Institute of Technical Physics

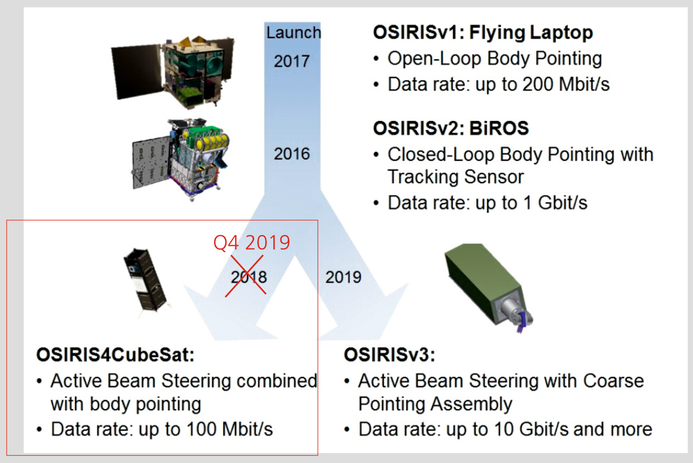
Design and qualification of a recessed satellite cornercube retroreflector for ground-based attitude determination via satellite laser ranging

Nils Bartels[1], Paul Allenspacher[1], Sven Bauer[2], Daniel Hampf[1], Benjamin Rödiger[3], Wolfgang Riede[1]

1) Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Technische Physik, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany
2) Helmholtz-Zentrum Potsdam, Deutsches Geoforschungszentrum, Telegrafenberg, 14473 Potsdam, Germany
3) Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Kommunikation und Navigation, Münchner Straße 20, Oberpfaffenhofen, 82234 Wessling, Germany

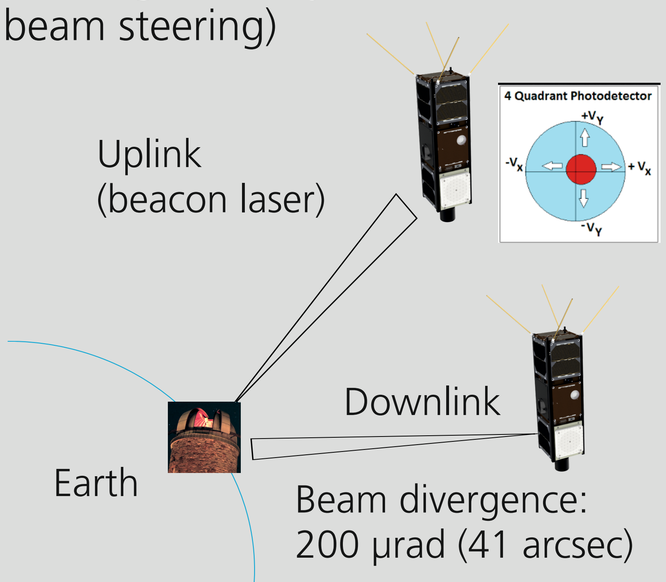
Introduction

The German Aerospace Center (DLR) is working on the development of compact laser communication payloads for low-earth orbit (LEO) satellites.



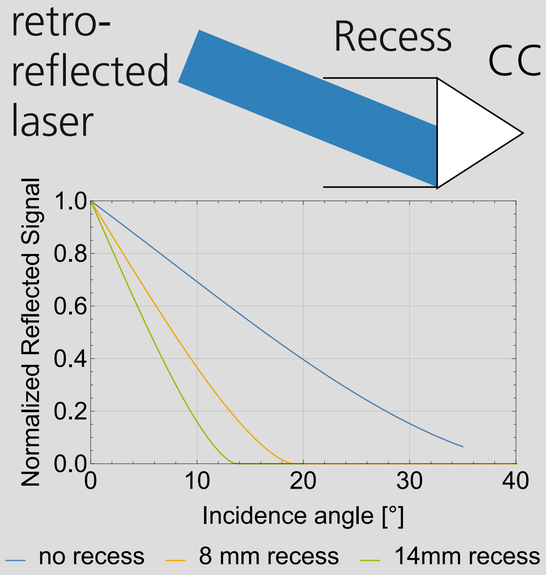
Challenge of accurate pointing

The attitude control system (ACS) needs to be accurate by ±1° (remaining pointing accuracy comes from active beam steering)



Attitude verification via SLR

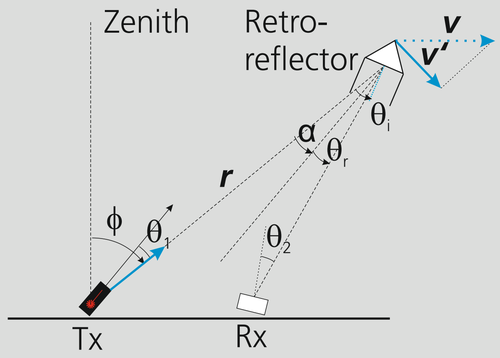
Goal: Independent verification of the functioning of the ACS via SLR to ± 1°



A retroreflector with a 5mm cicular front face needs a 14 mm recess to obtain a field of view FWHM of 5°

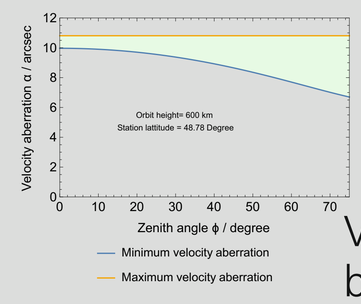
Design of the recessed cube corner retroreflector (CCR)

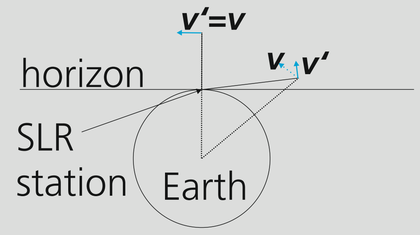
SLR Geometry



Emitter (Tx) and reciever (Rx) are typically collocated, apparent reciever angle θ_r due to velocity abberation α

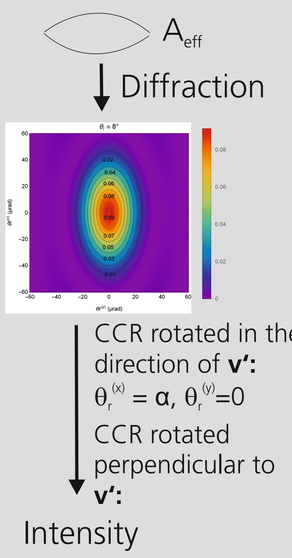
Velocity abberation

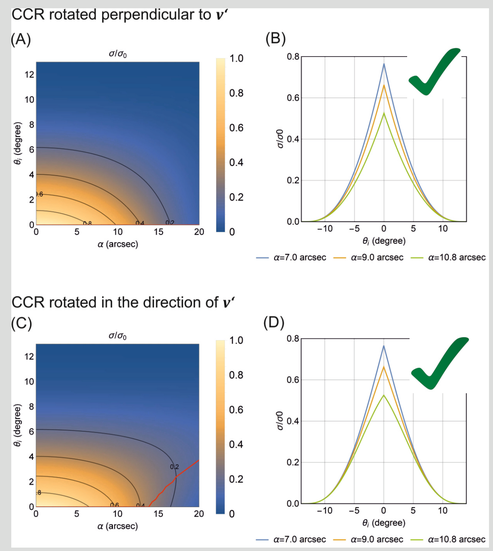


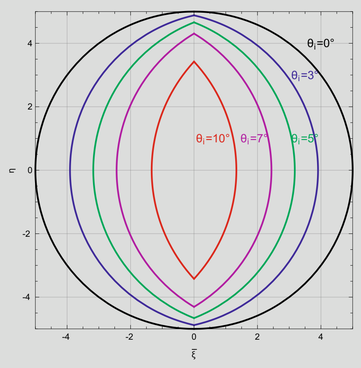


Velocity abberation α is between 7 and 10 arcsec

Does the SLR signal peak when the retro-reflector points towards the SLR station?



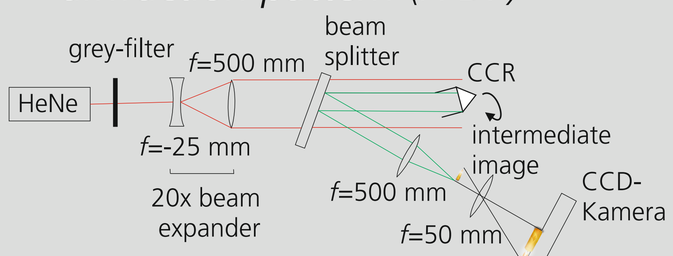


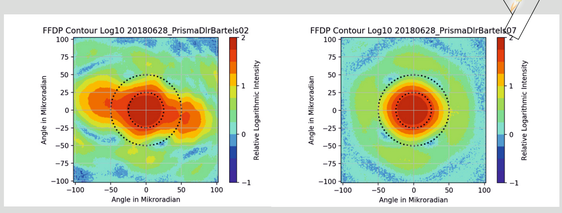


Reflectivity of the CCR is proportional to the effective area A_{eff}.

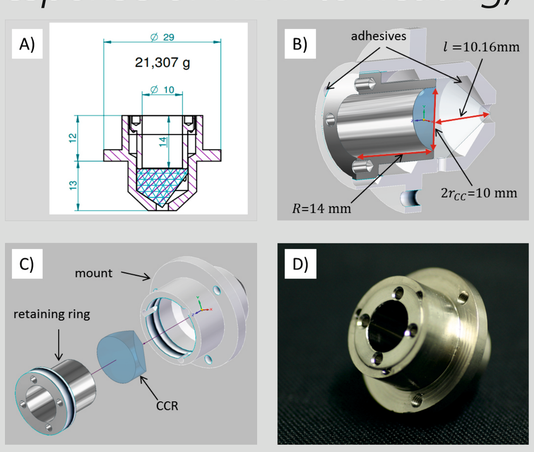
Manufacturing and testing

1. Measurement of the far-field diffraction pattern (FFDP)



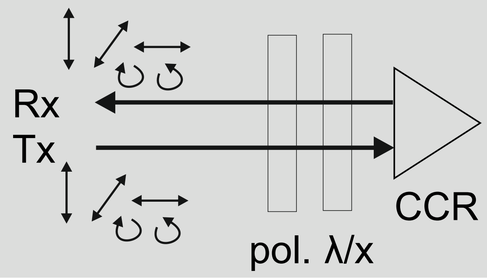


2. CAD design, manufacturing, glueing, response of FFDP to heating, vibration



Future plans:

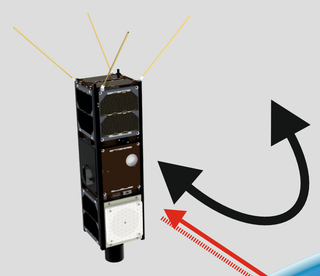
1. Smart retroreflectors + arrays



	Retardance	Diattenuation
CCR1	0°	0
CCR2	45°	0.5
CCRn		

Retroreflectors with polarimetric ID (could be passive or active as modulated retroreflector)

2. SLR of the CubeL retroreflector



Correlate the SLR signal to the orientation of the rotating satellite

Knowledge for Tomorrow

Wissen für Morgen

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