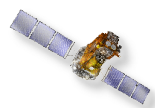
Community interfaces



Observatory status



Science highlights



Outreach



- Not attending today (i.e., absence notified): Wim Hermsen, Miguel Mas Hesse
- IUG Invitees: Guillaume Bélanger (secretary/minuteer), Albert Domingo Garau (replacing Miguel Mas Hesse), Lorrain Hanlon (see below), Luigi Colangeli (AM, 22 February)

- US Mission Scientists since October 2017 (replacing Neil Gehrels):

Brad Cenko (NASA/GSFC)

Julie McEnery (NASA/GSFC)

This IUG meeting remotely as much as possible



NEW

- Mission Scientist: Sergei Grebenev (silently) re-appointed for 3 years from Jan 2017

- Upcoming: new IUG member & chair from July 2018 – Lorraine Hanlon (UCD, Ireland) (replacing Peter von Ballmoos)



NEW



Updates since last meeting

➤ Apr/May 2017: AO-15 [AO-14] call: 65 [57] proposals received (33 [31] normal, data rights on 341 [359] sources & 32 [26] ToO)
21 Ms available → oversubscription 4.2 [5.5] - **see Next slide**
TAC accepted 54 proposals (22 ToO) and granted 140 ks [20 ks] of XMM-Newton time, 158 ks [153 ks] of Swift time and 70 ks [0 ks] of NuSTAR time to, respectively, 3 [1] , 7 [5] and 4 [0] INTEGRAL proposals.

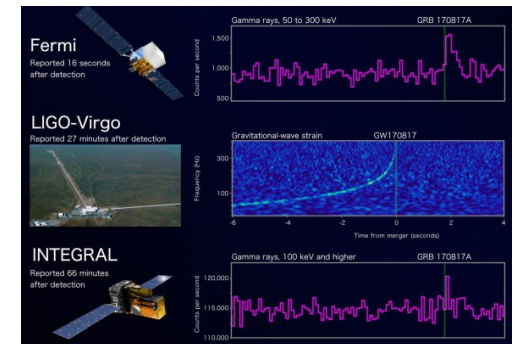
➤ 16 Oct 2017: GW170817 & GRB170817A announced – birth of multi-messenger astrophysics

➤ 17 Oct 2017: 15 years of INTEGRAL operations

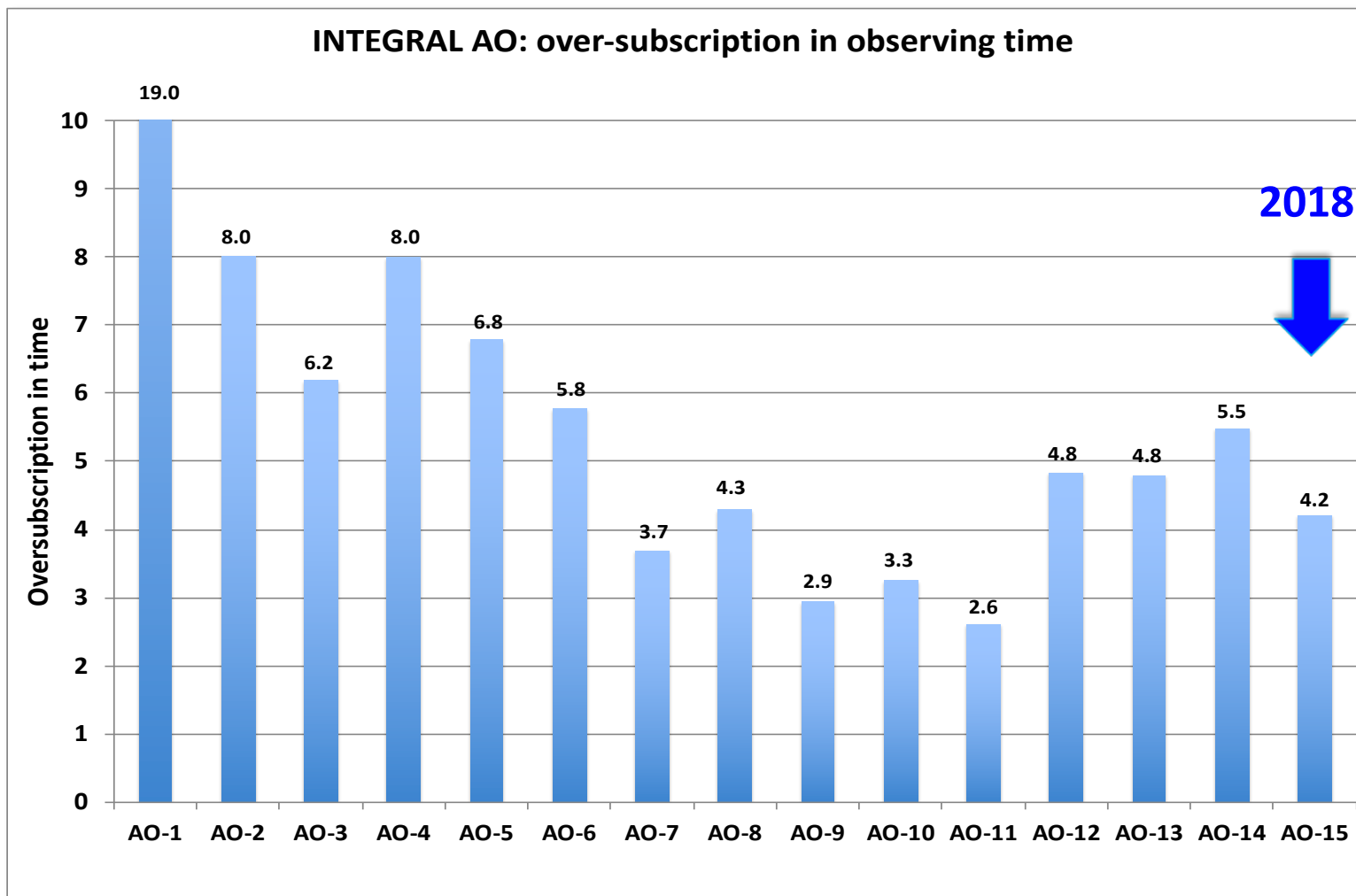
➤ 16–20 Oct 2017: 15 Years INTEGRAL Symposium
"Energetic Time Domain Astrophysics ", Venice, Italy

- New: "Mikhail Revnivtsev Prize", a distinction established in honour of the renowned high-energy astrophysicist from the Russian Federation, to be given to a young scientist (younger than 35 years old): awarded to Volodymyr Savchenko for his outstanding scientific contribution to INTEGRAL

➤ Next INTEGRAL Conference (Jan/Feb 2019): Switzerland



[INTEGRAL] Community interfaces



➤ 2018: INTEGRAL serves 44 (293) unique PI's (+co-I's) **CHECK**



Near future

➤ AO-16 Observing Time proposals:

- Release of AO-16: call for proposals: **5 March 2018**
- Deadline for submission of proposals: **13 April 2018 (14:00 CEST)**
- Meeting of the TAC: **29-31 May 2018**
- Start of AO-16 cycle of observations: **1 January 2019**

➤ Coordination:

- XMM-Newton (300 ksec), Swift (150 ksec), & NuSTAR (100 ksec) [& Fermi through their AO]
- To be notified: INTEGRAL users, HEAD, Swift/NuSTAR community
- To be notified Chinese/Indian/Japanese high-E community
- More ideas to foster cooperation & INTEGRAL awareness?!



- Mission operations currently funded until **31 December 2018**
- Indicative approval of mission operations until **31 December 2019**; **31 December 2020** expected to be done during March SPC meeting
- New extension case (2-year cycle):
 - Confirmation of funding extension period **2019-2020** (if 2020 approved)
 - Approval of extending operations period **2021-2022**
 - Coming future events:
 - Mission Operations Extension Review (MEOR): 5/6 June 2018
 - Extension case ready: by Summer 2018
 - AWG meeting 16/17 October 2018: presentation extension case
 - SSAC meeting 30/31 October; SPC meeting 20/21 November 2018
- Re-entry still in 2029...



- Current Memorandum of Understanding (MoU) / Letter of Intent (LoI):
 - Until 1 June 2017 (extended up to 25 Aug 2017) - MoU with LIGO/Virgo consortium to participate to EM follow-up campaign of **GW signals**
Note: start of next LIGO/Virgo observing run (O3), expected in last quarter of 2018!
New MoU in the making – strong GW events become public
 - 25 October 2016 - MoU with IceCube collaboration to receive private **very-high energy neutrino** multiplet alerts + establish close collaboration in general
 - 29 March 2017 – LoI for follow-up of **Fast Radio Bursts (FRBs)** discovered by SUPERB project (Parkes radio observatory), in collaboration with SUPERB team
 - 29 December 2017 – LoI with deep-sea neutrino telescope ANTARES, to receive **neutrino events** alerts + targeted follow-up observations with INTEGRAL in collaboration with ANTARES team. [Expected typical rate is ~3/month]

- Sep 2016 – Now: Define/optimize observing strategies and protocols/procedures for follow-up on GW and high-energy neutrino events (and FRBs)
→ done by core INTEGRAL team (IBAS, ISDC, PI's, PS, +)

A small icon of the INTEGRAL satellite, showing its complex structure with various instruments and solar panels.

Community interfaces

A small icon of the INTEGRAL satellite, showing its complex structure with various instruments and solar panels.

Observatory status

A small icon of the INTEGRAL satellite, showing its complex structure with various instruments and solar panels.

Science highlights

A small icon of the INTEGRAL satellite, showing its complex structure with various instruments and solar panels.

Outreach



Update since last meeting

- SPI annealing: #29 (25/7-9/8 2017) & #30 (27/1-14/2 2018)
[Note: #29 followed by co-PI SPI team @ MPE]
- NASA's Neutron star Interior Composition Explorer (NICER, 0.2–12 keV; onboard ISS) launched 3 June 2017
- China's Hard X-ray Modulation Telescope (HXMT, 1–250 keV; dubbed "Insight" 慧眼) launched 15 June 2017
- Cross-calibration/coordinated observations (INTEGRAL mostly public):
 - i. GRS 1915+105 : Astrosat, Swift, radio in Mar 2017, May & Sep 2017 with XMM-Newton & VLT
 - ii. 3C273 : Chandra, NICER, NuSTAR, Swift and XMM-Newton in Jun 2017;
 - iii. GX 301-2 (Aug 2017) & Her X-1 (Sep 2017) : HXMT-Insight
 - iv. Crab : HXMT-Insight, NICER and NuSTAR in Sep 2017
 - v. GRS 1915+105, FRB121102 and NGC2110 with radio in Sep & Oct 2017



Update since last meeting (continued)

➤ 6 & 10 September: Sun produced pair of X-class flares, strongest observed in over 10 years. It made its impact on Earth and its surroundings, including INTEGRAL:

1st flare: OMC and JEM-X into safe Mode for about less than a day

2nd flare: all instruments affected. All instruments active again by 15 September

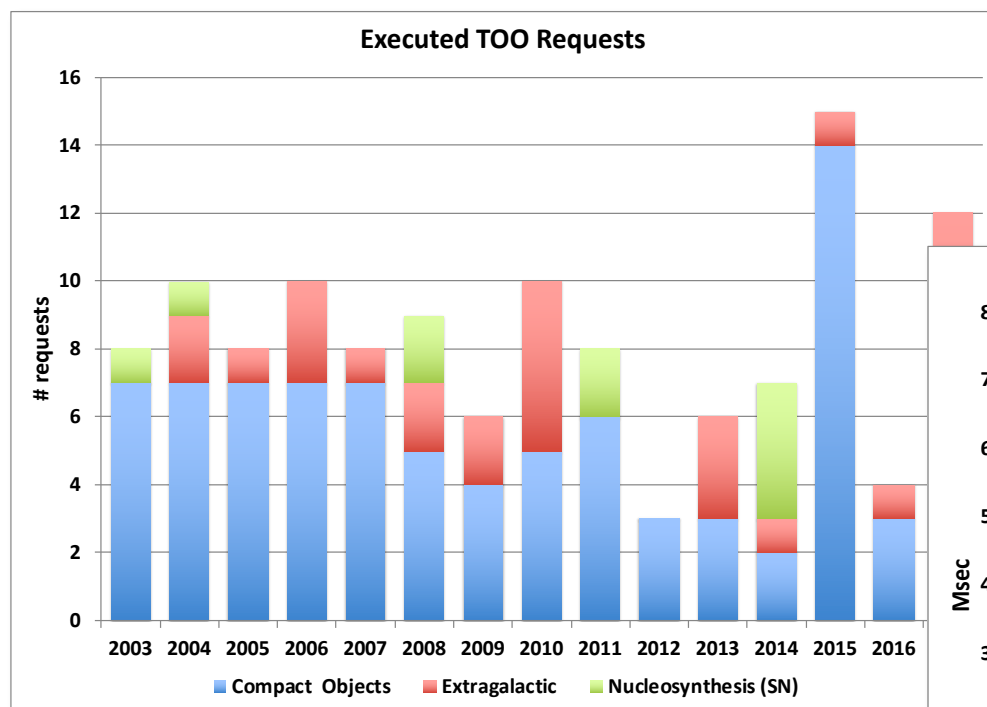
➤ Only 2 GRBs in FOV: GRB 170710C, GRB 170730A

➤ Russian return:

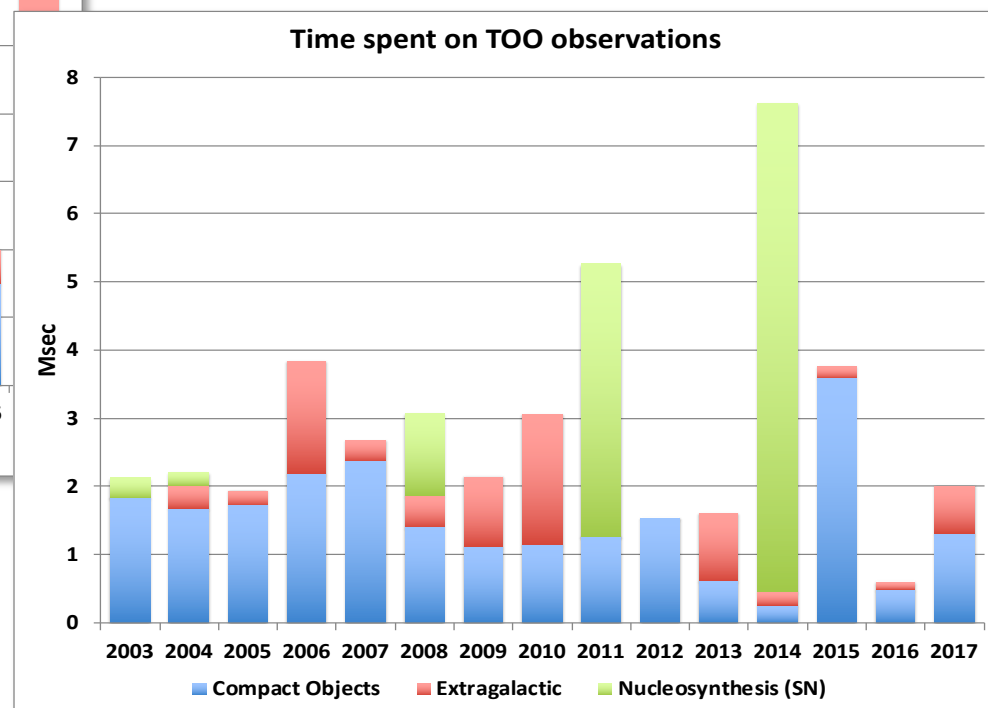
- AO-1–AO-14 ISOC scheduled 316.2 Msec GO/KP time & 80.5 Msec of Russian time
- Official Russian return = 81.7 Msec → Total underreturn of 1.2 Msec
- ISOC will intend to compensate this either in AO-15 and/or AO-16, whenever possible



INTEGRAL ToOs (up to Jan 2018)



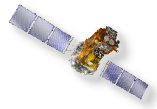
- 2017: 3 ToOs on GW events
2 ToOs on high-E neutrino's



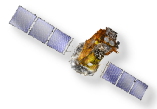


Issues/questions/to be solved

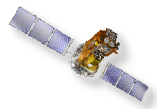
- SPI/ACS calibration? – RD, SPI
- INTEGRAL inter-calibration status? – PI's
- [Note: AO16 – Crab monitoring observations in calibration program]
- High-E cross-calibration status? – PI's, IACHEC?
- OSA11 – delays... & status? – ISDC, PI's
- > OSA11? – PI's
- Legacy Archive – ISOC, ISDC, PI's
- List of PhD thesis'
- ... any more?



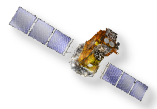
Observatory status



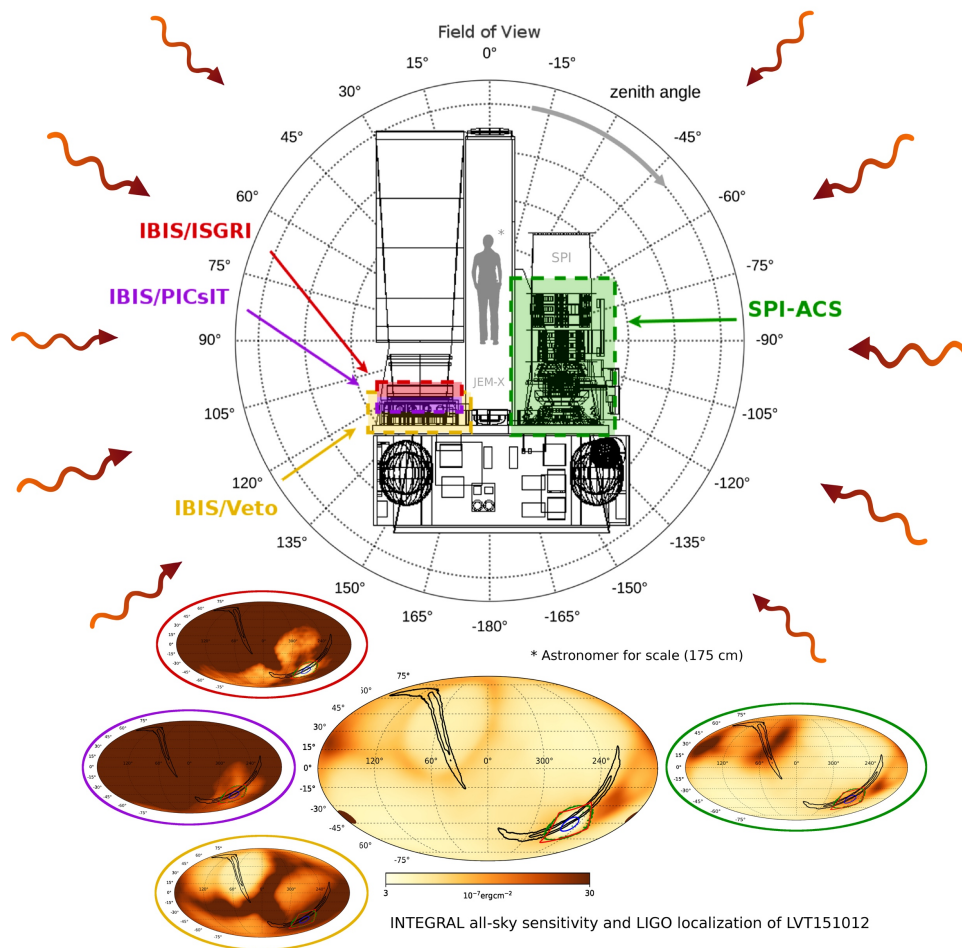
Community interfaces



Science highlights

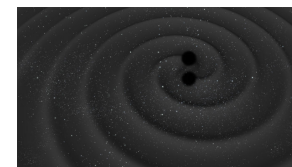


Outreach



Savchenko et al. 2017, A&A 603, A46

- LIGO/Virgo O1: after GW150914 and GW151226 came LVT151012; slightly lower LIGO detection certainty
- Large fraction of LIGO localization of LVT151012 was in the Field of View of JEM-X, IBIS, and SPI → high-sensitivity over more than 3 decades in photon energy: 3 keV to 10 MeV.
- Stringent upper limit:
 $E_{75-2000 \text{ keV}} / E_{\text{GW}} < 4.4 \times 10^{-5}$
 [remember GW150914: $< 10^{-6}$]



SSAC & SPC
May/Jun 2017

[INTEGRAL] Science highlights

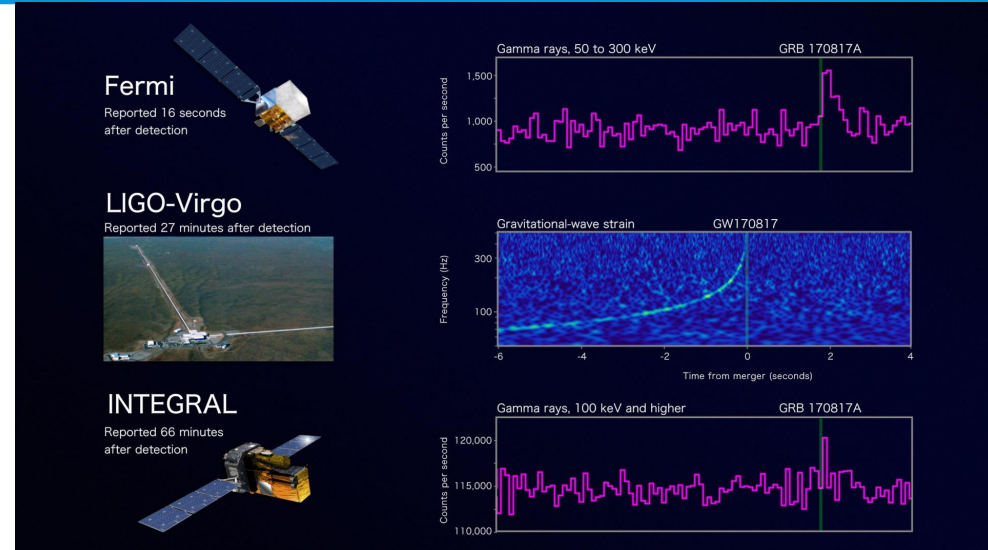


GW180717 / GRB170817A

INTEGRAL POM Nov 2017

SSAC & SPC
Oct/Nov 2017

>84 papers appeared on 16 august 2017



☐ [2017ApJ...848L..15S](#)

1.000 10/2017 [A](#) [E](#) [F](#) [L](#) [X](#) [R](#) [C](#) [S](#) [U](#)

INTEGRAL Detection of the First Prompt Gamma-Ray Signal Coincident with the Gravitational-wave Event GW170817

Savchenko, V.; Ferrigno, C.; Kuulkers, E.;
Bazzano, A.; Bozzo, E.; Brandt, S.;
Chenevez, J.; Courvoisier, T. J.-L.; Diehl, R.;
Domingo, A.; and 13 coauthors

☐ [2017ApJ...848L..13A](#)

1.000 10/2017 [A](#) [E](#) [F](#) [L](#) [X](#) [R](#) [C](#) [S](#) [U](#)

Gravitational Waves and Gamma-Rays from a Binary Neutron Star Merger: GW170817 and GRB 170817A

Abbott, B. P.; Abbott, R.; Abbott, T. D.;
Acernese, F.; Ackley, K.; Adams, C.;
Adams, T.; Addesso, P.; Adhikari, R. X.;
Adya, V. B.; and 1146 coauthors

☐ [2017ApJ...848L..12A](#)

1.000 10/2017 [A](#) [E](#) [F](#) [L](#) [X](#) [D](#) [R](#) [C](#) [S](#) [U](#)

Multi-messenger Observations of a Binary Neutron Star Merger

Abbott, B. P.; Abbott, R.; Abbott, T. D.;
Acernese, F.; Ackley, K.; Adams, C.;
Adams, T.; Addesso, P.; Adhikari, R. X.;
Adya, V. B.; and 3657 coauthors



➤ All public GW events:

- GW150914 [O1] – prompt observations
- LVT151012 [O1] – prompt observations, partially in FOV
- GW151226 [O1] – no data (perigee, within radiation belts)
- GW170104 [O2] – prompt observations
- GW170608 [O2] – prompt observations
- GW170814 [O2] – prompt observations, ToO follow-up
- GW170817 [O2] – prompt detection, ToO follow-up

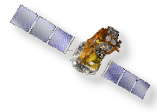
Savchenko et al.

2015, ApJ 820, L36
2017, A&A 603, A46
2015, GCN #18737
2017, ApJ 846, L23
2017, GCN #21231
2017, GCN #21478
& GCN #21695
2017, ApJ 848, L15

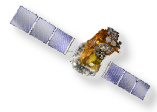
➤ high-E neutrino events (2017):

- IceCube HESE 65274589 129281 – prompt observations
- IceCube-170321A – prompt observations, ToO follow-up
- IceCube-170922A – prompt observations
- IceCube-171015A – prompt observations
- IceCube-171106A – prompt observations , ToO follow-up

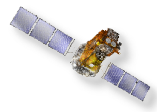
2017, GCN #20856
2017, GCN #20928
& GCN #20937
2017, GCN #21917
2017, GCN #22018
2017, GCN #22109
& GCN #22167



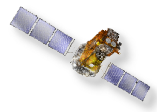
Observatory status



Community interfaces

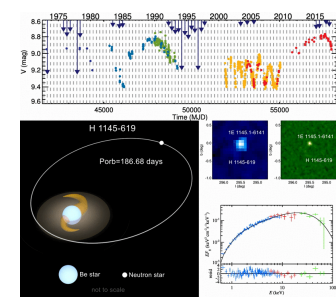
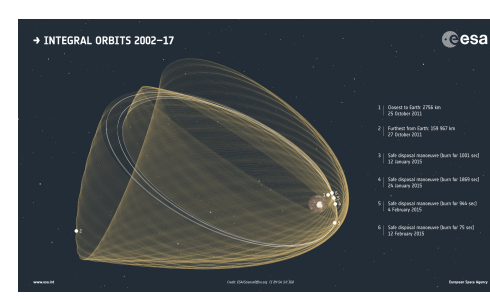
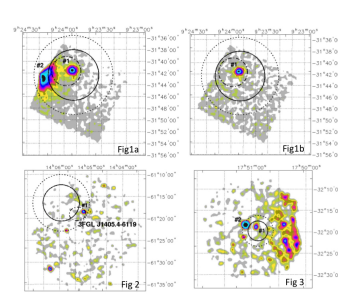
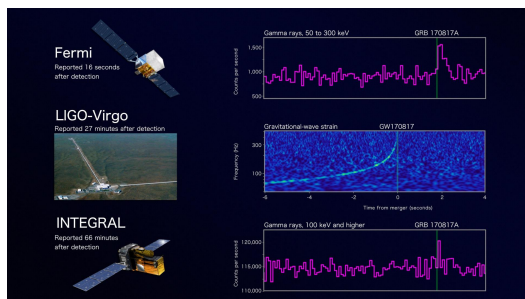
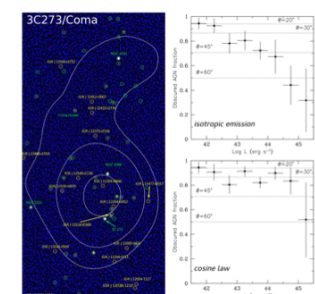
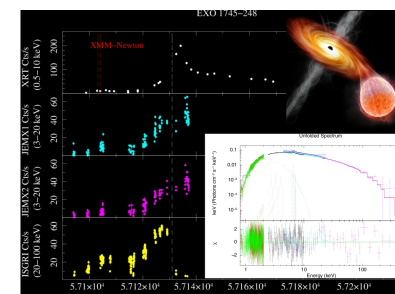
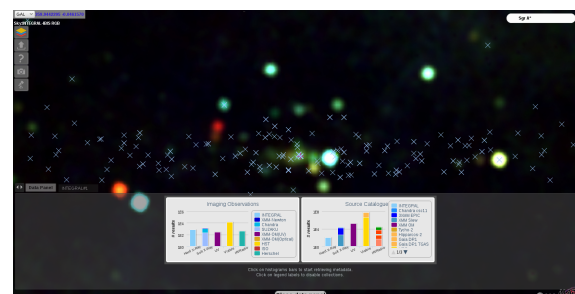
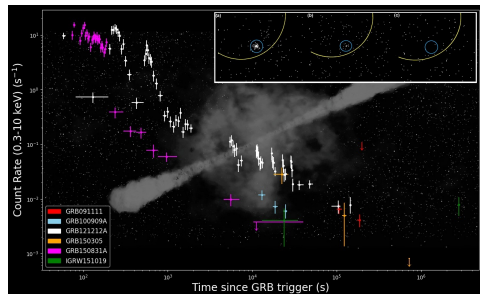
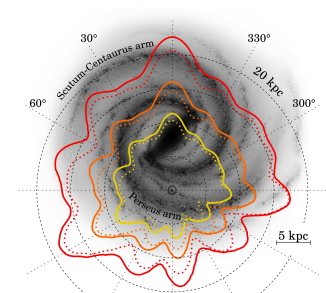
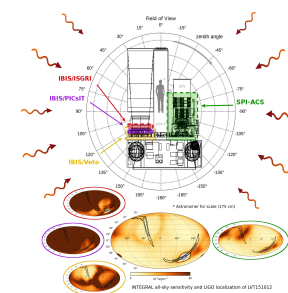
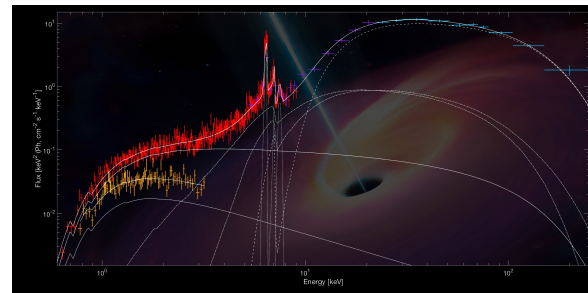
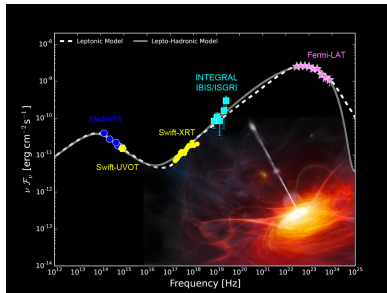


Science highlights



Outreach

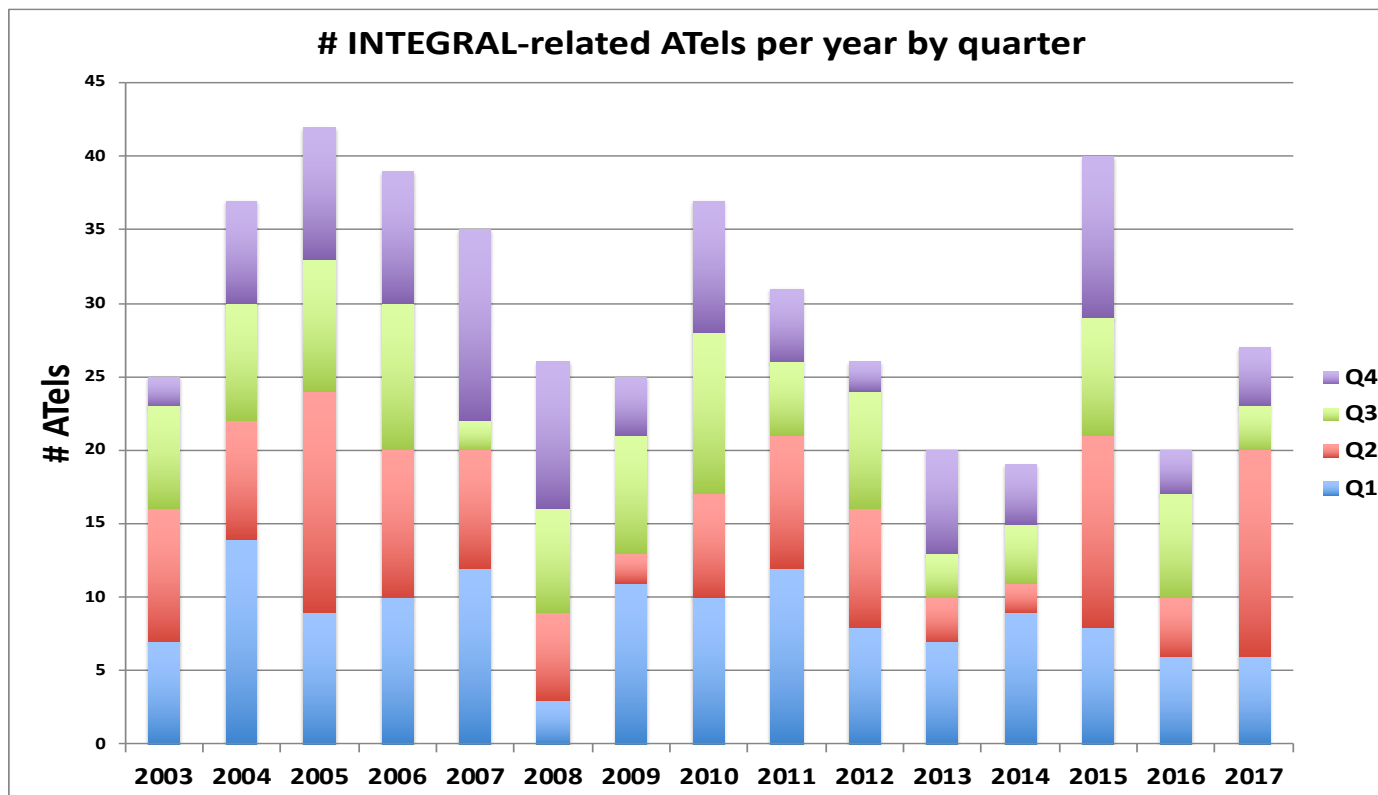
[INTEGRAL] Science highlights (POM)



INTEGRAL POM: <http://www.cosmos.esa.int/web/integral/pom-archive>



ATel publication rate (up to Jan 2017)



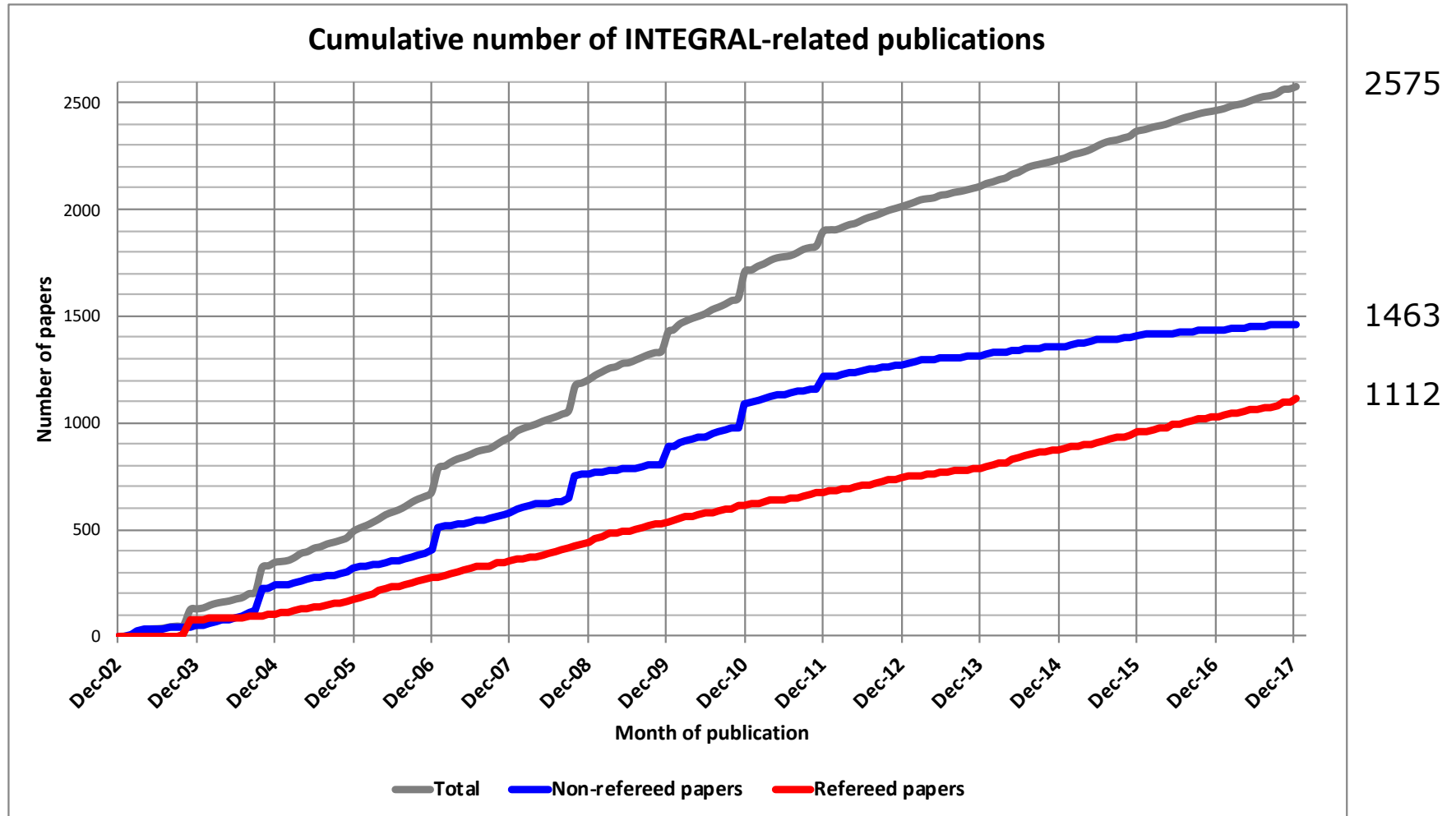
ATel total:
~100/month

INTEGRAL:
~2.5/month

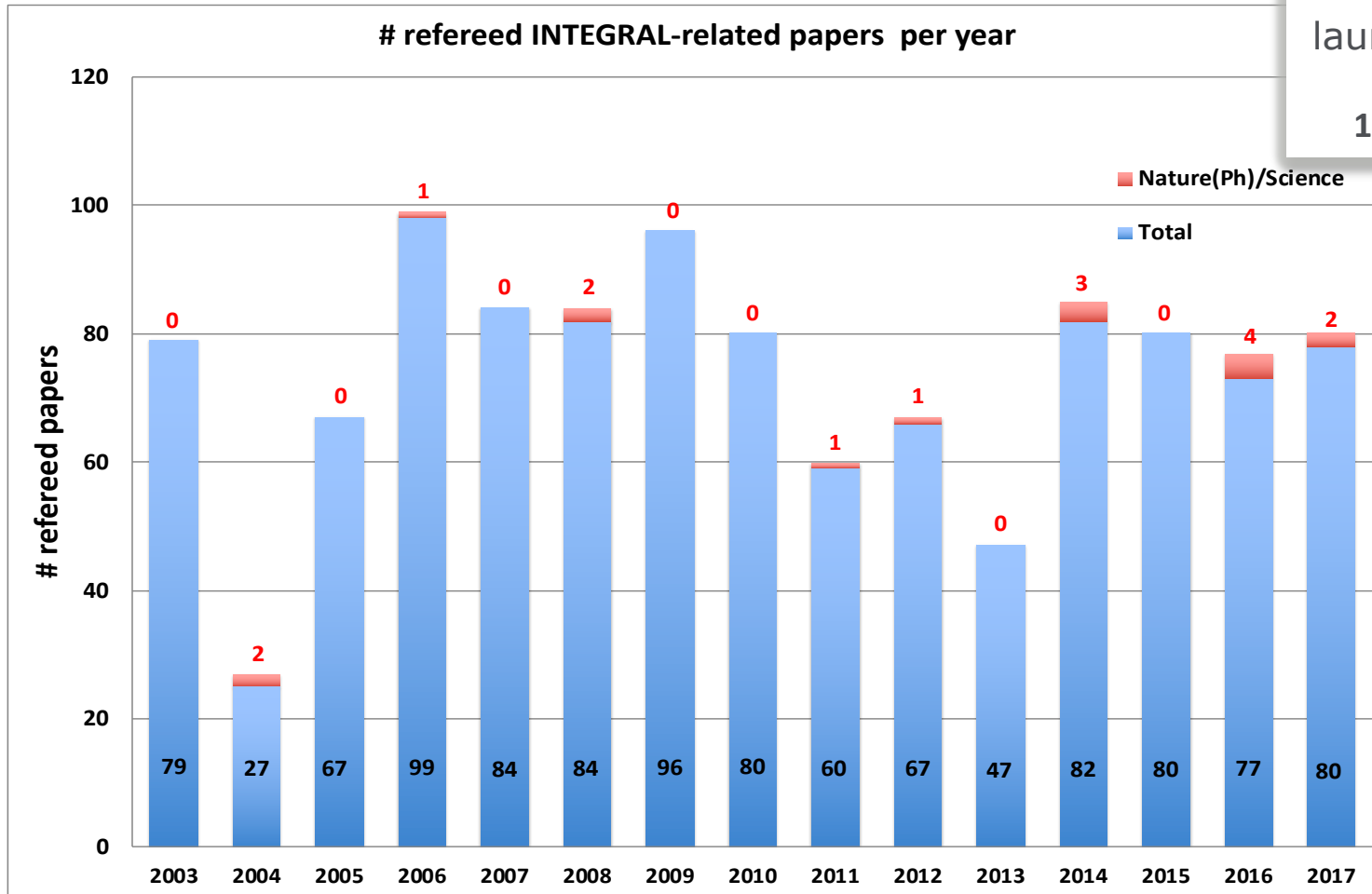
- 2015: out of 40 INTEGRAL-related ATels → 11 on V404 Cyg!
- Not taken into account GCN (GW & high-E neutrino events) - TBD



Refereed publication statistics (up to January 2017)



[INTEGRAL] Outreach



Total since launch, up to Jan 2018:
1112 refereed

Note:
2014-2017
using ADS/Beta
(Bumblebee)

➤ 2015-2018: 29 papers using V404 Cyg (public) data!



Status since last meeting (1+2 March 2017)

ESA's INTEGRAL-related PR web-stories	
Solar antics (Space Situational Awareness – Solar X-class flares 6 & 10 Sep)	19 September 2017
INTEGRAL sees blast traveling with gravitational waves (GRB170817A/GW170817) ESA satellites supporting ground-based search for gravitational waves Exceptional operations enables exceptional science (ESA Rocket Science Blog)	16 October 2017
La aventura de INTEGRAL cumple 15 años	9 November 2017

Average # stories in:

2017	-	5 (3 GW) + Twitter!
2016	-	3 + Twitter!
2015	-	3 + Twitter!
2014	-	1
2013	-	4



As always...: suggestions and proposals for new outreach products welcome!
(not only Nature or Science papers...)

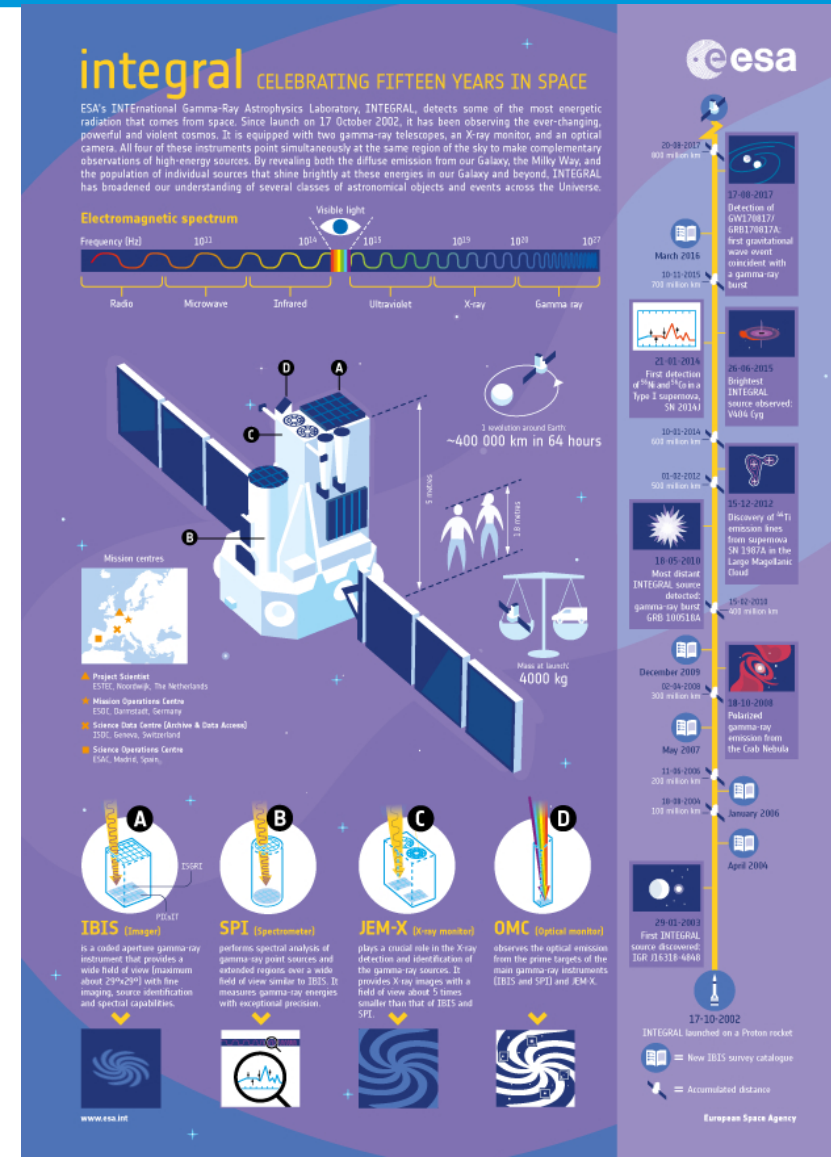


[INTEGRAL] Outreach



17 October 2017: 15 years in space!

➤ INTEGRAL infographic

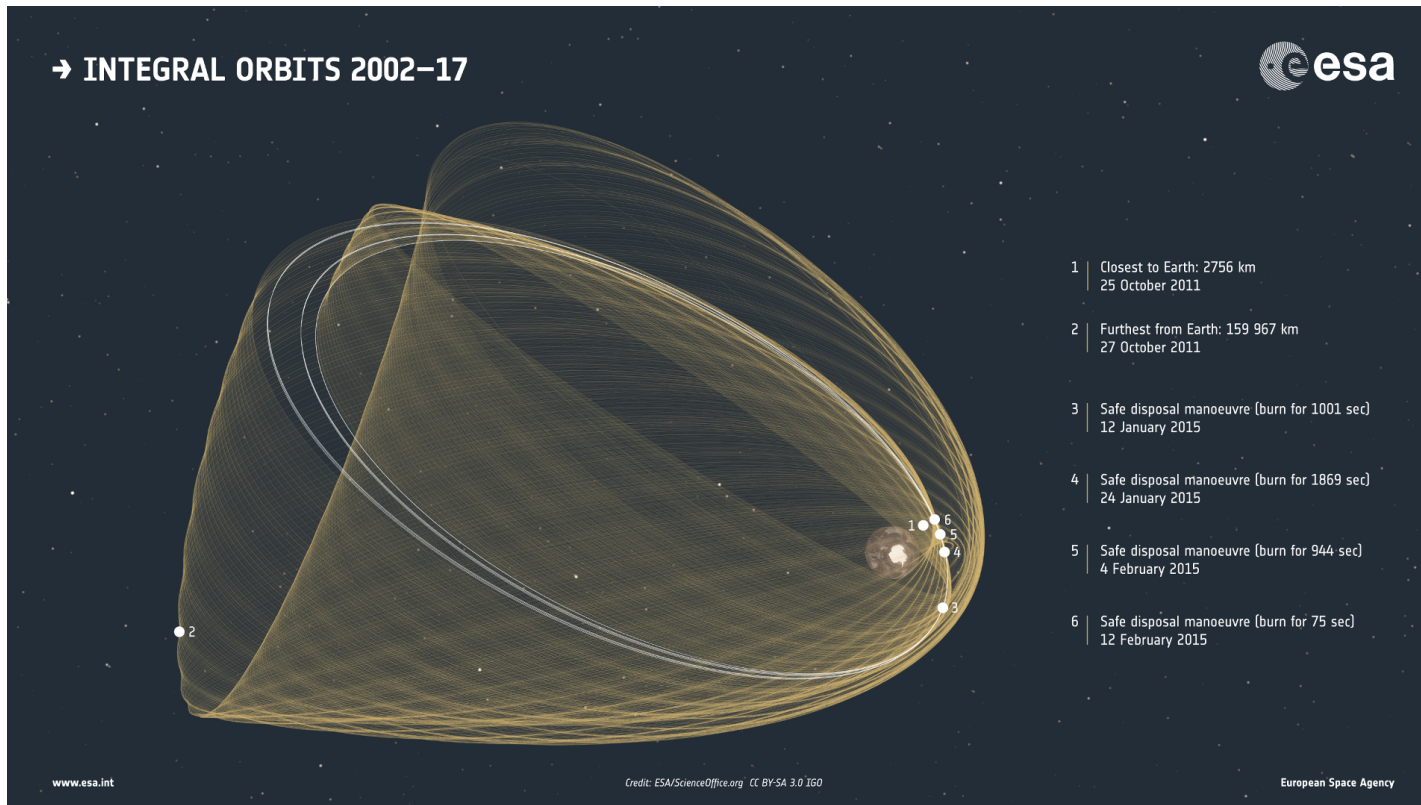


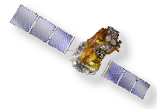


17 October 2017: 15 years in space!

- INTEGRAL orbits 2002 – 2017
 - image + movie

Image: INTEGRAL POM Jan 2018
(<http://www.cosmos.esa.int/web/integral/pom-archive>)





Miscellaneous

[INTEGRAL] Dinner tonight



Restaurant “De Zeemeeuw” in Noordwijk
www.zeemeeuw.com



@19:00 - Who's joining?



That's it for now