

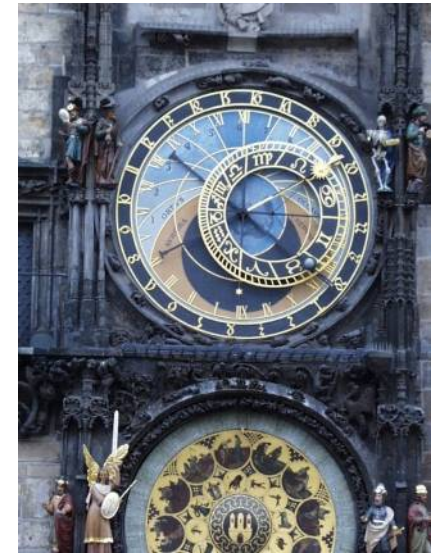
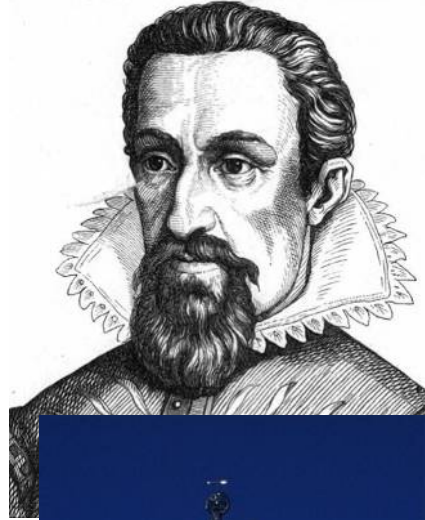
Welcome to Prague, AXRO 2023

City of Astronomy and X-ray Astronomy

René Hudec



Prague – historical city of astronomy: Tycho de Brahe, Kepler, Einstein, Doppler ... and astronomical X ray optics



History of Grazing Incidence X-Ray Optics in the Czech Republic

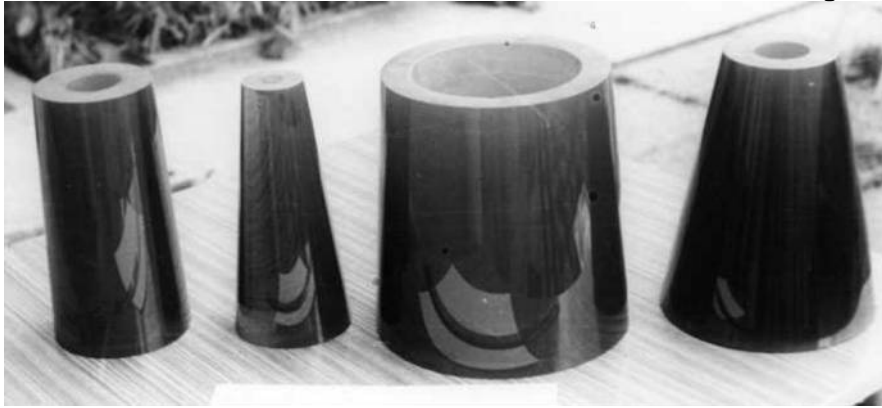
- 1st X-ray mirror in **1969/1970**, for solar telescope in INTERKOSMOS program
- The early stages of the X-ray optics developments in the Czech Republic are closely related to the INTERKOSMOS Space Program (Soviet and East European equivalent of ESA operated until 1989). All of the X-ray imaging telescopes onboard Soviet spacecrafts were equipped with the Czech X-ray optics (exception: X-ray normal incidence mirrors in the special channel of the TEREK telescope). Later on, laboratory applications have started.
- **Total number of X-ray mirrors produced: more than 50**
- Total number of mirrors flown in space: 10
- Total spacecrafts with Czech X-ray optics: 5
- Total number of space experiments with Czech X-ray optics onboard: 10

Various replicated X-ray optics

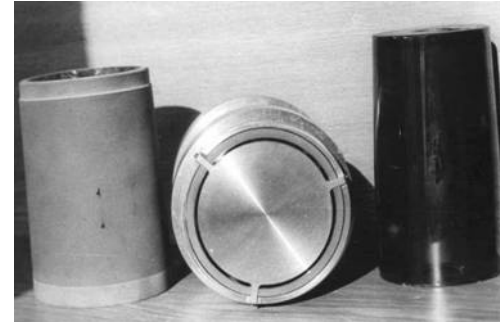


The Grazing Incidence Astronomical X-Ray Optics in the Czech Republic: more than 50 years of development

X - ray mirrors produced by replication in the Czech Republic



The four mandrel used for the manufacture of X-ray mirror nested array for the RT-4M soft X-ray telescope (Glass ceramics Sital). Flown onboard the space station Salyut 7 in 1981.



TEREK
Phobos 1
1988



Two identical mirrors (large hyperbolas) of the RT-4M mirror array (Ni surfaces), 1981.



Replicated Wolter - 1 X-ray mirrors of the KORONAS satellite (aperture 80 mm), 1989

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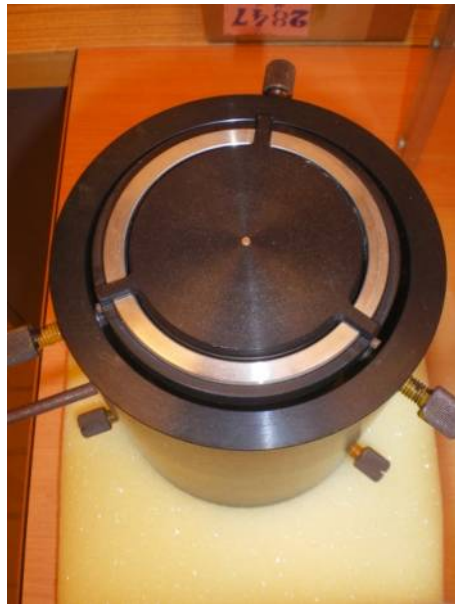
One of the first Czech X-ray Wolter mirrors, 1970, aperture 50 mm



The galvanoplastic (electroforming) replication adopted from gramophone industry



115 mm aperture X-ray mirror for AUOS-S-IK, solar, FWHM < 10 arcsec, thick Ni



Solar X-ray Wolter mirror 8'0 mm thick Ni



Thin Ni mirror for DSRI, 1986, thin Ni, 150 mm



115 mm Wolter, Ni/epoxy, 1979

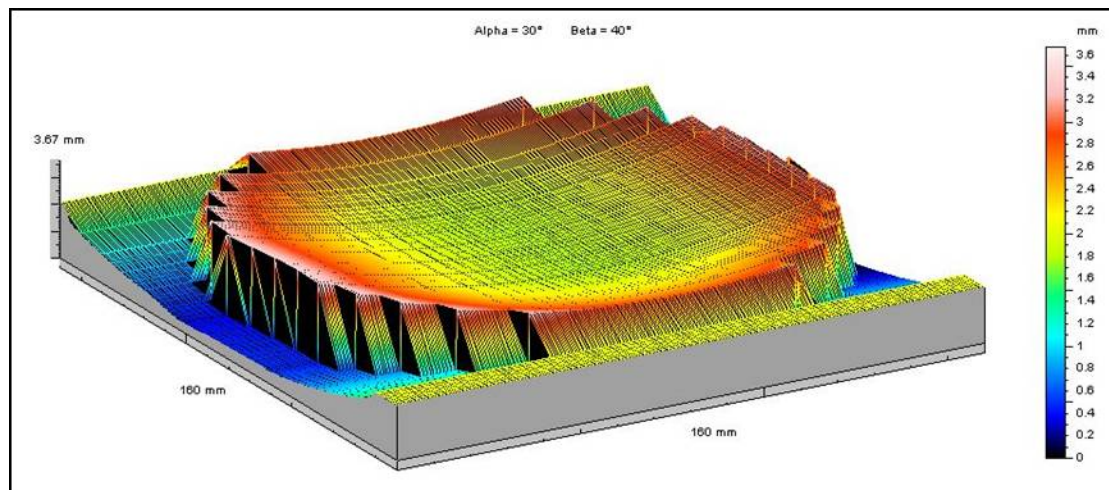
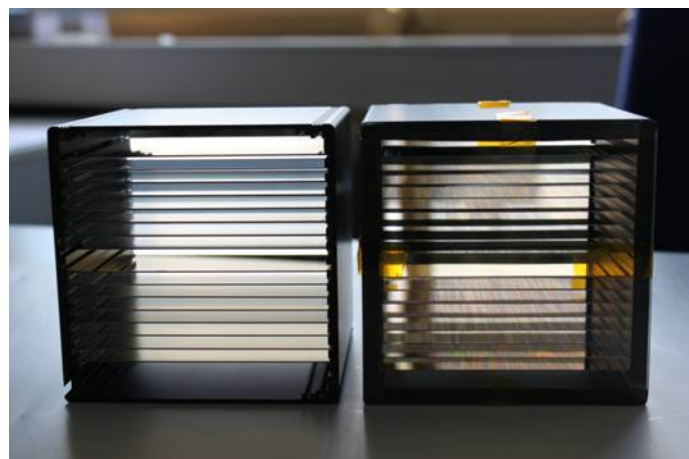


**X-ray Optics
laboratory at
Astronomical
Institute
Ondřejov**

Years 2005-2015

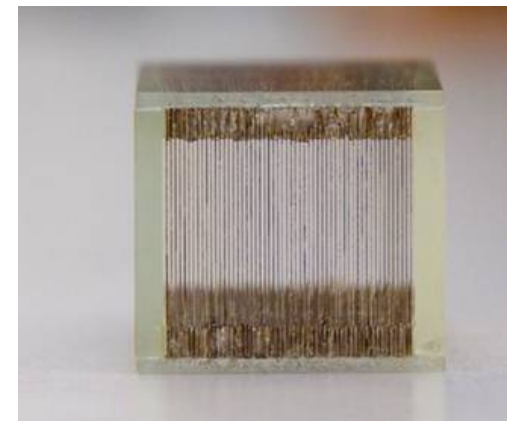
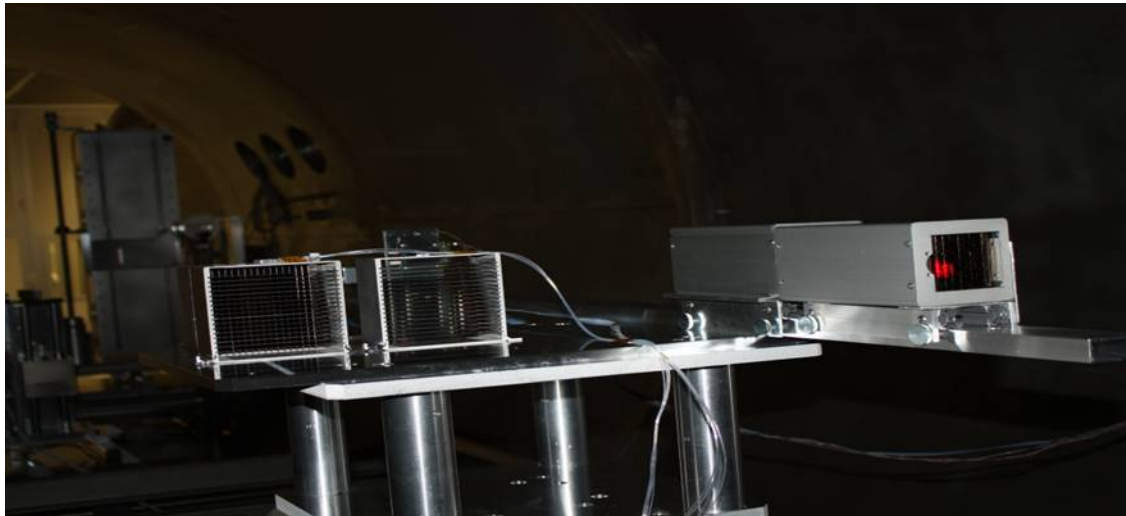
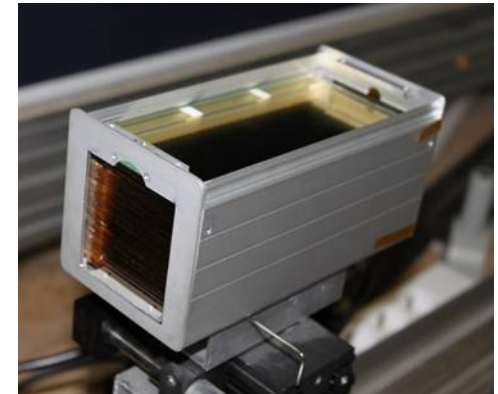


Various modules of MFO Multi Foil Optics
Novel substrates bent thin glass foils
Lobster Eye Optics
K-B Optics



Recent 2016-22

- Participation in AHEAD EU project, KB modules
- LE VZLUSAT1 and 2 (cubesats)
- LE REX (rocket experiment)
- Glass foils/Si substrates
- More in relevant talks/posters



Czech-US Seminar on Astronomical X-Ray Optics May 2007



Visit to Komorní Hrádek Chateau

Train ride to ON Semiconductor



International Workshop on Astronomical X-ray Optics AXRO2008 Prague Dec 2008



A new tradition is born

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AXRO2009



AXRO2009 at the Komorní Hrádek Castle



AXRO2010 at Liblice Chateau



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AXRO2011:with Prince Lobkowicz at Melnik Castle



AXRO 2012





AXRO2013



AXRO 2014



AXRO2015



AXRO2016



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AXRO2017 official photo



AXRO2018



AXRO2019

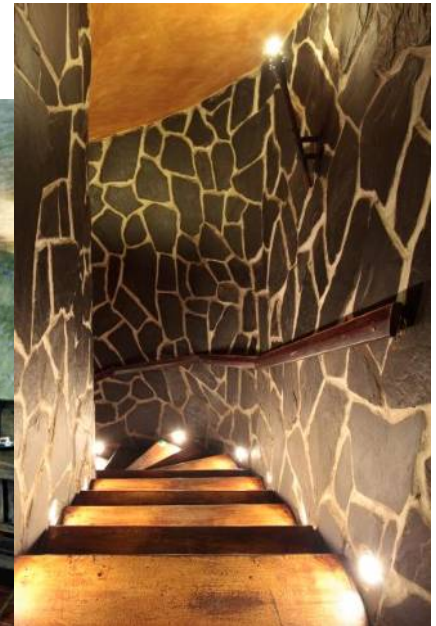


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AXRO 2023 Conference Evening Event and Dinner on Dec 5 Tuesday

- **Dinner in Restaurant U Sádľů, Klimentská 2, Prague 1, 19.00-22.00 provided by LOC**
- **Meeting 18.00 Lanna Lobby tram tickets will be provided**
- **In emergency call my mobile phone 00420731502542**



AXRO 2023 Conference Tour and Dinner on Dec 7 Thursday

- **Guided tour of Klementinum old library and astronomical tower**
- **Led by Dr. Zdik Sima top scientist on Prague astronomical history**
- **Meet 15.00 in Lanna lobby, tram tickets will be provided**
- **Dinner in the Baroque refectory of the Dominican monastery, Jilská 5, Praha 1, 18.30-22**
- **In emergency call my mobile phone
00420731502542**

Klementinum Old Prague Observatory



Jesuit College

**1st Prague Observatory
Observatory tower from 1722
Today National Library**

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Klementinum

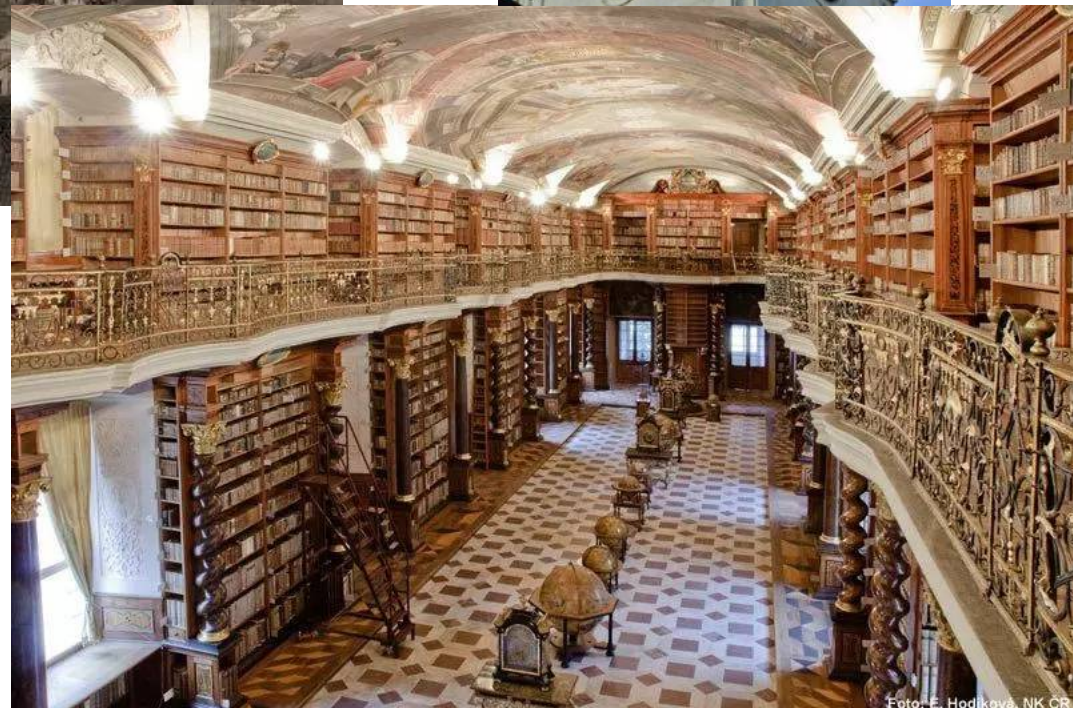


Foto: E. Hodíková, NK ČR

Baroque refectory of the Dominican monastery



Some logistics

- Breakfast included in accommodation price
- All lunches included in the fee
- Conference evenings events included in the fee
- Guest tickets 50 Euro/1000 CZK each event
- Time of conf photo today before lunch
- Please sign the AXRO page in the Lanna guest book
- **Public transport in Prague is free for everybody over 65 picture ID or passport required**

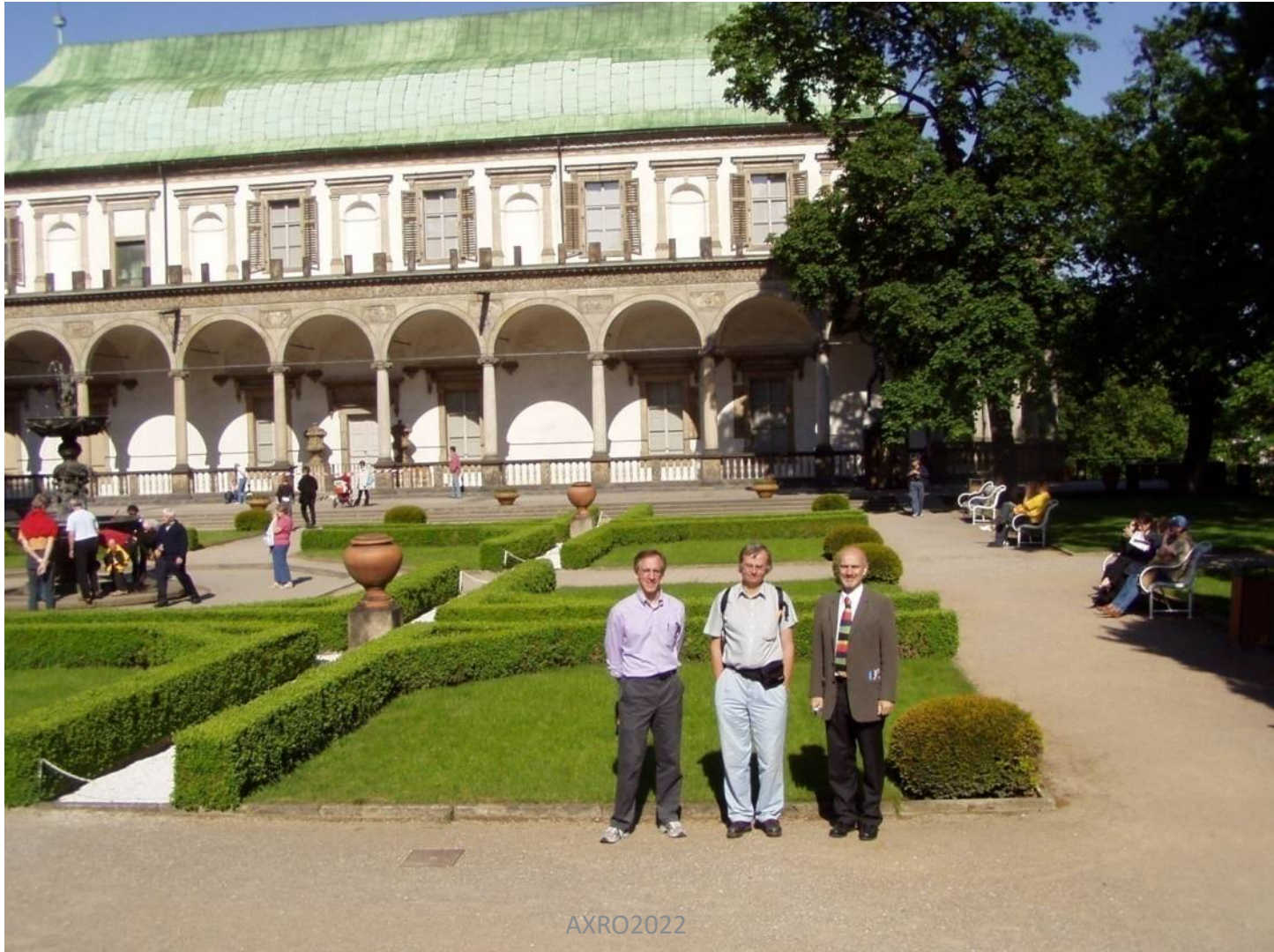
Places to see in Prague

- **Kepler house and Kepler Museum inside**
- **Thumb of Tycho Brahe in Tyn church,
Staromestske namesti**
- **Astronomical clock, old city hall Staromestske
namesti = place of Christmass market**
- **Monument of Kepler and Brahe at Pohorelec,
Tram station 22 near Prague castle**

Visit to Astronomical Prague



Belveder: Former Observing Place of Tycho de Brahe



Kepler House in Prague (and Kepler museum inside)



<http://www.keplervomuzeum.cz/en/>



Tycho de Brahe House



**House No. 76 Nový Svět 1
Praha 1 Hradčany (Prague
Castle)**

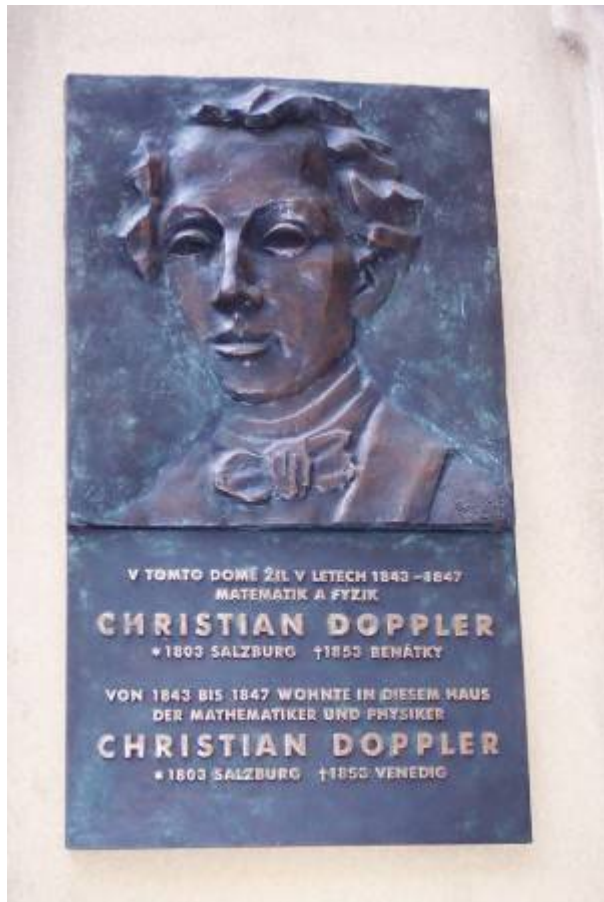


Doppler and Prague

**High school professor in Prague
1835-1847**

Professor in Prague 1835-1847

In 1843, at the proposal of František Palacký, he became a full member of the Royal Czech Society of Science. At the meeting of the science section of the Society, he lectured on May 25, 1842, "On the Color of the Binary Stars", where he described the so-called Doppler phenomenon. However, since he had no experimental evidence, the work did not receive too much attention



U obecního dvora 5, Praha 1
Staré Město

L

Tycho de Brahe Thumb



Astronomical Clock



V. International Workshop on Astronomical X-Ray Optics 2012

***Villa Lanna, Prague, Czech Republic
December 10 - 13***

**The Workshop is organized by Astronomical
Institute of the Academy of Sciences of the Czech
Republic,
Czech Technical University in Prague and
Ministry of Transport
<http://axro.cz>**





The X mass market
starts on Dec 1,
2018



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Enjoy the meeting and Prague

