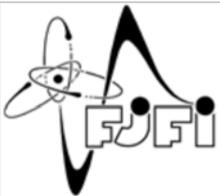


Influence of flight parameters on the dosimetric characteristics measured with Liulin semiconductor detector on board ISS during solar maximum and minimum

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- (2) Space and Solar-Terrestrial Research Institute of BAS, Sofia, Bulgaria, dachev@bas.bg**
- (3) National Institute of Radiological Sciences, Chiba, Japan & Institute of Nuclear Physics of the ASCR, Department of Radiation Dosimetry, Prague, Czech Republic, ploc@ujf.cas.cz**



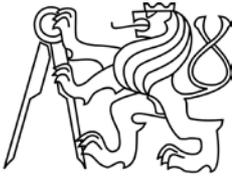


:: Introduction ::



- on 38th COSPAR my colleague presented results of the Monte Carlo simulations of the Matroshka-R experiment
- results show that there is dose increase/decrease by about 15% with every 10 km ISS altitude gain/loss (see next slide)

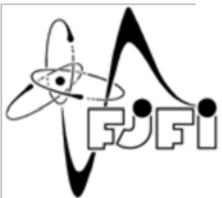
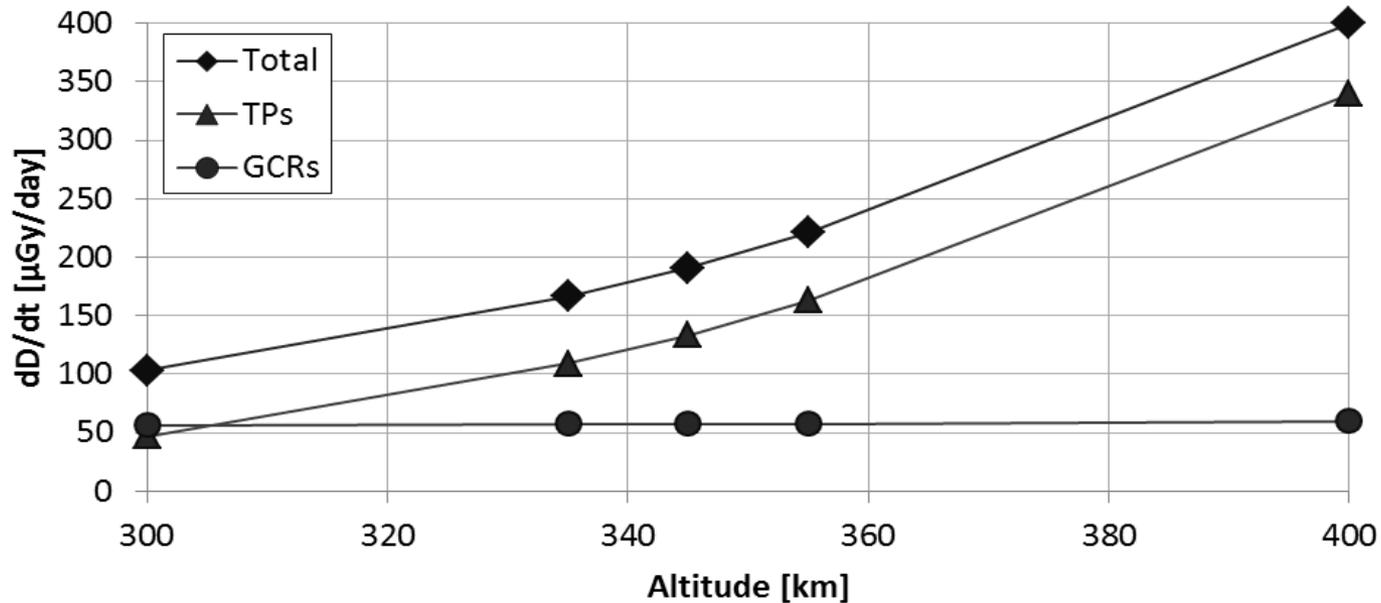


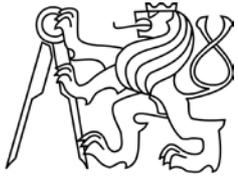


:: Introduction ::



- dependence of the dose rate in the phantom placed onboard ISS (calculated using PHITS code, using simplified tube geometry; GCR and trapped protons (TP) spectra were calculated with CREME96 code for solar minimum conditions)

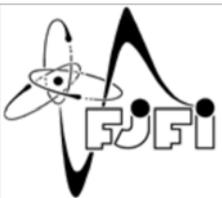


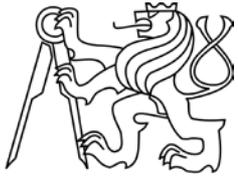


:: Introduction ::



- purpose of this work was to use data from for us available instruments and find dependence of dose rate on altitude
- works is based on
 - data measured with Liulin R3DE instrument from January 2009 until March 2009 (Solar minimum)
 - data measured with Liulin E094 instrument from July 2001 until July 2001 (Solar maximum)
 - data measured with TEPC in the same period; data were downloaded from NASA Goddard Space Flight Center Coordinated Data Analysis Web





:: Instruments ::

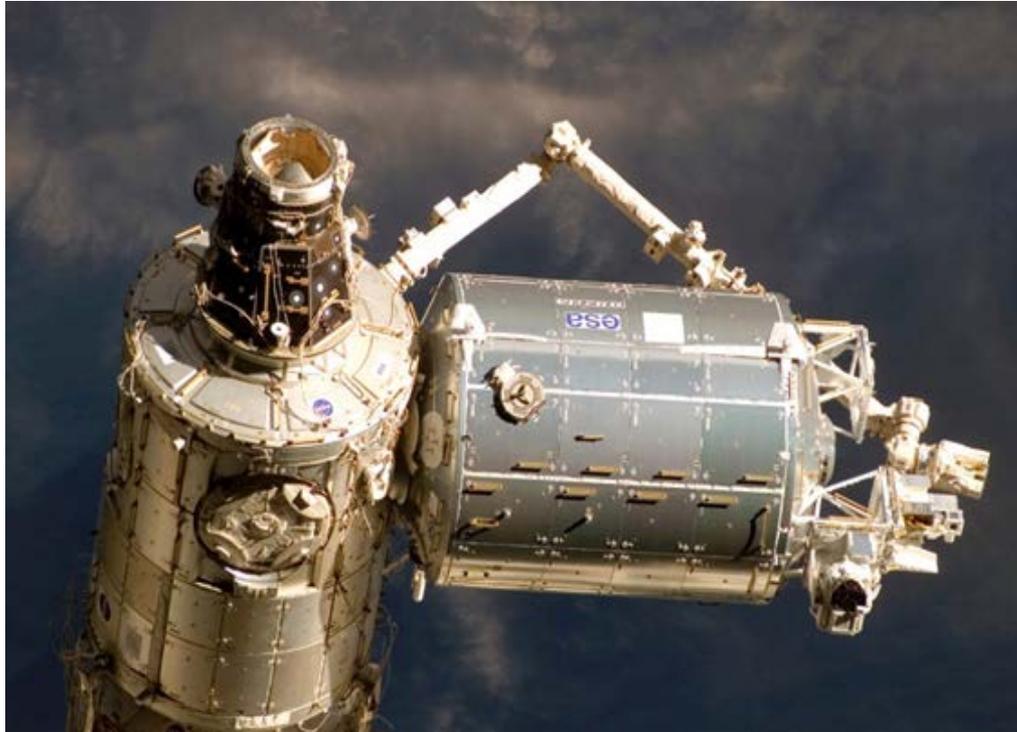


- R3DE and E094 instruments are successors and slight modifications of the Liulin device primarily developed in the 80's of the 20th century; they have sensitive volume made of the same photodiode and their processing electronics is based on same components
- properties of Liulins were tested in mixed, fast neutrons as well as in different types high-energy ion beams in facilities like CERF, HIMAC etc.
- R3DE device was placed on EuTEF platform outside of ISS Columbus module
- E094 device was placed on-board US laboratory module
- TEPC was placed on-board ISS US laboratory module





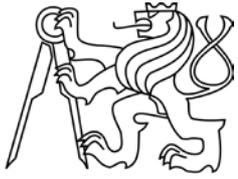
:: Instruments :: R3DE



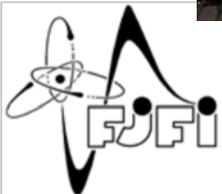


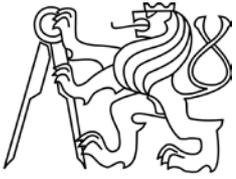
:: Instruments :: E094





:: Instruments :: TEPC

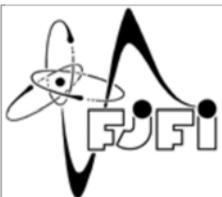
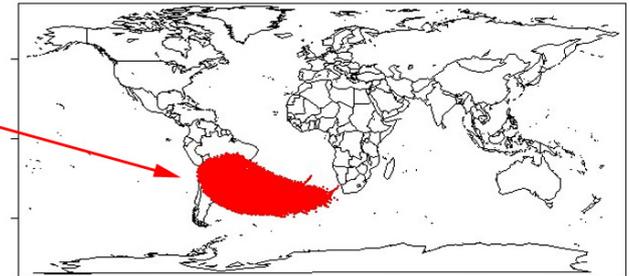
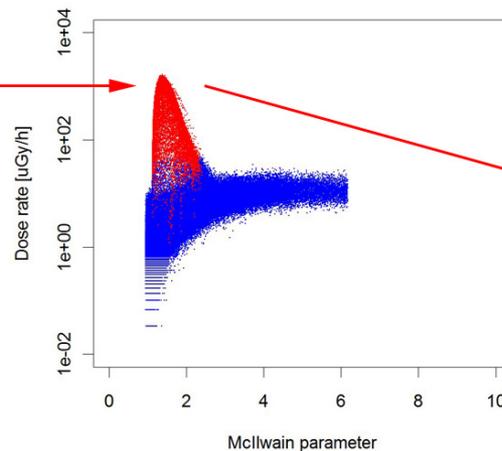
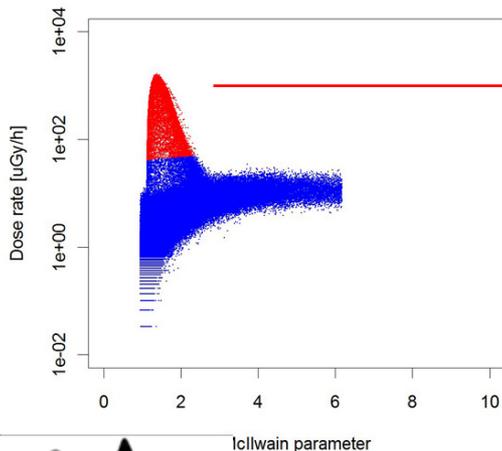




:: Results ::



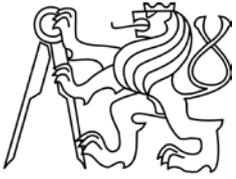
- data were always separated into two groups
- first group contained data measured within area of the SAA
- second group contained data measured in area with dominant GCR contribution
- separation of the groups was performed using plot of dose rates against corresponding McIlwain's parameter values (measured with Liulin)



McIlwain parameter

McIlwain parameter





:: Results ::



- data were averaged through altitude intervals equal to 10 km and time period equal to one month
- as statistical indexes, mean value and median of the dose rate were used
- results are shown in following figures

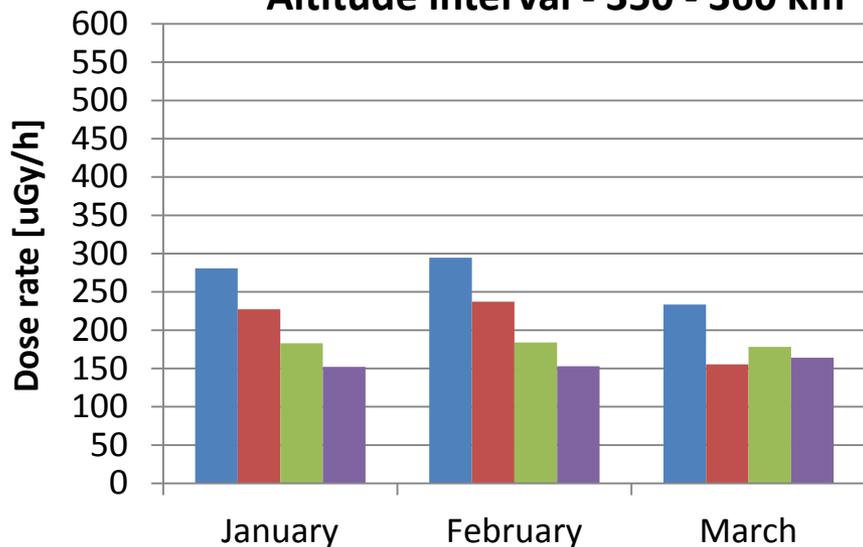




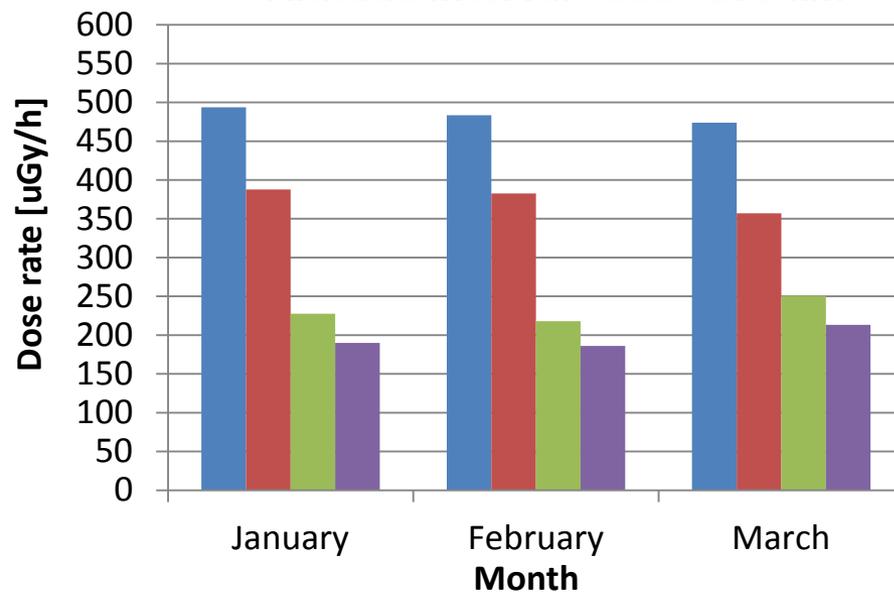
:: R3DE & TEPC :: SAA :: 2009 ::



Altitude interval - 350 - 360 km



Altitude interval - 360 - 370 km



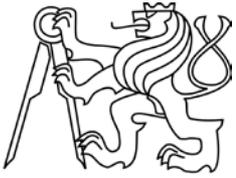
■ Mean - R3DE [uGy/h]

■ Median - R3DE [uGy/h]

■ Mean - TEPC [uGy/h]

■ Median - TEPC [uGy/h]

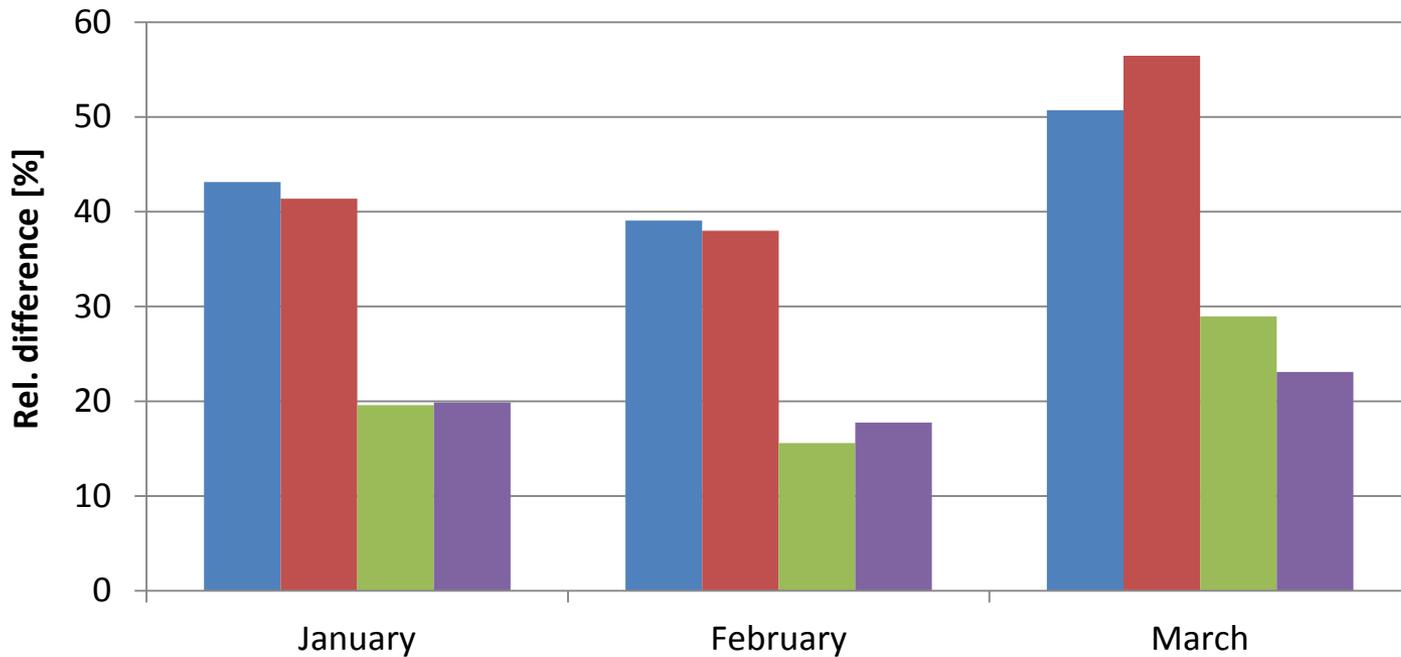


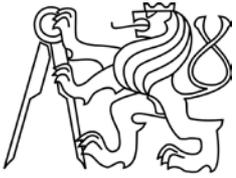


:: R3DE & TEPC :: SAA :: 2009 ::



Relative ratio of dose rate between orbital levels
350 - 360 km and 360 - 370 km

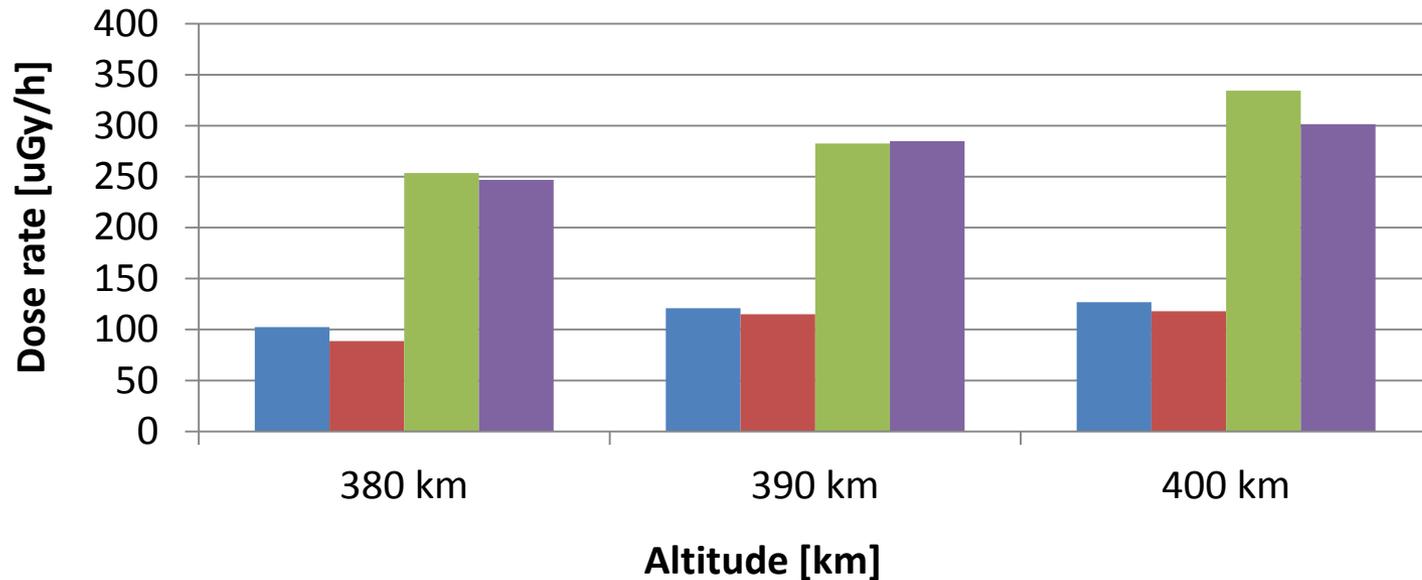




:: E094 & TEPC :: SAA :: 2001 ::

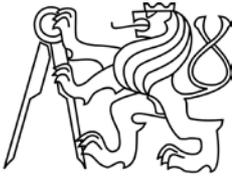


Dose rates at different altitudes from June 4 until July 16



■ Mean - E094-2 [uGy/h] ■ Median - E094-2 [uGy/h]
■ Mean - TEPC [uGy/h] ■ Mean - TEPC [uGy/h]

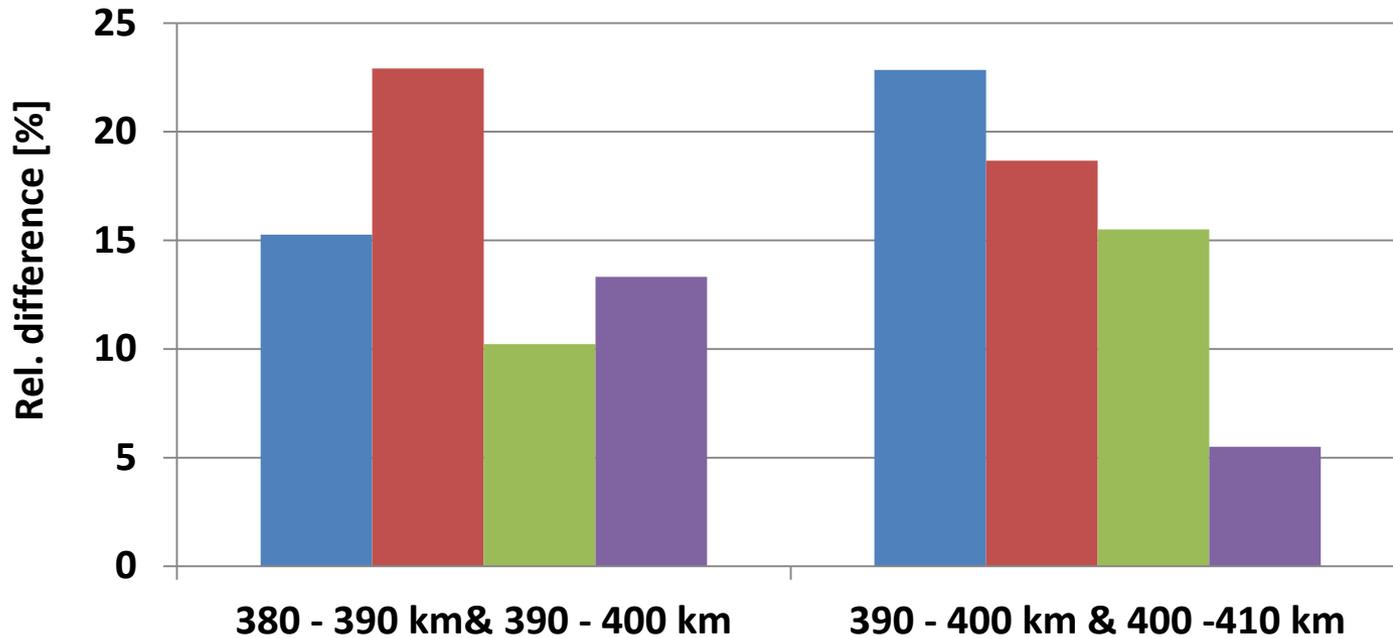




:: E094 & TEPC :: SAA :: 2001 ::



Relative ratio of dose rate between orbital levels



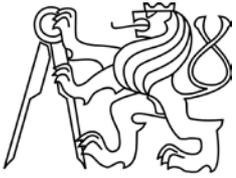
■ Mean - R3DE [uGy/h]

■ Median - R3DE [uGy/h]

■ Mean - TEPC [uGy/h]

■ Median - TEPC [uGy/h]



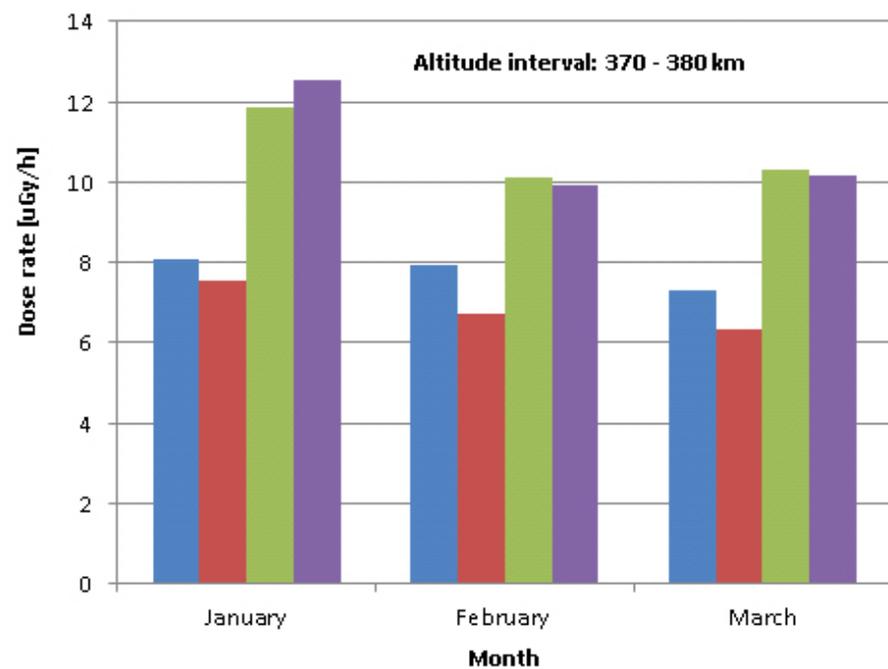
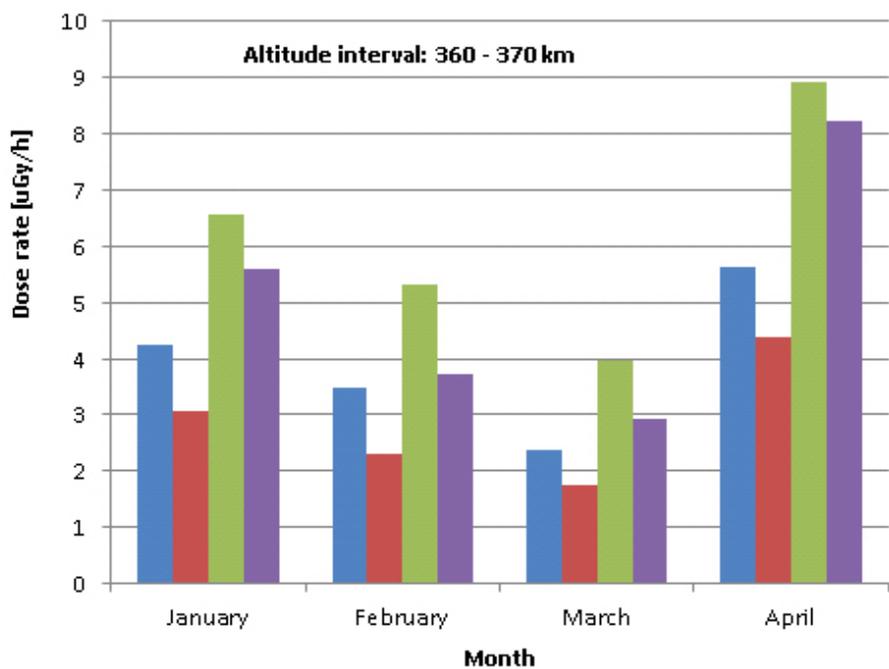
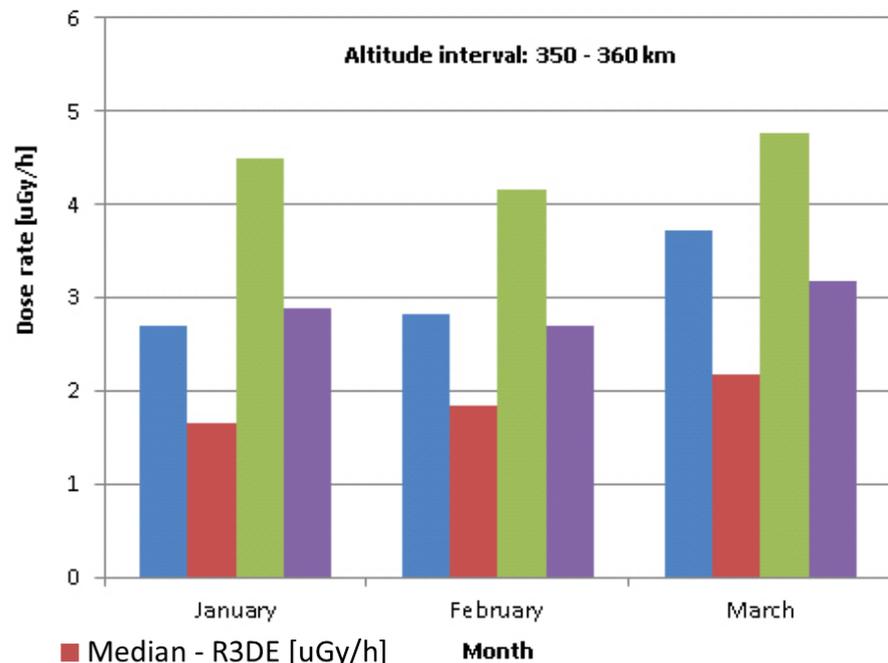
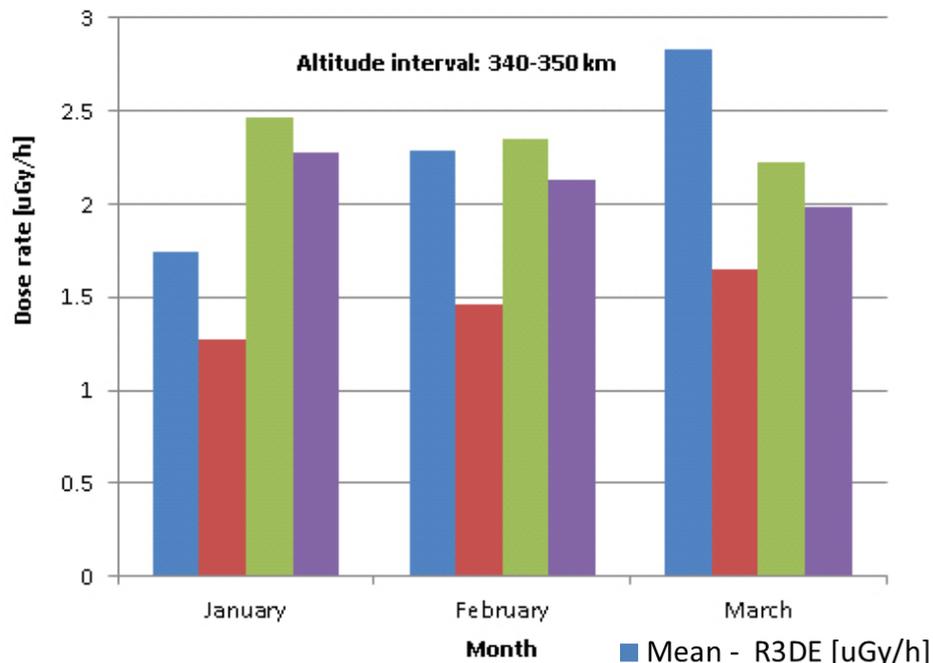


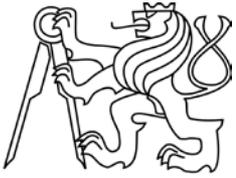
:: Results :: GCR :: 2009



- mean and median dose values measured with R3DE, E094 and TEPC devices in GCR region are shown in next slides



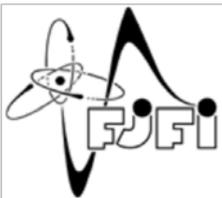
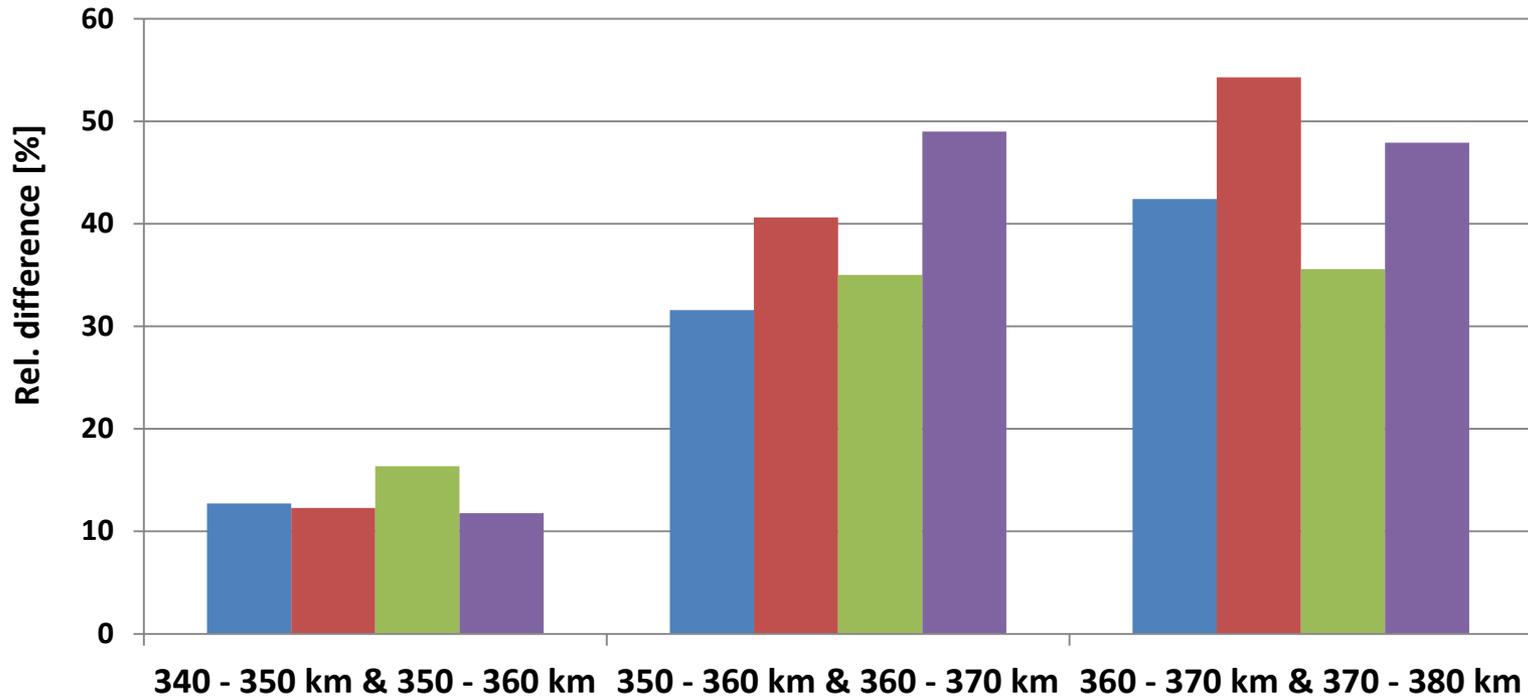


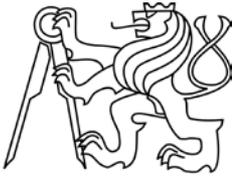


:: R3DE & TEPC :: GCR :: 2009



Relative difference of dose rates between orbital levels

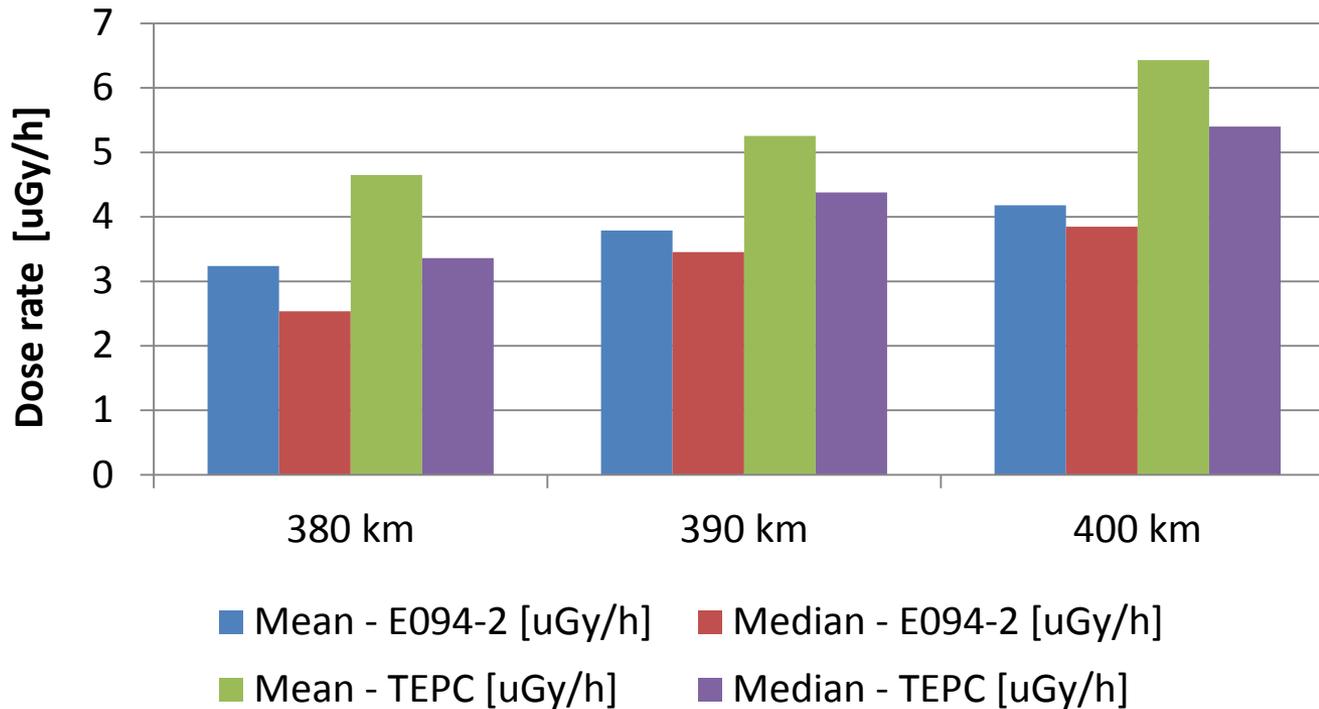


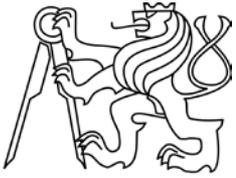


:: E094 & TEPC :: GCR :: 2001



Dose rates at different altitudes from June 4 until July 16

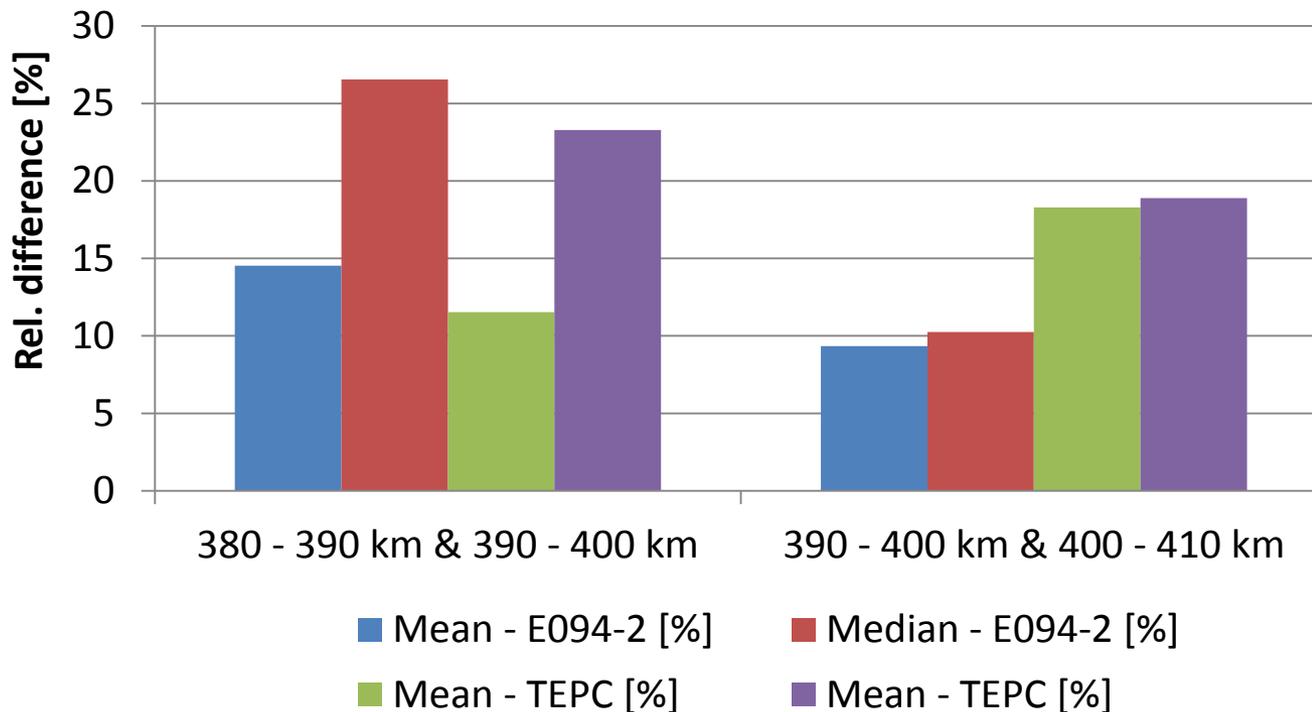


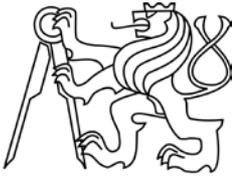


:: E094 & TEPC :: GCR :: 2001



Relative difference of dose rates between respective altitudes





:: Discussion



- in all cases, dose rate between respective altitude intervals increases about from 5 to 30 %
- increase is observable for median as well as mean dose rate values but differs
- increase is observable in GCR and SAA areas
- observed trends corresponds with simulation performed with Z.K.





:: Used literature

[Dachev et al., 2002](#): Calibration results obtained with Liulin-4 type dosimeters, *Adv. Space Res.* **30** (2002) (4)

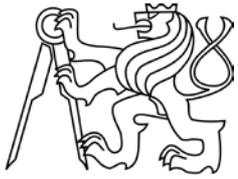
[Uchihori, 2003](#): Comparison of results from the 1st ICCHIBAN experiment and current status of the 3rd ICCHIBAN Experiment, 8th Workshop on Radiation Monitoring for the ISS, 3–5 September 2003, LBNL, Berkeley, USA.

[Uchihori et al., 2002](#): Analysis of the calibration results obtained with Liulin-4J spectrometer-dosimeter on protons and heavy ions, *Radiat. Meas.* 35 (2002)

[Spurný, 2005](#): Response of a Si-diode-based device to fast neutrons, *Radiat. Meas.* 39 (2005)

[Spurný et.al, 2005](#): The angular dependence of an Si energy deposition spectrometer response at several radiation sources, *Radiat. Meas.* 39 (2005)





:: Thank you for your attention



