Mass photometry (MP) is a label-free optical microscopy technique, which detects the interference between the light scattered by a biomolecule and the light reflected from the glass-water interface. Due to the linear relationship between interferometric contrast and protein mass, MP has found rapid adoption when studying the stoichiometry of proteins and protein complexes, and quantification of the kinetics and thermodynamics of biological systems. To expand the scope of biological systems that can be investigated with MP, improvement of the mass-resolution and detection limit of the technique is critical. The performance is theoretically limited by shot-noise; therefore instrument design is focussed on identifying and reducing all sources of non-shot-limited-noise. Here, we present a novel optical design, which significantly simplifies the optical path of an MP instrument, enabling easier optimization and facilitating more technologically complex experimental designs to be developed. We demonstrate the advantages of our design by developing highly sensitive multi-colour illumination and multi-colour detection. We demonstrate substantial improvements in both the quantitative detection limit and mass-resolution, relaxing constraints on sample purity and biomolecule size, thereby substantially broadening the scope of MP.