

Mini-Grant
(20kEuro)

Retrieval of exoplanetary atmospheres exploiting high resolution spectroscopic data

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Obiettivo progetto:

- Sviluppo e test di un framework per i retrieval atmosferici con spettroscopia ad alta(+bassa) risoluzione

Obiettivi in stato avanzato/raggiunti:

- sviluppo del tool Guibrush® : **Graphic User Interface for Bayesian Retrieval Using Spectroscopy at High Resolution**. -> Traduzione del codice bayesiano Differential Evolution Monte Carlo Markov Chain (DE-MCMC) da IDL a Python; parallelizzazione del codice DE-MCMC in modo tale che il calcolo del modello e della relativa funzione di verosimiglianza tra gli spettri di trasmissione degli esopianeti osservati e quelli teorici a ogni passo di ciascuna delle N catene DE-MCMC sia eseguito simultaneamente su N processori del server HOT-ATMOS presso l'INAF-OATo, dove tipicamente $N > 20$. Il codice è una deliverable dello Spoke3@PNRR
- Test del codice sui dati HR nell'infrarosso (Giano-b@TNG) su due benchmark targets del progetto GAPS: HD209458b & HD189733 -> Paper in preparazione
- Combinazione con i dati HST di archivio per HD209458b & HD189733 -> paper in preparazione

Spese sostenute:

- 11k euro per acquisto server con GPU (al 7/11/2023 la pratica è aperta)
- 1756,95 euro per missioni (Andes@ELT meeting, Ariel meeting, Collaborazione con Pallé/Carleo @IAC)

Obiettivi futuri:

- Porting del codice di trasporto radiativo su GPU -> 10-100x più veloce
- Estensione del codice ad altri strumenti HR quali Carmenes, Cires+, HARPS-N, Spirou
- Combinazione con i primi dati JWST

Screenshots of GUIbrushR

GUIbrushR: GUI for Bayesian Retrieval Using Spectroscopy at High Resolution

General configuration: Parameter configuration | Corner Plot | Model Plot | Delete run from DB and/or in the system | Data Reduction | Tell file | Cross Correlation | Manual Model | Resume Retrieval

Target: wdJ999 | Night: 20190724_2019089_2021028 | Night Sim. maxsteps: 100000 | Seed: 1990

Mode: Free Chemistry | Atmos: IS2 | Ec & Opt | Scattering | molec_instr: Full | LM sampling: 4

Tell file method: Eigenvalues | continuum_opacity: H2_K2_K2_H2 | Resolution: High/Low | Instrument: NIST | Model Reps: Hard |

Min pressure (Eq. 10'): 9 | Max pressure (Eq. 10'): 1 | Pressure layers: 50

Comments: Window size: 40

General parameters	Temperatures	VMR	Molecules	Scale	Range_min	Range_max	In_layers	Fixed values (199 + None)	mass (199 + None)	Signal Prior (199 + None)	Constant VMR
Name	Prior	Value	Molecule	Scale	Range_min	Range_max	In_layers	Fixed values (199 + None)	mass (199 + None)	Signal Prior (199 + None)	Constant VMR
H2	0	0	H2	0	0	0	0	0.055	2.016	999	0
He	0	0	He	0	0	0	0	0.143	4.002602	999	0
H2O_trop	5	0.1	-10	-1	-1	0	0	999	18.013	999	0
HCl_exomol	5	0.1	-10	-1	-1	0	0	999	37.026	999	0
NH3_exomol_cs_paper	5	0.1	-10	-1	-1	0	0	999	17.031	999	0
OH_trop	5	0.1	-10	-1	-1	0	0	999	18.043	999	0
CH2_acety	5	0.1	-10	-1	-1	0	0	999	26.0373	999	0
CO2_ams	5	0.1	-10	-1	-1	0	0	999	22.009	999	0
CO_trop	5	0.1	-10	-1	-1	0	0	999	28.01	999	0
OH_main_tro	5	0.1	-10	-1	-1	0	0	999	17.008	999	0
O2	5	0.1	-10	-1	-1	0	0	999	32	999	0
Na_alard	5	0.1	-10	-1	-1	0	0	999	22.99	999	0
K	5	0.1	-10	-1	-1	0	0	999	39.1	999	0
SiO_main_tro	5	0.1	-10	-1	-1	0	0	999	60.08	999	0
TiO	5	0.1	-10	-1	-1	0	0	999	61.87	999	0
Cr	5	0.1	-10	-1	-1	0	0	999	52	999	0

START

PID	Target	Time	ID	Output

UPDATE OUTPUT **KILL SELECTED PROCESS**

From Retrieval: From Right

Target: wdJ999 | Mode: None | Blac: None | Scattering: None | Resolution: None | Eccentricity: None | Distribution: None | Median Dist: None

Beer1	Parabolic	ID	Bestests	Fixed	Molec EQ	Priors	Molec Model	Nights	Method
		2023_11_0711_38_32	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190603	Eigenvalues
		2023_11_0711_26_21	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190827	Eigenvalues
		2023_11_0614_38_49	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190827	Eigenvalues
		2023_11_0614_54_54	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0314_06_24	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0314_06_15	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0217_28_09	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=5.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190707_20190829	Eigenvalues
		2023_10_2914_12_32	km150.01 rvm0.01 To10000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	hdu_jutape			hdu_jutape	20190829	Eigenvalues
		2023_10_2914_12_11	km150.01 rvm0.01 To10000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	hdu_jutape			hdu_jutape	20190707	Eigenvalues
		2023_10_2412_38_49	km150.01 rvm0.01 To14850.01 Pcr=1.01 cweaco0.01 cf=0.01 H2O_0955 Mem0_1451 rsm1.31	cbe			cbe	20190603	Eigenvalues

SEARCH IN DB

Run CC: **WFilter**

SUM CC FROM TABLE

START

Beer1	Parabolic	ID	Bestests	Fixed	Molec EQ	Priors	Molec Model	Nights	Method
		2023_11_0711_38_32	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190603	Eigenvalues
		2023_11_0711_26_21	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190827	Eigenvalues
		2023_11_0614_38_49	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190827	Eigenvalues
		2023_11_0614_54_54	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0314_06_24	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0314_06_15	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0217_28_09	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=5.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190707_20190829	Eigenvalues
		2023_10_2914_12_32	km150.01 rvm0.01 To10000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	hdu_jutape			hdu_jutape	20190829	Eigenvalues
		2023_10_2914_12_11	km150.01 rvm0.01 To10000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	hdu_jutape			hdu_jutape	20190707	Eigenvalues
		2023_10_2412_38_49	km150.01 rvm0.01 To14850.01 Pcr=1.01 cweaco0.01 cf=0.01 H2O_0955 Mem0_1451 rsm1.31	cbe			cbe	20190603	Eigenvalues

SHOW PREVIOUS PLOTS **SHOW PREVIOUS PLOT** **SHOW PREVIOUS PLOTS** **SHOW COMMENTS** **SHOW COMMENTS**

Plot Parameters:

- Gravity: 9823074.366680001
- Likelihood: 11646126.733317602
- Risc: 0
- String reduced: 0
- Bad Chains: 0

Plot: **SHOW PREVIOUS PLOTS** **SHOW PREVIOUS PLOTS**

START

Beer1: Parabolic

Target: wdJ999 | Mode: None | Blac: None | Scattering: None | Resolution: None | Eccentricity: None | Distribution: None | Median Dist: None

Beer1	Parabolic	ID	Bestests	Fixed	Molec EQ	Priors	Molec Model	Nights	Method
		2023_11_0711_38_32	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190603	Eigenvalues
		2023_11_0711_26_21	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190827	Eigenvalues
		2023_11_0614_38_49	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190827	Eigenvalues
		2023_11_0614_54_54	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0314_06_24	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0314_06_15	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190829	Eigenvalues
		2023_11_0217_28_09	km150.01 rvm0.01 To7000.01 Pcr=1.01 H2O=5.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	jeunh			jeunh	20190707_20190829	Eigenvalues
		2023_10_2914_12_32	km150.01 rvm0.01 To10000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	hdu_jutape			hdu_jutape	20190829	Eigenvalues
		2023_10_2914_12_11	km150.01 rvm0.01 To10000.01 Pcr=1.01 H2O=2.01 H cf=0.01 H2O_0955 Mem0_1451 rsm1.31	hdu_jutape			hdu_jutape	20190707	Eigenvalues
		2023_10_2412_38_49	km150.01 rvm0.01 To14850.01 Pcr=1.01 cweaco0.01 cf=0.01 H2O_0955 Mem0_1451 rsm1.31	cbe			cbe	20190603	Eigenvalues

SEARCH IN DB

LM sampling: 4 | WFilter | Run CC: **WFilter** | Distribution: **WFilter** | **SHOW PREVIOUS PLOTS** **SHOW PREVIOUS PLOTS**

Transmission spectra

Plot Parameters:

- Min pressure (Eq. 10'): 9823074.366680001
- Likelihood: 11646126.733317602
- Risc: 0
- String reduced: 0
- Bad Chains: 0

Plot: **SHOW PREVIOUS PLOTS** **SHOW PREVIOUS PLOTS**

START