Australian Government
Geoscience Australia

General Relativity tests with AOV

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Three sessions in 2017-2018

AUA and AOV

01-May-17	AUA020	**Asia, Russia, South Africa**
07-Oct-17	AUA029	**Asia, Oceania, Europe, South Africa**
01-May-18	AOV022	**Asia, Oceania, Europe, South Africa**

General relativity test

1 May 2017 (custom, scheduled in WUT, correlated in SHAO)
(Hartrao, Hobart26, Svetloe, Zelenchuk, Badary, Sejong, Seshan25)

577 observations of 0229+131 ($2^{\circ}.26$ to $2^{\circ}.52$)
452 observations of 0235+164 ($1^{\circ}.46$ to $1^{\circ}.15$)
1029 observations in total

Telescopes were not affected
Solar corona effect is negligible, and electron content is estimated easily

Solar thermal noise grows rapidly as elongation decreases
Large telescopes are required (narrow beam)

General relativity test

Results for gamma $\cdot 10^{-4}$

Quasar	Sources	OCCAM estimate of $\gamma \times 10^{-4}$
AUA020 1.05.17	0229+131 & 0235+164	0.9 +/- 0.9
AUA029 7.10.17	3C279	2 +/- 12
AOV020 1.05.18	0229+131 & 0235+164	-2.3 +/- 2.0

$\Delta\gamma = 2.1(\pm 2.3) \times 10^{-5}$ "Cassini" Bertotti et al (2003)

Source structure effect caused some problems for AOV020

Publications

A&A 618, A8 (2018)
https://doi.org/10.1051/0004-6361/201833459

Astronomy & Astrophysics

Testing general relativity with geodetic VLBI

What a single, specially designed experiment can teach us

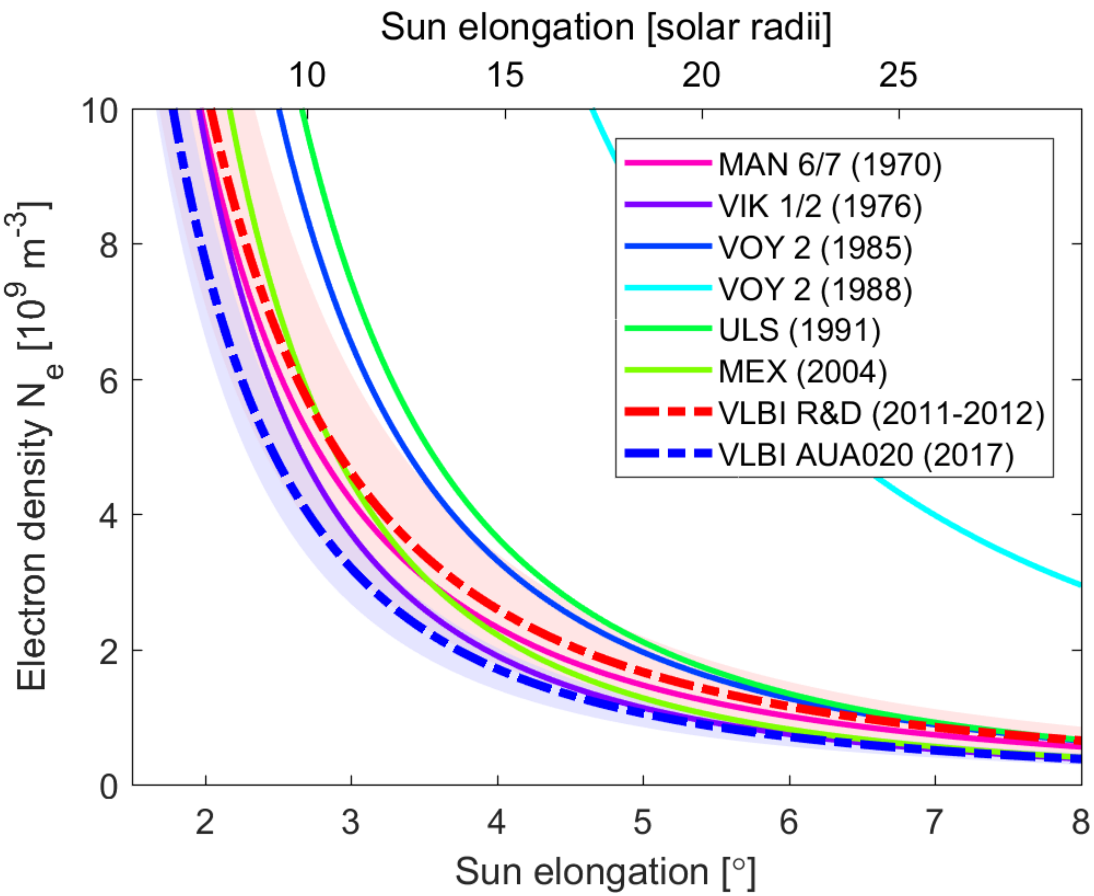
O. Titov[1], A. Girdiuk[2], S. B. Lambert[3], J. Lovell[4], J. McCallum[4], S. Shabala[4], L. McCallum[4], D. Mayer[2], M. Schartner[2], A. de Witt[5], F. Shu[6], A. Melnikov[7], D. Ivanov[7], A. Mikhailov[7], S. Yi[8], B. Soja[9], B. Xia[6], and T. Jiang[6]

$\Delta\gamma = 0.9(\pm 0.9)\cdot 10^{-4}$ The best estimate ever done with geodetic VLBI

$\Delta\gamma = 2.1(\pm 2.3)\cdot 10^{-5}$ “Cassini” Bertotti et al (2003)

Electron content of the corona

(by Benedikt Soja, from AUA020, 1-May-2017)



$$N_e(r) = N_0 \cdot r^{\beta}$$

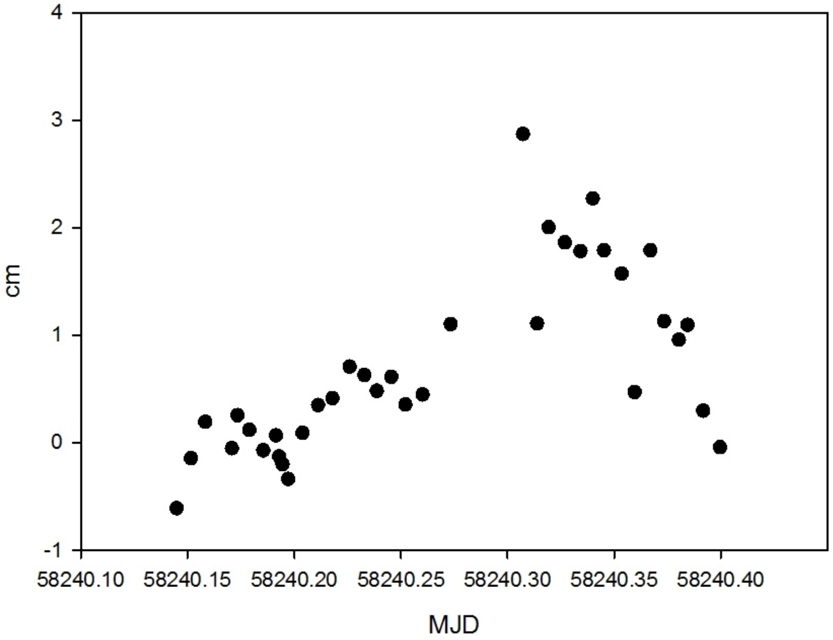
$$N_0 = (0.61 \pm 0.05) \cdot 10^{12}\ \text{m}^{-3}$$

$$\beta = (2.18 \pm 0.01)$$

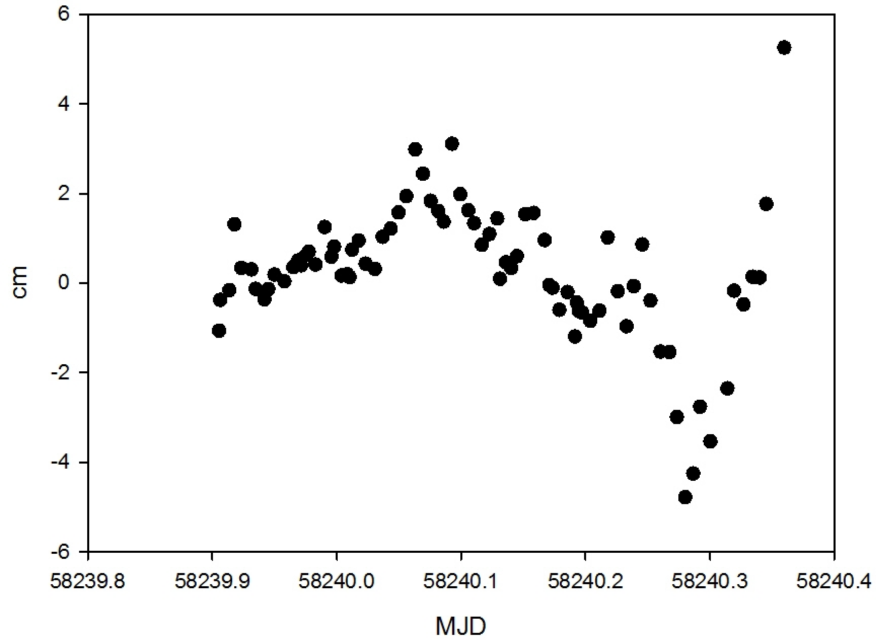
Session AOV022, 1-May-2018

Residuals for 0229+131, different baselines

0229+131, Kunming - Zelenchk



0229+131, Ishioka - Seshan25



Session AOV022, 1-May-2018

Residuals for 0229+131, different baselines

Conclusion

1. Geodetic VLBI has a good potential of further improvement of the general relativity tests.
2. Observations near 1º from the Sun are possible.
3. Custom schedule to be prepared; a strong source in a good time by many large radio telescopes at high recording rate.
4. Source structure needs to be reduced for the AOV020

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Any Questions?

Thank you for your attention

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