

Radio Source Variability: *a tale of 1965*

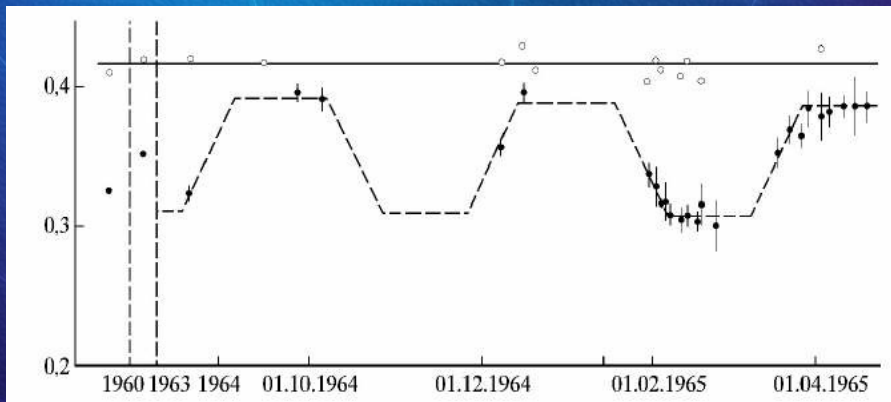
Leonid Gurvits
JIVE and TU Delft
The Netherlands

Ken Kellermann
NRAO
USA

with contributions by Mikhail Larionov and
Alexander Midler

The view from the West

- It's Wrong!
- Unknown antenna
- No discussion of techniques
- Not confirmed at OVRO, Arecibo
- Theoretically Impossible
- No credibility - ETI



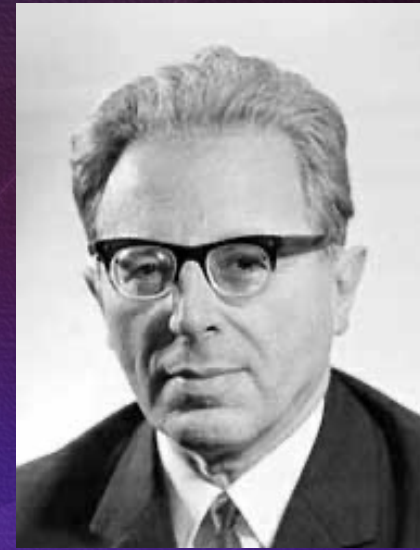
1960s: Golden decade of Moscow astrophysics



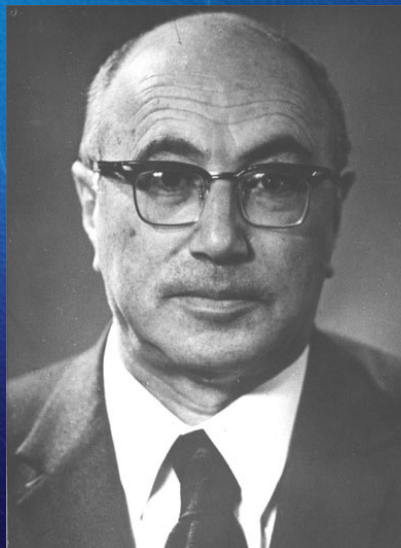
Solomon Pikelner
1921–1975



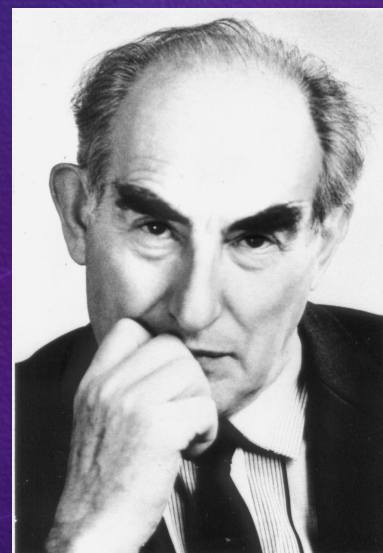
Samuil Kaplan
1921–1978



Iosif Shklovsky
1916–1985



Yakov Zeldovich
1914–1988



Vitaly Ginzburg
1916–2009

1960: Somewhere, at undisclosed location...

Eight 16-m parabolas
900 m² effective area

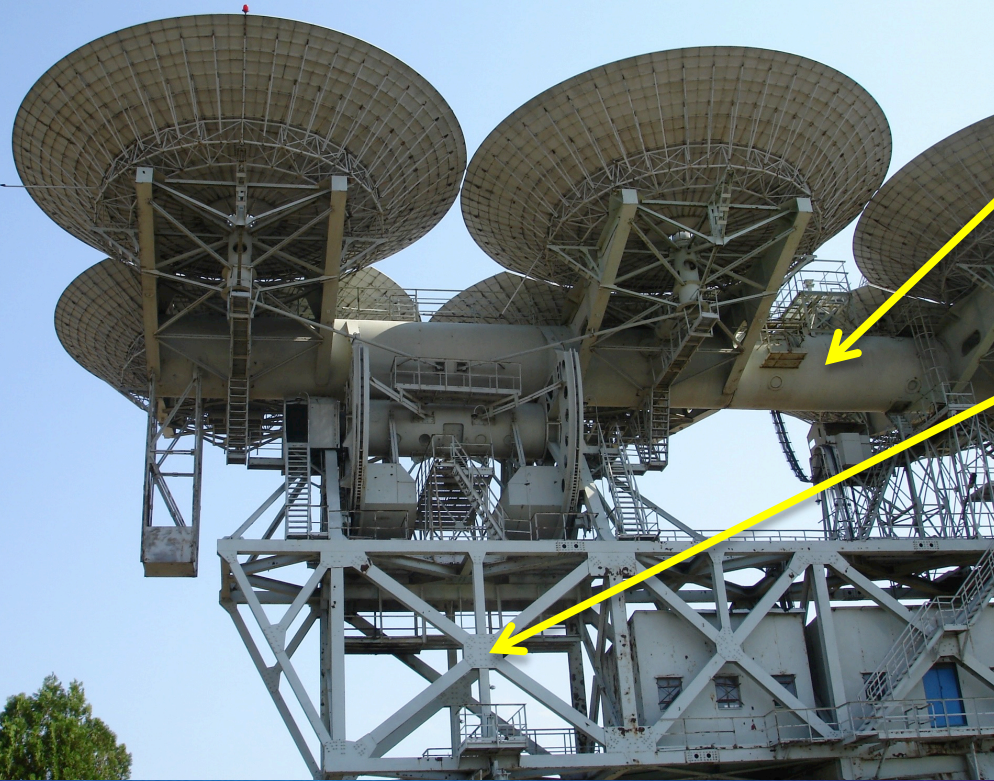


NIP-16, Vitino, near Yevpatoria, Crimea

ADU-1000, Solar system intercom

- Purpose: 2-way comm for planetary missions (Mars, Venus)
 - *Command up-link*
 - *Data downlink*
 - *Ability to support manned missions too (voice comm)*
 - *Nominal operational distance – 2 AU (but code name “Pluton”)*
- Decision to build – mid 1959 (M. Keldysh, S. Korolev)
- Construction starts – January 1960
- Three installations operational – December 1960
 - Two facilities for reception, ~1 km apart
 - One transmitting, 8.5 km apart
- Efrem Korenberg proposed an 8-element interferometer
 - *Maximum utilisation of available structures/design*
 - *Minimum automation (a regiment per installation anyway)*

ADU-1000, the discovery machine



Two (Italian) submarine hulls
for elevation axis

Trapezoid military railway bridge
(upside-down)

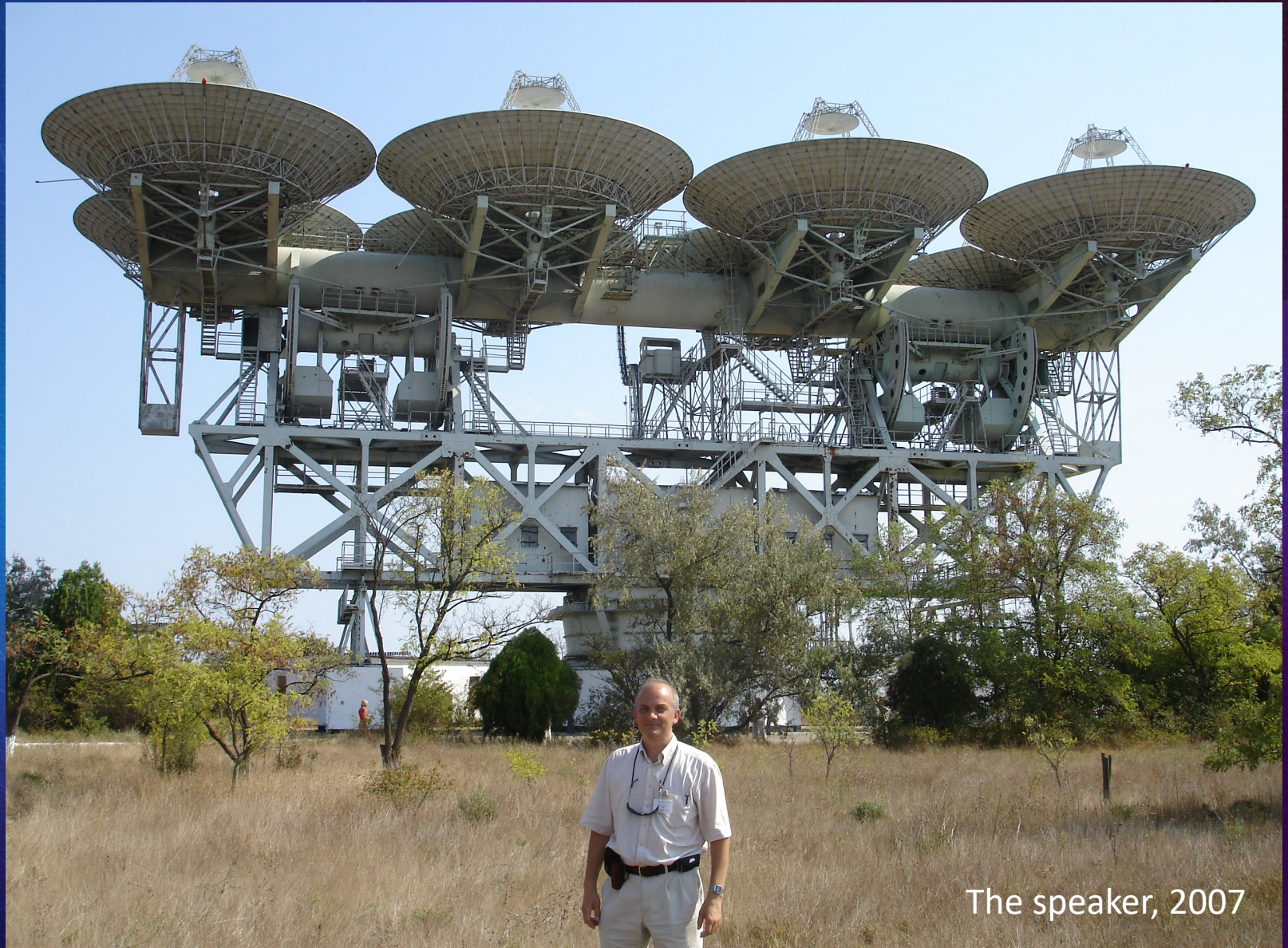


Transmitter installation, 2007



Rotator of main cruiser canon
for azimuth pointing

Forgotten artefact



The speaker, 2007

Sternberg institute in Yevpatoria

- Access to Yevpatoria – a recognition of GAISh by space programme leadership
 - Not least – because of the “artificial comet” success in 1959:
- Observing projects by
 - V. Kurilchik
 - L. Matveenکو
 - G. Khromov
 - G. Sholomitsky
- Receiver:
 - 921 MHz (telemetry, voice)
 - Parametric
- Gennady Sholomitsky assisted by a student M. Larionov



V. Moroz, V. Esipov, I. Shklovsky,
V. Kurt, P. Shcheglov, 1959

Astronomy for deep space navigation: *a bit of side history...*

Shklovsky I.S., 1960,

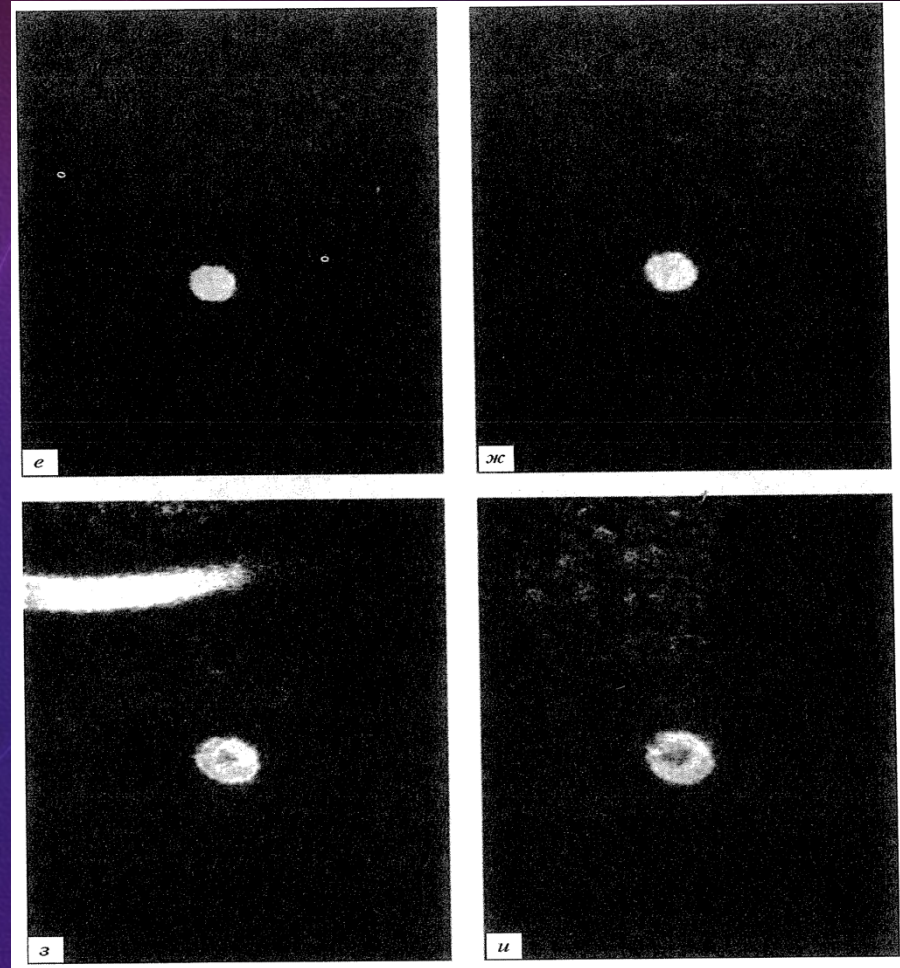
*“Artificial comet as a method of
observations of spacecraft in optics”,
in “Artificial satellites of Earth”, v. 4,
195-204*

Artificial sodium (Na) comet onboard
the 2nd “space rocket”, 12 Sept 1959:

$$m_v = 4.5$$

$$R = 156,000 \text{ km}$$

$$\sigma_{Dec,RA} \approx 0.5''$$



Variability published - I

G. Sholomitsky

Submitted 27 Feb 1965

One page, no technical details

Periodic variability, $T \approx 100$ days

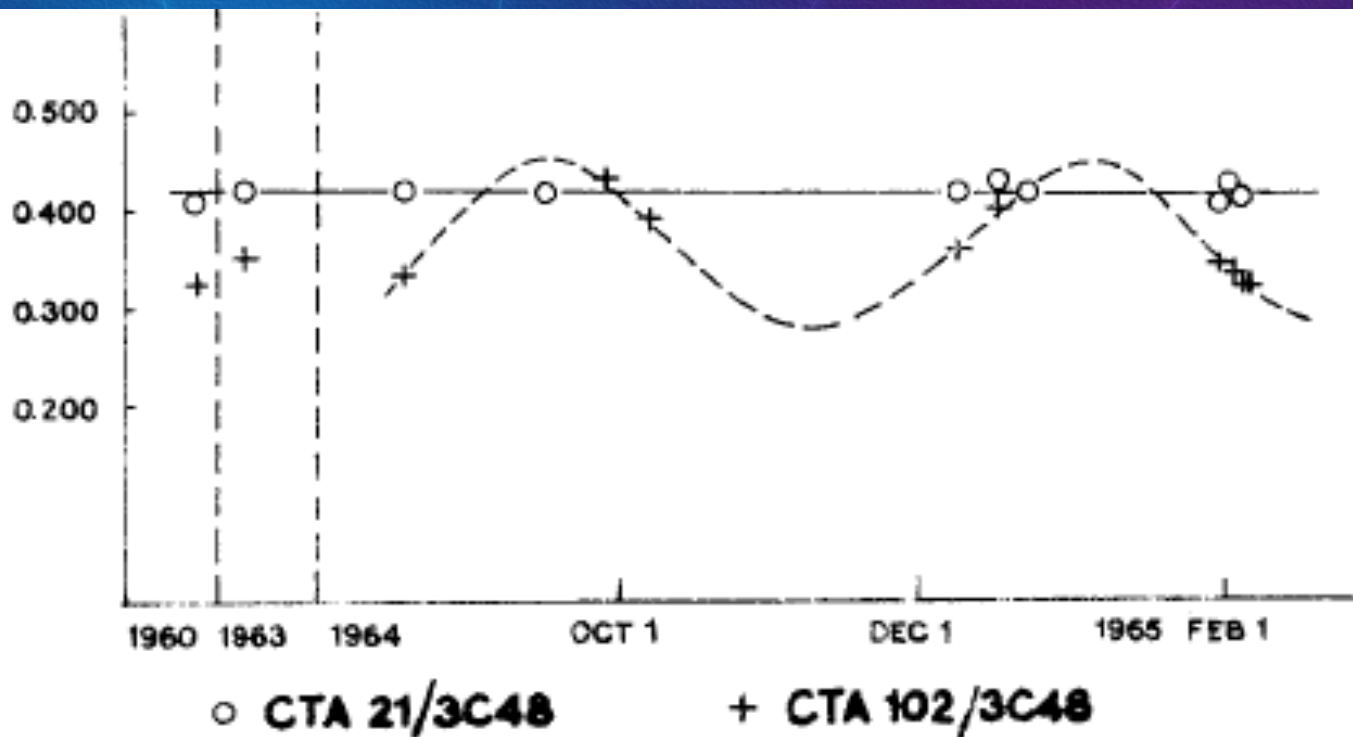
CTA 102 size by Shish 1963 (10 mas)

Interpretation: galactic source, closer than 2 Mpc

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
NUMBER 83

Konkoly Observatory
Budapest
27 February 1965

VARIABILITY OF THE RADIO SOURCE CTA - 102



Variability published - II

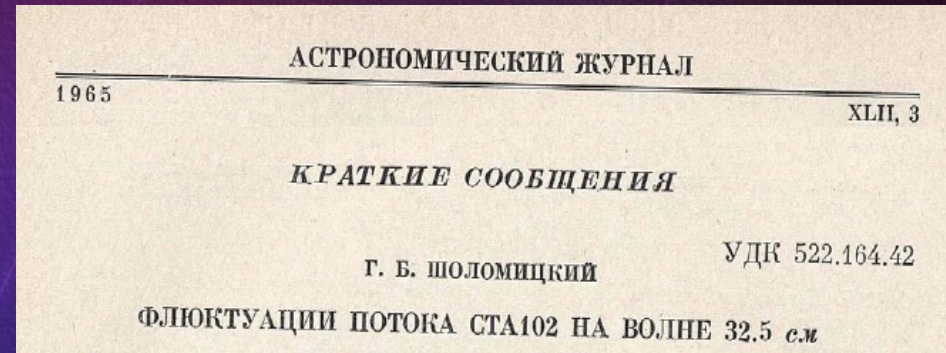
G. Sholomitsky

Submitted **17 Nov 1964 !!!**

Data from 1964.08.18 to 1965.02.24

One page, no plot

Technical details - Sholomitsky et al. 1964



Отношения СТА21/3С48 и СТА102/3С48

Дата	СТА102 3С48	Средне- квадр. ошиб- ка	СТА21 3С48	Средне- квадр. ошиб- ка	Дата	СТА102 3С48	Средне- квадр. ошиб- ка	СТА21 3С48	Средне- квадр. ошиб- ка
[2]	0.325	—	0.410	—	02.02.1965	—	—	0.425	0.013
[3]	0.352	—	0.419	—	03.02.1965	0.333	0.020	0.410	0.020
18.08.1964	0.333	0.009	0.421	0.010	05.02.1965	0.322	0.005	—	—
15.09.1964	—	—	0.415	0.010	06.02.1965	0.323	0.025	—	—
27.09.1964	0.430	0.006	—	—	08.02.1965	0.314	0.012	—	—
05.10.1964	0.391	0.011	—	—	12.02.1965	0.309	0.020	0.407	0.008
08.12.1964	0.357	0.008	0.417	0.008	14.02.1965	0.314	0.010	0.436	0.022
16.12.1964	0.400	0.008	0.433	0.008	18.02.1965	0.310	0.010	—	—
22.12.1964	0.412	0.025	0.414	0.008	19.02.1965	0.320	0.030	0.402	0.020
31.01.1965	0.342	0.015	0.404	0.013	24.02.1965	0.326	0.013	—	—

Результаты приведены в табл. 4. Там же указаны

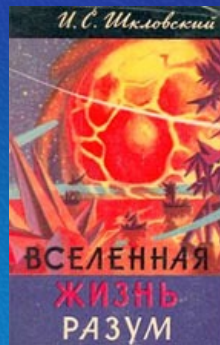
Press-conference @ Sternberg, 12 Apr 1965

- Alexander Midler, correspondent of TASS, covers science
 - *Commonly attends colloquia at Sternberg Institute*
 - *On 12 April 1965, overhears semi-formal discussion by I. Shklovsky and N. Kardashev on possible ETI explanation of CTA 102 variability*
 - *At 16:40 MSK, 12 April 1962, TASS issues a “telegram” on discovery by Soviet scientists of a cosmic artificial signal*
- The day after: a huge press-conference at Sternberg
- Careful statements by Shklovsky and Kardashev
- The news reproduced around the world (all major agencies)
- “Pravda” article on 14 Apr 1965
- April 1965, a very special time...



1960s: SETI background [in Moscow]

- I. Shklovsky, 1960, Priroda
Is communication to intelligent creatures on other planets possible?
- I. Shklovsky, 1962, “The Universe, life, and mind”



- N. Kardashev 1964, Soviet Astronomy 8, 217
 - *Broadcast of information by extraterrestrial civilisations*
 - *3 types of civilizations*
- The impact: “SETI” is on the agenda of science discussions
 - *support (moral and otherwise) by I. Tamm, Ya. Zeldovich, V. Kotel’nikov, S. Khaikin, V. Siforov, V. Troitsky, S. Sobolev, V. Ambartsumian, S. Pikel’ner et al.*
- “Project Au” [“Hey, is there anybody?”]
 - *not implemented, but played its role*

The first space walk, 18 March 1965



Alexei Leonov



UP: The only other example?

5 May 1933

Karl Jansky

The New York Times.

LATE CITY EDITION
MAY 4, 1933
NEW YORK, FRIDAY, MAY 4, 1933

**NEW RADIO WAVES
TRACED TO CENTRE
OF THE MILKY WAY**

Direction is toward the center of the galaxy, according to the latest findings of the American Physical Society, which announced today that it had traced the source of the radio waves to the center of the Milky Way.

Recorded and Tested for More Than Year to Identify It as From Earth's Galaxy

Only Delicate Receiver is Able to Hear—Also, Evidence of Interference Signaling

**KIDNAPPERS URGED
TO ANSWER PLEAS**

New Yorker Named to Act as Secret Agent for Return of Month Child

Wanted Ready as Hostage

Frank Kopt of Detroit and J. Payne, N. C.—Massachusetts

Two Men Held in Connection with Kidnapping of Child

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**BIG NEW INVASION
PLANNED BY JAPAN
ON ROAD TO PEIPING**

Larger-Scale Offensive Than Last Is Announced to Open Soon in North China

CHIANG RUSHES AID NORTH

Shanghai Aes Dispatched

BRITISH GOVT MANCHURIA

By MAILERS

Conferees Reach Accord on All Except the Castles

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**ROOSEVELT ASKS PAY RISE FOR WORKERS;
PROMISES TO HELP BUSINESS END CHAOS;
HE SENDS RAILROAD BILL TO CONGRESS**

Features of Railroad Bill

Recapture Repeal Made Retroactive Under a Far-Reaching Plan

RATE-MAKING RULE SAVED

And L. C. Jurisdiction Would Be Extended to Embankment Holding Companies

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Variability of CTA 102 re-discovered

Four Variable Radio Sources at 408 MHz

R. W. HUNSTEAD *Cornell-Sydney University Astronomy Centre, School of Physics,
University of Sydney, Australia*

Evidence is presented for large fractional variations in the 408-MHz emission from two quasi-stellar objects (CTA 102 and 3C 454.3) and two radio galaxies (PKS 1504-16.7 and 1524-13). In each source significant changes in flux density have occurred on a time scale of a few months. If the variations observed at 408 MHz are intrinsic to the radiating regions, they raise some important astrophysical questions concerning the physical processes operating in non-thermal radio sources.

Astrophysical Letters, 1972, Vol. 12, pp. 193-200

It does vary on the scale of weeks!

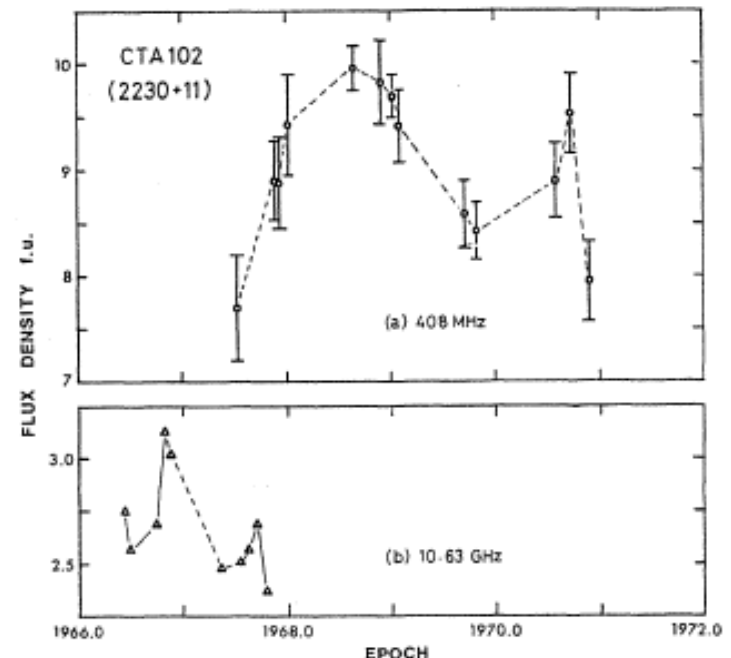


FIG. 4. Variations in the flux density of CTA 102 (2230 + 11) at (a) 408 MHz and (b) 10.63 GHz (Medd, Locke and Andrew 1968).

Aftermath...

- Gennady Sholomisky switched to sub-mm & IR astronomy
- Studies of ISM and IPM scintillations become a “speciality” in Moscow
 - Some 20 PhD defended in the period 1971 – 1990
- RadioAstron conceived on the fringes of the “variability saga” ...



Gennady Sholomitsky, Iosif Shklovsky, Bill Howard, Leonid Matveenko, Slava Slysh, GAISH, 1967?

Acknowledgements

- Nikolay Kardashev
- Nadezhda Sleptsova
- Vladimir Andreyanov
- Tatiana Lozinskaya
- Valentin Esipov
- Ekaterina Borovikova