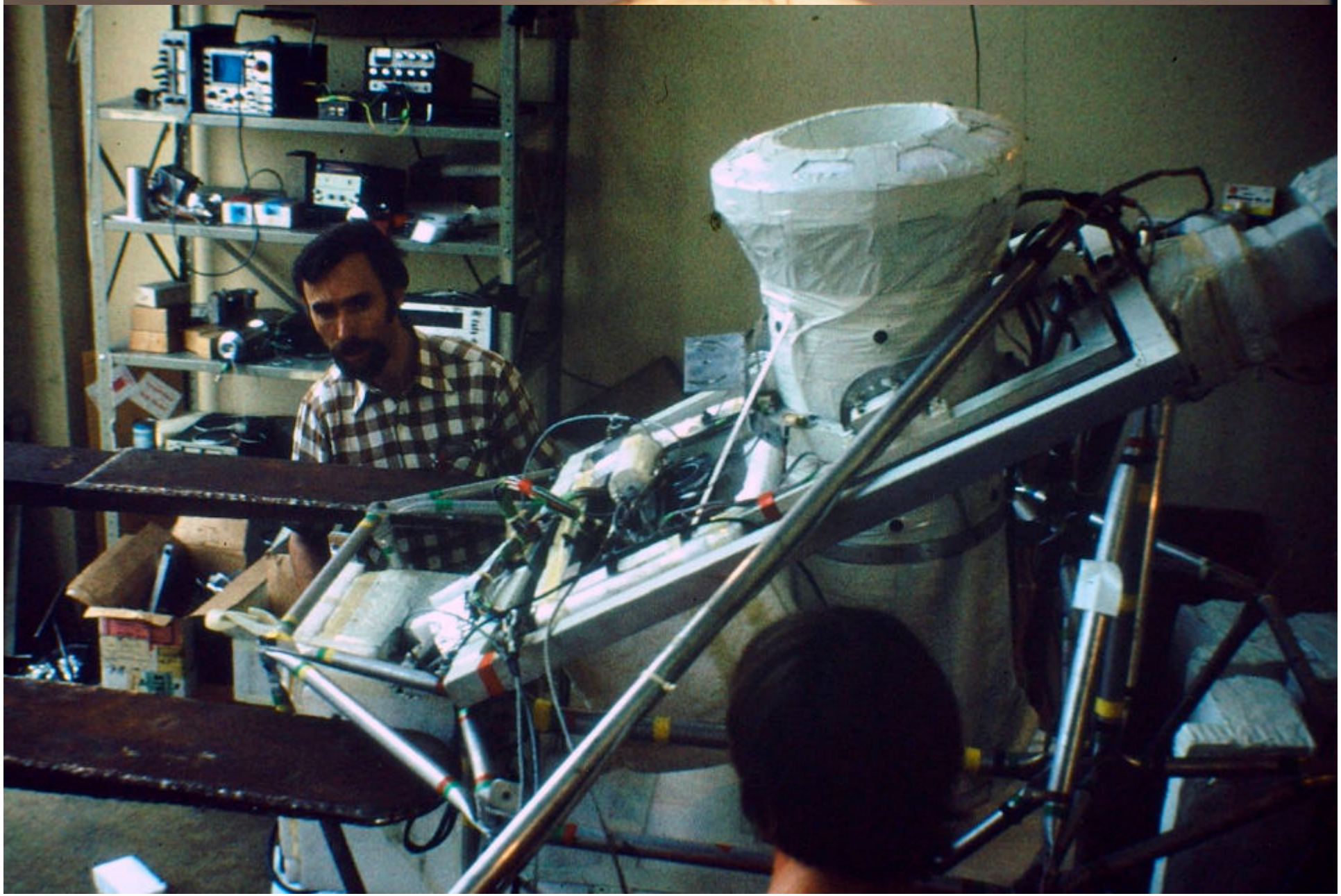
Topics in X-Ray Astronomy

Pietro Ubertini, IASF Roma

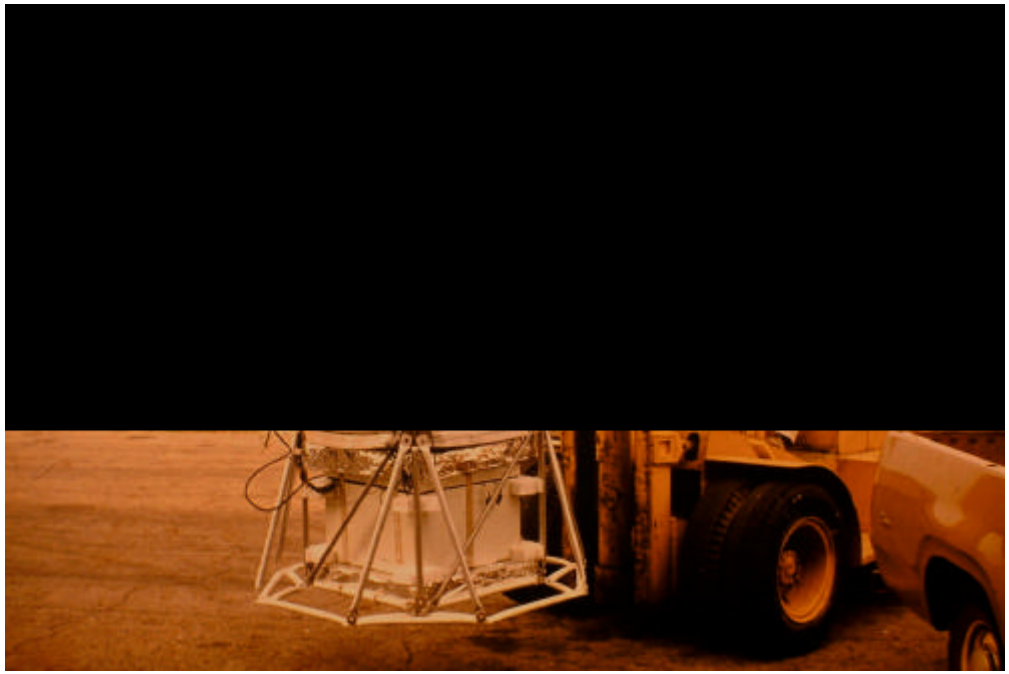
Tuebingen, 22 February 2004

Old Glory Balloon Days ?

1973, the first step in ballooning. Who is the “barbudos”?



line: a striking result!



J. Trümper, W. Pietsch, C. Reppin, B. Sacco*), Garching, E. Kendziorra, R. Staubert,
Tübingen: Evide
of Her X-1**)

spectrum

Abstract

We have meas
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Introduction

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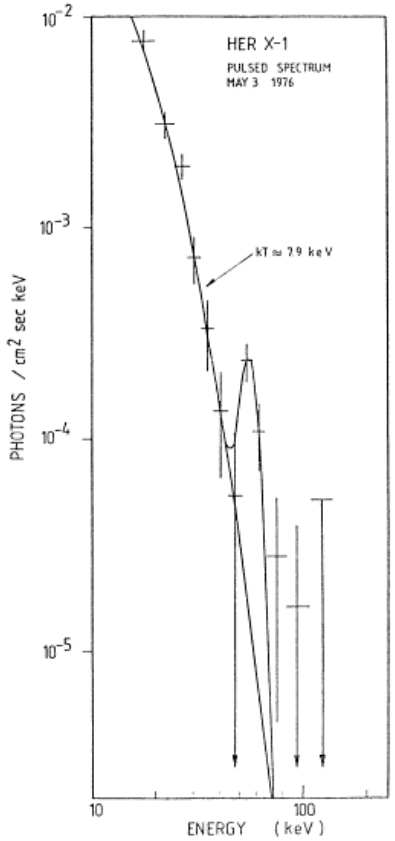

Fig. 2 Energy spectrum of the pulsec excess (taken between phase 0.025 and 0.45. The bars are 1 σ. The data is preliminary, see remarks in the text and the footnote.

Interpreation of the line feature

A line at 53 keV represents a new phenomenon in observational X-ray astronomy. A priori it may be of atomic, nuclear or magnetic origin where the latter means cyclotron emission. Any production mechanism should not only explain the line energy but also the intensity observed which corresponds in our case to a luminosity of

$$L_x \text{ (53 keV-line)} = 1.7 \times 10^{35} \text{ erg/sec}$$

for an assumed distance of 4 kpc and isotropic emission.

†) Jetzt MPI Plas
*) Now at Istituto
**) Submitted for
trophysics, Bos

lativistic As-

Title:

Evidence for strong cyclotron line emission in the hard X-ray spectrum of Hercules X-1

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Journal:

Astrophysical Journal, Part 2 - Letters to the Editor, vol. 219, Feb. 1, 1978, p. L105-L110.

Publication Date: 02/1978

Two propedeutic happening for modern Astrophysics ballooning: first one

- **1782 Joseph-Michel and Jaques-Etienne Montgolfier flew the first silk, hot air filled, cube: just a genial idea from two rich industrialists**
- **It was so successful that they decided to build a 30 m almost spherical *aerostat:* the 4th of June 1783 in the Annonay market square in front of the city political authorities. It reached 2000m and flew for about 15 minutes running one km!**
- **They were so succesful that were invited to repeat the experiment in front of the Royal Famiy the 19th September of the same year from the Chateaux de Versaille. The volume was now 1600 m^3 and carried one sheep, one duck and one chicken… it reminds me the small russian dog Laika on the sputnik….**
- **Finally, after a number of experimen, the first uman flight. The 21st of November the doctor Pilatre de Rozier and the nobil homme Francois Laurent d'Arlandes flew from the the garden of the castle de la Muette to Butte-aux-Cailles. The "Montgolfier",this was the common name, was now 21m high and 14 wide and the hot air was coninuously replaced by on-board burning carbon coke, the first propelled space craft!**

Two propedeutic happening for modern Astrophysics ballooning: second one

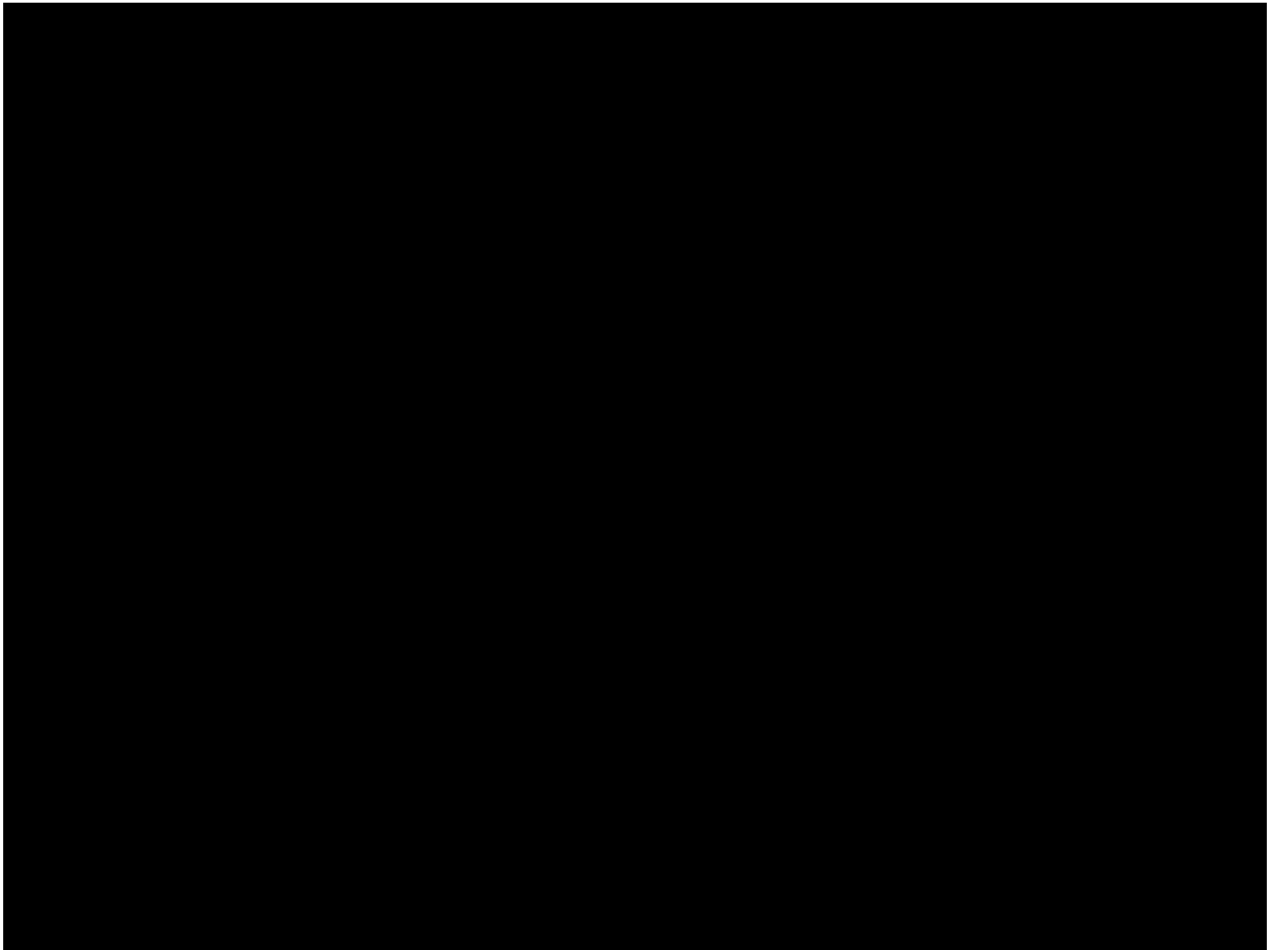
- **The 12 April 1961 the space era starts with the Yuri Gagarin fligh on board the Vostok.**
- **Two weeks later the satellite Explorer 11 is launched: it will record the first 22 gamma ray photons. Gamma ray is born before X ray astronomy!**
- **Seven days later Alan Shepard is the first USA to fligh, 15m sub orbital.**
- **The same days the President Kennedy says in front of the congress that he will commit himself "to achieve the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth".**
- **In the next two years X and Gamma ray science were born.**
- **The 19th June 1962 at 6:59 UT an Aerobee 150 is launched from the Navy base of White Sands, New Messico, with proportional counters on board, sensitive to X-rays. Bruno Rossi and Riccardo Giacconi are the ideator.**
- **Two years later, the 21st July 1964 Gamma ray emission is discovered from the Crab Nebula and Pulsar with a scintillator based experiment on board a stratospheric balloon launched from the NASA Baloon Facility in Palelestine, Texas.**

The modern ballooning: a Tubingen/Frascati-centric view

- A number of campaign from Trapani (Sicily) started in 1976 with a transatlantic flight were performed to look for galactic and extragalactic sources. The basic detector was a one squared meter PC array.
- In 1983 the frist attempt to disentangle the high energy emission from SGRA* adding 2 RMCs built by Tuebingen group over one of the 4 PCs.
- A beautiful 5 arcmin device .. State of art technology, in term of pointing system, ½ degree, on board star sensors and ground pointing capability
- **BUT**……..
- The payload was smashed on ground during a wrong launch (thanks CNES!)
- The payload refurbished in a few days, a new baloon found in Uberaba, from a former German campaign, and bought by CRN on the spot
- **BUT**……..
- After a 2 weeks launch attempt the CNES crew decieded to quit….
- **Catastrophy! No science, large expenditure 5 baloons failure out of 6 launch!**
- **The FIGARO gamma ray timing experiment free-falled!**

The attempt to fix a hole in the first FIGARO launch: failed, balloon destroyed

BUT… this is the good one! In the next attempt the baloon was properly launched BUT…. Free falled!!



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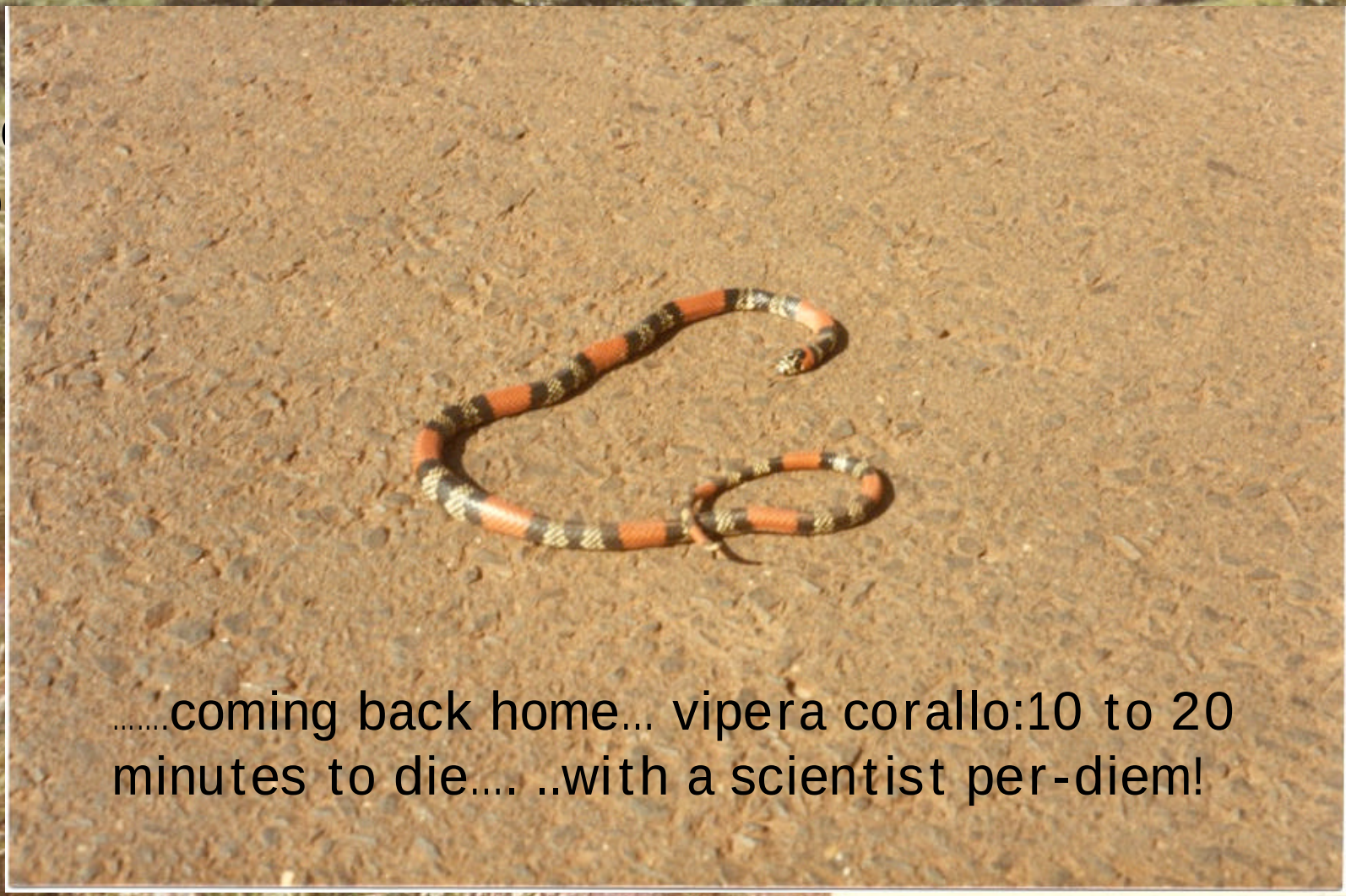
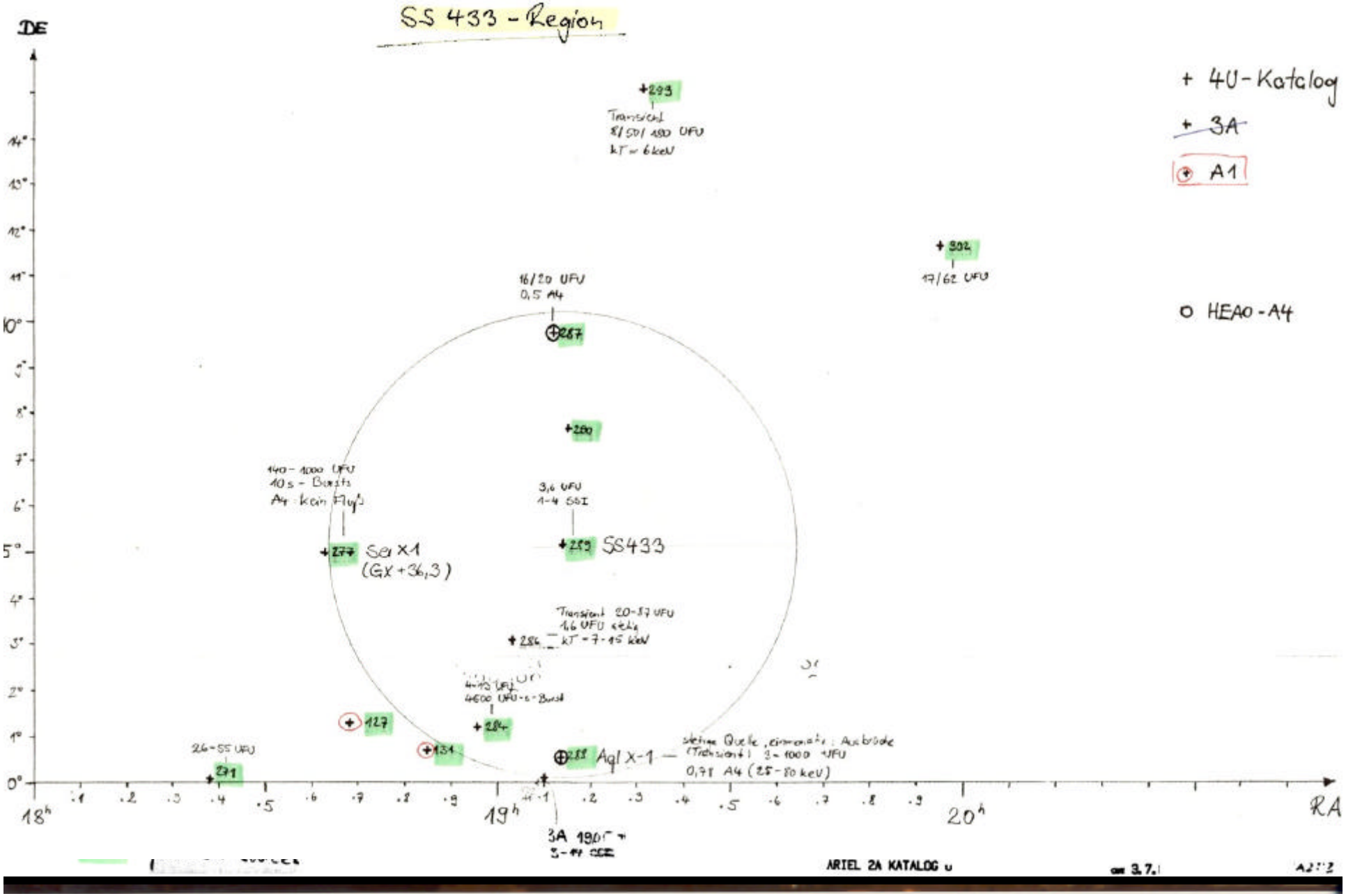


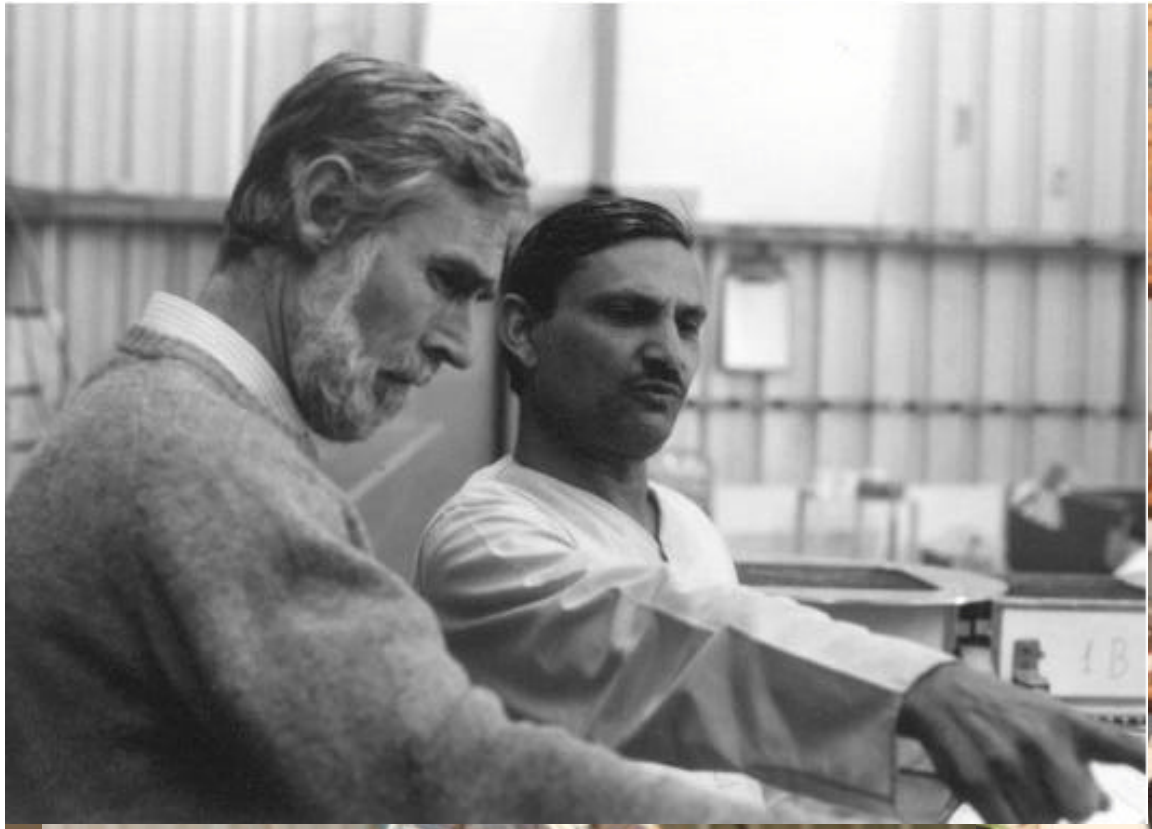
.....coming back home... vipera corallo:10 to 20 minutes to die.... ..with a scientist per-diem!

The Ruediger catalogue at that time …1983



All the campaign start like that…

and end like this…

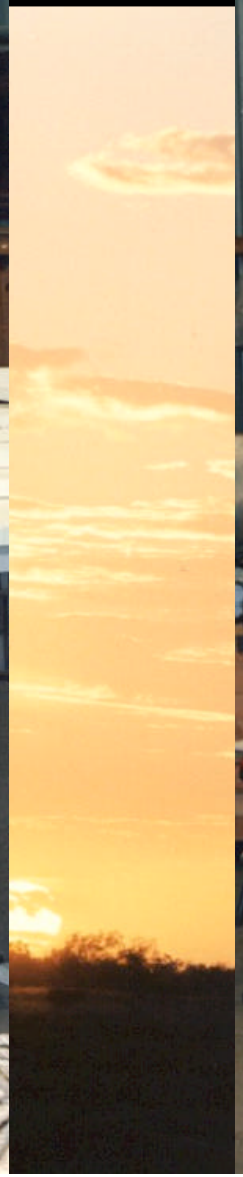


Outdoor calibration of the sensors, magnetometers, sun and star sensors etc

Working at night in the container
to calibrate star sensors……

Beautiful outdoors and sunset...

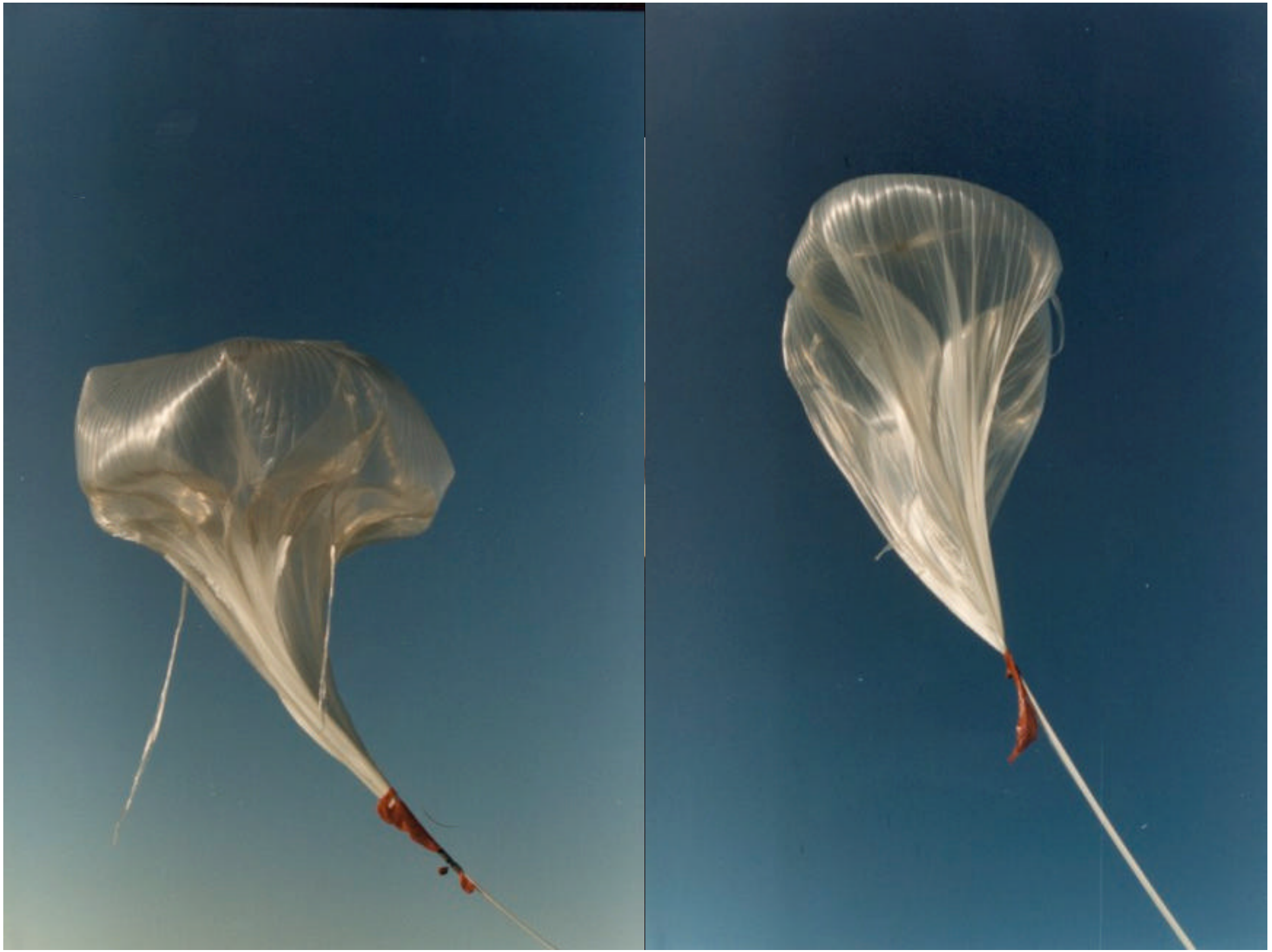
... and devastating effects of a long, difficult campaign...!

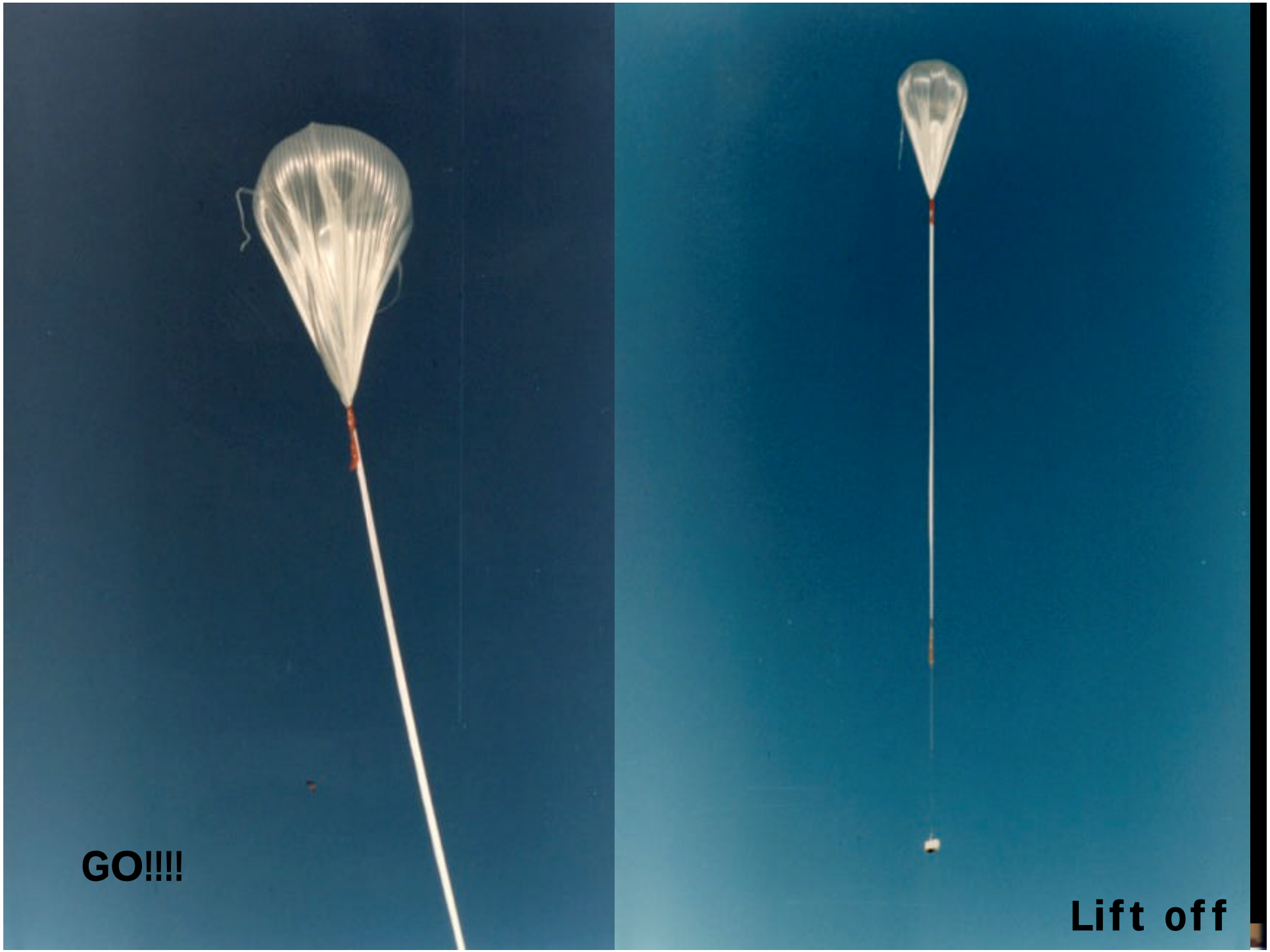



..the pr
... the crew work..
controlling....

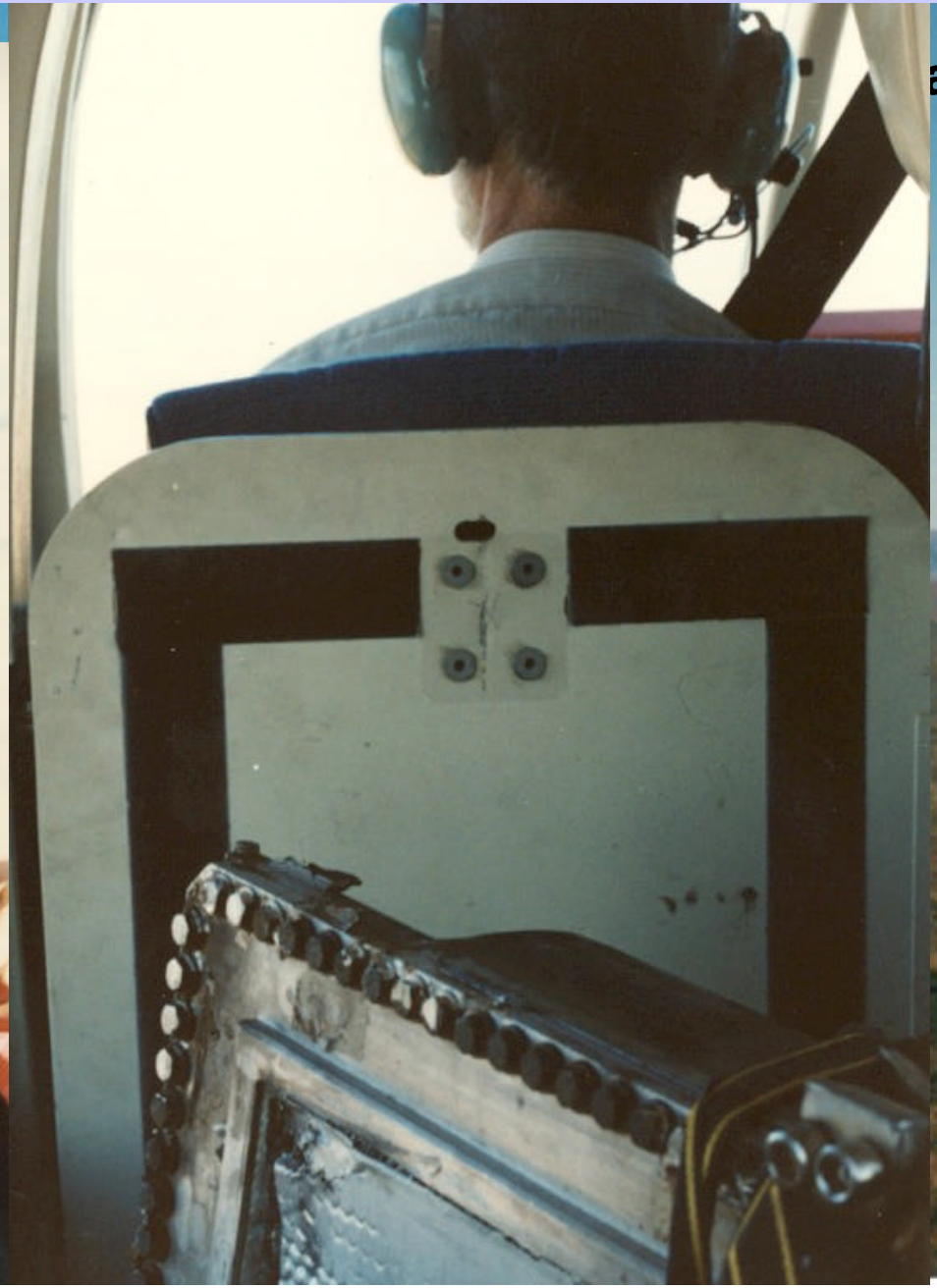
Non return point…….the balloon is up lifting tons…..

Last check on the field….




GO!!!!
Lift off

… long and difficult recovery after a long search and a ride with a 4WD with 200 barrel of kerosene for nthe helicopter refuelling..



all...


The only surviver: the Tasmania devil..!

At least some scientific results arrived from GX1+4

Astron. Astrophys. 208, L1–L4 (1989)

Letter to the Editor

ASTRONOMY AND ASTROPHYSICS

Resumed spin-up in GX 1+4

J. G. Greenhill[1], A. B. Giles[1], D. P. Sharma[1], S. Dieters[1], R. K. Sood[2], J. A. Thomas[2], L. Waldron[2], R. K. Manchanda[2], R. Carli[3], P. Hammer[3], E. Kendziorra[3], R. Staubert[3], A. Bazzano[4], P. Ubertini[4], and C. La Padula[4]

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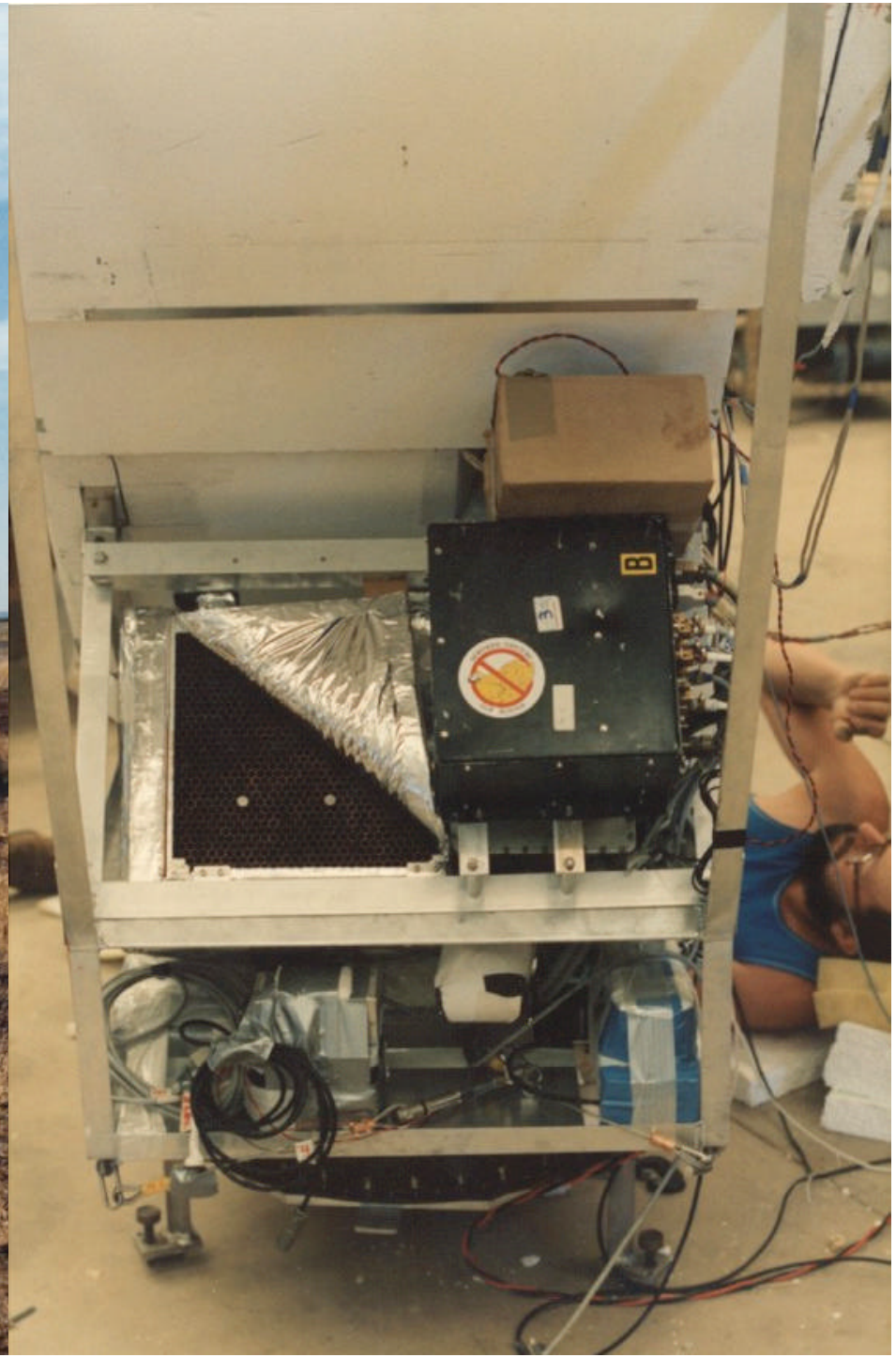
Received August 25, accepted September 29, 1988

...and we had a spared balloon abandoned there.... great when a quasi-galactic Supernova is going to blast off few months later... ready to go again, of course with another experiment!

In February 1977 a short visit to Tuebingen and we were ready to start again..... with a spark chamber and a 900 cm^2 PC

…. A long night ride..

…international scientists initially working… then tired…



Professionality is optimised

Launch again and recovery….

..others will try later….a lot of effort injected by NASA

1988 the 407 day spectrum…! But…

NO high energy GAMMAs …..

THE ASTROPHYSICAL JOURNAL, 337:L19–L22, 1989 February 1

HARD X-RAY SPECTRUM OF SUPERNOVA 1987A ON DAY 407

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Received 1988 October 6; accepted 1988 November 14

ABSTRACT

We report evidence for a hard X-ray continuum emission from a source in the LMC region centered on the optical position of SN 1987A. The supernova region was observed on day 407 with a hard X-ray and a high-energy (>50 MeV) gamma-ray detector flown together on a balloon payload. The X-ray data show a very hard power-law spectrum with a photon index $\alpha = 1.1$ in the range 17–165 keV, with an intensity of 1.2×10^{-4} photons cm^{-2} s^{-1} keV^{-1} at 50 keV. If compared with previous observations our data indicate an almost steady, if not increasing, high-energy emission from SN 1987A in the last 9 months. Our data are compared with the predictions expected from theoretical models based on the Comptonization of the ^{56}Co nuclear lines or the presence of an internal continuum power source.

Subject headings: stars: supernovae — X-rays: spectra

Malcomb and Gerhels, ApJ Suppl., 1999

TABLE 2A

ACCRETING GAMMA-RAY SOURCE OBSERVATIONS

Source (1)	Instrument (2)	E1 (MeV) (3)	E2 (MeV) (4)	Flux (cm^{-2} s^{-1}) (5)	Normalization (cm^{-2} s^{-1} MeV^{-1}) (6)	Index (7)	E0 (MeV) (8)	Date (9)	Reference (10)
1A 0535+262	MIT76	1.80E−02	1.01E−01	...	...	17.6 ± 0.6[a]		1975 Jun 1	1
1A 0535+262	BATSE	2.00E−02	1.00E−01	1.37 ± 0.05[b]	...	...	...	1994 Feb–Mar	2
1A 0535+262	LEGS	2.00E−02	1.00E−01	8.74 ± 1.38E−01[c]	1.08 ± 0.17E+2	−3.42 ± 0.12	0.02	1980 Sep 25	3
1A 0535+262	HEXE	2.00E−02	1.10E−01	...	...	...	...	1989 Apr 8,9,14	4
1A 0535+262	*Ariel 5*	2.60E−02	7.30E−02			0.998 ± 0.001		1976 Aug 13–20	5

Source (1)	Instrument (2)	E1 (MeV) (3)	E2 (MeV) (4)	
1A 0535+262	MIT76	1.80E−02	1.01E−01	
1A 0535+262	BATSE	2.00E−02	1.00E−01	
1A 0535+262	LEGS	2.00E−02	1.00E−01	8.
1A 0535+262	HEXE	2.00E−02	1.10E−01	
1A 0535+262	*Ariel 5*	2.60E−02	7.30E−02	
1A 0535+262	Signe 2MP	2.70E−02	3.08E−01	
1A 0535+262	TESRE85	3.00E−02	9.00E−02	
1A 0535+262	POKER	3.00E−02	1.00E−01	1.
1A 0535+262	*HEAO* A4	4.00E−02	8.00E−02	
1A 0535+262	OSSE	4.50E−02	2.00E−01	
1A 0535+262	Marshall76	9.00E−02	2.00E−01	
1A 0535+262	SIGNE 2	1.00E−01	1.46E−01	
1A 0535+262	MIFRASO	1.17E−01	1.75E−01	
1A 1742−294	*HEAO* A4	8.00E−02	1.80E−01	
1E 1740.7−2942.....	POKER	1.50E−02	1.80E−01	7.
1E 1740.7−2942.....	SIGMA	3.50E−02	4.00E−01	
1E 1740.7−2942.....	HEXE	3.50E−02	1.30E−01	
1E 1740.7−2942.....	GRIP	3.60E−02	2.00E−01	1.
1E 1740.7−2942.....	OSSE	2.00E−01	4.50E−01	
1E 1740.7−2942.....	BATSE	3.00E−01	6.00E−01	
1E 1740.7−2942.....	COMPTEL	7.50E−01	1.00	
4U 0352+30	*HEAO* A4	4.00E−02	1.70E−01	

Now we are in satellite days ! INTEGRAL launched just more than one year ago ……

Already solving some of the open questions in high energy astrophysics:

Few examples:

- The gamma ray emission from the SMBH coincident with SGRA*
- The nature of the soft gamma ray emission of the Galaxy
- The Survey/catalogue of the soft gamma ray Milky Way
- First light on the 511 keV from the Galactic centre