

# History and scientific results of radar meteor research in Ukraine: Kharkiv National University of Radio Electronics (NURE) and its Research Laboratory (RA LAB) named after Boris Kashcheyev

**Authors:** Svitlana **Kolomiyets**<sup>1,2 \*</sup>, Wayne **Hocking**<sup>3</sup>   
Kirill **Khrustalev**<sup>4</sup>, Serhii **Kundyukov**<sup>2</sup>, Iryna **Kyrychenko**<sup>2</sup>,  
Stanislav **Borbulov**<sup>2,4,5</sup>, Yurii **Prymachov**<sup>2</sup>

<sup>1</sup>-Interplanetary Matter Department, Astronomical Inst.(ASU) ASCR  
Ondrejov, Czech Republic

<sup>2</sup>-Kashcheyev Radio Astronomy LAB, NURE, Kharkiv , Ukraine

<sup>3</sup>-University of Western Ontario, London, Canada (emeritus)

<sup>4</sup>-NURE, Kharkiv,Ukraine; <sup>5</sup>-Metal Processing Inst., Kharkiv,Ukraine



\* E-mail: [s.kolomiyets@gmail.com](mailto:s.kolomiyets@gmail.com)



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# Kashcheyev Radio Astronomy Research Laboratory of Kharkiv National University of Radio Electronics, Kharkiv, Ukraine (Kashcheyev RA LAB, NURE)

## CV Kashcheyev RA LAB



### Prof. Boris Kashcheyev (1920-2004)

A well-known Ukrainian scientist in the field of meteor radar research, provided the best radar surveys during the IGY 1957 and later

1954 : Year of birth "Meteor Radio Astronomy in Kharkiv" (registration of the first radio meteors)

1957 Year of birth "Meteor Radar MARS\*"

2007 Official date of birth of the Laboratory named after Boris Kashcheyev in connection with the celebration of the 50th anniversary of the IGY 1957 in 2007 and issuance of a certificate and a gold medal in the name of Kashcheyev for his contribution to the IGY 1957

2022 - 2024 A full-scale war is being waged in Ukraine, unleashed by Russia.

Kharkiv is located 35 km from the Russia under bombs and shelling. Houses are being destroyed, people are dying.

*\*In 2022, the territory with the MARS meteor radar was under the occupation of Russian troops for 190 days.*

# High-quality, world-class meteor radar research has been carried out in Kharkiv (Ukraine) since 1957 till 2022

## Kharkiv RadioMeteors (1954-...)

- Meteor automated radar system (**MARS**) with a powerful (1 MW) meteor transmitter. Operating frequency 31.1 MHz.
- The number and characteristics of meteor radio reflections, radiants of meteor bodies, as well as to study the dynamic parameters of the Earth's atmosphere in the meteor region, the study of tides and gravitational waves etc.
- Complex for passive location of meteor tracks, frequency 48 MHz (ATV channel).



## Multipurpose Geophysical Complex for Research of the Atmosphere and Inflow of Meteor Substance

include meteor radar **MARS** (1957 – 2021)... **needs renovation** has gained the status of the National Scientific Heritage of Ukraine since 2004.



Vilhuvatka village, near Balakliia, Izum district, Kharkiv region  
(~ 90 km from Kharkiv, ~49 ° N, ~37 ° E )  
about 80 kilometers to the **Russian border**

➔ **192 days under the occupation of the Russian Federation**

Project “Kashcheyev Seminar” Conference  
In 2025, Prof. Kashcheyev (1920-2004) would have turned 105 years old.

<https://nure.ua/en/conference-workshops/kashcheyev-seminar>

**2005, September 21** Seminar “Radar studies of meteors and modern studies of small bodies of the solar system” dedicated to the 85th anniversary of the birth of BL Kashcheyev.

**2010, March, 12.** Seminar “Meteoric Research: Scientific and Applied Aspects” dedicated to the 90th anniversary of the birth of B.L Kashcheyev.

**2016, March, 15.** “Radio meteors, meteors and the interplanetary component: nearby and at a distance” dedicated to the 96th anniversary of Kashcheyev birthday

**2021, March, 30-31.** «Meteors and celestial objects, weather and space: from data and technology to heritage and development» dedicated to the 100 years since the birth (March 8, 2020) of NURE Honorary Professor Kashcheyev B.L. (1920-2004). Among the participants Prof. Wayne Hocking

**2025    WHAT ABOUT “Kashcheyev Seminar 2025**





In the 21st century, on February 24, 2022, a terrible war began, which actually began in February 2014, and in 2022 it entered a full-scale phase (Russia attacked Ukraine). Due to its location and importance\* for Russia, Kharkiv was and continues to be one of the first cities to receive military strikes.

\*Before the war, Kharkiv was the second most populous city in Ukraine, its population exceeded 1.5 million people, and during the Soviet period for some time it was the first capital of the Ukrainian Soviet Republic.



These are drawings by the Ukrainian artist Kateryna Vasechko about the war  
<https://cntime.cn.ua/nizhinka-katerina-vasechko-svoyimi-malyunkami-pidk-article/>

Due to the war, it became impossible to carry out meteor scientific research in Kharkiv and observations at a rural base near Balaklia in the Kharkiv region.

*The territory with the MARS meteor radar was under the occupation of Russian troops for ~190 days in 2022 (Kharkiv region). After five months, is released, but the mines remained -in the picture on the right below, turquoise color*





**There is a symbolic mural in Prague, Czech Republic : “The child who protects the world”. It is related to the war in Ukraine 2014 - 2022 - 2024. It shows a Ukrainian girl trying to save the world, presented in the form of cartoon characters : covers them with a blue-yellow flag...**

**ДИТИНА, ЯКА ЗАХИЩАЄ СВІТ**

A Child Who Protects the World



Pay attention to the toys that the girl covers with a yellow-blue flag: Mickey Mouse (USA); **Little Mole** (Czech Republic / in **Czech: Krtek, Krteček**); Moomin (Finland); Obelix (France); Bolek and Lolek (Poland); Bitzer dog (Great Britain); the bee Maya (Germany)...

In Ukraine there are also other meteor research centers that are also suffering from the war in Ukraine, some of them also received a boost in development thanks to the IGY 1957 program but the radar method was continued only in Kharkiv (Kharkov - in russian).

### Participants of program IGY 1957 on meteor research in the USSR

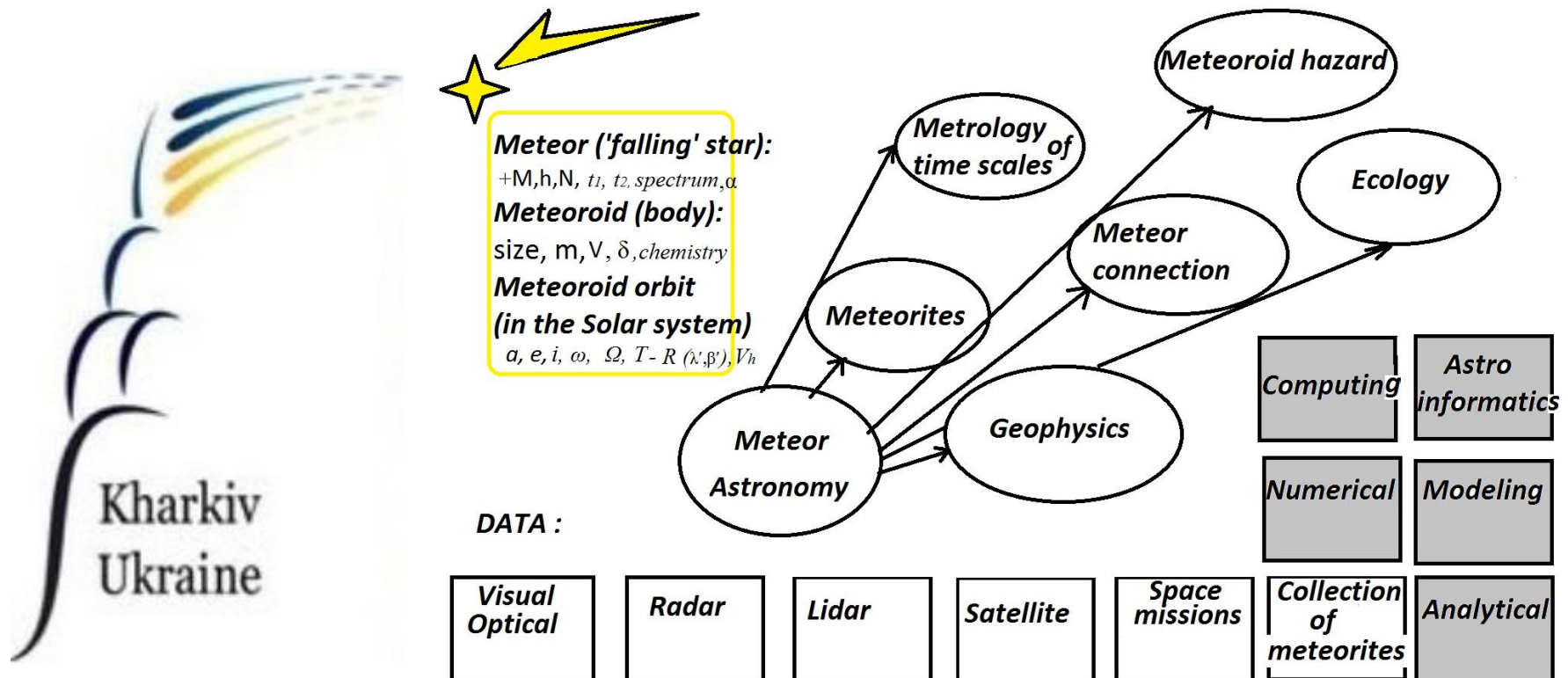
R - radar, Ph - photographic, V - visual

| N | City                          | $\varphi$    | $\lambda$    | $H_m$ | Scientific institutes / Country / Chairs   | Program, N igy             |
|---|-------------------------------|--------------|--------------|-------|--|----------------------------|
| 1 | <i>Ashkhabad</i>              | 37 °<br>56 ' | 58 °<br>24 ' | 200   | Astrophysical Laboratory of the Institute of Physics and Geophysics AS <b>Turkmen SSR</b><br>I.A. Astapovich, Ya.F. Sadykov. | R, Ph, V<br>N696<br>(C126) |
| 2 | <i>Kazan</i>                  | 55 °<br>47 ' | 49°<br>07 '  | 80    | Astronomical observatory named Engelgardt of the Kazan University <b>Russian SFSR</b> K.V. Kostilyov.                        | R<br>N233                  |
| 3 | <u>Kiev</u>                   | 50 °<br>27 ' | 30°<br>30 '  | 185   | Astronomical observatory of the Kiev University <b>Ukrainian SSR</b> A.F.Bogorodskiy,  | R, Ph, N320                |
| 4 | <u>Odessa</u>                 | 46 °<br>29 ' | 30°<br>46 '  | 50    | Astronomical observatory of the Odessa University <b>Ukrainian SSR</b> V.P.Tsesevich, E.N. Kramer                            | R, Ph, V<br>N621           |
| 5 | Stalinabad<br><i>Dushanbe</i> | 38 °<br>34 ' | 68°<br>46 '  | 820   | Institute of Astrophysics AS <b>Tajik SSR</b><br>L.A. Katasev, P.B. Babadzhanov, A.M. Bakharev.                              | R, Ph, V<br>N680<br>(C115) |
| 6 | <i>Tomsk</i>                  | 56 °<br>29 ' | 84°<br>59 '  | 120   | Tomsk Polytechnical Institute ( <i>faculty of Radiophysics</i> ) <b>Russian SFSR</b> Ye.F.Fialko.                            | R<br>N224                  |
| 7 | <u>Kharkov</u>                | 50 °<br>00 ' | 36°<br>14 '  | 140   | Kharkov Polytechnical Institute ( <i>faculty of Radioengineering</i> ) <b>Ukrainian SSR</b> B.L. Kashcheyev                  | R<br>N358(B141)            |





The **meteor research** is the example of cross-disciplinary research having sharp rise due to the project of the IGY 1957 and others geophysical projects. **Meteor astronomy** is an independent science that supports other sciences and applied problems (in particular, geophysics, meteor communication, and solving meteor hazard problems).



# What is the main value and the main tradition of all geophysical years?

The implementation of the innovative idea of Karl Weyprecht (1875) about the need to unite the efforts of scientists from all countries to solve the pressing scientific problems of humanity

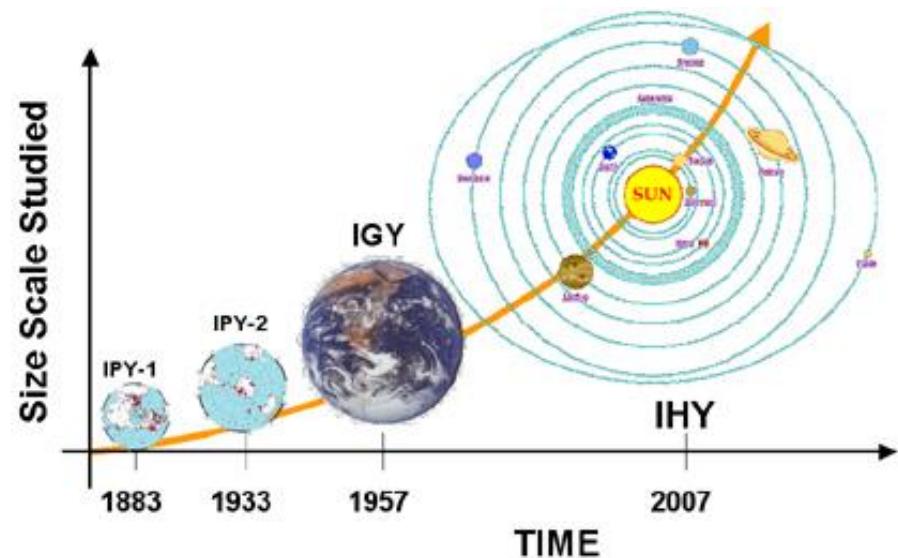
**1883** International Polar Year  
(First) : **IPY-1**

**1933** International Polar Year  
(Second) : **IPY-1**

**1957** International  
Geophysical Year : **IGY**

**(solar-terrestrial  
connections / V section :  
Ionosphere, meteors)**

**2007** International  
Heliophysical Year : **IHY**



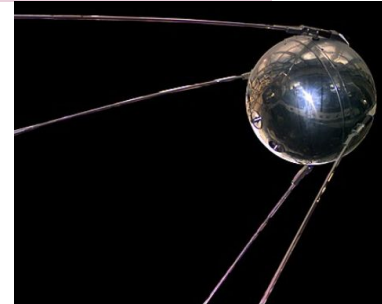
The IGY triggered an 18-month year of Antarctic science. The International Council of Scientific Unions, a parent body, broadened the proposals **from polar studies to geophysical research (solar-terrestrial connections/V. Ionosphere, meteors)**. More than 70 existing national scientific organizations then formed IGY committees, and participated in the cooperative effort.



A commemorative stamp issued by Japan in 1957 to mark the IGY. The illustration depicts the Japanese Research Ship *Sōya* and a penguin.



Official emblem of the IGY



A replica of Sputnik 1, which was launched into orbit on October 4, 1957.





# International Geophysical Year 1957 (IGY) program

IAU - IGY Coordinator

**V. Guth** (former ČSR); **V. Fedynsky** and **Kashcheyev** (former USSR).



## METEOR ASTRONOMY

IGY Coordinator - IAU Commission 22 (Division III)

C22 President 1952 - 1958 : **V. Guth** (former Czechoslovakia-ČSR)

C22 President after 1958 : **V. Fedynsky** (former USSR)



## Results of researches on the program of the International Geophysical Year

### **V Section of IGY program “IONOSPHERE and METEORS”**

were published in Annals of IGY (France, Paris) and numerous collections of articles in the Russian language (former USSR, Moscow; Ukraine, Kharkiv etc.)

**1957 – 1958 – 1959 : In Kharkiv, under the leadership of Kashcheyev and Fedynsky, the best IGY 1957 radar observations of meteors were organized and conducted**



**20th century: Revolutionary radio and rocket technology; increased interest in the ionosphere and radio meteors. In the 1950s, preparations were underway for the global International Geophysical Year program, involving 67 countries with more than 600,000 scientists worldwide. People were tired of World War II and wanted to create. The death of the tyrant Stalin in the former USSR in 1953 contributed to a political thaw.**

- Oct 4, 1957: Open space era
- IGY1957: Global International Geophysical Year 1957 project
- 1954: B. Lovell\* proposed the meteor radar research program for the IGY1957
- 1954: B.Kashcheyev\*\* & team registered the first radio meteors in Ukraine (USSR)
- 1947: E.Appleton obtained a Nobel Prize (for his confirmation of existence of ionosphere in 1927)
- 1945: the first radio meteor observations in UK

*Proposed to research meteors using radar method in IGY1957*



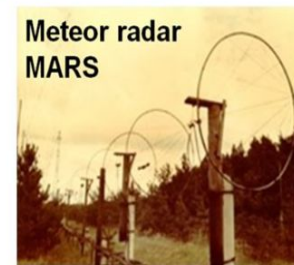
\*B.Lovell (1913-2012), UK



*Became the best in meteor research using radar method in IGY1957 and...*



\*\*B.Kashcheyev (1920-2004), Ukraine



**MARS: Meteor Automated Radar System**

Table shows  
development stages  
and achievements of  
Kharkiv radar meteor  
research (compressed)

| Periods<br>(KhPI/<br>NURE) | Meteor<br>radar<br>systems   | Some Global<br>International<br>Projects etc. | Some dissertations,<br>catalogs etc.         | Registered<br>meteor<br>orbits (N) |
|----------------------------|--|---|--|------------------------------------|
| 1954□                      | Registration of the first radiometers in Ukraine□  |   |  |                                    |
| 1954-1957□                 | Creations of the Kharkiv meteor observed base:<br>the Balakleva scientific and research polygon (BSRP)   |   |  |                                    |
| 1957-1959□                 | MRS  | IGY 1957/9                                    | (Kashcheyev et al.,<br>1961)□                |                                    |
| 1967-1971□                 | MARS<br>I  |   | (Kashcheyev et al., 1967)□                   | 90,000*                            |
| 1968-1970□                 |  | Equatorial<br>expedition□                     | Catalog I                                    | 5330□                              |
| 1971-1978□                 | MARS<br>II   |   | (Catalog II<br>1980)                         | 250,000<br>(5317)                  |
| 1981-1991□                 | MARS<br>III  |   | (Voloshchuk,<br>1984)                        |                                    |
| 1985-□                     |  | GLOBMET                                       |  |                                    |
| 1985-87□                   |  | IHW   |  |                                    |
| 1996-2000□                 |  |   | (Voloshchuk et al.,<br>1996)□                |                                    |
| 2000-2007□                 |  |   | (Voloshchuk&¶<br>Gorelov, 2011)□             | 5160<br>(showers)□                 |
| 2004□                      | Kharkiv meteor observed base ( NURE BSCP) was assigned<br>the status of the National property of Ukraine |   |  |                                    |
| 2007/9□                    |  | IHY 2007/9□                                   | (Kolomiyets, 2011)                           |                                    |
| 2007□                      | NURE Kashcheyev SRL RA SRD was created   |   |  |                                    |
| 2007-2021□                 |  | -   | (Kolomiyets, Voloshchuk<br>et.al 2015-2020)¶ |                                    |





**Tab.4.1.** Some statistical data on the orbits of meteoroids observed by MARS

Data

| Data type          | Obs. period | Orbits ( N) | Magnitudes       | Remarks                            |
|--------------------|-------------|-------------|------------------|------------------------------------|
| Total              | 1959-1960   | 12500       | +8 <sup>m</sup>  |                                    |
| Sporadic           | 1959        | 360         | +8 <sup>m</sup>  |                                    |
| <u>Geminids</u>    | 1959        | 298         | +8 <sup>m</sup>  |                                    |
| 195streams         | 1959-1960   | 3500        | +8 <sup>m</sup>  | Math                               |
| Total              | 1968-1970   | 5330        | +8 <sup>m</sup>  | 2 <sup>0</sup> N 45 <sup>0</sup> E |
| Total              | 1968-1970   | ~ 70 000    | +12 <sup>m</sup> |                                    |
| Total              | 1972-1978   | ~250 000    | +12 <sup>m</sup> |                                    |
| Total              | 1975        | 5317        | +12 <sup>m</sup> |                                    |
| Sporadic           | 1972-1978   | ~160 000    | +12 <sup>m</sup> |                                    |
| 5160 streams       | 1972-1978   | ~100 000    | +12 <sup>m</sup> | Math                               |
| <u>η- Aquarids</u> | 1986        | 41          | +12 <sup>m</sup> |                                    |
| <u>Orionids</u>    | 1985-1986   | 19          | +12 <sup>m</sup> |                                    |



## Data. Place of Kharkiv data among others.

There are five large archives of specular meteor radar (SMRs) data (**Tab.1**) : the HRMP (Harvard Radio Meteor Project radar, USA); the AMOR (Advanced Meteor Orbital Radar, New Zealand); the CMOR (Canadian Meteor Orbital Radar, Canada); the SAAMER (Southern Argentina Agile Meteor Radar, Argentina) and the MARS II (Meteor Automated Radar System, Kharkiv, Ukraine). Megawatt MARS radar registered faint meteors up to +12m (in the mass range:  $10^{-6}$ - $10^{-3}$  g) .

**Tab.1** Parameters of known orbital meteor radars/SMR and their archives

| Radar name | Country | LAT, deg | LONG, deg | f, MHz | N orbits    | M magnitude | Years   |
|------------|---------|----------|-----------|--------|-------------|-------------|---------|
| HRMP       | USA     | 40.20N   | 90.02W    | 41.10  | ~10,000     | +12         | 1960s   |
| 💙 MARS I   | UKR 💙   | 49.42 N  | 36.87E    | 22.38  | ~70,000     | +12         | 1967-71 |
| 💛 MARS II  | UKR 💛   | 49.42 N  | 36.87E    | 31.10  | ~250,000    | +12         | 1972-78 |
| AMOR       | NZL     | 43.60S   | 172.60E   | 26.20  | ~500,000    | +13         | 1990s   |
| CMOR       | CAN     | 43.26N   | 80.77W    | 29.85  | > 5 million | +7/+8       | 2000s   |
| SAAMER     | ARG     | 53.68S   | 67.87W    | 32.55  | > 1million  | +7/+8       | 2000s   |

We do not have access to our workplace in the university building after February 24, 2022. The NURE building (except for the broken windows) intact, but access to the building is limited . The windows were subsequently repaired. The university operates in a mixed mode in terms of education and conducting classes with students, sometimes switching completely to online teaching. The university survived! The university has a website and we plan to put the data and results of the Kashcheyev RA LAB there.



## Statistics of the Kharkiv meteor radar data, which we managed to restore and work with.

| 1  | 2  | 3     | 4                 | 5     | 6     | 7     | 8    | 9   |
|--|--|-------|-------------------|-------|-------|-------|------|---|
| References   | Years (1972-1978) with number of orbits in columns by years or total |       |                   |       |       |       |      | Remarks   |
|  | 1972   | 1973  | 1974              | 1975  | 1976  | 1977  | 1978 |   |
| Kharkiv meteor radar data in this research   | 10247  | 41889 | 3356              | 34042 | 21187 | 12114 | 6743 | *All meteors  |
| [22, Kashcheyev, Tkachuk (1980)]   |  |       |                   | 5327  |       |       |      | Published data (short Kharkiv catalog 1975)           |
| Catalog [33, Voloshchuk, Kolomiyets, Cherkas (2018)] (Kharkiv meteor radar data in this research ) |  |       |                   | 6743  |       |       |      | Published data (Kharkiv catalog 1978)                 |
| [32, Voloshchuk, Kashcheev,(1996)]   |  |       | 36979 (1974-1978) |       |       |       |      | *Sporadic   |
| Catalog of JAN-MAR 1978  |  |       | 52932 (1974-1978) |       |       |       |      | *Shower   |
| [35, Voloshchuk, Gorelov (2011)] (used in this research )  | 5160   |       |                   |       |       |       | 1346 | The data are published to this article                |
| Kharkiv meteor radar data in this research   |  |       | 39326 (1974-1978) |       |       |       |      | Meteor showers and associations (partially published) |
|  |  |       | 52932 (1974-1978) |       |       |       |      | *Sporadic   |
|  | 159319; 156713 (1972-1978)   |       |                   |       |       |       |      | *Shower   |
|  |  |       |                   |       |       |       |      | *Samples of all meteors                               |

Comment:\* - don't published data



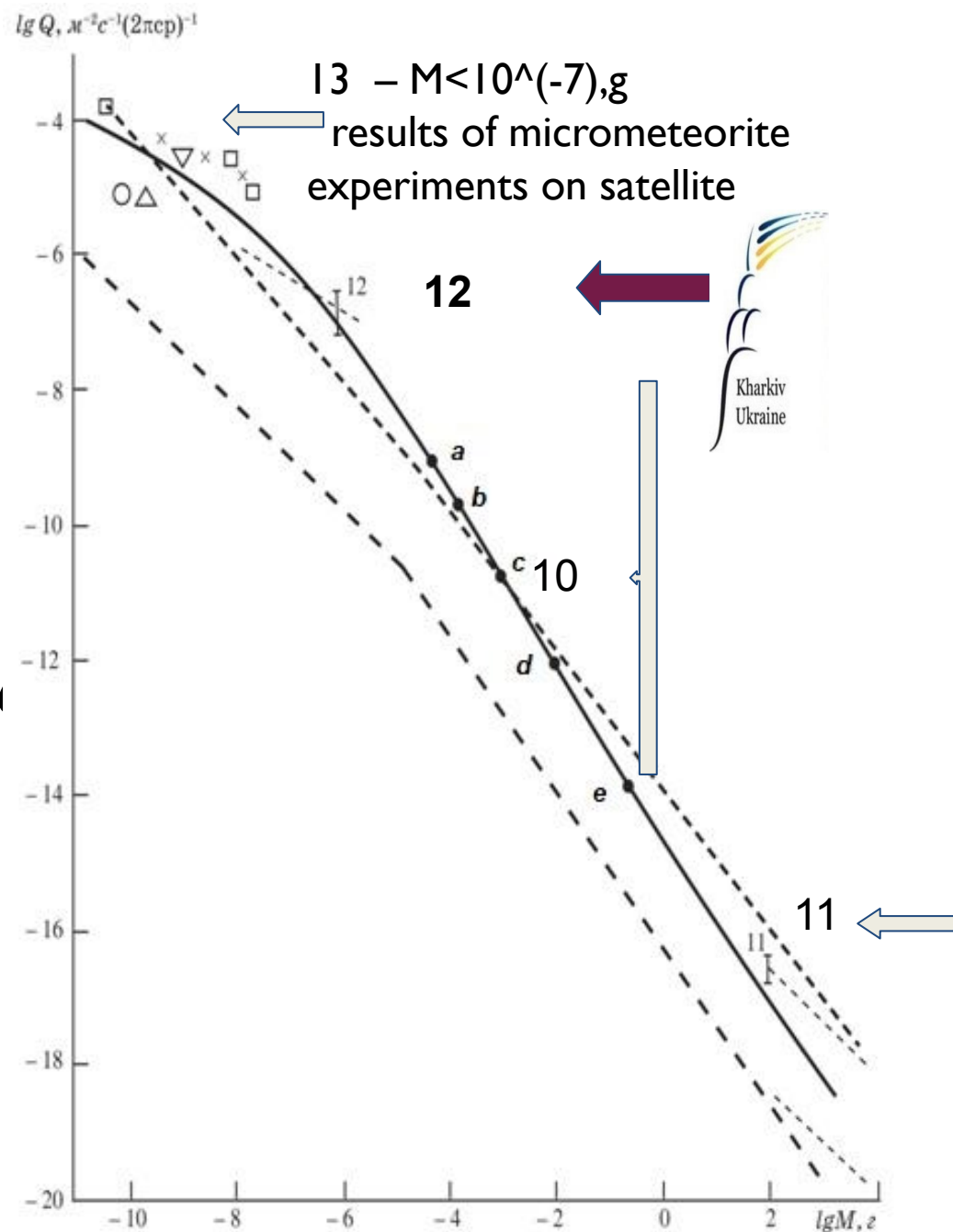
**Fig.** The total influx of meteors on the Earth's surface: (The **bold curve** is the integral flux density of meteoroids of different masses):

**13** - results of micrometeorite experiments on satellite  
( $M < 10^{-7}$ , g)

**12** - Radio observations of meteors by equipment of high effective sensitivity + **12** (MARS)  $M > 10^{-6}$ , g

**11** - photographic observations with fireball cameras

**10** - Results of radio and optical observations of meteors (**a**, **c** - telescopic, **b** - medium-power radar, **d**, **e** - photographic Super-Schmidt cameras)



# Some results\* on the restored data of the meteor radar MARS\*\*



- **\*PhD student** of Kharkiv National University of Radio Electronics (NURE) **Iryna Kyrychenko** will present (**in next our report**) some results of the distribution of MARS meteor radiants on the reconstructed MARS data lost due to the war(Fig.7)
- **\*Meteor Automated Radar System (Kharkiv, Ukraine)** Megawatt radar registered faint meteors up to +12m (in the mass range:  $10^{-6}$ - $10^{-3}$  g) / **See more about the MARS meteor radar in the Poster “About the stages of the modernization of the Kharkiv meteor radar "MARS" and its current state”** Dr. Serhii Kundyukov & Dr. Svitlana Kolomiyets

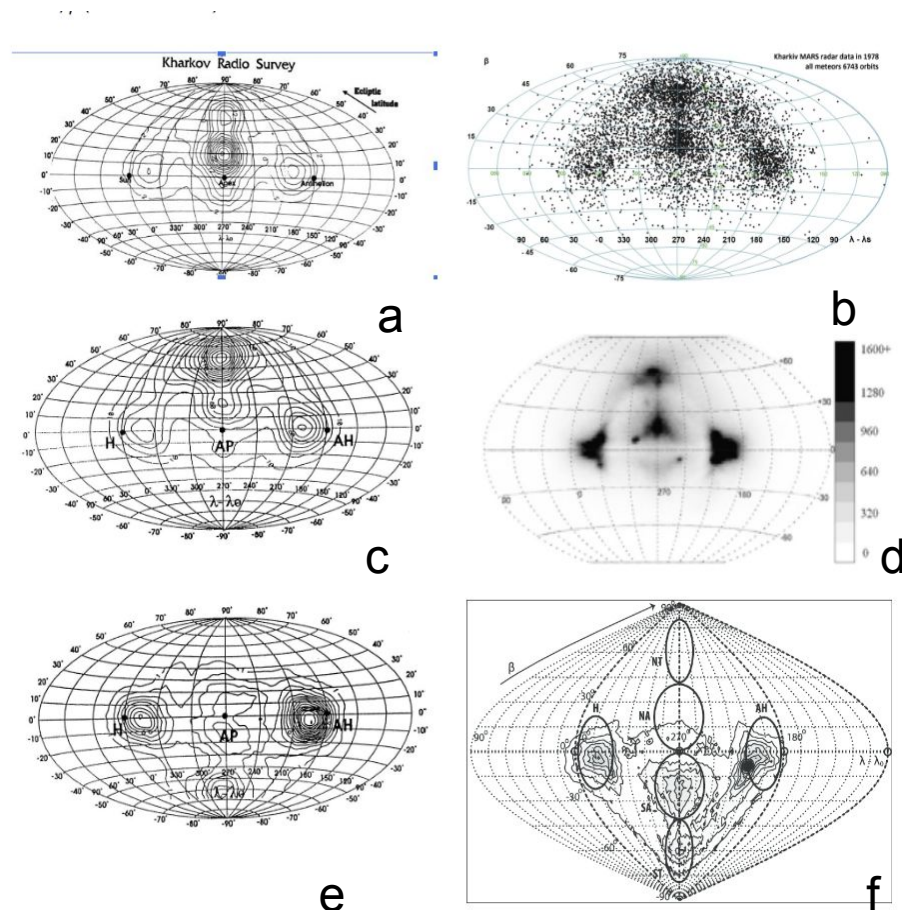


Figure 7: Comparison of distributions  $\beta$ ,  $\lambda$  –  $\lambda_s$  of meteor radiants from the Kharkiv MARS meteor radar data with data from other radars : (a) [13, Jones and Brown(1993)] for Kharkiv 5327 selected radiants from 1975 according [22, Kashcheyev, Tkachuk(1980)] ; (b) all meteors sampled for 1972-1978 in this research (a separate copy); (c and e) contours of apparent density of meteor radiants from the combined Harvard (c) and Adelaide (e); (d) radio surveys [13, Jones and Brown(1993)]; (f) the SAAMER radar radiants [12, Janches, Close, Hormaechea, et al., (2015)]. Here H denotes the position of the Sun (Helion) point, AP - the Earth apex point and AH - the Antihelion point; NT-North toroidal, NA -North Apex, SA - South Apex, ST - South toroidal.

## 21st century : new technologies, CMOR+SAAMER

In the 21st century, new opportunities have appeared associated with the development of radio electronics and the IT industry. All-sky meteor systems "SKiYMET meteor systems" have become widespread, and not so long ago another modification of them, ComMet/21i ("ComMet") appeared.

There were plans (**interrupted by the war**) that Prof. Wayne Hocking would install a **SKiYMET** system near Balakliia city (Kharkiv region, Ukraine).

Wayne Hocking [Hocking et al. 2001; Lau et al. 2006...].



Prof. Wayne Hocking during a radar installation in Costa Rica

SKiYMET antenna ground plan

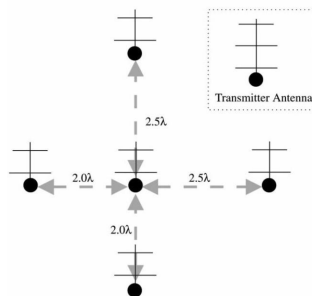
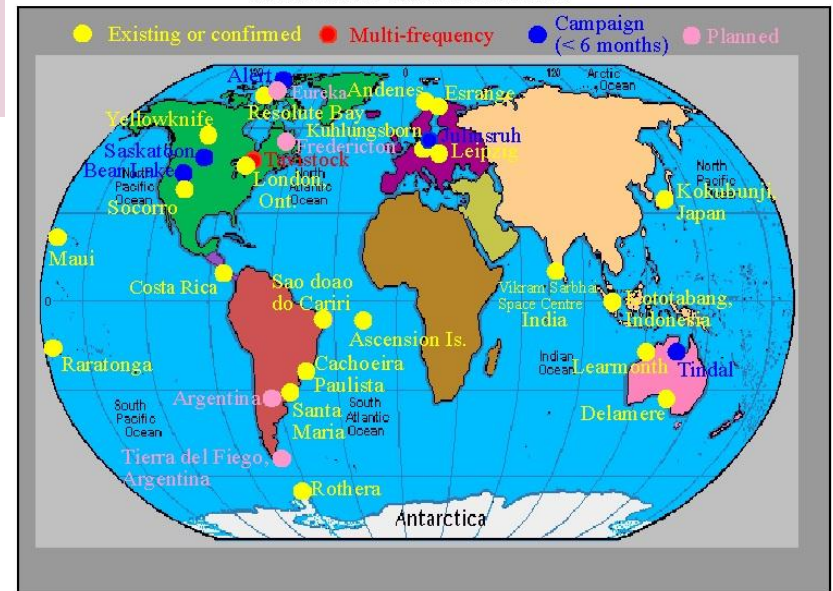


Fig. 1. Plan view of the antenna arrangement for the radar system. The location of the transmitter antenna is not critical and can be placed in any convenient location. The receiving antennas all need to be in a horizontal plane. The symbol  $\lambda$  represents the radar wavelength.

## SKiYMET Meteor Radars.



## The Canadian Meteor Orbit Radar: system overview and preliminary results

J. Jones<sup>a,\*</sup>, P. Brown<sup>a</sup>, K.J. Ellis<sup>b</sup>, A.R. Webster<sup>c</sup>, M. Campbell-Brown<sup>d</sup>,  
Z. Krzeminski<sup>a</sup>, R.J. Weryk<sup>a</sup>

## THE SOUTHERN ARGENTINA AGILE METEOR RADAR ORBITAL SYSTEM (SAAMER-OS): AN INITIAL SPORADIC METEOROID ORBITAL SURVEY IN THE SOUTHERN SKY

D. JANCHES<sup>1</sup>, S. CLOSE<sup>2</sup>, J. L. HORMAECHEA<sup>3,4</sup>, N. SWARNALINGAM<sup>1,5</sup>, A. MURPHY<sup>6</sup>, D. O'CONNOR<sup>6</sup>,  
B. VANDEPEER<sup>6</sup>, B. FULLER<sup>6</sup>, D. C. FRITTS<sup>7</sup>, AND C. BRUNINI<sup>8</sup>

**Two SKiYMET radars (CMOR+SAAMER) measure the orbits of meteoroids**



## **CONCLUSION 1-9 (first part 1-4) : 20th-21st century / meteor radar data and meteor radar research in Kharkiv and in Kashcheyev RA LAB, NURE**

- **1. Kharkiv meteor radar system (MARS, Ukraine) has acquired the status of the important historical astronomical instrument in world history.**
- **2. Meteor Centre for researching meteors in Kharkiv (now Kashcheyev LAB) is a analogue of the observatory and performs the same functions of a generator and a battery of special knowledge and skills (the world-famous studio).**
- **3. Kharkiv and the location of the instrument were brand points on the globe, as the place where the world-class meteor radar studies were carried out.**
- **4. Kharkiv meteor radar research went down in the history of world meteor astronomy.**



# CONCLUSION (continuation): 20th-21st century / meteor radar data and meteor radar research in Kharkiv and in Kashcheyev RA LAB, NURE

- 5. Observational data and accumulated knowledge about meteors in Kharkiv should be preserved and developed.



Table\* . Some information about meteor radars (HRMP, AMOR,CMOR, SAAMER) the data of which is used to build a model of the meteoroid environment for NASA (potentially Kharkiv meteor radar MARS data )

| Radar name | Country | LAT, deg | LONG, deg | f, MHz | N orbits    | M     |
|------------|---------|----------|-----------|--------|-------------|-------|
| HRMP       | USA     |          |           | 41.10  | ~10,000     | +12   |
| MARS       | UKR     | 49.42    | 36.87E    | 22.38  | ~70,000     | +12   |
| MARS       | UKR     | 49.42    | 36.87E    | 31.10  | ~250,000    | +12   |
| AMOR       | NZL     | 43.60S   | 172.60E   | 26.20  | ~500,000    | +13   |
| CMOR       | CAN     | 43.26N   | 80.77W    | 29.85  | > 5 million | +7/+8 |
| SAAMER     | ARG     | 53.68S   | 67.87W    | 32.55  | > 1million  | +7/+8 |

- 6. The Table\* shows some information about meteor radars, the data of which is used to build models of the meteoroid environment for NASA. The Kharkiv MARS data should also be included in this process.

## **CONCLUSION 1-9 (final points 6 - 9): 20th-21st century / meteor radar data and meteor radar research in Kharkiv and in Kashcheyev RA LAB, NURE**

- **6. In XXI century new technology in MSRs (Meteor Specular Radars) - SKiYMET / "all-sky" systems / were developed and embodied in radars: CMOR (Canadian Meteor Orbital Radar) and SAAMER (South Argentina Agile Meteor Radar).**
- **7. Negotiations are underway and project preparations are being made to purchase and install the SkiYMET system to replace the equipment destroyed by the war – The meteor observation complex in the Kharkiv region (Ukraine) near Balakliia.**
- **8. Work is underway to find sponsors and a temporary location for the SkiYMET system to implement this project in support of the restoration (in the form of a complete modernization) of the Balakliia Geophysical complex for studying the atmosphere and the influx of meteor matter (Kharkiv region near the Balakliia city.**
- **9. Looking for a way to continue observing meteors by radar method by installing a SkiYMET radar for Kharkiv researchers in another place, not in Ukraine, temporarily, until the war is over and the creation of a branch of the Kashcheyev RA LAB outside Ukraine (may be, as one of the options).**



# Acknowledgments



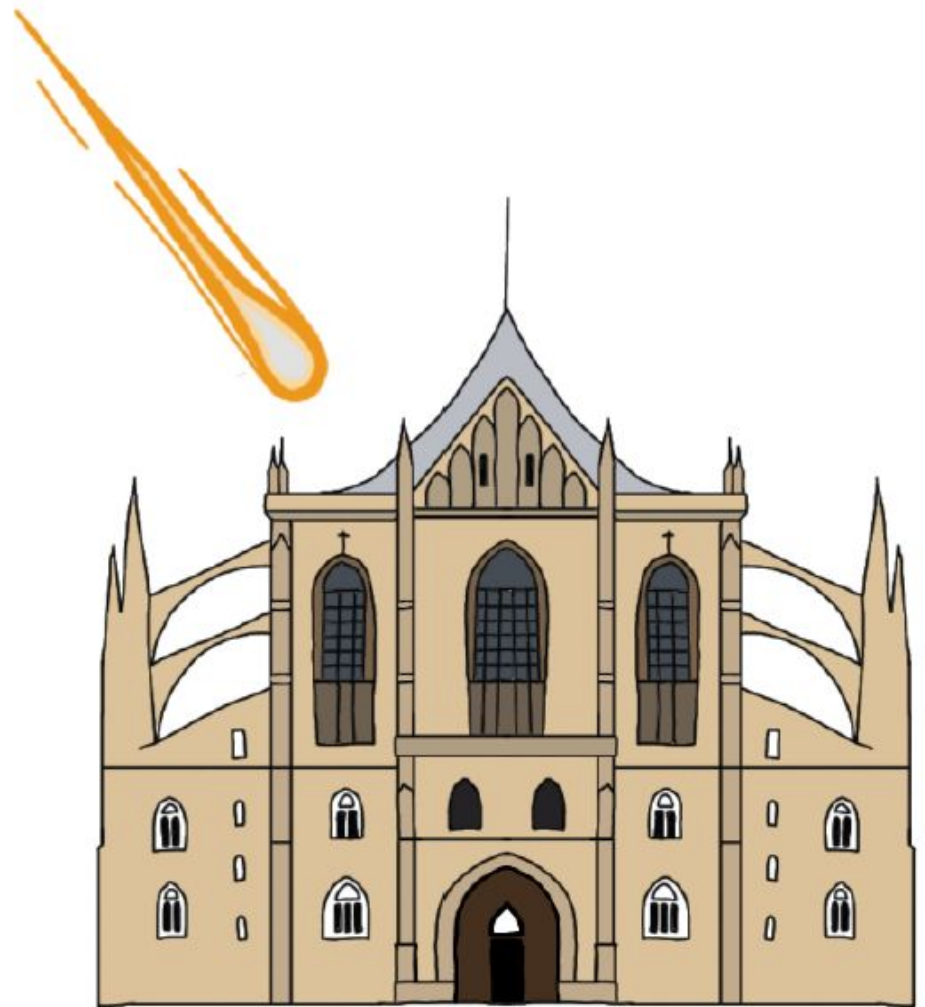
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Thank you for you attention!

