SOILM13

Participant	Title	Abstract
Robert Cameron	Helicity patterns	
Filippo Cardano	Generation of Vectorial and Polarization Singular Beams using a q-plate	A q-plate is a linear optical device that can generate OAM eigenmodes, controlled by the polarization state of the input beam. We used q-plates with different topological charge to show a simple way to generate "Vector Beams", paraxial beams with non uniform polarization in the transverse plane, e.g. azimuthal or radial polarization structure. In the same way we generated beams with polarization singularities on the optical axis. We investigated the dynamics of polarization structure of these beams under free air propagation, for different topological indexes of the singularities.
Matthew Coles	Optical angular momentum: Operators and compartmentalisation	
Electra Eleftheriadou	Overlapping Gaussians	
Ivan Fernandez-Corbaton	Necessary symmetry conditions for the rotation of light	Two conditions on symmetries are identified as necessary for a general linear scattering system to be able to rotate the linear polarisation of light: Lack of at least one mirror plane of symmetry and electromagnetic duality symmetry, which is equivalent to the conservation of the helicity of light. When the system is a solution of a single species of particles, the lack of at least one mirror symmetry leads to the familiar requirement of chirality of the individual particle, and, according to the analytical and numerical evidence presented in this paper, the solution preserves helicity if and only if the individual particle itself preserves helicity. However, in forward scattering the helicity preservation condition on the particle is relaxed: We show that the effective rotational symmetry of such system leads to helicity preservation in the forward scattering direction independently of any property of the particle. These results advance the current understanding of the phenomena of molecular optical activity and provide insight for the design of polarisation control devices at the nanoscale.
Jörg Götte	Singularimetry and topological aberrations	
Vincenzo Grillo	Quantum simulation of a spin polarization device in an electron microscope	A proposal for an electron-beam device that can act as an efficient spin-polarization filter has been recently put forward [E. Karimi et al., Phys. Rev. Lett. 108, 044801 (2012)]. It is based on combining the recently developed diffraction technology for imposing orbital angular momentum to the beam with a multipolar Wien filter inducing a sort of artificial non-relativistic spin-orbit coupling. Here we reconsider the proposed device with a fully quantum-mechanical simulation of the electron beam propagation, based on the well established multi-slice method, supplemented with a Pauli term for taking into account the spin degree of freedom. Using this upgraded numerical tool, we study the feasibility and practical limitations of the proposed method for spin-polarizing a free electron beam.
Armen Hayrapetyan	Radiation-assisted relativistic electron vortex beams	We study relativistic electron vortex beams under the impact of the field of a plane electromagnetic wave. We construct exact Bessel-beam solutions by making use of Volkov solutions for the Dirac equation. When switching off the field we show that these solutions contain the new type of free electron-Bessel beams, reported by Bliokh et al. [Phys. Rev. Lett. 107, 174802 (2011)]. We study total-angular-momentumdependent distribution of probability density and current for nonparaxial Bessel beams as a dependence on electromagnetic field parameters, such as frequency and amplitude of vector potential. Moreover, we show that the kinetic momentum density in the Bessel-state implies that the effective mass of the twisted electron coupled to the field acquires a shift. Such beams may be of interest for experiments relating to the Compton and electron-electron scattering under impact of external fields, as well as radiative electron capture in relativistic ion-atom collisions and photoelectric effects in atomic systems.
Maximilian Hollstein	Temporal dynamics in strong-field processes subjected to Coulomb correlations	Common theoretical approaches for studying atomic strong-field processes such as tunnel and multiphoton ionization of atoms or atom-like systems (e.g. quantum dots) rely on an (effective) one-particle description as for example the single-active-electron approach or the timedependent configuration-interaction singles (TD-CIS) method. Within these methods, Coulomb correlations are usually neglected. In contrast to these approaches we are investigating the temporal dynamics in strong-field processes subjected to Coulomb correlations on a model system by solving the time-dependent Schrödinger Equation numerically. We consider the time evolution of pair-correlation functions and investigate two-particle excitations which are exceeding the configuration-interaction singles approximation.
Gaurav Jayaswal	Weak Measurement of Goos Hanchen Shift	It is well known from quantum mechanics that weak measurements offer a means of amplifying and detecting very small signals. I could like to present the first experimental observation of the Goos-Hanchen shift via a weak measurement approach. Thanks Gaurav Jayaswal Ph.D student, LAFSI, Dept of Physics, Univeristy of Padova.
Vijay Kumar	Wavelength-dependent spin-orbit interaction in optical fibers	For an ideal two-mode optical fiber (TMF), the four higher-order annular modes (even HE21, TM01, odd HE21, TE01) with same propagation constant () forms four circularly polarized vortex modes as (±,±l), and (,±l), where '' is the spin angular momentum and 'l' is the orbital angular momentum [1,2]. But in a circular core step-index fiber, the degeneracy in the propagation constants are lifted by the spin-orbit interaction (SOI), where the polarization correction (i, i = 1 – 4) terms are added to the scalar propagation constant (i). The polarization correction terms to the even and odd HE21 modes have the same propagation (1 = 3) constant and forms circularly polarized vortex modes (1, 1) and (-1, -1) with same sense of energy circulations for spin and orbital motion. Whereas the TM01 and TE01 modes have different propagation constants (2 4; 4 = 0) resulting in two partial vortices (+1, -1) and (-1, +1), where the sense of rotation of the spin and orbital angular momentum are in opposite directions [2]. The propagation of partial vortices through the fiber exchanges polarization and topological charge along the fiber length due to the different propagation constants of the TE01 and TM01 modes or in other words due to SOI. The energy exchange between these two partial vortices can be identified by cutting the fiber length [2] or by tuning the input laser wavelength. We present our experimental results on the energy exchange between the two partial vortices in a step-index two-mode fiber by tuning the input wavelength insteps of 1nm. Experiment is carried out using a tunable Ti: Sapphire laser which can be tuned in the range of 700 - 1100 nm. The experiment is performed in the range of 740-760 nm, at this wavelength range fiber supports all the higher-order modes in addition to the fundamental mode. Linearly polarized light is coupled into the fiber of length 32.4 cm [3]. Input launching conditions are adjusted such that the output beam is a combination of TE01 and TM01 modes, which contain two partial vortices with unequal intensities. The presence of two partial vortices and their intensities in the output beam are measured by polarization interference and the third Stokes parameter (S3). In the polarization interference, changing the handedness of the reference beam circular polarization will interfere with the corresponding vortex and gives a up or down forklet pattern. The third Stokes parameter (S3), measured by passing the output beam through quarter-wave plate and analyzer combination (QWP at 90 deg. and the analyzer oriented at 45 deg. and 135 deg.) will give the information about the intensities of the two partial vortices. In our experiment when the input wavelength is at 740 nm the out beam is dominated by the (-1, 1) vortex mode intensity and by tuning the input wavelength from 740 to 760nm without changing the input conditions the output beam intensity is slowly exchanged to become a (1, -1) vortex mode. We constructed the state of polarization (SOP) map at every point in the output beam to further confirm the change of polarization across the beam cross section due to energy exchange between the two partial vortices. In this wavelength range the left circularly polarized beam is slowly converted into half left and half right circularly polarized beam via SOI. References [1] Alexeyev C. N. et.al., Fiber optical vortices, Chapter 5, Lasers, Optics and Electro-Optics Research Trends, Nova Science Publishers Inc., 2007 [2] Volyar A. V., Fiber Singular optics, Ukrs. J. Phys. Opt. 3, 69, 2002 [3] N.K. Viswanathan V.V.G.K. Inavalli, “Generation of optical vector beams using a two-mode fiber,” Opt. Lett. 34, 1189, 2009
Sophia Lloyd	Mechanical and electromagnetic properties and interactions of electron vortices	Recent advances have led to the creation in the laboratory of electron vortices, which are akin in some respects to optical vortices. However, in addition to orbital angular momentum as a major feature, an electron vortex is endowed with electric charge, mass and spin. These attributes imply, respectively, associated electromagnetic fields due to the electric charge and current density sources, mechanical properties due to electron mass flux and magnetic properties associated with the spin magnetic moment and spin orbit coupling. This presentation outlines research at York on the consequences of the charge, spin and mass of electron vortices. In

		particular it evaluates the fields, their electromagnetic-mechanical torque, and the spin and spin-orbit interactions. It also evaluates the mass flux and its mechanical linear and orbital angular momenta. The influence of the vortex on the motion of matter, either in the form of atoms or matter in the bulk is also discussed.
Wolfgang Löffler	Spatial "Fresnel" Coefficients	
Libo Ma	Non-cyclic geometric phase in asymmetric optical microcavity	Tracing the polarization states of photons on their evolutions in asymmetric microcavities, the geometric phase and vector length variations were measured. Non-cyclic and non-unitary evolution was revealed due to spin-orbit coupling of photons in the presence of non-Abelian gauge field.
Daniel Maldonado-Mundo	Renormalization in a single-branch spin-orbit system	In this talk we will consider the renormalization of the spin-orbit coupling in a single-branch theory of interacting polarized fermions. We will use renormalization techniques to show that it is possible to avoid a multi-channel treatment of the problem. This results open the path to a much more straightforward approach to the many-body physics of cold atoms.
Bouzid Manaut	Spin eects in laser-assisted semirelativistic excitation of atomic hydrogen by electronic impact	New insights into our understanding of the semirelativistic excitation of atomic hydrogen by electronic impact have been made possible by combining the use of polarized electron beams and intense laser eld. The paper reviews relativistic theoretical treatment in laser-assisted electron scattering with particular emphasis upon spin eects. Dierent spin congurations for inelastic electron-atom collisions is also discussed. The role of laser eld in such collision is of major importance and reveals new information on the dynamics of the collision process. The examined modern theoretical investigations of such relativistic laser-assisted collisions have shown that the need for experimental data is of a paramount importance in order to asses the accuracy of our calculations.
Oliver Matula	Angular distribution of electrons emitted in photoionization of hydrogen-like ions with twisted photons	Photoionization of atoms is one of the most fundamental processes in the interaction of radiation with matter and, therefore, has been studied intensively in the last decades, both in experiment and theory [1]. Besides total photoionization cross sections, much attention has been focused on the angular distribution of the emitted photoelectrons. However, up to now these angle-differential investigations considered only the spin degree of freedom of the incident light. Recent advances in photo-optics allow nowadays to precisely control not only the spin (polarization) of photon beams but also their orbital angular momentum (so-called twisted photons) [2]. In this contribution we present a theoretical analysis of the angular distribution of electrons emitted in photoionization of hydrogen-like ions with (twisted) Bessel beams. Here we pay special attention to the dependence of the electron distribution on the photon-ion impact parameter. Detailed computations and results are presented for photoionization of atomic hydrogen and hydrogen-like carbon and argon for a range of different impact parameters. [1] J. Eichler et al., Phys. Rep. 439, 1 (2009) [2] G. Molina-Terriza et al., Nature Phys. 3, 305 (2007)
Martin Neugebauer	Geometric Spin-Hall Effect of light in tightly focused polarization tailored light beams	
Fiona Speirits	Do waves carrying orbital angular momentum possess azimuthal momentum?	
Fiona Speirits	Helicity patterns	
Alison Yao	Helicity patterns	
Alison Yao	Overlapping Gaussians	