五神真博士の研究業績概要

　レーザー技術の革新により、光波の偏光、位相、振幅を時間軸および周波数軸上で自在に制御する技術が開拓され、それを活用した研究が自然科学の様々な分野で活発に進められている。五神博士は、原子系から固体系さらには人工ナノ構造といった幅広い物質系を対象として、物質系と光の結合系が示す新規な光学現象の探索を進め、物質科学と光科学の融合的な研究領域を開拓し多くの業績を上げてきた。以下に代表的な研究業績を紹介する。

１．固体におけるレーザー分光法の開拓と光励起物質相の量子多体効果の研究
半導体の電子正孔系を対象として、励起状態の物質相解明とその光学機能の探求を進めてきた。励起子分子２光子共鳴を利用したレーザー偏光分光法を開拓し[8]、励起子系の非局所応答効果の解明、強い光電場下での励起子分子ドレスト状態の観測に成功した[30]。励起子の内部遷移を利用する励起子ライマン分光法を提案実証し、量子縮退領域の極低温高密度励起子の生成・観測に成功した。[105,110,114,122,124]また、光エレクトロニクス応用上重要な半導体バンド端近傍の非線形光学応答について、定量的評価法を確立し、物理的機構を解明した。非線形光学応答が電子正孔系の４体の電子相関に帰着することを見出し、それが励起子間の２体相互作用として表現できることを示した[44,77,85]。その他、擬一次元有機電荷移動錯体結晶での励起子ストリング状態の観測[29]、一次元銅酸化物における超高速巨大非線形光学応答[69,75]、ハーフメタル強磁性体の超高速臨界緩和の検出[68]などの業績がある。また、ERATO協同励起プロジェクト(1997-2002)を主宰し、スピン禁制遷移によるレーザー冷却法によりストロンチウム原子をナノケルビン領域に急速に冷却する技術を開拓した[58,62]。

２．微小空間における光波制御：
　常温でも電子の量子性が顕在化するナノ空間領域で光と電子系を効果的に結合させるためには、波長以下のスケールで光波を操作する技術が必要である。誘電体微小球の特異な光閉じ込め効果に着眼し、単一のポリマー微小球によるレーザー発振[24]、共鳴連結構造によるフォトニック分子の実証[60]とレーザー発振[102]、一次元連結球導波路によるスローライト発生[116]などの成果を上げた。また、鏡映対称を持たないユニットの２次元配列－人工ナノキラル格子－が巨大旋光性を示すことを発見し[118]、その原理を解明し、光およびテラヘルツ電磁波の制御[130,144]に応用した。

　五神真博士は光量子科学の広い分野を研究対象とし分野をリードする研究を推進すると共に、国内外の研究者連携のプロジェクトも多数統括し、リーダーとして卓越した実績がある。教育面でも東京大学大学院工学系研究科において延べ修士課程38名、博士課程12名の大学院学生を直接指導するなど豊富な実績がある。研究機関連携・部局横断型の大学院教育プログラムや光量子科学研究センターを主導し、新しいプログラムを提唱するなどの教育研究の運営面でも豊富な実績がある。

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氏　　名　　　五神　真

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