

**Stanovisko habilitační komise ke jmenování RNDr. Pavla BAKALY, Ph.D.  
docentem pro obor Teoretická fyzika a astrofyzika**

**Vstupní a identifikační údaje:**

Složení habilitační komise:

Předseda:

Prof. Ing. Ivan Hubač, DrSc., (Filozoficko-přírodovědecká fakulta v Opavě, SU v Opavě)

Členové:

Prof. RNDr. Jiří Bičák, DrSc., dr. h. c. (Matematicko-fyzikální fakulta, Univerzita Karlova v Praze)

Prof. RNDr. Vladimír Karas, DrSc. (Astronomický ústav AV ČR, v.v.i. Praha)

Prof. RNDr. Zdeněk Stuchlík, CSc. (Filozoficko-přírodovědecká fakulta, Slezská univerzita v Opavě)

Doc. RNDr. Jiří Langer, CSc. (Matematicko-fyzikální fakulta, Univerzita Karlova v Praze)

Název habilitační práce:

***Computer Methods in Relativistic Astrophysics (Collection of annotated papers)***

Jména oponentů:

Doc. RNDr. Jiří Langer, CSc. (Matematicko-fyzikální fakulta, Univerzita Karlova v Praze)

Doc. RNDr. Petr Hadrava, DrSc. (Astronomický ústav AV ČR, v.v.i. Praha)

Doc. Ing. Oldřich Semerák, DSc. (Matematicko-fyzikální fakulta, Univerzita Karlova v Praze)

**1. Základní údaje o uchazeči:**

**1.1 Jméno, příjmení, tituly, místo a datum narození:**

Pavel Bakala, RNDr., Ph.D., nar. 22.2.1968 v Opavě

**1.2 Průběh vzdělání a získání vědeckých hodností:**

Ph.D.	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, obor Teoretická fyzika a astrofyzika (2010)
RNDr.	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, oblast přírodních věd (2008)
Mgr.	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, obor Teoretická fyzika (2006)
Bc.	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, obor Astrofyzika (2004)

### 1.3 Průběh zaměstnání:

2017 – dosud	Hvezdáreň a planetárium M.R: Štefánika v Hlohovci, projektový manažer (externí spolupráce, částečný úvazek)
2010 – dosud	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, Ústav fyziky, Centrum počítačové fyziky a zpracování dat; odborný Asistent; 2011 – 2017 proděkan pro informace a rozvoj
2006 – 2010	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, Ústav fyziky; vědecký pracovník
2005 – 2006	Slezská univerzita v Opavě, Filozoficko-přírodovědecká fakulta v Opavě, Ústav fyziky; technický pracovník
2000 – 2005	PHLANZER, spol. s.r.o.; technický ředitel
1995 – 2000	SARAI Computer, s.r.o.; technický ředitel
1991 – 1995	podnikatel OSVČ (vývoj SW)
1988 – 1991	OPBH Opava; podnikový informatik

### 1.4 Zahraniční stáže a pobytu spjaté s příslušným vědním oborem:

1. International Space Science Institute, Bern, Švýcarská federace, 10.–18.2.2018, na pozici visiting scientist
2. International Space Science Institute, Bern, Švýcarská federace, 19.–26.7.2016, na pozici visiting scientist
3. International Space Science Institute, Bern, Švýcarská federace, 10.–14.10.2016, na pozici visiting scientist
4. Canakkale Onsekiz Mart Üniversitesi, Canakkale, Turecko, LS 2011, pedagogická mobilita Erasmus
5. Canakkale Onsekiz Mart Üniversitesi, Canakkale, Turecko, LS 2010, pedagogická mobilita Erasmus
6. Canakkale Onsekiz Mart Üniversitesi, Canakkale, Turecko, LS 2009, pedagogická mobilita Erasmus
7. Canakkale Onsekiz Mart Üniversitesi, Canakkale, Turecko, ZS 2008, pedagogická mobilita Erasmus
8. Centrum pro jaderný výzkum (CERN), Ženeva, Švýcarsko, 2006, krátkodobý studijní pobyt
9. Scuola Internazionale Superiore di Studi Avanzati (SISSA), Trieste, Itálie, 2004-2005, pětiměsíční studijní pobyt

## **2. Pedagogická činnost:**

### 2.1 Vysokoškolská pedagogická praxe:

Filozoficko-přírodovědecká fakulta SU v Opavě:

#### **AR 2007/08**

- Kvantová mechanika I (UF/1U252)  
Kvantová mechanika I (UF/202)  
Speciální teorie relativity (UF/1U300)  
Speciální teorie relativity (UF/1U350)  
Základy počítačové fyzika (UF/PA140)

**AR 2008/09**

Kvantová mechanika I (UF/1U202)  
Kvantová mechanika I (UF/1U252)  
Speciální teorie relativity (UF/1U300)  
Speciální teorie relativity (UF/1U350)  
Základy počítačové fyzika (UF/PA140)

**AR 2009/10**

Speciální teorie relativity (UF/1U300)  
Speciální teorie relativity (UF/1U350)  
Základy počítačové fyzika (UF/PA140)

**AR 2010/11**

Fyzikální procesy v poli černých děr (UF/03380)  
Programování pro fyziky (UF/W3601)  
Proseminář z matematických metod ve fyzice (UF/01600)  
Fyzikální základy audiovize (UF/PB125)  
Programování v jazyce C (UF/BL124)  
Speciální teorie relativity (UF/1U300)  
Speciální teorie relativity (UF/1U350)  
Základy počítačové fyziky (UF/PA140)  
Základy počítačové fyziky (UF/PA240)

**AR 2011/12**

Fyzikální procesy v poli černých děr (UF/03380)  
Programování pro fyziky (UF/W3601)  
Proseminář z matematických metod ve fyzice (UF/01600)  
Fyzikální základy audiovize (UF/PB125)  
Programování v jazyce (UF/BL124)  
Speciální teorie relativity (UF/1U300)  
Speciální teorie relativity (UF/1U350)  
Základy počítačové fyziky (UF/PA140)  
Základy počítačové fyziky (UF/PA240)

**AR 2012/13**

Fyzikální procesy v poli černých děr (UF/03380)  
Proseminář žž matematických metod ve fyzice (UF/01600)  
Eschatologie, bod Omega, kolab. Hvězdy (UF/UF002)  
Fyzikální základy audiovize (UF/PB125)  
Speciální teorie relativity (UF/1U300)  
Speciální teorie relativity (UF/1U350)  
Základy počítačové fyziky (UF/PA140)  
Základy počítačové fyziky (UF/PA240)

**AR 2013/14**

Fyzikální procesy v poli černých děr (UF/TF501)  
Fyzikální procesy v poli černých děr (UF/03380)  
Hist.vývoj velkých mimověd.kosm.systémů (UF/TF527)  
Hist.vývoj velkých mimověd.kosm.systémů (UF/019)  
Numerické modelování v přírodních vědách (UF/PF011)  
Programování (UF/PF007)

Využití soft skills v projektovém řízení (UF/TF528)

Využití soft skills v projektovém řízení (UF/020)

Zvuková a hudební složka AV díla (UF/MM023)

#### **AR 2014/15**

Elektroakustická syntéza zvuku (UF/PF508)

Eschatologie, bod Omega, kolab.hvězdy (UF/TF522)

Eschatologie, bod Omega, kolab.hvězdy (UF/UF002)

Eschatology, Omega Point, Collaps, Stars (FPF/VA009)

Eschatology, Omega Point, Collaps, Stars (UF/TF722)

Fyzikální základy audiovize (UF/PB125)

Fyzikální základy audiovize (UF/MM512)

Klasická elektrodynamika (UF/1U106)

Klasická elektrodynamika (UF/1U156)

Speciální teorie relativity (UF/1U350)

Speciální teorie relativity (UF/F001)

Speciální teorie relativity (UF/1U300)

Vybrané partie z fyziky II (UF/PF004)

Základy počítačové fyziky (UF/PA240)

Základy počítačové fyziky (UF/MM008)

Základy počítačové fyziky (UFPA140)

Základy sound engineeringu (UF/MM518)

#### **AR 2015/16**

Digitální systémy pro přenos a záznam (UF/PF525)

Eschatologie, bod Omega, kolab. Hvězdy (UF/UF002)

Eschatologie, bod Omega, kolab. Hvězdy (UF/TF522)

Eschatology, Omega Point, Collaps, stars (FPF/VA009)

Hist. Vývoj velkých mimověd. Kosm. Systémů (UF/TF527)

Hist. Vývoj velkých mimověd. Kosm. Systémů (UF/019)

Numerické modelování v přírodních vědách (UF/PF011)

Praktikum zpracování zvuku (UF/PF526)

Programování (UF/PF007)

Special Relativity (FPF/VA015)

Využití soft skills v projektovém řízení (UF/TF528)

Využití soft skills v projektovém řízení (UF/020)

Elektroakustická syntéza zvuku UF/PF508)

Fyzikální základy audiovize (UF/MM512)

Fyzikální základy audiovize (UF/1U156)

Speciální teorie relativity (UF/1U350)

Speciální teorie relativity (TF001)

Vybrané partie z fyziky II (UF/PF004)

Základy počítačové fyziky (UF/PA240)

Základy počítačové fyziky (UF/PA140)

Základy počítačové fyziky (UFMM008)

Základy sound engineeringu (UF/MM518)

#### **AR 2016/17**

Digitální systémy pro přenos a záznam hudby (UF/PF525)

Eschatologie, bod Omega, kolab. Hvězdy (UF/UF002)  
Eschatologie, bod Omega, kolab. hvězdy (UF/TF522)  
Eschatologie, bod Omega, kolab. Hvězdy (UF/AF507)  
Eschatology, Omega Point, Collaps. Stars (FPF/VA009)  
Hist. vývoj velkých mimověd. kosm. systémů (UF/019)  
Numerické modelování v přírodních vědách (UF/PF011)  
Praktikum zpracování zvuku (UF/PF526)  
Programování (UF/PF007)  
Special Relativity (FPF/VA015)  
Využití soft skills v projektovém řízení (UF/020)  
Elektroakustická syntéza zvuku (UF/PF508)  
Fyzikální základy audiovizu (UF/PB125)  
Klasická elektrodynamika (UF/1U156)  
Klasická elektrodynamika (UF/AF007)  
Speciální teorie relativity (UF/SF008)  
Speciální teorie relativity (UF/TF001)  
Speciální teorie relativity (UF/1U350)  
Vybrané partie z fyziky II (UF/PF004)  
Základy počítačové fyziky (UF/PA140)  
Základy počítačové fyziky (UF/PA240)  
Základy počítačové fyziky (UF/MM008)  
Základy sound engineeringu (UF/MM518)

#### **AR 2017/18**

Digitální systémy pro přenos a záznam hudebních dat (UF/PF525)  
Eschatologie, bod Omega, kolab. hvězdy (UF/UF002)  
Eschatologie, bod Omega, kolab. hvězdy (UF/TF522)  
Eschatologie, bod Omega, kolab. hvězdy (UF/AF507)  
Eschatology, Omega Point, Collaps, Stars (FPF/VA009)  
Hist. vývoj velkých mimověd. kosm. systémů (UF/019)  
Numerické modelování v přírodních vědách (UF/PF011)  
Praktikum zpracování zvuku (UF/PF526)  
Programování (UF/PF007)  
Special Relativity (FPF/VA015)  
Využití soft skills v projektovém řízení (UF/020)

#### Oblast profesního zájmu:

relativistická fyzika a astrofyzika, modelování optických efektů v okolí černých dér a neutronovch hvězd, numerické metody a programování v relativistické astrofyzice, paralelní superpočítačové metody

## 2.2 Stručná charakteristika hlavních vyučovaných předmětů:

### **Název předmětu: Speciální Teorie Relativity**

#### Anotace:

Přednáška seznamuje se základy speciální teorie relativity na úrovni zajišťující průpravu pro navazující přednášku Relativistická fyzika a astrofyzika. Výklad je propojen s přednáškou Klasická elektrodynamika.

### **Název předmětu: Klasická elektrodynamika**

#### Anotace:

Výklad navazuje zejména na přednášku Elektřina a magnetismus. Maxwellovy rovnice se po krátné rekapitulaci zavádějí axiomicky, další teorie se buduje deduktivním způsobem.

### **Název předmětu: Numerické modelování v přírodních vědách**

#### Anotace:

Seznámení se základními algoritmy numerické matematiky a jejich zápisem v jazyce C. Seznámení se základními programovými balíky pro matematiku a počítačovou fyziku. Aplikace numerických metod ve vybraných tématech, grafický výstup simulačních a experimentálních dat.

## 2.3 Počet vedených kvalifikačních prací:

Bakalářské práce: 8

- Kateřina GOLUCHOVÁ: *Testování relací hmotnosti a spinu implikovaných modely kvaziperiodických oscilací*, 2011
- Tomáš HERUDEK: *Tvorba hudebních nahrávek*, 2013
- Kateřina HRBÁČOVÁ: *Zvuková knihovna se vzorky analogového syntezátoru*, 2017
- Marcel KLIMEŠ: *Vzhled oblohy pro pozorovatele volně padajícího do Kerrovy černé díry*, 2015
- Václav KUČERA: *Organizace hudebního festivalu se zaměřením na ozvučení*, 2013
- Jan PETŘÍK: *Vícestopý recording, počítačové procestování a mastering nahrávek rockových skladeb*, 2012
- Michal STANĚK: *Vizualizace optických efektů v prostředí extrémní gravitace za pomocí nástrojů virtuální reality*, 2016
- Svatopluk ŠIMÁNEK: *Uživatelské reozhraní k softwarovému simulátoru relativistické optiky*, 2010

Diplomové práce: 6

- Kateřina GOLUCHOVÁ: *Počítačové simulace oscilací akrečních struktur v okolí relativisticky kompaktních objektů*, 2013
- Debora LANČOVÁ: *Computer simulation of the trajectories of the particles driven by Poyting-Robertson effect*, 2016
- Martin PECHÁČEK: *Tvorba studiové hudební nahrávky pro rockovou skupinu Generace – 75*, 2016
- Jan PETŘÍK: *Vytvoření multipásmové šumové brány pro digitální audio aplikace jako zásuvný modul VST*, 2016

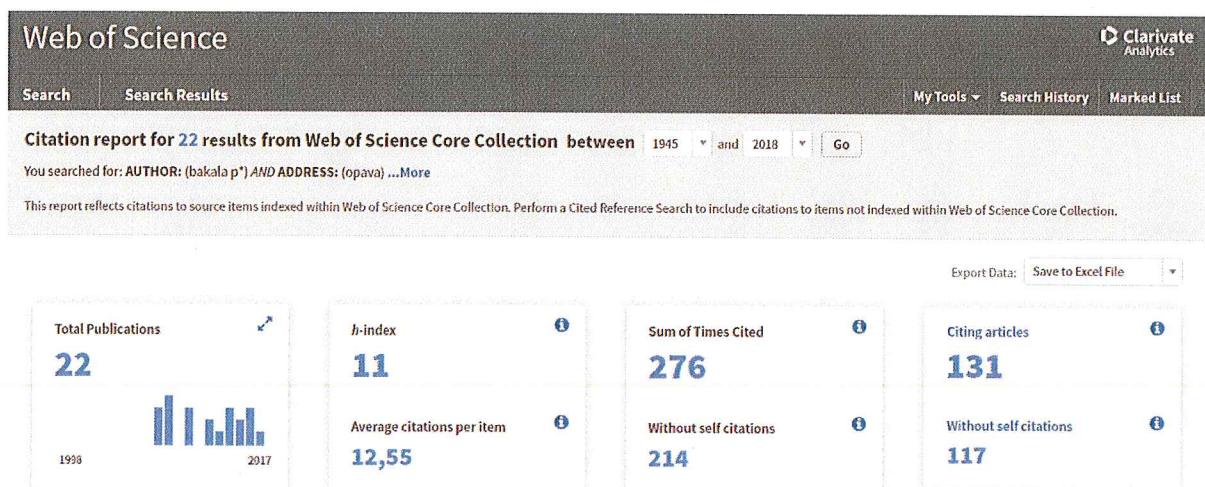
- Marek Vindyš: Počítačové simulace vzhledu vzdáleného vesmíru pro pozorovatele v blízkosti nabité sféricky symetrické černé díry, 2010
- Martin Wildner: Numerický výpočet orbitálních a epicyklických frekvencí v axiálních symetrických prostoročasech, 2011

### 3. Vědeckovýzkumná činnost:

#### 3.1 Publikační činnosti:

	Minimální kvantitativní požadavky	Doložený počet
Práce v impaktovaných vědeckých časopisech *	15	20
Články ve sbornících registrovaných na WOS a recenzovaných časopisech	nekvantifikováno	5
Vystoupení na vědeckých konferencích (v tom spoluautorské přednášky)	10	21 (+33 (spoluautorské přednášky)
Vysokoškolská pedagogická praxe	3 roky	2005 - dosud
Citace a ohlasy ve Web of Science (bez autocitací)	40	214
H-index (podle WOS)		11
Řešení grantů	nekvantifikováno	20

\* podrobný výčet publikační činnosti viz kapitola 3.2.



### Tři nejvýznamnější práce:

1. OPATRNÝ Tomáš, RICHTEREK Lukáš, **BAKALA Pavel**. Life under a black sun. *American Journal of Physics*, 2017, roč. 85, č. 1, s. 14-22.
2. **BAKALA Pavel**, GOLUCHOVÁ Kateřina, TÖRÖK Gabriel, ŠRÁMKOVÁ Eva, ABRAMOWICZ Marek A., VINCENT Frederic. H., MAZUR Grzegorz. Twin peak HF QPOs as a spectral imprint of dual oscillation modes of accretion tori. *Astronomy & Astrophysics*, 2015, roč. 581, č. A35, s. 1-13.
3. **BAKALA Pavel**, ŠRÁMKOVÁ Eva, STUHLÍK Zdeněk, TÖRÖK Gabriel. On magnetic-field induced non-geodesic corrections to relativistic orbital and epicyclic frequencies. *Classical and Quantum Gravity*, 2010, roč. 27, č. 4, s. 45001-45001.

### Tři nejvýznamnější citace:

1. Frolov, Valeri P.; Shoom, Andrey A.: Motion of charged particles near a weakly magnetized Schwarzschild black hole, *Physical Review D*, vol. 82, Issue 8, id. 084034

Citace článku:

**BAKALA Pavel**, ŠRÁMKOVÁ Eva, STUHLÍK Zdeněk, TÖRÖK Gabriel. On magnetic-field induced non-geodesic corrections to relativistic orbital and epicyclic frequencies. *Classical and Quantum Gravity*, 2010, roč. 27, č. 4, s. 45001-45001.

2. de Avellar, Marcio G. B.; Porth, Oliver; Younsi, Ziri; Rezzolla, Luciano: Kilohertz QPOs in low-mass X-ray binaries as oscillation modes of tori around neutron stars – I, *Monthly Notices of the Royal Astronomical Society*, Volume 474, Issue 3, p.3967-3975

Citace článku:

**BAKALA Pavel**, GOLUCHOVÁ Kateřina, TÖRÖK Gabriel, ŠRÁMKOVÁ Eva, ABRAMOWICZ Marek A., VINCENT Frederic. H., MAZUR Grzegorz. Twin peak HF QPOs as a spectral imprint of dual oscillation modes of accretion tori. *Astronomy & Astrophysics*, 2015, roč. 581, č. A35, s. 1-13.

3. Fragile, P. Chris; Straub, Odele; Blaes, Omer: High-frequency and type-C QPOs from oscillating, precessing hot, thick flow, *Monthly Notices of the Royal Astronomical Society*, Volume 461, Issue 2, p.1356-1362

Citace článku:

TÖRÖK Gabriel, GOLUCHOVÁ Kateřina, HORÁK Jiří, ŠRÁMKOVÁ Eva, URBANEC Martin, PECHÁČEK Tomáš, **BAKALA Pavel**. Twin peak quasi-periodic oscillations as signature of oscillating cusp torus. *Monthly Notices of the Royal Astronomical Society: Letters.*, 2016, roč. 457, č. 1, s. L19

### 3.2 Přehled publikační činnosti:

#### a) práce v impaktovaných vědeckých časopisech:

1. WATTS Anna L. et al: Dense matter with eXTP, *Science China Physics, Mechanics & Astronomy*, 2018, akceptováno pro publikaci

2. TÖRÖK Gabriel, GOLUCHOVÁ Kateřina, K., ŠRÁMKOVÁ Eva, HORÁK Jiří, BAKALA Pavel, URBANEC Martin : On one-parametric formula relating the frequencies of twin-peak quasi-periodic oscillations, *Monthly Notices of the Royal Astronomical Society: Letters*, 2018, roč. 473, číslo 1, s. L136
3. OPATRNÝ Tomáš, RICHTEREK Lukáš, BAKALA Pavel. Life under a black sun. *American Journal of Physics*, 2017, roč. 85, č. 1, s. 14-22.
4. TÖRÖK Gabriel, GOLUCHOVÁ Kateřina, URBANEC Martin, ŠRÁMKOVÁ Eva, ADÁMEK Karel, URBANCOVÁ Gabriela, PECHÁČEK Tomáš, BAKALA Pavel, STUCHLÍK Zdeněk, HORÁK J, JURYŠEK Jakub. Constraining Models of Twin-Peak Quasi-periodic Oscillations with Realistic Neutron Star Equations of State. *The Astrophysical Journal*, 2016, roč. 833, č. 2, s. 273-284.
5. TÖRÖK Gabriel, GOLUCHOVÁ Kateřina, HORÁK Jiří, ŠRÁMKOVÁ Eva, URBANEC Martin, PECHÁČEK Tomáš, BAKALA Pavel. Twin peak quasi-periodic oscillations as signature of oscillating cusp torus. *Monthly Notices of the Royal Astronomical Society: Letters*, 2016, roč. 457, č. 1, s. L19.
6. BAKALA Pavel, GOLUCHOVÁ Kateřina, TÖRÖK Gabriel, ŠRÁMKOVÁ Eva, ABRAMOWICZ Marek A., VINCENT Frederic H., MAZUR Grzegorz. Twin peak HF QPOs as a spectral imprint of dual oscillation modes of accretion tori. *Astronomy & Astrophysics*, 2015, roč. 581, č. A35, s. 1-13.
7. ŠRÁMKOVÁ Eva, TÖRÖK Gabriel, KOTRLOVÁ Andrea, BAKALA Pavel, ABRAMOWICZ Marek A., STUCHLÍK Zdeněk, GOLUCHOVÁ Kateřina, KLUŽNIAK W. Black hole spin inferred from 3:2 epicyclic resonance model of high-frequency quasi-periodic oscillations. *Astronomy & Astrophysics*, 2015, roč. 578, č. A90, s. 1-7.
8. BAKALA Pavel, TÖRÖK Gabriel, KARAS Vladimír, DOVCIAK Michal, WILDNER Martin, WZIENTEK Dalibor, ŠRÁMKOVÁ Eva, ABRAMOWICZ Marek A., GOLUCHOVÁ Kateřina, MAZUR Grzegorz, VINCENT Frederic H. Power density spectra of modes of orbital motion in strongly curved spacetime: obtaining the observable signal. *Monthly Notices of the Royal Astronomical Society*, 2014, roč. 439, č. 2, s. 1933-1939.
9. VINCENT Frederic H., MAZUR Grzegorz, STRAUB Odele, ABRAMOWICZ Marek A., KLUŽNIAK W, TÖRÖK Gabriel, BAKALA Pavel. Spectral signature of oscillating slender tori surrounding Kerr black holes. *Astronomy & Astrophysics*, 2014, roč. 563, č. A109, s. 1-9.
10. MAZUR Grzegorz, VINCENT Frederic H., MAGNUS Johansson, ŠRÁMKOVÁ Eva, TÖRÖK Gabriel, BAKALA Pavel, ABRAMOWICZ Marek A.. Towards modeling quasi-periodic oscillations of microquasars with oscillating slender tori. *Astronomy and Astrophysics*, 2013, roč. 554, č. A57, s. 1-8.
11. TÖRÖK Gabriel, BAKALA Pavel, ŠRÁMKOVÁ Eva, STUCHLÍK Zdeněk, URBANEC Martin, GO LUCHOVÁ Kateřina. Mass–angular-momentum Relations Implied by Models of Twin Peak Quasi-periodic Oscillations. *The Astrophysical Journal*, 2012, roč. 760, č. 2, s. 138-153.
12. BAKALA Pavel, URBANEC Martin, ŠRÁMKOVÁ Eva, STUCHLÍK Zdeněk, TÖRÖK Gabriel. On magnetic-field induced corrections to the orbital and epicyclic frequencies Paper II: Slowly rotating magnetized neutron stars. *Classical and Quantum Gravity*, 2012, roč. 29/6, č. 065012, s. 1-22.
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e) popularizace:

Publikace věnované relativistické astrofyzice ve vědeckopopularizačních časopisech *VESMÍR* a *KOZMOS*. Dlouholetá organizace workshopu *Školička moderní astrofyziky* pro studenty středních škol, řada dalších přednášek pro širší veřejnost věnovaných relativistické astrofyzice. Spolupráce s vědeckopopularizačním serverem OSEL.CZ (články, komentáře).

3.3 Celkové hodnocení publikační činnosti uchazeče:

RNDr. Pavel Bakala, Ph.D. publikoval 20 článků v impaktovaných časopisech. Tyto práce, jako i dalších 10 prací tvoří podklad jeho habilitační práce. Na tyto práce je 214 citací. H-index je 11, což svědčí o kvalitě autorových prací.

3.4 Řešitelství grantů, výzkumných záměrů, apod.:

Rok realizace	Název a číslo	Poskytovatel	Forma účasti řešitel/spoluřešitel
2018 - 2020	Zvyšovanie exaktných, přírodovědných a technických kompetencií študentov stredných a vysokých škol na slovensko-českom pomedzí (SCINET NFP304010D204)	Interreg V-A Slovenská republika- Česká republika, Hvezdáreň a planetárium Milana Rastislava Štefánika v Hlohovci	spoluřešitel, manažer projektu
2017 - 2020	Podpora a rozvoj mezinárodní vědecké spolupráce v oblasti relativistické astrofyziky a přípravy rentgenových kosmických misí (LTI17018.)	MŠMT LT - INTER- EXCELLENCE (2016 - 2024)	člen řešitelského týmu

2017 - 2022	Rozvoj vzdělávání na Slezské univerzitě v Opavě (CZ.02.2.69/0.0/0.0/16_015/0002400)	ESF – MŠMT OP VVV	odborný pracovník přípravy mezinárodního studijního programu, senior K3
2017 - 2022	Modernizace výukové infrastruktury Filozoficko-přírodovědecké fakulty SU v Opavě (CZ.02.2.67/0.0/0.0/16_016/0002503)	ERDF – MŠMT OP VVV	odborný garant projektu
2017 - 2019	Oscilace a koherentní jevy v akrečních discích kolem kompaktních objektů a jejich observační podpisy (17-16287S)	GAČR	člen řešitelského týmu
2013 - 2014	Pokročilá analýza dat a modelování družicových observačních dat za účasti mladých vědeckých pracovníků a Determinanty firemní filantropie a orientace na regionálním rozvoji (02983/2012/RRC)	MSK – Podpora vědy a výzkumu v Moravskoslezském kraji	řešitel
2012 - 2014	Podpora zapojení do mezinárodních sítí teoretického a observačního výzkumu v oblasti relativistické astrofyziky kompaktních objektů (CZ.1.07/2.3.00/20.0031)	MŠMT – OPVK 2.3 – Lidské zdroje ve výzkumu a vývoji	manažer klíčové aktivity projektu
2012 - 2015	Intenzifikace internacionálních, mezioborových a intersektorálních přístupů při studiu (CZ.1.07/2.2.00/28.0271)	MŠMT – OPVK 2.2 – Vysokoškolské vzdělávání	manažer klíčové aktivity projektu
2006 - 2011	Centrum teoretické astrofyziky (LC06014)	MŠMT – Centrum základního výzkumu „LC“	člen řešitelského týmu
<b>Interní grantový systém SU:</b>			
2017	Habilitační řízení v oboru Teoretická fyzika a astrofyzika (IGS/1/2017)	SU	řešitel
2009	Aktivní účast na konferenci IAU XXVII GENERAL ASSEMBLY (IGS/26/2009)	SU	řešitel
2015	Podpora spolupráce s excelentními pracovišti v oblasti studia záření z okolí černých dér (IGS/11/2015)	SU	řešitel
2007	Aktivní účast na konferenci 18th International Conference on General Relativity and Gravitation – Sydney 2007(IGS/29/2007)	SU	řešitel
2006	Aktivní účast na konferenci Eleventh Marcel Grossmann Meeting on General Relativity - Petrohrad 2006 IGS/29/2006)	SU	řešitel

<b>Projekty specifického výzkumu (Studentská grantová soutěž):</b>			
2016 - 2018	Modelování a data astrofyzikálních procesů v okolí relativistických kompaktních hvězd (SGS/15/2016)	SU	člen řešitelského týmu
2013 - 2015	Analýza a modelování astrofyzikálních observací relativistických kompaktních hvězd (SGS/11/2013)	SU	člen řešitelského týmu
2010 - 2012	Černé díry, galaktická jádra, neutornové a podivné hvězdy: analýza a modelování astrofyzikálních observací (SGS/1/2010)	SU	člen řešitelského týmu
<b>Institucionální rozvojový plán SU:</b>			
2016 - 2018	Příprava akreditace mezinárodního HOINT-DEGREE studijního programu v oblasti astrofyziky a teoretické fyziky, dílčí projekt FPF (IRP 01/2016)	MŠMT	řešitel
2016 - 2018	Rozšíření a inovace laboratorní technologické základny pro výzkum astrofyziky, teoretické fyziky, počítačové fyziky a aplikované fyziky (P09/ISIP/2016)	MŠMT	řešitel
2015 - 2017	Zapojení mladých akademických pracovníků, doktorských studentů a zahraničních expertů do aktivit výzkumného centra počítačové fyziky a zpracování dat (RP 06-5/15)	MŠMT	řešitel

### 3.5 Hodnocení vědecko-výzkumné činnosti uchazeče:

Vědecko-výzkumná činnost dr. Pavla Bakaly se týká problematiky šíření elektromagnetického záření a phyb hmoty v Kerrově metrice se započtením její interakce se zářením. Za tímto účelem vyvinul počítačové programy LSDCode+ a PTtrajectories. Cílem práce dr. Pavla Bakaly je umožnit ověřování teoretických představ o fyzice kompaktních objektů (černých dér anebo neutronových zvězd). Značná část článků habilitační práce se týká kvaziperiodických oscilací ve spektru některých astrofyzikálních objektů, jako jsou mikrovásary.

### **4. Ostatní činnost:**

#### 4.1 Recenzní a hodnotitelská činnost:

Recenze článků pro mezinárodní impaktové časopisy: *Monthly Notices of the Royal Astronomical Society, The Astrophysical Journal, Astronomy and Space Science*

Hodnotitel projektů financovaných MŠMT v rámci programů: *INGO II - VES, MOBILITY, INTER-EXCELLENCE (INTER-ACTION, INTER-TRANSFER), Česko-bavorská spolupráce ve VaV*.

Hodnocení a posudky interních projektů pro *Grantovou agenturu Univerzity Karlovy (GAUK), Astronomický ústav AV ČR*.

#### 4.2 Členství v komisích, radách, orgánech a odborných společnostech:

- Scientific Organising Committee (SOC), Conference about successes of stellar astronomy 2017, Slovenská astronomická spoločnosť pri Slovenskej akadémii vied, člen
- Scientific Organising Committee (SOC), The RAGtime 19 workshop, 2017, Ústav fyziky, Filozoficko-přírodovědecká fakulta, Slezská univerzita v Opavě, člen
- Scientific Organising Committee (SOC), Conference about successes of stellar astronomy 2016, Slovenská astronomická spoločnosť pri Slovenskej akadémii vied, člen
- Scientific Organising Committee (SOC), The RAGtime 18 workshop, 2016, Ústav fyziky, Filozoficko-přírodovědecká fakulta, Slezská univerzita v Opavě, člen
- Scientific Organising Committee (SOC), Conference about successes of stellar astronomy 2015, Slovenská astronomická spoločnosť pri Slovenskej akadémii vied, člen
- Scientific Organising Committee (SOC), Conference about successes of stellar astronomy 2014, Slovenská astronomická spoločnosť pri Slovenskej akadémii vied, člen
- Scientific Organising Committee (SOC), Conference about successes of stellar astronomy 2013, Slovenská astronomická spoločnosť pri Slovenskej akadémii vied, člen
- Scientific Organising Committee (SOC), Conference about successes of stellar astronomy 2012, Slovenská astronomická spoločnosť pri Slovenskej akadémii vied, člen

#### 4.3 Další osobní zájmy:

Klasická a i non-artificiální hudba, elektronické hudební nástroje, literatura, filozofie.

### **5. Závěrečné stanovisko habilitační komise:**

V posudku doc. RNDr. Petra Hadravy, DrSc. se konstatuje, že předložená práce svědčí o vysoké odborné úrovni vědecké práce dr. Pavla Bakaly, a to jak v oblasti relativistické astrofyziky, tak i v oblasti výpočetních metod. Doc. RNDr. Jiří Langer, CSc., konstatuje, že práce je napsána velmi přehledně a velmi pečlivě. Autor prokázal schopnosti k samostatné vědecké práci. Autor srozumitelně sděluje fakta, a proto je třeba ocenit i jeho práci popularizační. Doc. Ing. Oldřich Semerák, DSc. konstatuje, že celá práce je velmi dobře napsaná. Články byly publikovány v prestižních časopisech. Práci doporučuje přijmout jako habilitační práci. Člen komise prof. RNDr. Zdeněk Stuchlík, CSc. upozorňuje na skutečnost, že na všech pracích je počet autorů větší nebo roven 3, a přitom práce s minimem 3 autorů jsou ještě spíše výjimky. Není žádná práce, kde by byl jen předkladatel a spoluautor v podobě vedoucího práce, resp. vedeného studenta. Závěrem je třeba konstatovat, že všichni oponenti navrhují přijmout práci jako habilitační práci.

Habilitační komise je přesvědčena, že RNDr. Pavel Bakala, Ph.D. splňuje všechny předpoklady k udělení vědecko-pedagogické hodnosti a doporučuje Vědecké radě Filozoficko-přírodovědecké fakulty v Opavě Slezské univerzity v Opavě titul docenta v oboru Teoretická fyzika a astrofyzika RNDr. Pavlu Bakalovi, Ph.D. udělit.

**Příloha 1:** Seznam citací, 34 s.

**Výsledek tajného hlasování habilitační komise:**

Počet členů komise - 5

Počet hlasujících - 5

Počet hlasů kladných - 4

Počet hlasů záporných - 0

Zdržel se hlasování - 1

Místo a datum: Praha, 13. 12. 2018

Podpisy:

Předseda:



Prof. Ing. Ivan Hubač, DrSc.

Členové:



Prof. RNDr. Jiří Bičák, DrSc., dr. h. c.



Prof. RNDr. Vladimír Karas, DrSc.



Prof. RNDr. Zdeněk Stuchlík, CSc.



Doc. RNDr. Jiří Langer, CSc.

## Příloha 1 ke Stanovisku habilitační komise

RNDr. Pavel Bakala, Ph.D.

## Seznam citací – stav k 23. 5. 2018

### CITACE ČLÁNKU:

#### Life under a black sun

Opatrný, Tomáš; Richterek, Lukáš; Bakala, Pavel  
AMERICAN JOURNAL OF PHYSICS Volume: 85 Issue: 1 Pages: 14-22 Published: JAN 2017

1. Particle collisions and optical effects in the mining Kerr-Newman spacetimes

Stuchlík, Zdeněk; Blaschke, Martin; Schee, Jan  
PHYSICAL REVIEW D Volume: 96 Issue: 10 Article Number: 104050 Published: NOV 28 2017

2. AN APOLOGY FROM THE FORMER ASSOCIATE EDITOR

Schroeder, Daniel V.

### CITACE ČLÁNKU:

#### CONSTRAINING MODELS OF TWIN-PEAK QUASI-PERIODIC OSCILLATIONS WITH REALISTIC NEUTRON STAR EQUATIONS OF STATE

By: Toeroek, Gabriel; Goluchová, Katerina; Urbanec, Martin; et al.  
ASTROPHYSICAL JOURNAL Volume: 833 Issue: 2 Article Number: 273 Published: DEC 20 2016

1. Rotating stars in relativity

Paschalidis, Vasileios; Stergioulas, Nikolaos  
LIVING REVIEWS IN RELATIVITY Volume: 20 Article Number: 7 Published: NOV 29 2017

### CITACE ČLÁNKU:

#### Twin peak quasi-periodic oscillations as signature of oscillating cusp torus

Toeroek, G.; Goluchová, K.; Horák, J.; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 457 Issue: 1 Pages: L19-L23 Published: MAR 21 2016

1. Kilohertz QPOs in low-mass X-ray binaries as oscillation modes of tori around neutron stars - I

de Avellar, Marcio G. B.; Porth, Oliver; Younsi, Ziri; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 474 Issue: 3 Pages: 3967-3975 Published: MAR 2018

2. **Correlations between the frequencies of twin kHz QPOs and spins of neutron stars in LMXBs**  
Wang, De-Hua; Zhang, Cheng-Min; Qu, Jin-Lu; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 473 Issue: 4 Pages: 4862-4867 Published: FEB 2018
3. **Upper-twin-peak quasiperiodic oscillation in x-ray binaries and the energy from tidal circularization of relativistic orbits**  
Germana, C.  
PHYSICAL REVIEW D Volume: 96 Issue: 10 Article Number: 103015 Published: NOV 20 2017
4. **Super-spinning compact objects and models of high-frequency quasi-periodic oscillations observed in Galactic microquasars II. Forced resonances**  
Kotrlova, A.; Sramkova, E.; Torok, G.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 607 Article Number: A69 Published: NOV 15 2017
5. **Relation between the properties of the kilohertz quasi-periodic oscillations and spectral parameters in 4U 1636-53**  
Ribeiro, Evandro M.; Mendez, Mariano; Zhang, Guobao; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 471 Issue: 1 Pages: 1208-1214 Published: OCT 2017
6. **MHD simulations of oscillating cusp-filling tori around neutron stars - missing upper kHz QPO**  
Parthasarathy, Varadarajan; Kluzniak, Wlodzimierz; Cemeljic, Miljenko  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 470 Issue: 1 Pages: L34-L38 Published: SEP 2017
7. **Investigating the instability of the torus around the black hole in the presence of the radial and angular velocity perturbations**  
Donmez, Orhan  
TURKISH JOURNAL OF PHYSICS Volume: 41 Issue: 1 Pages: 25-40 Published: 2017
8. **CONSTRAINING MODELS OF TWIN-PEAK QUASI-PERIODIC OSCILLATIONS WITH REALISTIC NEUTRON STAR EQUATIONS OF STATE**  
Toeroek, Gabriel; Goluchova, Katerina; Urbanec, Martin; et al.  
ASTROPHYSICAL JOURNAL Volume: 833 Issue: 2 Article Number: 273 Published: DEC 20 2016
9. **High-frequency and type-C QPOs from oscillating, precessing hot, thick flow**  
Fragile, P. Chris; Straub, Odele; Blaes, Omer  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 461 Issue: 2 Pages: 1356-1362 Published: SEP 11 2016

## CITACE ČLÁNKU:

### Twin peak high-frequency quasi-periodic oscillations as a spectral imprint of dual oscillation modes of accretion tori

By: Bakala, P.; Goluchova, K.; Torok, G.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 581 Article Number: A35 Published: SEP 2015

#### 1. Kiloherz QPOs in low-mass X-ray binaries as oscillation modes of tori around neutron stars - I

de Avellar, Marcio G. B.; Porth, Oliver; Younsi, Ziri; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 474 Issue: 3 Pages: 3967-3975 Published: MAR 2018

#### 2. Life under a black sun

Opatrný, Tomáš; Richterek, Lukáš; Bakala, Pavel  
AMERICAN JOURNAL OF PHYSICS Volume: 85 Issue: 1 Pages: 14-22 Published: JAN 2017

#### 3. Oscillations of radiation pressure supported tori near black holes

Mazur, Grzegorz P.; Zanotti, Olindo; Sadowski, Aleksander; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 456 Issue: 3 Pages: 3245-3252 Published: MAR 1 2016

## CITACE ČLÁNKU:

### Power density spectra of modes of orbital motion in strongly curved space-time: obtaining the observable signal

Bakala, P.; Toeroek, G.; Karas, V.; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 439 Issue: 2 Pages: 1933-1939 Published: APR 2014

#### 1. Upper-twin-peak quasiperiodic oscillation in x-ray binaries and the energy from tidal circularization of relativistic orbits

Germana, C. PHYSICAL REVIEW D Volume: 96 Issue: 10 Article Number: 103015 Published: NOV 20 2017

#### 2. Quasi-periodic oscillations from relativistic ray-traced hydrodynamical tori

Mishra, B.; Vincent, F. H.; Manousakis, A.; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 467 Issue: 4 Pages: 4036-4049 Published: JUN 2017

#### 3. Twin peak high-frequency quasi-periodic oscillations as a spectral imprint of dual oscillation modes of accretion tori

Bakala, P.; Goluchova, K.; Torok, G.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 581 Article Number: A35 Published: SEP 2015

#### 4. Black hole spin inferred from 3:2 epicyclic resonance model of high-frequency quasi-periodic oscillations

Sramkova, E.; Torok, G.; Kotrlova, A.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 578 Article Number: A90 Published: JUN 2015

5. **Evidences of an innermost stable bound orbit predicted by general relativity from the amplitude of the twin-peak quasiperiodic oscillations**  
Germana, C.; Casana, R.  
PHYSICAL REVIEW D Volume: 91 Issue: 8 Article Number: 083013 Published: APR 29 2015
6. **Solutions to the relativistic precession model**  
Ingram, Adam; Motta, Sara  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 444 Issue: 3 Pages: 2065-2070 Published: NOV 1 2014

## CITACE ČLÁNKU:

### **Spectral signature of oscillating slender tori surrounding Kerr black holes**

By: Vincent, F. H.; Mazur, G. P.; Straub, O.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 563 Article Number: A109 Published: MAR 2014

1. **Kilohertz QPOs in low-mass X-ray binaries as oscillation modes of tori around neutron stars - I**  
de Avellar, Marcio G. B.; Porth, Oliver; Younsi, Ziri; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 474 Issue: 3 Pages: 3967-3975 Published: MAR 2018
2. **Quasi-periodic oscillations from relativistic ray-traced hydrodynamical tori**  
Mishra, B.; Vincent, F. H.; Manousakis, A.; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 467 Issue: 4 Pages: 4036-4049 Published: JUN 2017
3. **Quasi-periodic oscillations of perturbed tori**  
Parthasarathy, Varadarajan; Manousakis, Antonios; Kluzniak, Włodzimierz  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 458 Issue: 1 Pages: 666-672 Published: MAY 1 2016
4. **Oscillations of radiation pressure supported tori near black holes**  
Mazur, Grzegorz P.; Zanotti, Olindo; Sadowski, Aleksander; et al.  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 456 Issue: 3 Pages: 3245-3252 Published: MAR 1 2016
5. **A possible imprint of quasi-periodic oscillations in the X-ray spectra of black hole binaries**  
Varniere, P.; Mignon-Risse, R.; Rodriguez, J.  
ASTRONOMY & ASTROPHYSICS Volume: 586 Article Number: L6 Published: FEB 2016
6. **Twin peak high-frequency quasi-periodic oscillations as a spectral imprint of dual oscillation modes of accretion tori**  
Bakala, P.; Goluchova, K.; Torok, G.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 581 Article Number: A35 Published: SEP 2015
7. **Black hole spin inferred from 3:2 epicyclic resonance model of high-frequency quasi-periodic oscillations**  
Sramkova, E.; Torok, G.; Kotrlova, A.; et al.

## CITACE ČLÁNKU:

### The Large Observatory For x-ray Timing

Feroci, M.; den Herder, J. W.; Bozzo, E.; et al.

Conference: Conference on Space Telescopes and Instrumentation - Ultraviolet to Gamma

Ray Location: Montreal, CANADA Date: JUN 22-26, 2014

Sponsor(s): SPIE

SPACE TELESCOPES AND INSTRUMENTATION 2014: ULTRAVIOLET TO GAMMA

RAY Book Series: Proceedings of SPIE Volume: 9144 Article

Number: 9144-2T Published: 2014

1. **Super-spinning compact objects and models of high-frequency quasi-periodic oscillations observed in Galactic microquasars II. Forced resonances**  
Kotrlova, A.; Sramkova, E.; Torok, G.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 607 Article  
Number: A69 Published: NOV 15 2017
2. **X-Ray Reflection and an Exceptionally Long Thermonuclear Helium Burst from IGR J17062-6143**  
Keek, L.; Iwakiri, W.; Serino, M.; et al.  
ASTROPHYSICAL JOURNAL Volume: 836 Issue: 1 Article  
Number: 111 Published: FEB 10 2017
3. **STROBE-X: X-ray timing and spectroscopy on dynamical timescales from microseconds to years**  
Wilson-Hodge, Colleen A.; Ray, Paul S.; Gendreau, Keith; et al.  
Group Author(s): STROBE-X Collaboration  
RESULTS IN PHYSICS Volume: 7 Pages: 3704-3705 Published: 2017
4. **Accuracy of Mass and Radius Determination for Neutron Stars in X-ray Bursters from Simulated LOFT Spectra**  
Majczyna, A.; Madej, J.; Rozanska, A.; et al.  
ACTA ASTRONOMICA Volume: 67 Issue: 2 Pages: 171-180 Published: 2017
5. **ACCRETION DISK SIGNATURES IN TYPE I X-RAY BURSTS: PROSPECTS FOR FUTURE MISSIONS**  
Keek, L.; Wolf, Z.; Ballantyne, D. R.  
ASTROPHYSICAL JOURNAL Volume: 826 Issue: 1 Article  
Number: 79 Published: JUL 20 2016
6. **Testing the no-hair theorem with observations of black holes in the electromagnetic spectrum**  
Johannsen, Tim  
CLASSICAL AND QUANTUM GRAVITY Volume: 33 Issue: 12 Article  
Number: 124001 Published: JUN 23 2016
7. **Magnetised accretion discs in Kerr spacetimes II. Hot spots**  
Garcia, Federico; Ranea-Sandoval, Ignacio F.; Johannsen, Tim  
ASTRONOMY & ASTROPHYSICS Volume: 587 Article  
Number: A141 Published: MAR 2016

8. **Large Observatory for x-ray Timing (LOFT-P): A Probe-class Mission Concept Study**  
Wilson-Hodge, Colleen A.; Ray, Paul S.; Chakrabarty, Deepto; et al.  
Group Author(s): LOFT Consortium US-LOFT SWG; LOFT-P Collaboration  
Conference: Conference on Space Telescopes and Instrumentation - Ultraviolet to Gamma Ray Location: Edinburgh, SCOTLAND Date: JUN 26-JUL 01, 2016  
Sponsor(s): SPIE  
SPACE TELESCOPES AND INSTRUMENTATION 2016: ULTRAVIOLET TO GAMMA RAY Book Series: Proceedings of SPIE Volume: 9905 Article Number: UNSP 99054Y-1 Part: 1 Published: 2016
9. **The X-ray optics for X-ray pulsar navigation**  
Jin Dongdong; Li Wenbin; Lian Jian; et al.  
Conference: Photoelectronic-Technology-Committee Conference Location: PEOPLES R CHINA Date: NOV 15-28, 2015  
Sponsor(s): Photoelectron Technol Comm  
SELECTED PAPERS OF THE PHOTOELECTRONIC TECHNOLOGY COMMITTEE CONFERENCES HELD NOVEMBER 2015 Book Series: Proceedings of SPIE Volume: 9796 Article Number: UNSP 979622 Published: 2016
10. **Magnetars: the physics behind observations. A review**  
Turolla, R.; Zane, S.; Watts, A. L.  
REPORTS ON PROGRESS IN PHYSICS Volume: 78 Issue: 11 Article Number: 116901 Published: NOV 2015
11. **Four-hair relations for differentially rotating neutron stars in the weak-field limit**  
Bretz, Joseph; Yagi, Kent; Yunes, Nicolas  
PHYSICAL REVIEW D Volume: 92 Issue: 8 Article Number: 083009 Published: OCT 19 2015
12. **Twin peak high-frequency quasi-periodic oscillations as a spectral imprint of dual oscillation modes of accretion tori**  
Bakala, P.; Goluchova, K.; Torok, G.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 581 Article Number: A35 Published: SEP 2015
13. **Inertial-acoustic oscillations of black hole accretion discs with large-scale poloidal magnetic fields**  
Yu, Cong; Lai, Dong  
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY Volume: 450 Issue: 3 Pages: 2466-2472 Published: JUL 1 2015
14. **Soft proton scattering efficiency measurements on x-ray mirror shells**  
Diebold, Sebastian; Tenzer, Chris; Perinati, Emanuele; et al.  
EXPERIMENTAL ASTRONOMY Volume: 39 Issue: 2 Pages: 343-365 Published: JUN 2015
15. **Properties and observability of glitches and anti-glitches in accreting pulsars**  
Ducci, L.; Pizzochero, P. M.; Doroshenko, V.; et al.  
ASTRONOMY & ASTROPHYSICS Volume: 578 Article Number: A52 Published: JUN 2015

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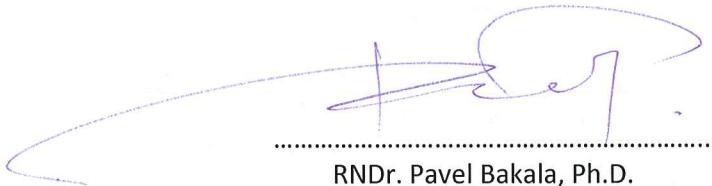
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