Technology Transfer Activities @ ICE-CSIC

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ICE/CSIC & IEEC, UAB

VII CPAN DAYS, Segovia, 1 Dec 2015

Summary

- Short note on Science @ ICE-CSIC
- Hard-X and gamma-ray imaging
- Summary of other projects:
  - PAU, DES
  - LISA Pathfinder
  - Robotic telescopes
  - Remote-sensing techniques
- Two very recent distinctions

Instituto de Ciencias del Espacio (ICE/CSIC)

Institut d’Estudis Espacials de Catalunya (IEEC)

SCIMAGO INSTITUTIONS RANKINGS

SIR World Report 2011 :: Normalized Impact Report

NORMALIZED IMPACT REPORT

This document is an attachment extracted from SIR World Report 2011, it contains exactly the same information but the ordering variable has been set to Normalized Impact. All the values as well as insitutitutions coincide with those included in SIR World Report 2011 :: Global Ranking also available at http://www.scimagoir.com

This report uses two decimal values for the Normalized Impact variable instead just one as it is usual in SIR Reports in order to avoid an extremely high number of identical ranks in institutions. For those institutions which have identical NI values using two decimals, the alphabetical order has been set.

Introduction

The current report involves the third release of our annual series *Scimago Institutions Rankings World Reports*, that based on quantitative data of citation and publication shows bibliometric indicators that unveil some of the main dimensions of research performance of worldwide research-devoted institutions. As in former editions, **SIR World Report 2011** aims at becoming an evaluation framework of research performance to Worldwide Research Organizations.

The report shows six indicators that will help users evaluate the scientific impact, thematic specialization, output size and international collaboration networks of the institutions.

The period analyzed in the current edition covers 2005-09. The tables include institutions having published at least 100 scientific documents of any type, that is, articles, reviews, short reviews, letters, conference papers, etc., during the year 2009 as collected by worldwide leader scientific database Scopus by Elsevier. The report encompasses Higher Education Institutions (HEIs) as well as other research-focused organizations from different sizes, with different missions and from

Indicators

Selected indicators seek to reveal main aspects of research size, performance, impact and internationalization at Worldwide Research Institutions.

O::Output

An institution's publication output reveals its scientific outcomes in terms of published documents in scholarly journals.

IC::International Collaboration

IC shows an institution's output ratio that has been produced in collaboration with foreign institutions. The values are computed by analyzing the institution's output whose affiliation includes more than one country address over the whole period.

NI::Normalized Impact

The values, expressed in percentages, show the relationship of an institution's average scientific impact and the world average, which is 1, --i.e. a score of 0.8 means the institution is cited 20% below average and 1.3 means the institution is cited 30% above average. More on NI.

Q1::High Quality Publications

Ratio of publications that an institution publishes in the most influential scholarly journals of the world; those ranked in the first quartile (25%) in their

NORMALIZED IMPACT REPORT

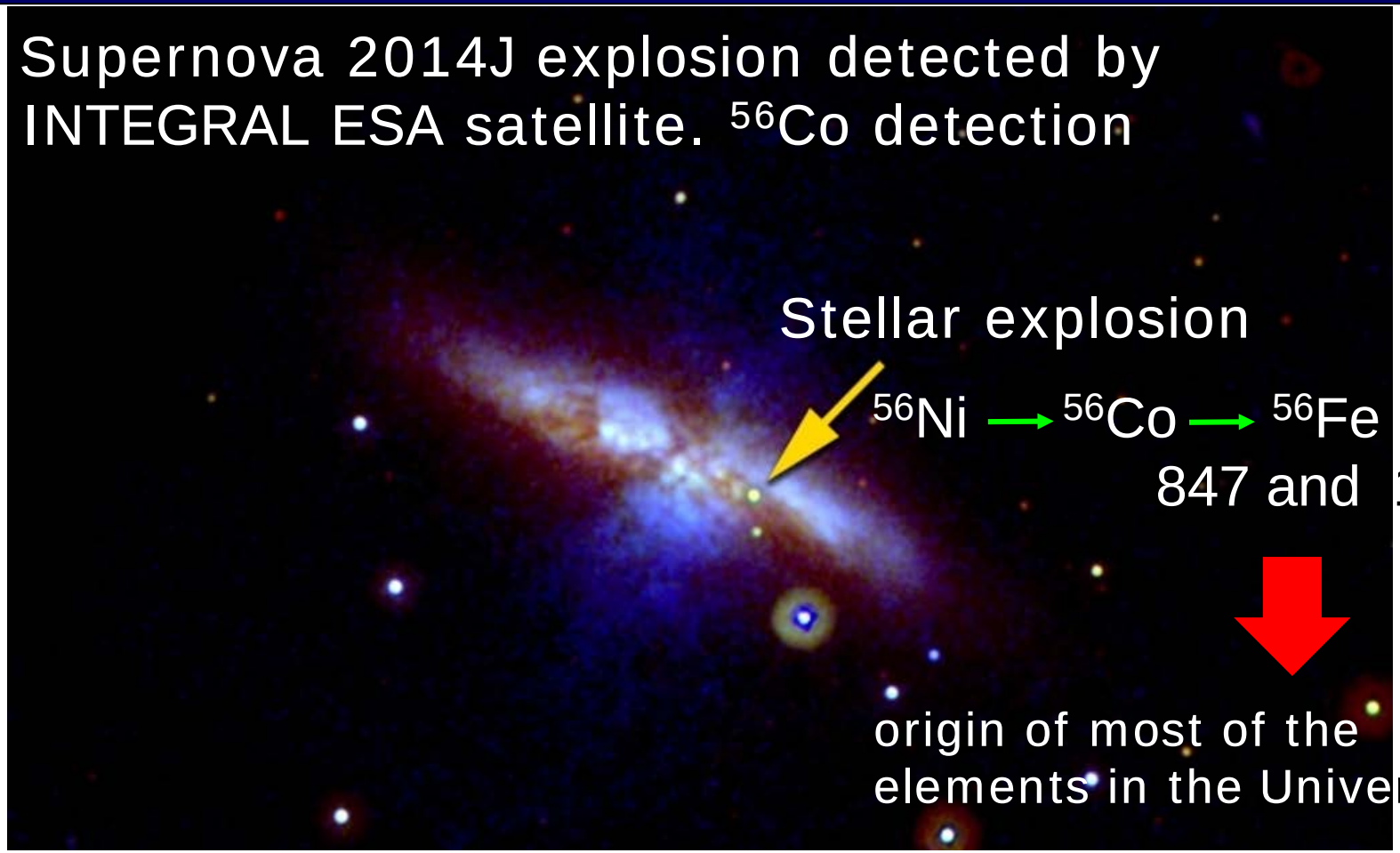
SIR World Report 2011
http://www.scimagoir.com

WR	RR	CR	Organization	Sector	Country	Region	Output	IC(%)	Q1(%)	NI
1	1	1	George Institute for International Health	GO	AUS	OC	362	58.0	82.9	6.17
2	1	1	American Cancer Society	HL	USA	NA	600	23.0	83.3	5.94
3	2	2	Whitehead Institute for Biomedical Research	GO	USA	NA	759	33.5	95.3	5.72
4	3	3	Broad Institute of MIT and Harvard	GO	USA	NA	1,377	49.2	94.1	5.71
5	1	1	Wellcome Trust Sanger Institute	HL	GBR	WE	1,581	66.5	90.7	3.98
6	4	4	Novartis Pharma SA, East Hanover	CO	USA	NA	932	53.0	74.9	3.46
7	5	1	Hamilton Health Sciences	HL	CAN	NA	1,293	36.9	63.7	3.26
8	2	1	Institut d'Estudis Espacials de Catalunya	GO	ESP	WE	753	71.1	60.6	3.21
9	6	5	Dana Farber Cancer Institute	HL	USA	NA	5,966	30.3	85.9	3.14
10	7	6	J. Craig Venter Institute	HL	USA	NA	754	49.6	90.1	3.13
11	8	7	Centocor, Incorporated	CO	USA	NA	555	36.4	80.9	3.12
12	9	8	Howard Hughes Medical Institute	HL	USA	NA	10,807	30.7	94.9	3.10
13	3	2	Microsoft Research Cambridge	CO	GBR	WE	748	58.0	34.2	3.10
14	10	9	Kaiser Permanente	HL	USA	NA	1,008	12.5	87.2	3.08
15	11	10	F. Hoffmann-La Roche, Ltd.	CO	USA	NA	2,476	31.9	83.1	3.07
16	12	11	Institute for Systems Biology	HL	USA	NA	591	56.9	88.3	3.07
17	13	2	Institute for Clinical Evaluative Sciences	HL	CAN	NA	786	23.2	71.1	3.01
18	14	12	Cold Spring Harbor Laboratory	HL	USA	NA	1,018	42.0	93.0	3.00
19	4	1	World Health Organization Switzerland	HL	CHE	WE	2,885	76.6	74.6	2.94
20	15	13	Harvard-MIT Division of Health Sciences and	HE	USA	NA	607	29.7	72.8	2.91

WR	RR	CR	Organization	Sector	Country	Region	O	% IC	NI	% Q1	Spec	% Exc	% Lead	% EwL
1	1	1	American Cancer Society	HL	USA	NA	633	27.65	6.15	79.15	0.92	33.49	43.92	15.48
2	2	2	Broad Institute of MIT and Harvard	GO	USA	NA	1779	51.83	5.46	89.88	0.9	52.52	18.1	9.34
3	3	3	Whitehead Institute for Biomedical Research	GO	USA	NA	816	35.42	5.26	91.3	0.92	51.91	47.55	25.4
4	1	1	Swiss Institute of Bioinformatics	OT	CHE	WE	486	61.32	4.74	76.34	0.89	40.8	21.19	5.5
5	1	1	George Institute for International Health	HL	AUS	OC	602	56.98	4.68	74.75	0.89	30.22	54.15	15.86
6	2	1	Wellcome Trust Sanger Institute	HL	GBR	WE	1818	67.88	4.19	86.36	0.91	38.21	31.19	10.71
7	3	2	Wellcome Trust	GO	GBR	WE	567	62.61	3.99	73.19	0.91	36.26	44.09	13.55
8	4	3	European Bioinformatics Institute EMBL	GO	GBR	WE	897	65.77	3.92	73.47	0.9	35.91	40.69	12.24
9	5	1	Institut de Ciencies de l'Espai (sub)	GO	ESP	WE	682	78.74	3.43	63.78	0.97	31.25	25.37	3.57
10	6	2	World Health Organization Switzerland	HL	CHE	WE	3036	78.52	3.38	68.48	0.85	30.62	38.93	9.73
10	4	4	Doe Joint Genome Institute	GO	USA	NA	510	62.94	3.38	72.75	0.95	42.09	24.12	8.5
11	7	1	GlaxoSmithKline, Belgium (sub)	PR	BEL	WE	512	88.09	3.35	53.52	0.93	27.15	28.71	7.23
12	5	5	John E. Fogarty International Center for Advanced Study in the Health Sciences (sub)	HL	USA	NA	401	54.11	3.3	81.55	0.94	31.75	20.2	5
13	6	6	National Heart, Lung and Blood Institute (sub)	HL	USA	NA	3203	30.72	3.26	80.71	0.84	32.52	41.93	11.26
14	7	7	Dana Farber Cancer Institute	HL	USA	NA	6637	31.85	3.24	79.57	0.87	36.17	44.33	15.42
15	8	8	Novartis Pharmaceuticals, United States (sub)	PR	USA	NA	1338	53.96	3.23	67.34	0.83	34.71	22.87	5.03
16	9	1	Montreal Heart Institute	HL	CAN	NA	758	42.35	3.21	69.92	0.93	28.42	46.97	10.79
17	10	9	Yahoo Research Labs	GO	USA	NA	739	24.63	3.19	38.43	0.93	29.4	49.8	13.81
18	11	10	National Center for Biotechnology Information (sub)	GO	USA	NA	789	37.39	3.16	78.71	0.9	32.68	53.23	17.12
19	8	4	Manchester Academic Health Science Centre	HE	GBR	WE	318	45.91	3.15	75.16	0.89	27.76	49.69	10.09
20	12	11	Howard Hughes Medical Institute	HL	USA	NA	11800	30.86	3.12	91.81	0.87	43.05	35.93	15.3
21	9	5	Microsoft Research Cambridge	PR	GBR	WE	906	61.37	3.1	36.42	0.93	32.48	45.03	13.22
22	13	12	Genentech Inc. (sub)	PR	USA	NA	1956	26.18	3.09	78.89	0.82	34.95	47.7	14.89
23	14	13	J. Craig Venter Institute	HL	USA	NA	738	50.81	3.07	83.47	0.92	41.26	26.15	11.07
23	14	13	National Institute of Arthritis and Musculoskeletal and Skin Diseases (sub)	HL	USA	NA	724	38.4	3.07	81.22	0.91	37.25	46.27	16.39
24	1	1	Microsoft Research, India	PR	IND	AS	309	58.25	3.05	25.89	0.95	25.88	49.51	9.41
24	15	14	Mitsubishi Electric Research Laboratories	GO	USA	NA	623	43.5	3.05	29.05	0.95	26.79	47.03	11.41
25	16	15	Los Angeles Biomedical Research Institute	HL	USA	NA	1027	20.64	3.02	75.27	0.87	29.63	48.78	12.09
26	17	16	Cold Spring Harbor Laboratory	HL	USA	NA	1072	44.4	3.01	89.65	0.9	43.21	43.84	18.4
27	18	17	AstraZeneca, United States (sub)	PR	USA	NA	775	40.65	3	72.65	0.9	30.4	25.81	5.17
28	19	18	San Francisco VA Medical Center (sub)	HL	USA	NA	1962	21.56	2.99	79.66	0.84	35.43	45.77	15.03
28	19	18	Centocor, Incorporated	PR	USA	NA	619	37.96	2.99	68.98	0.93	31.07	36.03	7.44
29	10	2	Institut d'Estudis Espacials de Catalunya	GO	ESP	WE	898	71.16	2.98	55.46	0.97	26.68	27.95	3.94
29	20	19	Baylor Health Care System	HL	USA	NA	1174	21.21	2.98	65.84	0.88	22.74	49.74	6.5
30	2	1	Genome Institute of Singapore (sub)	GO	SGP	AS	601	65.39	2.97	78.87	0.88	31.53	38.27	10.12
30	21	20	Institute for Systems Biology	HL	USA	NA	609	56.81	2.97	80.46	0.88	41.01	32.84	11.26
31	22	21	New England Research Institutes	GO	USA	NA	500	26.6	2.96	83.2	0.92	36.8	37	12.6
31	2	1	Auckland City Hospital	HL	NZL	OC	1137	42.22	2.96	53.56	0.87	20.7	51.28	6.43
32	23	22	National Human Genome Research Institute (sub)	HL	USA	NA	1462	39.67	2.94	74.9	0.86	30.43	39.88	11.21
33	24	23	Hoffmann-La Roche, Inc., United States (sub)	PR	USA	NA	3147	32.19	2.93	76.96	0.8	32.68	40.32	11.74
34	11	1	Laboratoire Leprince-Ringuet (sub)	GO	FRA	WE	703	92.75	2.92	82.36	0.99	35.53	7.4	0.29
35	25	24	Harvard-MIT Division of Health Sciences and Tecnology	HE	USA	NA	1312	33.31	2.91	70.2	0.83	39.74	24.09	6.54
35	12	1	Steno Diabetes Center	HL	DNK	WE	553	54.79	2.91	78.66	0.96	24.23	44.48	7.78
36	13	3	Institut Catala d'Oncologia, Hospitalet de Llobregat	HL	ESP	WE	1019	58.59	2.88	65.46	0.9	30.52	30.91	6.18
36	26	25	Group Health Cooperative	HL	USA	NA	994	15.79	2.88	80.28	0.87	33.13	32.9	8.38
36	26	25	Sanofi-Aventis, United States (sub)	PR	USA	NA	533	35.08	2.88	64.92	0.85	22.64	18.39	1.13
37	14	1	Laboratorio de Instrumentacao e Fisica Experimental de Particulas	GO	PRT	WE	440	85.45	2.85	40	0.98	23.08	21.59	2.16
37	14	2	Laboratoire d'Annecy-le-Vieux de Physique des Particules (sub)	GO	FRA	WE	588	91.5	2.85	75.68	0.99	27.52	58.5	12.14
38	27	26	Bristol-Myers Squibb Company	PR	USA	NA	2196	26.82	2.84	70.77	0.84	24.56	50.87	8.02
39	28	27	Tufts Medical Center	HL	USA	NA	3195	26.76	2.82	74.99	0.77	28.22	45.88	10.78
40	1	1	F. Hoffmann-La Roche*	PR	MUL		4488	41.07	2.81	74.31	0.8	30.54	39.08	10.93
40	15	1	Max Planck Institut fur Molekulare Pflanzenphysiologie (sub)	GO	DEU	WE	683	63.4	2.81	83.46	0.93	44.43	45.53	20.67
40	29	28	Novartis Institutes for Biomedical Research, United States (sub)	PR	USA	NA	998	49.7	2.81	80.26	0.85	38.12	33.17	10.62
40	29	28	Google Inc.	PR	USA	NA	1518	28.66	2.81	36.63	0.9	28.48	43.94	11.7

Hard-X and gamma-ray imaging detector for astrophysics based on pixelated CdTe semiconductors

JL. Gálvez, M. Hernanz, L. Álvarez, B. Artigues
M. Lozano, G. Pellegrini, M. Ullán, E. Cabruja, R. Martínez
(IMB-CNM CSIC)
M. Chmeissani, C. Puigdengoles (IFAE)


Supernova 2014J explosion detected by INTEGRAL ESA satellite. ^{56}Co detection
Stellar explosion
^{56}Ni → ^{56}Co → ^{56}Fe
847 and 1238keV
origin of most of the elements in the Universe

Radioactive isotopes relevant for γ-ray astronomy

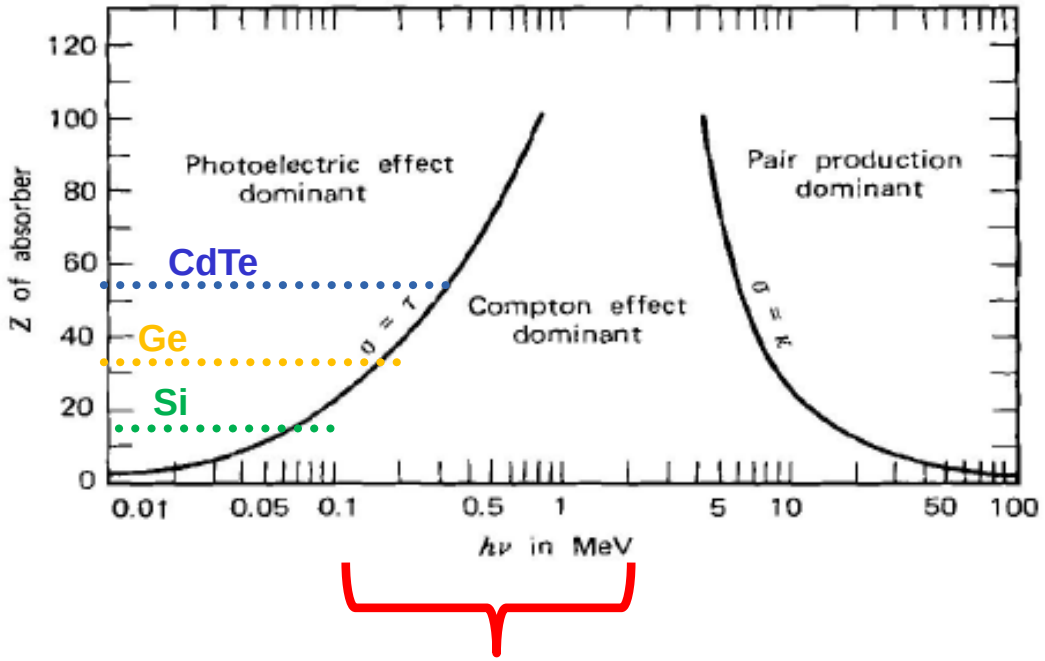
	Isotope	Decay chain	Lifetime	Line energy (keV)
Supernovae mainly	^{56}Ni	^{56}Ni → ^{56}Co	8.8 d	158, 812, 750, 480
	^{56}Co	^{56}Co → ^{56}Fe	111 d	847, 1238
	^{57}Ni	^{57}Ni → ^{57}Co → ^{57}Fe	(52 h) 390 d	122
	^{44}Ti	^{44}Ti → ^{44}Sc → ^{44}Ca	89 y (5.4 h)	78, 68, 1157
	^{26}Al	^{26}Al → ^{26}Mg	1.0 x 10^6 y	1809
	^{60}Fe	^{60}Fe → ^{60}Co → ^{60}Ni	2.0 x 10^6 y (7.6 y)	1173, 1332
Novae mainly	^{7}Be	^{7}Be → ^{7}Li	77d	478
	^{22}Na	^{22}Na → ^{22}Ne	3.8 y	1275

→ e⁻ capture → β⁺ → β⁻

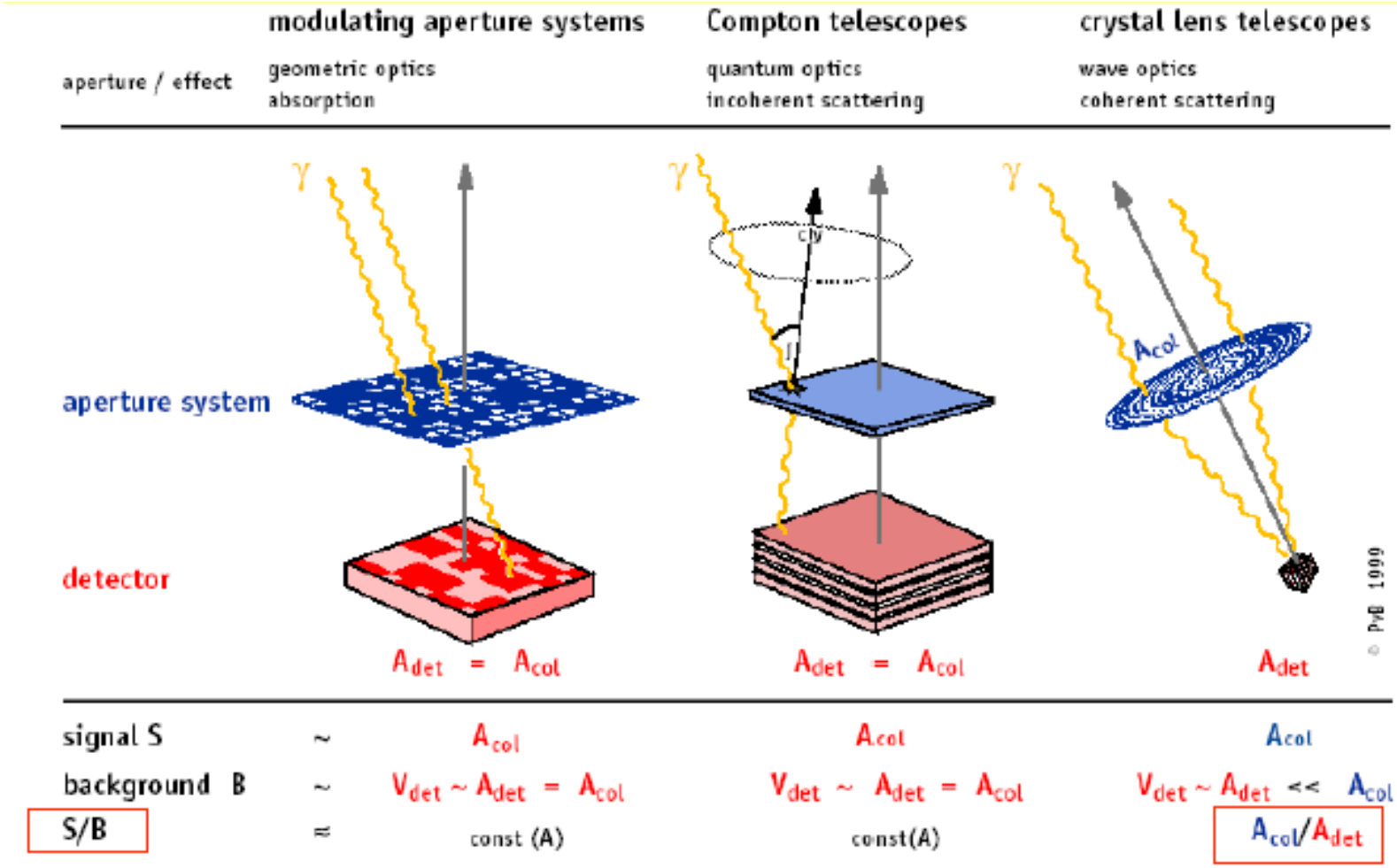
positrons: 511 keV

How can hard-X / γ-ray be detected?

γ-ray absorption mechanism: photoelectric absorption; Compton scattering; pair (e^--e^+) creation



Region of interest **(~100keV to 2MeV)** is dominated by the Compton effect

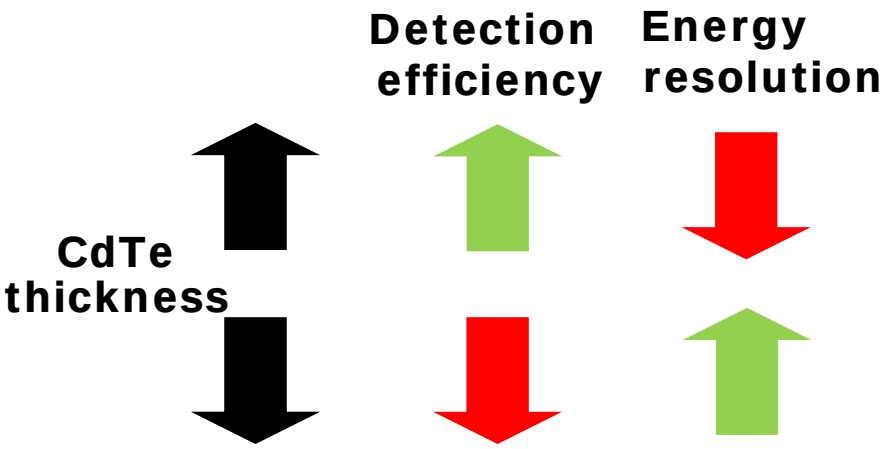


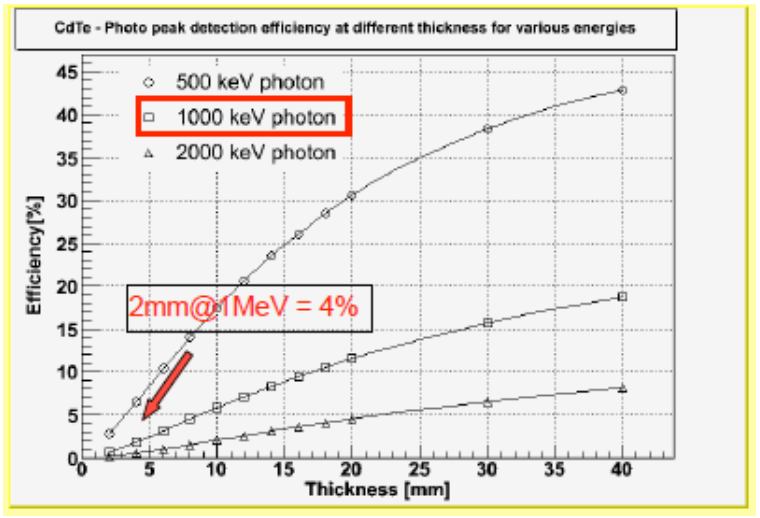
from Peter von Ballmoos, CESR, Tolouse

aperture / effect	modulating aperture systems geometric optics absorption	Compton telescopes quantum optics incoherent scattering	crystal lens telescopes wave optics coherent scattering
			
	INTEGRAL/SPI and IBIS (2002-) Swift/BAT (2004-)	CGRO/COMPTEL (1991-2000) ASTRO-H/SGD (2015/16-) ACT concept	Claire balloon flight (2001) MAX proposal GRI proposal DUAL proposal
detector			
	$A_{det} = A_{col}$		A_{det}
signal S ~	A_{col}	A_{col}	A_{col}
background B ~	$V_{det} \sim A_{det} = A_{col}$	$V_{det} \sim A_{det} = A_{col}$	$V_{det} \sim A_{det} << A_{col}$
S/B ≈	const (A)	const(A)	A_{col}/A_{det}

Challenge: Reaching E ~ 1MeV with high detection efficiency, keeping a good spatial and energetic resolution.

Trade-off detector design:

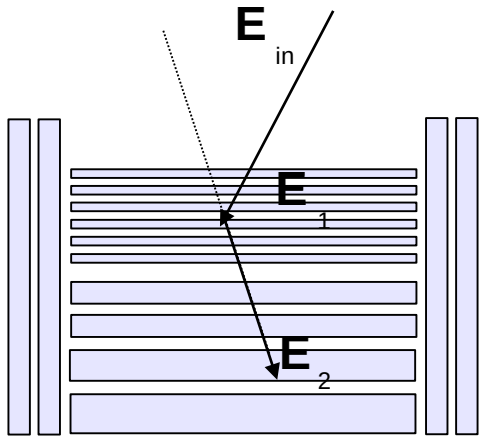




Optimal trade-off between the efficiency and the energy resolution via GEANT4 Monte-Carlo simulation

Proposal:

1. **Stack of CdTe pixel/strip detectors**



- A Hard X/gamma-ray imaging detector concept, based on a stack or PTF arrangement, able to achieve a good energy resolution and high detection efficiency for Astrophysics in the MeV range is presented.

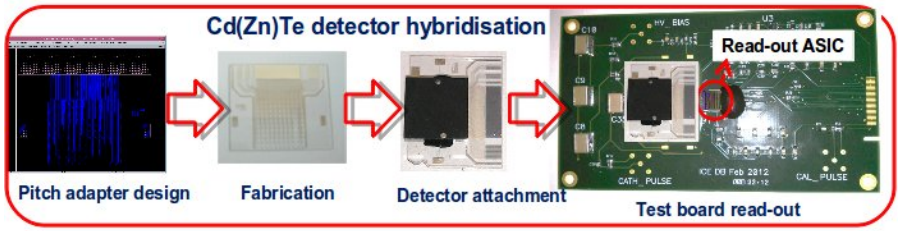
- A single layer CdTe pixellated detector with the NUCAM read-out ASIC has been developed and successfully tested with some radiation sources.

- A new CdTe pixel detector prototype is now under test. It consists of a Al-schottky//CdTe//Pt pixel detector and a new read-out ASIC with trigger signal capability. The arrangement in a stack will lead the detector to operate as a Compton telescope.

X and Gamma Ray Detectors

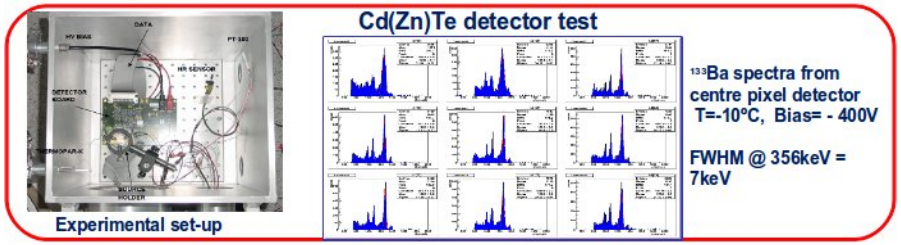
Cd(Zn)Te Detector Hybridization

- Design and manufacturing of X and Gamma ray sensors
- Read-out electronics
- Laboratory testing and characterization with radiactive sources



Potential applications

- Compton camera
- Hard X-ray polarimetry (space application)
- Medical devices
- Radiation surveillance



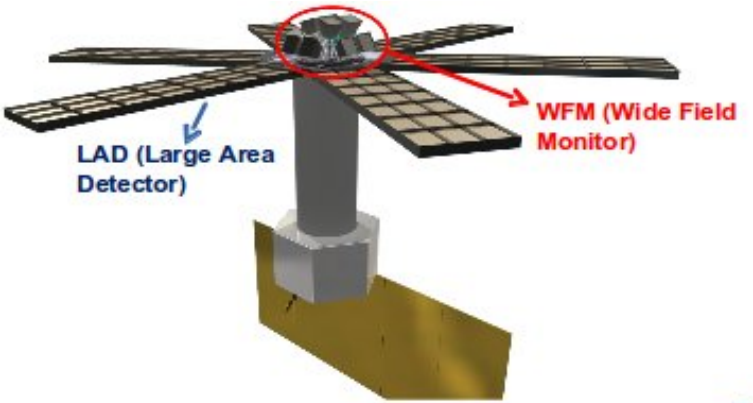
X-Ray Instruments

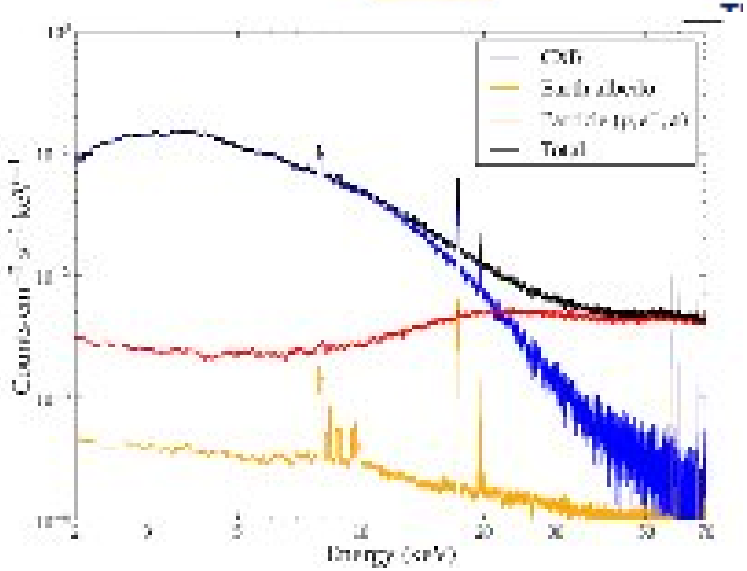
LOFT: Large Observatory for X-Ray Timing

- Mechanical design and analysis of wide field camera
- Simulations
- Thermal analysis

Potential applications

- X-ray instrumentation





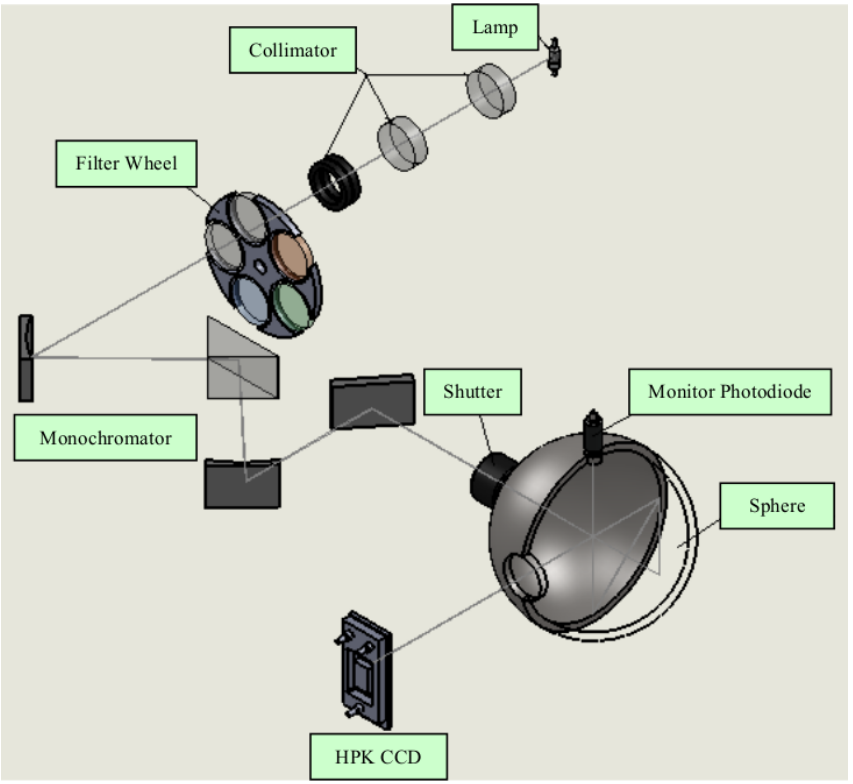
Visible and Infrared Optic Characterization

PAU: Physics of the Accelerating Universe

- Characterization of CCDs
- Spectral characterization of optical glass

Potential applications

- In-house test set-up
- Spectral characterization of (semi-)transparent materials, liquids, gases,...



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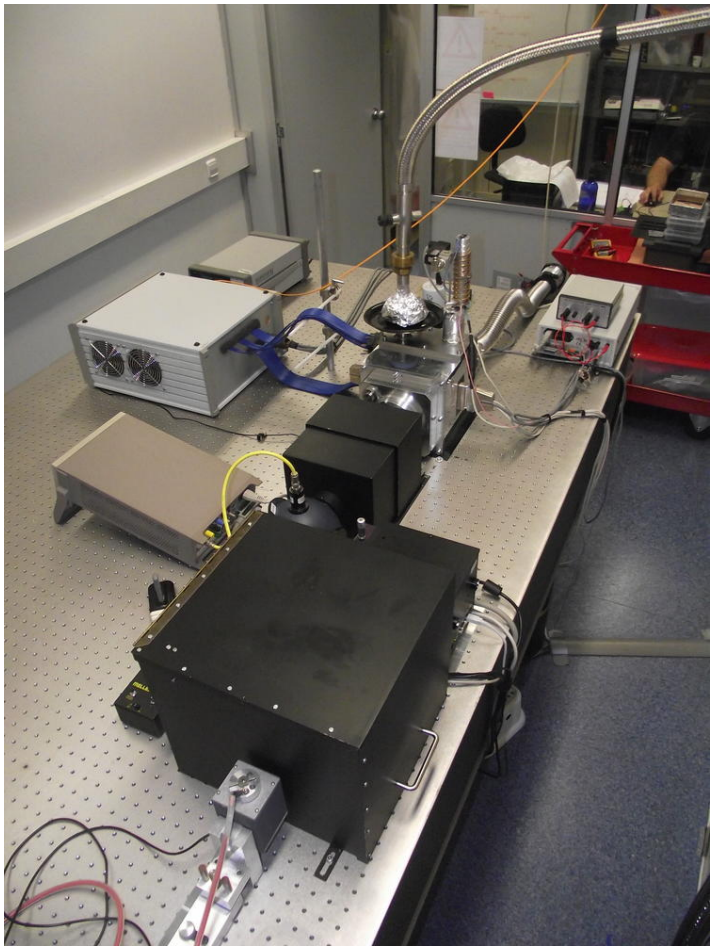


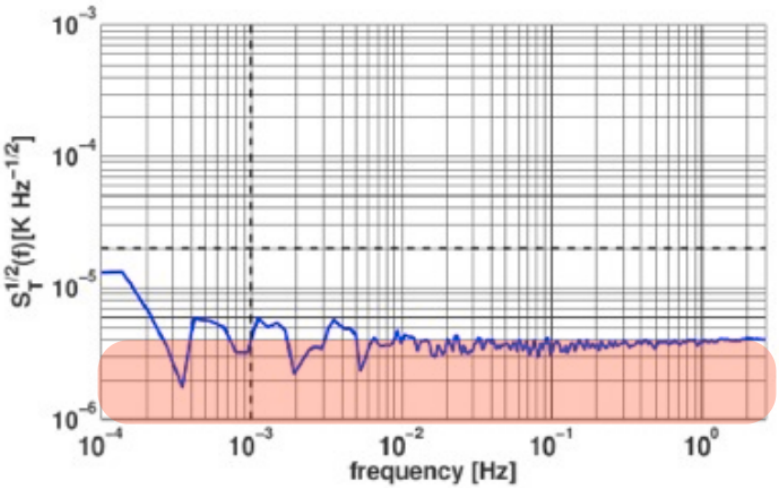
High Stability Thermal Measuring and Control

LISA Pathfinder

- Measurement and control of very low frequency variations of temperature
- $S_T < 10^{-5}\mathrm{K}/\sqrt{\mathrm{Hz}}$

Potential applications

- Physical or chemical processes with very slow temperature variation needs
- Advanced materials manufacturing



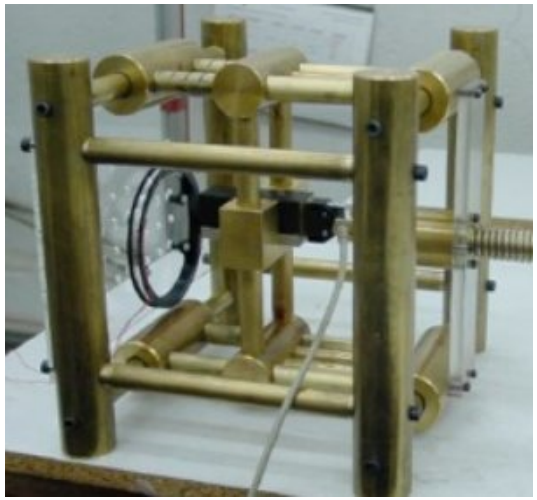
High Stability Magnetic Measuring and Control

LISA Pathfinder

- Measurement and control of very low frequency variations of magnetic fields ($10^{-3} < f < 10^{-1}\mathrm{Hz}$)
- Magnetometers: $S_H \leq 10^{-8}\mathrm{T}/\sqrt{\mathrm{Hz}}$
- Coils: $S_I \leq 10^{-7}\mathrm{T}/\sqrt{\mathrm{Hz}}$

Potential applications

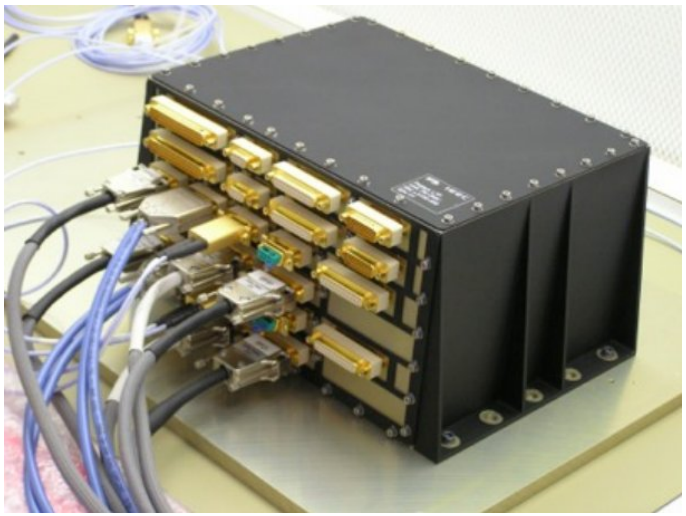
- Characterization of magnetical properties



Critical On-board Software

LISA Pathfinder

- On-board software of the Data Management Unit
- Single command and control interface to spacecraft, except TM attitude ctrl.
- Commanding of subsystems and monitoring of HK data
- ECSS-E40-Part 1B standard codification,
- 406646 LOC (C99, Python, Assembler)
- 4.7 lines of test per LOC
- Real-time embedded RTems
- Software verification Facility and functional tests



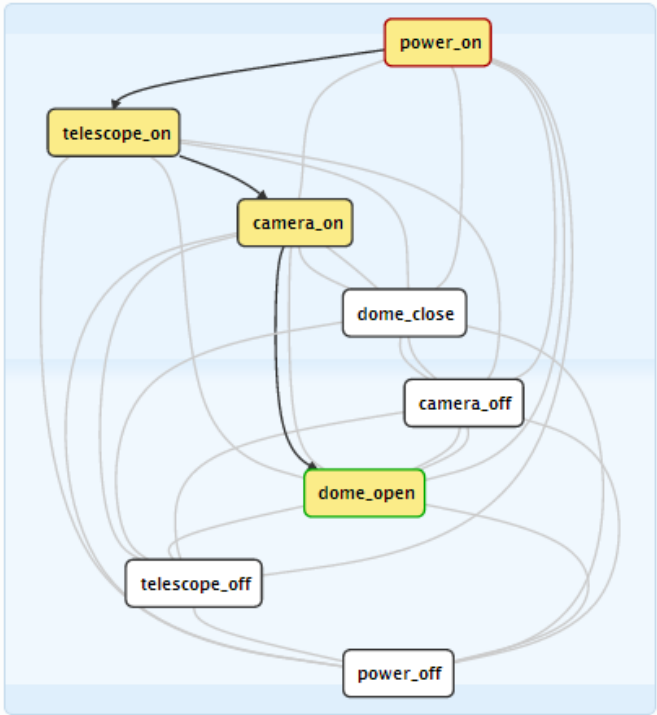
Potential applications

- Critical Software

Robotic Telescopes

Joan Oró and SQT Telescopes

- Software/hardware control architecture
- Open source software for monitoring and control of complex systems: OpenROCS
- STRIPS intelligent decision core
- Dynamic closed loop control
- Distributed system



Potential applications

- Industrial manufacturing control
- Intelligent buildings
- Smart Cities

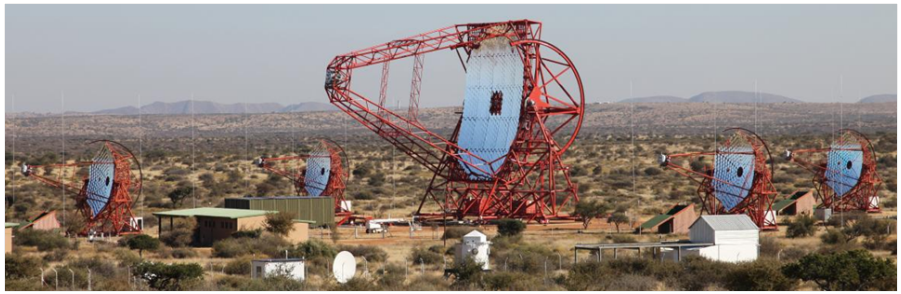
Artificial Intelligence Scheduling

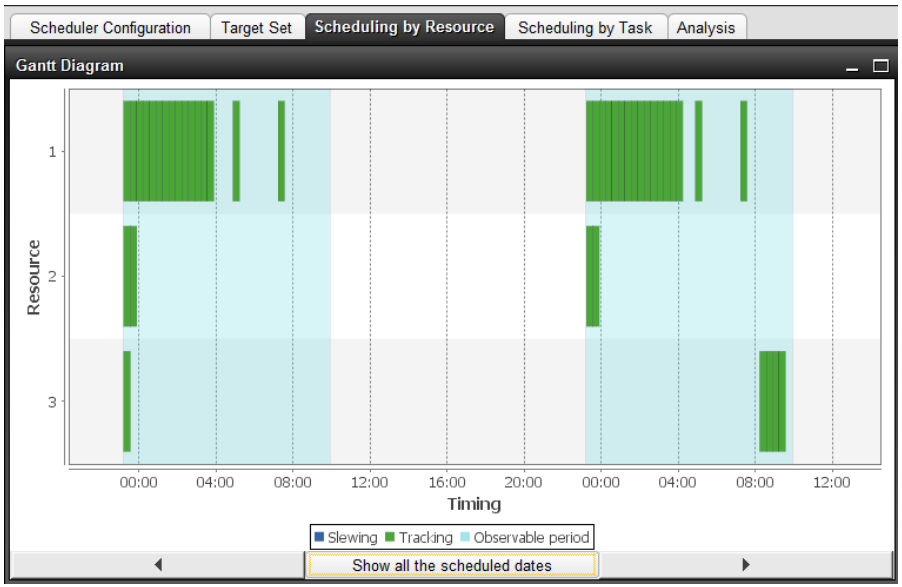
Scheduling of Astronomical Observations

- Optimisation of multi-constraints problems
- Dynamic change of contstraints
- Genetic, greedy and constraints propagation algorithms

Potential applications

- Smart cities
- Logistics
- Flexible manufacturing





Bi-static RADAR Systems

Remote Sensing of the Ocean Surface: PARIS-IOD

- RF electronics
- Digital electronics
- Real-time signal processing
- Precise (radio-)interferometric measuring
- High-speed data recording: 320MB/s
- Airborne experience

Potential applications

- High speed data grabbers
- Bi-static radar systems

Two very recent distinctions

ComFuturo
Ciencia, Juventud y Talento

- Miquel Nofrarias has been selected in the first edition of the Program ComFuturo, of the CSIC General Foundation (FGCSIC), carried out in collaboration with several corporations

- Estel Cardellach has been selected in the call for Distinguished Researchers with I3 (Ref.35862) *"Tecnologías Físicas para Retos Sociales"*