How to write a (good!) proposal

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Thanks to Mariano Méndez, who thanks Jörn Wilms, who thanks…

Proposals

- Why do we write proposals?
- The review process
- Tips and tricks

Proposals

- Why do we write proposals?

1. We have a good idea, and we want to explore it/test it.
2. We need money to carry out research.
3. We need a PhD student/postdoc in our group (to do the actual work for us!)

Observing Proposals

If you have a good idea:

You will need to convince others that the idea is good

You will have to convince others that the new data you apply for will be sufficient to address the question you ask, test the model, hypothesis, idea…

Proposals

- I have a good idea for an observation: Why don't they just do it?
- Answer: There are many other interesting ideas around.
  Facilities are oversubscribed.
  Strong competition for limited resources.
  Observations cost money.

(oversubscription = requested time / available time)

Oversubscription

- Typical oversubscription rates:

  ✳Small optical telescopes: **0.5 - 2**
  ✳VLA: **2 - 3**
  ✳Herschel, Spitzer: **3** (Spitzer in warm phase: **2 .7 !**)
  ✳8-m class telescopes (e.g. VLT), HST, X-ray observatories (Chandra/XMM-Newton): **5 - 6**
  ✳ALMA: **~ 4**
  ✳ JWST: ? (could go up to ~ 8-10)

MOST PROPOSALS WILL BE REJECTED!!!

(Best science or Lottery?)

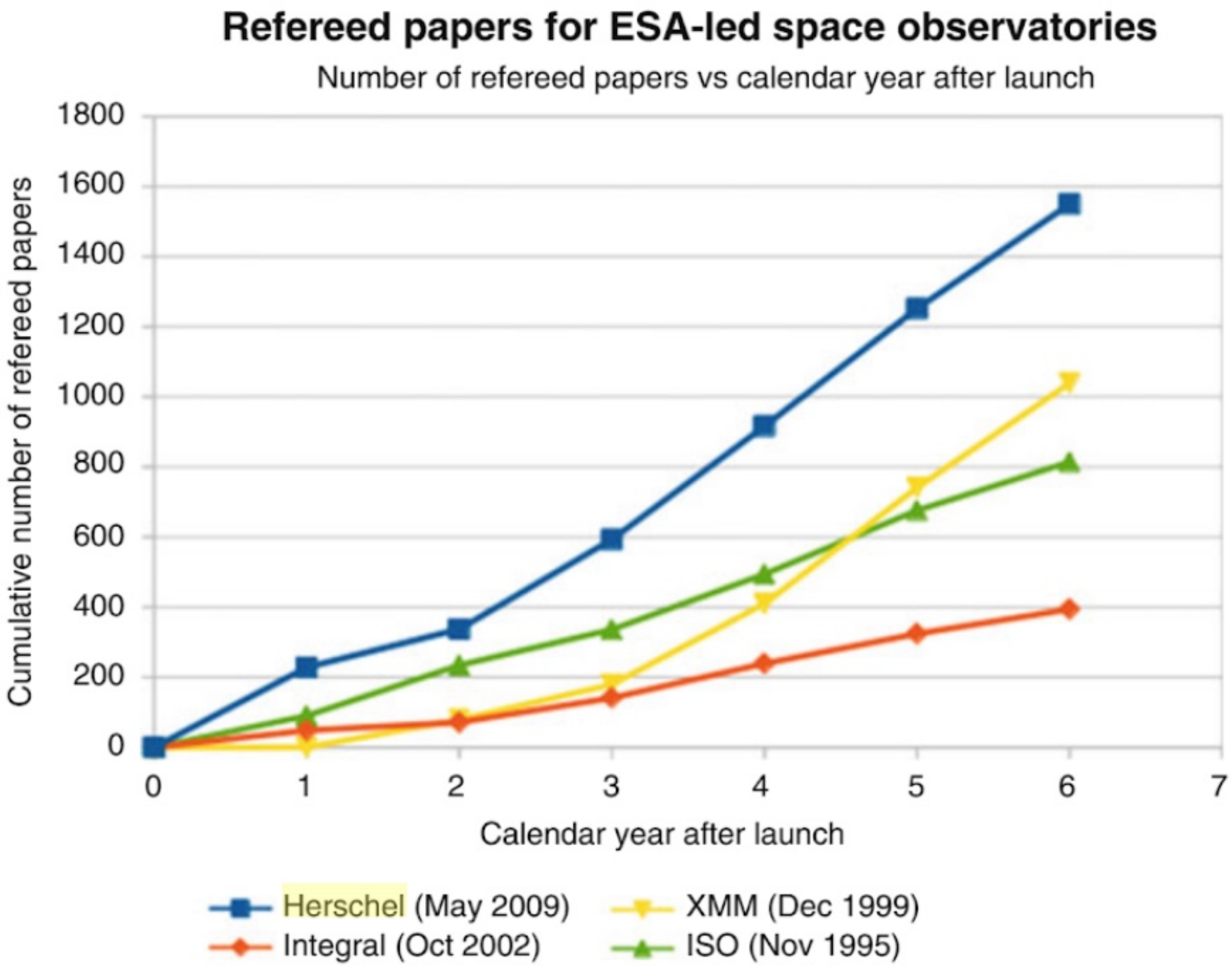
Example: Spitzer AO 2016

Science Category	Submitted		Selected	
	Hours	Props	Hours	Props
Our Solar System				
Asteroids	10.4	1	10.4	1
Comets	268.7	1	268.7	1
Kuiper Belt Objects	145.5	1	12	1
Near Earth Objects	2189.6	2	1780	2
Planets & Satellites	172.5	3	0	0
Our Galaxy				
Brown Dwarfs	471.9	6	363.8	4
Compact Objects	148.9	1	48	1
Debris Disks	216.8	10	145.4	4
Evolved Stars	74.5	5	3.8	2
Exoplanets	12182.7	27	3585.7	11
Galactic Structure	295.8	2	295.8	2
Stars & Stellar Pops	164.1	3	0	0
Extragalactic Stars	361.9	4	289.9	2
YSOs	599.6	3	59.2	1
Extragalactic				
AGN/QSOs	530.3	4	231.9	2
Galaxy Clusters	170.1	5	139.5	3
High-z Gals/Cosmol.	19589.3	24	7324.1	8
Nearby Galaxies	362.5	12	194.9	4
ULIRGS	1840.1	1	0	0
Total	**39795.2**	**115**	**14753.1**	**49**

Oversubscription

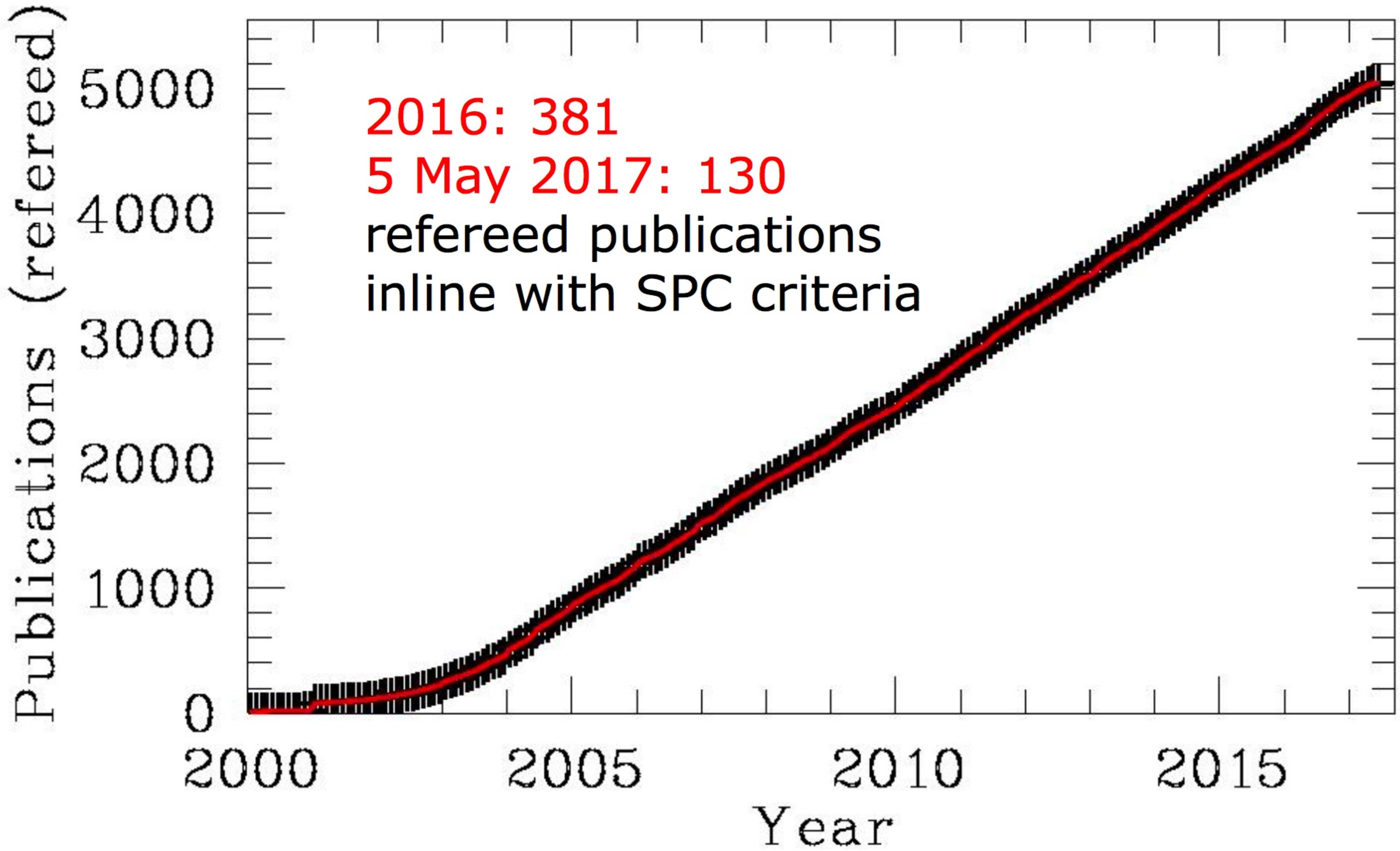
- Oversubscription is good for those who run telescopes and satellites.
- They want the best science done with their facilities (as many papers as possible in refereed journals with high impact factor, especially Nature or Science).
- Oversubscription factors play a key role when NASA/ESA missions go for extensions.

Productivity



From "Inventing a Space Mission: The Story of the Herschel Space Observatory" - V. Minier et al 2017

XMM-Newton - Cumulative publications



Operating costs - examples

RADIO:

- VLBA: 133 € / ksec (assuming construction cost of 85 M€)
- Effelsberg: 205 € / ksec

OPTICAL:

- ESO NTT (La Silla): 233 €/ksec
- ESO VLT (Paranal): 330 €/ksec
- HST: > 11000 € / ksec (adding up cost 1990-2009)

Operating costs - examples

X-RAY:

- RXTE: 360 € / ksec
- SWIFT: 630 € / ksec
- XMM-Newton[(1)]: 1800 € / ksec
- Chandra: 7700 € / ksec

XMM-Newton	in M€
Total costs for building it (just ESA)	900
With instrument costs	1200
Running costs / year (first 10 years)	35
Running costs / year (second 10 years)	17

	2000-2010	2000-2020
Total costs	1550	1720
Number of ksec	252460,8	504921,6
Cost / ksec	€6.140	€3.406

(Actually 3400 € / ksec)[(2)]

(1) Only ESA costs, not those of member states

(2) Including instruments and running operational costs, after 20 years

Operating costs - examples

IR:

- Spitzer: 2500 U$S / ksec
- ALMA: 4100 U$S / ksec (assuming 10-yr ops)
- ISO[(1)]: 8200 € / ksec
- Herschel[(1)]: 8700 € / ksec

[(1)] Only ESA costs, not those of members states

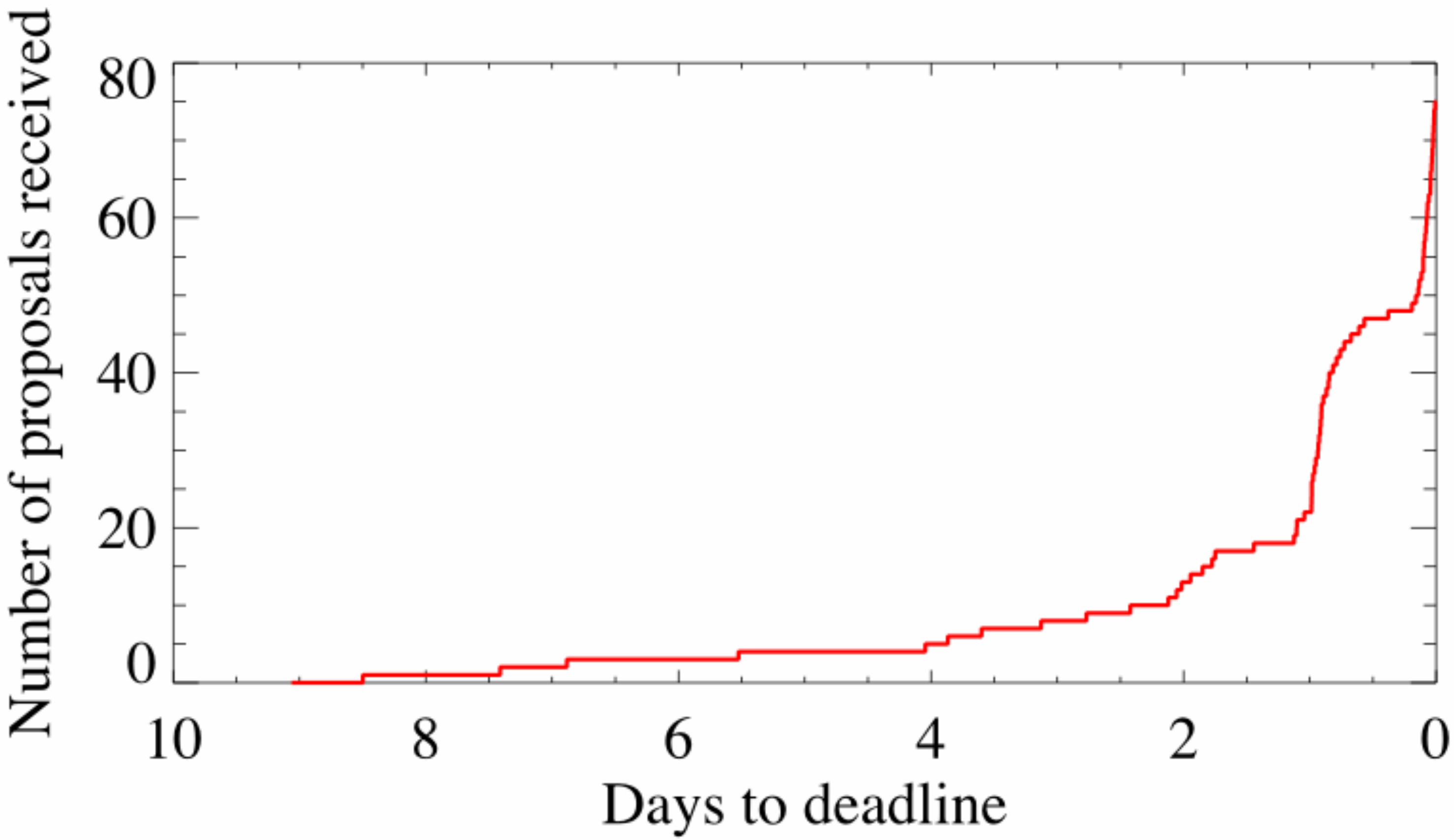
Observing Proposals - the process

- T ~ -4 months Announcement of Opportunity (AO).
  This is the Call for Proposals.

- Space missions: One per year
- Ground-based telescopes: Twice per year
- Radio telescope: Sometimes per trimester

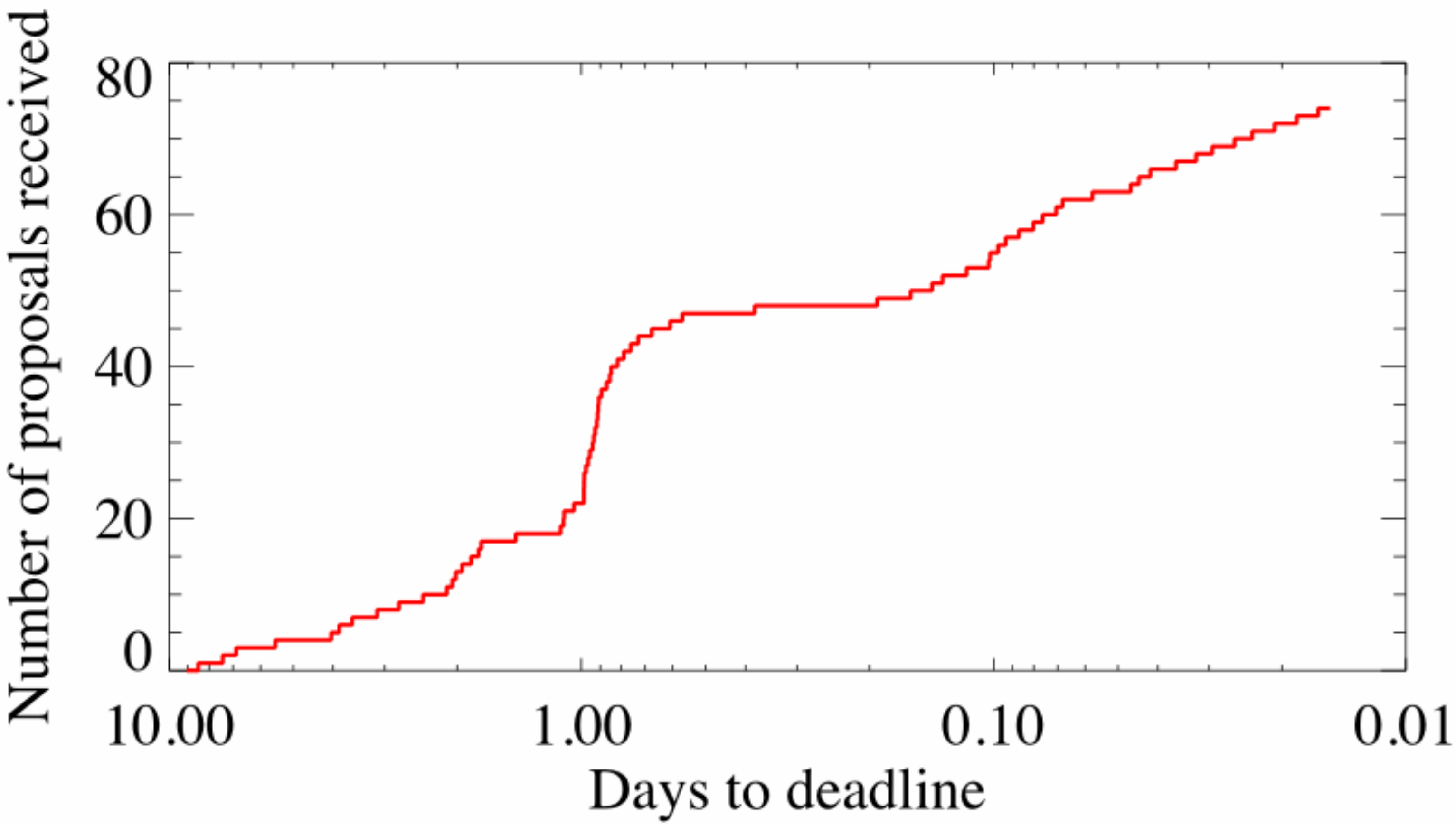
Multiwavelength campaigns require significant planning and multiple proposals. You may end up spending all your time in writing proposals.

Proposals: The process



T ~ 0: Arrival of INTEGRAL proposals for KP AO7

Proposals: The process



T ~ 0: Arrival of INTEGRAL proposals for KP AO7

Proposals: The process

- Proposals are submitted via website. They are checked for correctness (length, object coordinates).
- Technical feasibility (e.g., pointing constraints)
- Archival observations of the source available?
- Proposals assigned to panels (by subject)

Evaluation

- Example of XMM-Newton:

About 800 proposals divided in ~10 panels (5-8 members per panel).

All panel members are supposed to read all proposals in their panel.

Each panel member has to read ~ 80 proposals!

Initial grading by all panel members.

Evaluation

- Example of XMM-Newton:

Panels meet for ~2-3 days to discuss the proposals.

In some cases the last 25% of the proposals is immediately rejected.

Each remaining proposal is discussed, and graded again.

Typically 10 minutes discussion per proposal.

Possible constraints (visibility, coordination with other facilities) are discussed. Some good proposals get killed at this stage!

Evaluation - Panels

- Example of XMM-Newton:

Panel chairs meet to merge their lists.

Possible duplicates are discarded.

Large/Very large programs are discussed.

Evaluation - main tasks

- Main (formal) task of panels: Select the best scientific case for an instrument. The case that produces the largest possible scientific impact.

- Main (practical) task of panels: Find flaws in proposals. Every little glitch in a proposal is a potential killer.

How to write a good proposal

- First, and most important: You need to have a good and clear goal. E.g.:
  Test the prediction of a model.
  Compare predictions of two competing models.

- Must be ambitious but doable.

- You need to convince the panel, so lay out your case carefully and concisely first for yourself. Write down the case in a single paragraph, maximum two or three sentences.

How to write a good proposal

- Do your homework:

- Read all documentation about the instrument you propose to. Manuals, observing modes, Understand capabilities and limitations.

- Read instructions: Page limit for scientific justification. Submission software.
  Your proposal can be rejected because of a simple formality.

How to write a good proposal

- Do your homework:

- Check the archives for similar observations of your source, or another source that could address your same question.
  If data already exist, you will have to address this in your proposal. If you don't, your proposal can be killed very easily.

How to write a good proposal

- Do your homework:

- Are there other facilities that could be used to do a similar study? If so, why is this one the best?
- Feasibility study: Visibility? Signal-to-noise ratio? Exposure time?
- Run (and if possible show the result of) a simulation of the proposed observation.
- Justify the requested exposure time.

How to write a good proposal

- There are many good proposals. Each panel member has to read $\sim$ 50 – 100 proposals. You have to impress them right from the start!

- If the proposal does not state in the first page what the goal is, and why it is important, chances are that it will not be accepted.

- Abstract: Make it your Executive Summary. Reviewers must be able to remember your case from this.

How to write a good proposal

- Panel members are in your field, but may not be specialist in your topic. Ask a colleague to read it and comment on it.
- Emphasize important parts using **boldface**. But use it sparingly!
- Get to the point as quickly as possible. Proposals may be read in a hurry.
- Check your English, if possible with a native speaker (or a more senior colleague).
- Avoid jargon, acronyms and complicated language.

How to write a good proposal

- If the referee cannot understand it, you lost. And it is not his/her fault. It is yours!!!

- Because oversubscription, panels are looking for arguments to kick your proposal out, not to keep it in.

- You must answer all potential questions and concerns in your proposal. If the referee has a concern and you did not addressed it, you lost.

How to write a good proposal

- You are 100% responsible for your proposal. You should not expect that the reviewer will explain things you did not explain. Even if in the end you are right, if you didn't explain it, it may be that you did not even consider it.

If you fail...

- ... do not despair!! Oversubscription factors are usually very large - It is hard to get time!

- You will receive feedback from the panel. Not always very useful but occasionally it may help you to understand the areas for improvement.

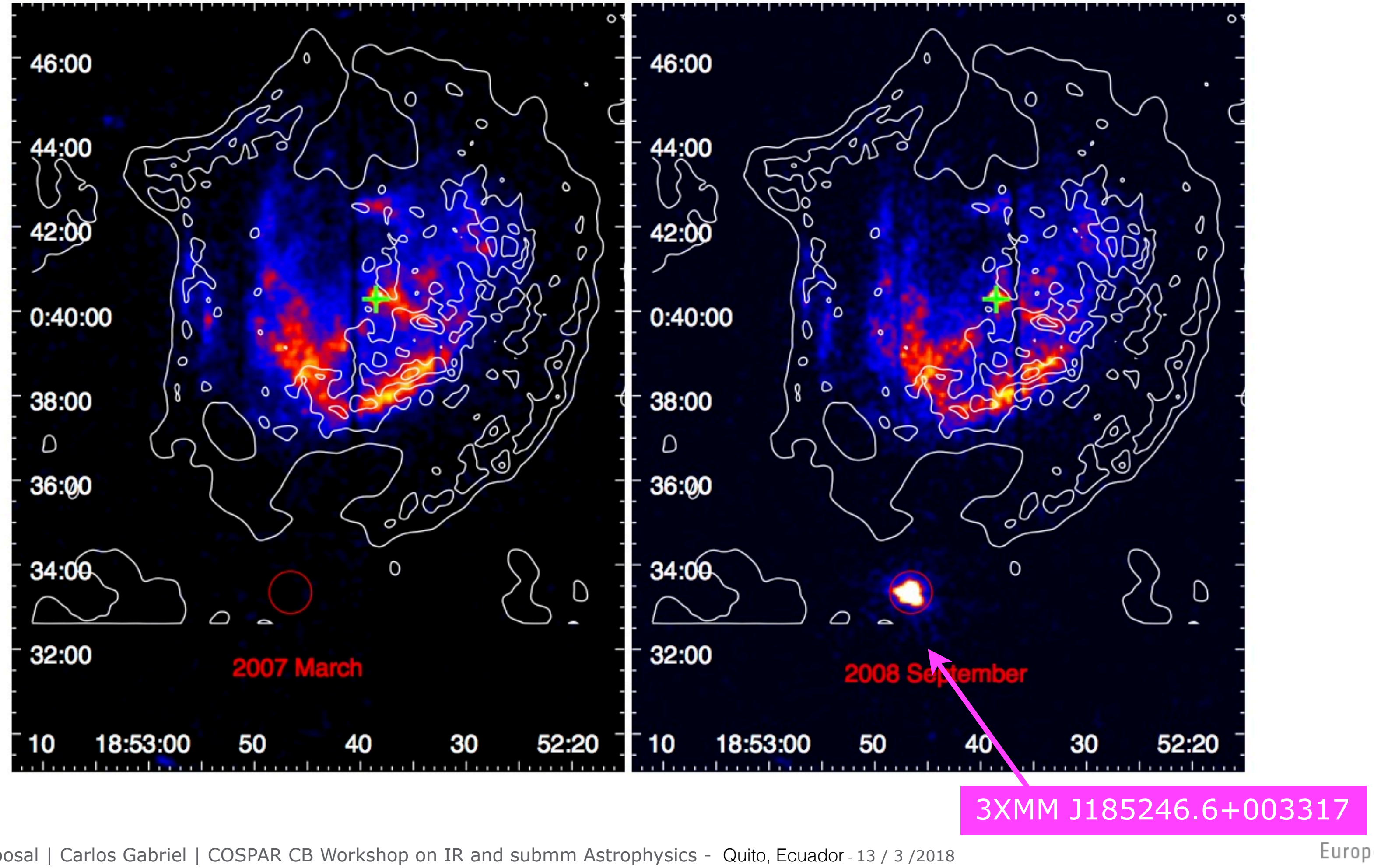
- Decisions depend on panel members = human beings - Another panel may have different views next time - try again!!

In the meanwhile ... use the archives!!

A magnetar discovery in a CB-WS

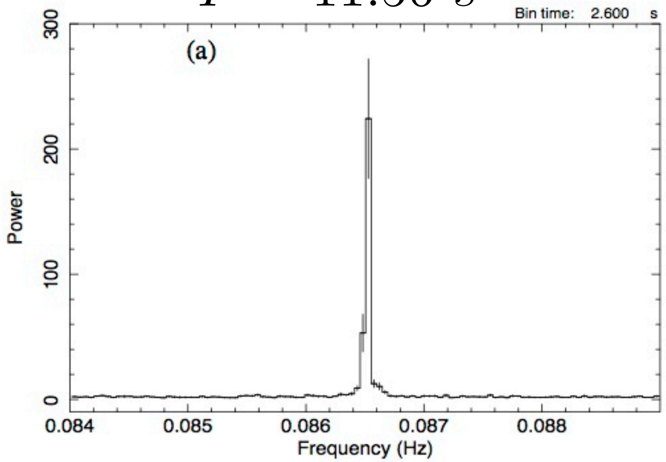
At the X-ray astronomy CB Workshop (Xuyi, China, 9/2013) - The student Ping Zhou revisited data from the XMM-Newton archive (observations of the SNR - Kes 79)

XMM-Newton (0.3 – 10 keV) + VLA (continuum @ 1.4 GHz)

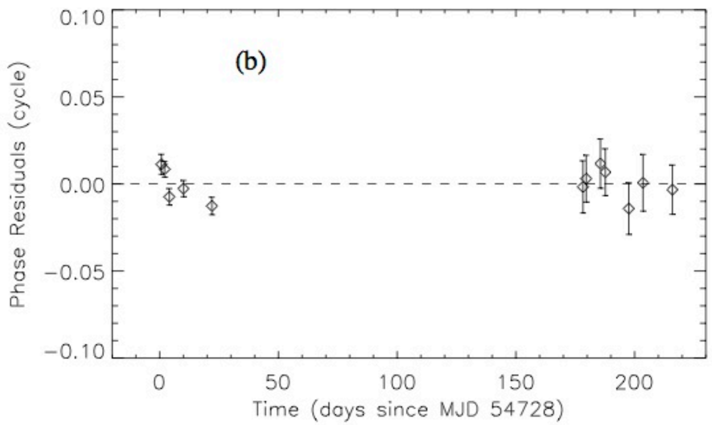


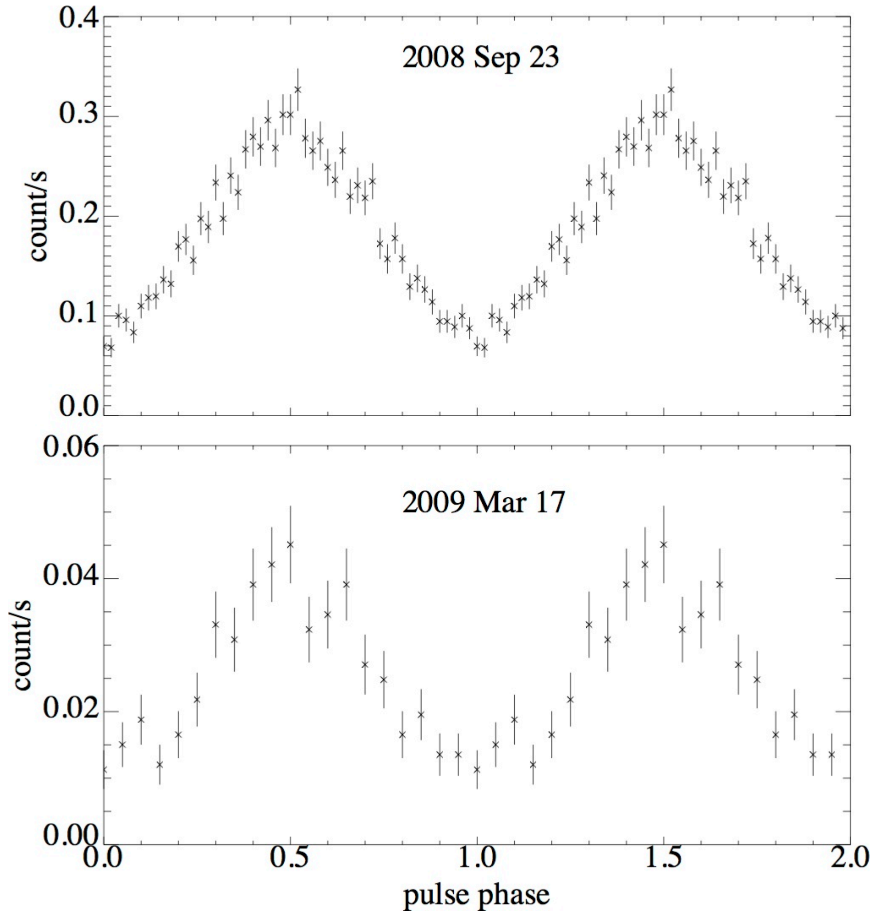
Power spectrum analysis of 3XMM J185246.6+003317

$$P = 11.56\ s$$



$$\dot{P} < 1.1 \times 10^{-13}$$

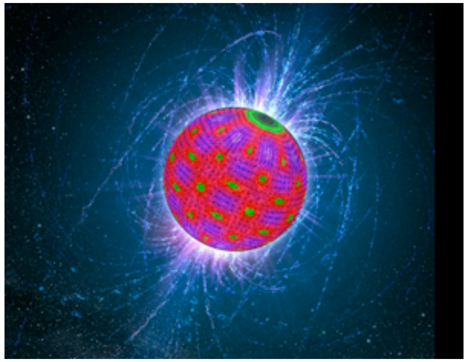




Zhou et al 2014

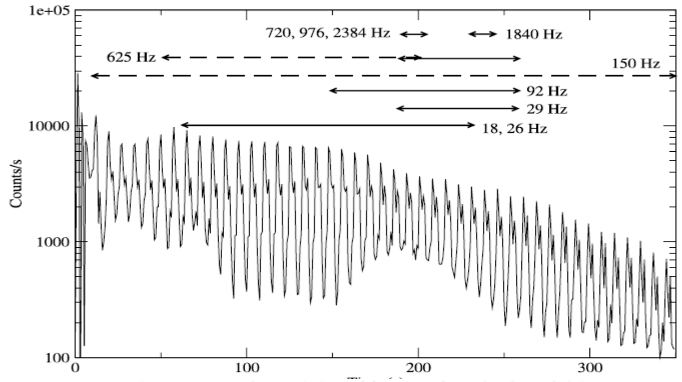
The magnetar theory in a nutshell

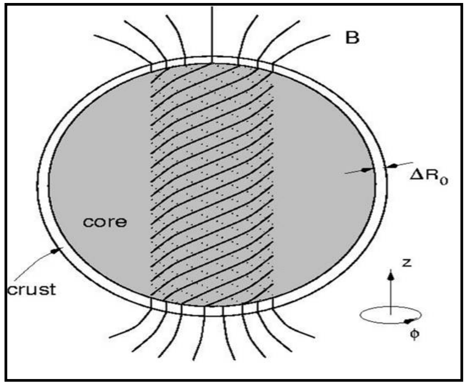
Magnetar: neutron star with an extremely **high magnetic field**
(unique labs to study physics of ultra-magnetized objects)



Star-quakes on a neutron star producing quasi-periodic oscillations

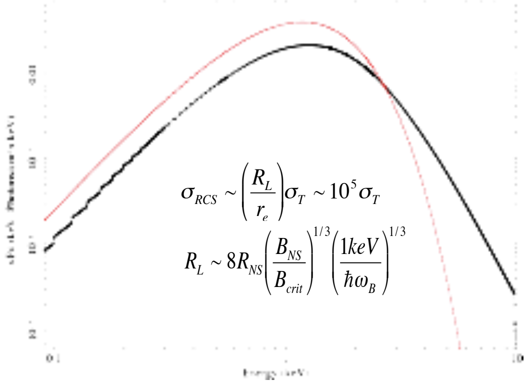
(Israel et al. 2005; Stromayer & Watts 2006)

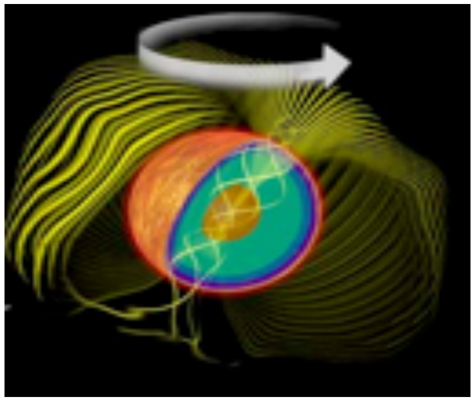


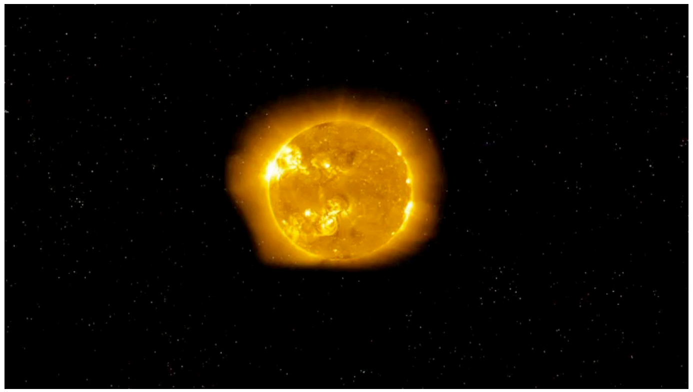


Magnetars have magnetic fields twisted up, inside and outside the star. Their magnetospheres are filled by charged particles trapped in the field lines, interacting with the surface thermal emission through resonant cyclotron scattering.

(Rea et al. 2008 and refs.)







At intervals, stresses build up in the crust which might cause glitches, flares...

Further reading

- Fomalont, E.: Preparing a competitive radio proposal

  http://www.aoc.nrao.edu/events/xraydio

- Leibundgut, B.: ESO proposals

  http://www.eso.org/~bleibund/talks/Proposals_Prague09_pub.pdf

- Seward, F.D.: How to write an X-ray proposal

  http://www.aoc.nrao.edu/events/xraydio